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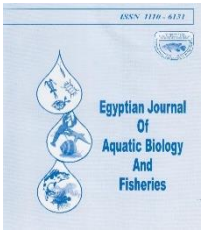

Competitiveness and Determining Factors of Indonesian Shrimp Exports to Main Importer Countries

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ABSTRACT

An archipelagic country, Indonesia has a significant fisheries sector, ranking second as the world's largest producer after China. Shrimp is the commodity with the highest export value in this sector. However, between 2018 and 2022, Indonesia only ranked fifth among the most significant global shrimp exporters, with an average annual export growth of just 1.55%. This study aimed to analyze the competitiveness and determine factors affecting Indonesia's shrimp exports to enhance its competitiveness in the international market. The Revealed Comparative Advantage (RCA) formulation, Export Product Dynamic (EPD), and the X-Model measure comparative advantage, competitiveness, and export potential to key importing countries. Additionally, panel data regression using a gravity model approach is applied to identify the determinants of shrimp exports. The data consist of panel observations on shrimp commodities from 1993 to 2023, covering seven major global importers. The results indicate that Indonesian shrimp demonstrates strong competitiveness and export potential in China, Japan, the United States, and Spain. Conversely, exports to France and Italy show strong competitiveness but limited potential, while exports to South Korea lack both competitiveness and potential. The key factors influencing shrimp exports include Indonesia's real GDP per capita, the real exchange rate of importers, and distance, which negatively impact exports. On the other hand, the importers' GDP per capita, Indonesia's real effective exchange rate, shrimp export prices, and the population size in both Indonesia and importing countries positively influence shrimp exports.

INTRODUCTION

The main goal of a country engaging in trade with other nations is to meet domestic needs that cannot be produced locally and to achieve economies of scale **(Krugman, 2009)**, which ultimately impacts economic growth and public welfare. Currently, Indonesia has signed nine bilateral agreements, including the Comprehensive Economic Partnership Agreement (CEPA) and the Preferential Trade Agreement (PTA) with various countries **(Sekretariat Kabinet Republik Indonesia, 2023)**. In this context, export and import activities are the main instruments of foreign trade.

Its domestic needs determine a country's import activities, while its exports are influenced by the endowment factors of resources owned by the government. Indonesia, being the largest archipelagic country in the world, with three-quarters of its territory consisting of water, possesses significant endowment factors in the fisheries sector, both from aquaculture and capture fisheries. Additionally, the 1957 Juanda Declaration, reinforced by the United Nations Convention on the Law of the Sea (UNCLOS), recognizes Indonesia as an archipelagic state **(Darusman *et al.*, 2020; van Rossum, 2022)**. Indonesia's total water area covers 6.4 million km², consisting of 0.29 million km² of territorial sea, 3.11 million km² of internal and archipelagic waters, and an exclusive economic zone (EEZ) of 3.00 million km². Additionally, it has a coastline stretching 108,000 km, a continental shelf covering 2.8 million km², and an additional zone reaching 0.27 million km² **(KKP, 2022)**. These factors strengthen and affirm Indonesia's position to capitalize its abundant fisheries resources.

Moreover, the fisheries sector is labor-intensive, absorbing significant labor and serving as a key driver of the lower-middle economy **(World Bank, 2024)**. The sector also significantly impacts Indonesia's economy **(Yusuf *et al.*, 2024)**. Indonesia consistently ranked second as the world's largest fisheries producer by volume in 2020, 2021, and 2023, with production levels of 21,834,095 metric tons in 2020, 21,718,023 metric tons in 2021, and 22,032,425 metric tons in 2023 **(World Bank, 2024)**. Despite a 0.53% decline in 2021, production increased by 1.45% in 2022. These Figures surpass India and Vietnam but remain far below China.

Shrimp is the top commodity in terms of export volume and value in Indonesia's fisheries sector between 2017 and 2021, with an export volume growth trend of 8.63% **(KKP, 2022)**. In Indonesia, shrimp ranks as the commodity with the highest export transactions compared to other fishery products and holds high market value both domestically and internationally **(Sanny *et al.*, 2021; Rindayati & Akbar, 2022; Wati, 2023)**. Despite being the world's second-largest fisheries producer and positioning shrimp as its main export commodity, Indonesia only ranked fifth globally among the largest shrimp exporters during 2018–2022, with an average annual export growth of just 1.55%. Meanwhile, India and Vietnam, though ranked below Indonesia in overall fisheries production, outperform Indonesia in shrimp exports, with annual growth rates of 4% and 5.8%, respectively **(UN Comtrade, 2024)**.

Empirical findings, such as those by **Wati and Aini (2022)**, reveal that Indonesia's shrimp exports possess competitive advantages but suffer from weak competitiveness due to stagnant export growth, attributed to the suboptimal quality and quantity of exports. Similarly, **Sanny *et al.* (2021)** and **Yolandika *et al.* (2022)** highlight that Indonesia's frozen shrimp exports demonstrate strong competitiveness but face a declining trend in international markets. There are several factors contributing to the highly dynamic nature of Indonesia's shrimp exports in the international market. The first is the declining competitiveness of Indonesian shrimp exports due to the emergence of strong competitors such as Ecuador, Vietnam, and India **(Khanal & Deb, 2022; Yolandika *et al.*, 2022; Wati,**

2023; Rodríguez-Mañay, 2024). The second factor is the tightening of import safety certification requirements by several shrimp-importing countries **(Lucas *et al.*, 2021)**. **Choi *et al.* (2018)**, **Han *et al.* (2020)**, **Kim *et al.* (2021)** and **Lee *et al.* (2022)** explain that shrimp diseases such as *Enterocytozoon hepatopenaei* (EHP) and *Vibrio parahaemolyticus* (VP AHPND) are still present in Indonesian shrimp exports. These conditions pose ongoing challenges to Indonesia's shrimp export performance. Given Indonesia's vast fisheries potential and its position as the second-largest global fisheries exporter, the fact that it ranks only fifth in global shrimp exports presents a unique challenge. Previous empirical findings show a dynamic and declining trend in shrimp export competitiveness.

Additionally, the average annual shrimp export growth rate of 1.55% during 2018–2022 falls far short of the 8% annual growth target set in Minister of Marine Affairs and Fisheries Regulation No. 15 of 2024, which amends Regulation No. 17/PERMEN-KP/2020 on the Strategic Plan of the Ministry of Marine Affairs and Fisheries for 2020–2024 **(KKP, 2022)**. The gap between Indonesia's position as a leading global fisheries exporter and the government's shrimp export growth target of 8% per year, combined with empirical findings on declining competitiveness, underscores the need for further research.

This study aimed to analyze the competitiveness of Indonesia's shrimp exports to major importing countries from 1993 to 2023. The extended research period is expected to provide comprehensive insights into the dynamics of Indonesia's shrimp exports, thereby facilitating the formulation of strategies to enhance export competitiveness in international markets. Additionally, this study will examine the factors affecting Indonesia's shrimp exports to form the basis for policy recommendations to improve export competitiveness.

MATERIALS AND METHODS

1. Data collection

This study utilized secondary data in panel data covering the period from 1993 to 2023. The period selection is based on data availability. For the case of Indonesian shrimp exports to major importing countries, the research focuses on the United States, China, Japan, France, South Korea, Spain, and Italy. Based on UN COMTRADE data, these seven countries were selected as the significant global shrimp importers during the 2018–2023 period. The shrimp commodity in this study refers to the 4-digit Harmonized System (HS) code 0306. The variables used in this study include the value of Indonesian shrimp exports to the central importing countries as trading partners (in billion USD), the Gross Domestic Product (GDP) per capita of Indonesia and its partner countries (in billion USD), the Real Effective Exchange Rate (REER) of Indonesia and its partner countries (in billion USD), the population size of Indonesia and its partner countries, the geographical distance between Indonesia and its trading partners, and the export price of Indonesian shrimp to partner countries. Data for these variables are sourced from UN Comtrade, the World Bank, and Center for Prospective Studies and International Information (CEPII).

2. Data analysis methods

2.1 RCA analysis

The Revealed Comparative Advantage (RCA) method was used to analyze the export competitiveness of a country's commodity in foreign markets. The comparative advantage is calculated based on the RCA value, as formulated by **(Balassa, 1965):**

RCA = (Xijt / Xjt) / (Wijt / Wjt)…….(1)

RCA (Revealed Comparative Advantage) Index, where: Xijt: The export value of Indonesia's shrimp commodity to major importing countries in year t. Xjt: The total export value of all Indonesian commodities to major importing countries in year t. X*Wijt*: The global shrimp export value to major importing countries in year t. *Wjt:* The total global export value of all commodities to major importing countries in year t. Interpretation: RCA> 1: Indicates a comparative advantage, meaning the product is competitive and suitable for export orientation (high competitiveness). RCA< 1: Indicates no comparative advantage, meaning the product is less competitive and not recommended for export orientation (low competitiveness).

2.2 Export product dynamics (EPD)

EPD determines the level of export competitiveness of a country's commodity. The EPD analysis is categorized into a four-quadrant matrix (Fig. 1): Quadrant 1 - Rising Star: Indicates that the export product has a high market share and growth potential. Quadrant 2 - Falling Star: Indicates an increase in market share, but the product stagnates and tends to decline. Quadrant 3 - Lost Opportunity: Indicates a decrease in market share for dynamic products. Quadrant 4 - Retreat: Indicates a decline in both market share and product competitiveness **(Destiarni *et al.*, 2021; Fahmid *et al.*, 2022; Wibowo & Rejekiningsih, 2024)**.

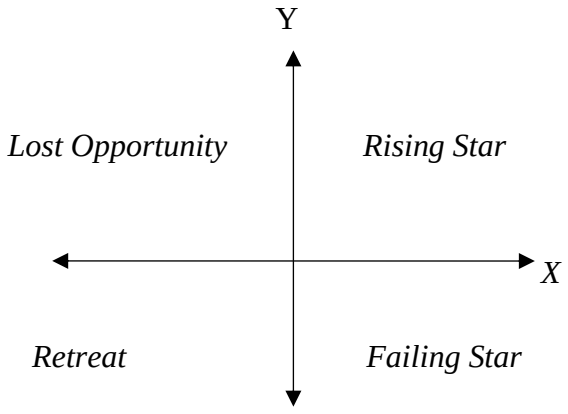

Fig. 1. Export product dynamics quadrant

Source: **(Destiarni *et al.*, 2021; Fahmid *et al.*, 2022; Wibowo & Rejekiningsih, 2024).**

Fig. (1) visualizes the classification of export products into the four quadrants, helping identify the current position and trends of Indonesia's shrimp commodity in international markets. Mathematically, to calculate the market share growth of a country's product (X-axis) and the market share growth of a country's exports (Y-axis) in trade, the formulas are as follows: X-Axis: Growth of Indonesia's shrimp export market share to partner countries.

$$X = \frac{\sum_{t=1}^{t} \left(\left(\frac{\text{Xijk}}{Xiwk}\right) t \text{ x } 100\ \% - \left(\frac{\text{Xijk}}{Xiwk}\right) t-1 \text{ x } 100\ \% \right)}{T} \ldots\ldots\ldots\ldots\ldots\ldots(2)$$

The Y-axis represents the growth of Indonesia's total commodity export market share to partner countries.

$$X = \frac{\sum_{t=1}^{t} \left(\left(\frac{\text{Xjk}}{Xwk}\right) t \text{ x } 100\ \% - \left(\frac{\text{Xjk}}{Xwk}\right) t-1 \text{ x } 100\ \% \right)}{T} \ldots\ldots\ldots\ldots\ldots\ldots(3)$$

From equations 2 and 3, it can be explained that Xijk is the export of Indonesian shrimp commodities to the importing country. Xiwk is the export of world shrimp commodities to the importing country. Xjk is the total export of Indonesian commodities to the importing country. Xwk is the total export of world commodities to the importing country. T and t form the observation time.

2.3 X-model

RCA and EPD are formulated into the X-Model to evaluate the potential and prospects of Indonesia's shrimp exports in the international market. The X-Model categorizes export market potential into four clusters **(Rindayati & Akbar, 2022)**. The criteria and descriptions of each cluster are presented in Table (1).

Table 1. X-model clusters

RCA	EPD	X-Model
	Rising Star	Optimistic
	Failing Star	Potential
RCA > 1	Lost Opportunity	Potential
	Retreat	Less Potential
	Rising Star	Potential
	Failing Star	Less Potential
RCA < 1	Lost Opportunity	Less Potential

RCA	EPD	X-Model
	Retreat	Not Potential

Source**: (Rindayati & Akbar, 2022)**.

2.4 Gravity model analysis

To identify the factors influencing Indonesia's shrimp exports to importing countries, this research employs panel data regression analysis using the Gravity Model approach. The model specification refers to studies by **He *et al.* (2013)**, **Muryani *et al.* (2019)** and **Wati (2023)**, with modifications to transform the model into a natural logarithm form (LN) to address normality issues (**Muryani *et al.*, 2019**). The econometric model is as follows:

$$\text{Ln Expijt} = \beta 0 + \beta 1 \text{ Ln GDPjt} + \beta 2 \text{ Ln GDPit} + \beta 3 \text{ Ln REERjt} + \beta 4 \text{ Ln REERit} + \beta 5 \text{ Ln PEt} + \beta 6 \text{ Ln POPjt} + \beta 7 \text{ Ln POPit} + \beta 8 \text{ Ln DISTijt} + \varepsilon ijt \quad \ldots\ldots\ldots\ldots\ldots\ldots (4)$$

Where, β0 is the Dependent Variable Coefficient. β 1 – β 8 is the Independent Variable Coefficient. Expijt is the Value of Indonesian shrimp exports to the main importing country in year t. Ln is the Natural Logarithm. GDPjt is the GDP Percapita value of the importing country in year t. GDPit is the GDP Percapita value of Indonesia in year t. REERjt is the real effective exchange rate of the importing country in year t. REERit is the real effective exchange rate of Indonesia in year t. PEt is the export price of Indonesian shrimp commodities in the importing country in year t. POPjt is the population of the importing country in year t. POPit is the population of Indonesia in year t. DISTijt is the distance between Indonesia and the importing country, and εijt is the error term. Table (2) presents a summary of the statistics of the dependent variables and independent variables used in the study.

The hypotheses are tested simultaneously (F-test) and partially (t-test) to determine the influence between independent and dependent variables.

Source: Author (2024)

Fig. 2. Illustration of determinant factors of Indonesian shrimp exports to main importing countries

2.4.1 GDP per capita of importing countries

GDP per capita in importing countries acts as an independent variable that is anticipated to positively influence the value of Indonesia's shrimp exports to key destination markets. As the GDP per capita of these major importing countries rises, the export value of Indonesian shrimp is expected to increase accordingly.

H0: A rise in the GDP per capita of major importing countries will increase Indonesia's shrimp export value (positive coefficient).

H1: A rise in the GDP per capita of major importing countries will result in a decline in Indonesia's shrimp export value (negative coefficient).

2.4.2 GDP per capita of Indonesia

Indonesia's GDP per capita serves as an independent variable that is predicted to negatively affect the value of Indonesia's shrimp exports to key importing countries. As Indonesia's GDP per capita rises, the export value of shrimp to these major markets is expected to decline.

H0: A rise in Indonesia's GDP per capita will reduce the value of Indonesia's shrimp exports (negative coefficient).

H1: A surge in Indonesia's GDP per capita will increase the value of Indonesia's shrimp exports (positive coefficient).

2.4.3 Real effective exchange rate (REER) of importing countries

The real effective exchange rate (REER) of importing countries acts as an independent variable that is anticipated to have a negative impact on the value of Indonesia's shrimp exports to major importing nations. A depreciation in the REER of the importing country is expected to lower the value of shrimp exports to these markets.

H0: A decline in the REER of importing countries will decrease Indonesia's shrimp export value (negative coefficient).

H1: A decline in the REER of importing countries will increase Indonesia's shrimp export value (positive coefficient).

2.4.4 The real effective exchange rate (REER) of Indonesia

Indonesia's real effective exchange rate (REER) is an independent variable projected to positively influence the value of shrimp exports to key importing countries. A depreciation in Indonesia's REER is expected to boost shrimp export value to these major markets.

H0: A decline in Indonesia's REER will increase shrimp export value (positive coefficient).

H1: A decline in Indonesia's REER will decrease shrimp export value (negative coefficient).

2.4.5 Shrimp prices

The price of Indonesian shrimp in key importing countries serves as an independent variable that is expected to negatively impact the value of shrimp exports. When the price of Indonesian shrimp rises, the export value is anticipated to decline.

H0: A rise in the price of Indonesian shrimp will decrease the export value (negative

coefficient).

H1: A drop in the price of Indonesian shrimp will increase the export value (positive coefficient).

2.4.6 Population of major importing countries

The population size of major importing countries is an independent variable anticipated to influence the value of Indonesia's shrimp exports positively. As the population in these key importing nations grows, the export value of shrimp is expected to increase.

H0: A growth in the population of major importing countries will increase shrimp export value (positive coefficient).

H1: A growth in the population of major importing countries will lead to a decline in shrimp export value (negative coefficient).

2.4.7 Population of Indonesia

The population of Indonesia acts as an independent variable that is predicted to have a negative effect on the value of shrimp exported to major importing countries. As Indonesia's population grows, the value of shrimp exports is expected to decline.

H0: A rise in Indonesia's population will decrease the value of shrimp exports (negative coefficient).

H1: A surge in Indonesia's population will increase the value of shrimp exports (positive coefficient).

2.4.8 Distance

Distance is an independent variable predicted to negatively affect the value of shrimp exports to major importing countries. As the distance between Indonesia and the importing countries increases, the value of shrimp exports is expected to decline.

H0: A longer distance will decrease the value of shrimp exports (negative coefficient).

H1: A longer distance will increase the value of shrimp exports (positive coefficient).

Table 2. Summarized statistics of variables

Variable	Obs	Mean	Std Dev	Min	Max
Lnexpijt	217	16.330	3.367	0.000	20.859
Lngdpjt	217	9.988	1.008	5.933	11.311
Lngdpit	217	7.550	0.713	6.129	8.505
Lnreerjt	217	4.646	0.620	0.000	7.599
Lnreerit	217	4.442	0.828	0.000	4.965
Lnpet	217	1.893	0.537	0.000	2.753
Lnpopjt	217	18.620	1.157	17.488	21.069
Lnpopit	217	19.279	0.112	19.072	19.441
Lndistijt	217	9.092	0.418	8.560	9.703

Source: Author's calculation (2024).

Panel data regression estimation with gravity model approach is estimated using pooled least square (PLS), Fixed Effect Model (FEM), or Random Effect Model (REM). Chow test was used to determine the model used whether using PLS or FEM. Hypothesis for Chow test is H0: PLS and H1: FEM. If the probability value is less than the significance level of 0.05% ($P < \alpha$) then H0 is rejected and H1 is accepted, conversely if the probability value is greater than the significance level of 0.05% ($P > \alpha$) then H1 is rejected and H0 is accepted. Hausman test was applied to determine the best model whether using FEM or REM. Hypothesis for Hausman test is H0: FEM and H1: REM. If the probability value is smaller than the significance level of 0.05% ($P < \alpha$) then H0 is rejected and H1 is accepted, conversely if the probability value is greater than the significance level of 0.05% ($P > \alpha$) then H1 is rejected and H0 is accepted. Lagrange Multiplier Test (LM Test) was implemented to determine the best model whether using REM or using PLS. The hypothesis for the LM test is H0: REM and H1: PLS. If the probability value is smaller than the significance level of 0.05% ($P < \alpha$) then H0 is rejected and H1 is accepted **(Muryani *et al.*, 2019; Wati, 2023)**.

RESULTS AND DISCUSSION

1. The comparative advantage condition of Indonesian shrimp exports in major import markets with RCA analysis

The RCA analysis results for Indonesian shrimp exports to major global importers (China, Japan, the United States, South Korea, France, Spain, and Italy) during 1993-2023 are presented in Table (3).

Table 3. RCA calculation results for Indonesian shrimp

Year	The World's Main Shrimp Importing Countries						
	China	France	Japan	South Korea	USA	Spain	Italy
1993	1.330	14.680	4.340	1.900	5.380	0.000	0.340
1994	3.400	10.320	5.210	2.140	0.270	0.040	0.020
1995	2.370	9.250	6.320	1.990	2.470	0.000	0.000
1996	3.090	9.840	6.270	1.540	5.250	0.000	0.000
1997	7.440	15.730	6.690	1.830	7.080	0.040	0.000
1998	6.030	15.890	8.060	1.240	7.480	0.190	3.460
1999	8.330	12.610	6.530	1.080	9.000	0.150	3.150
2000	3.310	9.640	5.370	1.370	7.920	0.310	3.910
2001	3.290	11.290	6.180	0.730	8.120	0.270	2.380
2002	2.130	7.060	5.840	0.530	9.150	0.620	1.680
2003	3.250	11.600	5.870	0.430	9.880	1.300	2.590

2004	4.210	9.770	4.950	0.600	13.170	2.940	5.330
2005	3.920	13.320	5.030	0.540	14.510	1.050	5.430
2006	3.510	6.250	5.400	0.540	16.110	0.340	4.010
2007	1.700	5.080	4.940	0.520	16.920	0.220	3.960
2008	5.690	5.100	4.930	0.730	20.280	0.040	2.580
2009	1.670	11.140	4.900	0.300	14.310	0.110	1.600
2010	1.740	8.190	4.220	0.190	12.780	0.030	1.280
2011	2.860	5.500	3.780	0.180	15.420	0.020	0.690
2012	4.790	6.970	4.560	0.200	19.260	0.040	1.120
2013	7.720	6.930	5.490	0.210	18.850	0.220	1.790
2014	6.320	5.600	6.090	0.520	23.310	0.090	0.940
2015	5.320	3.480	5.600	0.450	18.890	0.100	0.760
2016	2.340	5.280	5.630	0.280	21.370	0.160	0.670
2017	1.260	5.460	5.390	0.240	21.920	0.070	0.620
2018	1.210	6.390	5.960	0.250	22.130	0.130	0.920
2019	1.010	6.650	6.670	0.460	18.570	0.190	0.590
2020	1.260	6.960	7.040	0.300	19.960	0.240	0.410
2021	0.900	4.450	6.490	0.400	13.280	0.060	0.250
2022	0.850	2.900	6.160	0.670	14.260	0.530	0.350
2023	0.850	5.850	8.040	1.110	14.070	0.320	0.290
Average	3.320	8.360	5.740	0.760	13.590	0.320	1.650

Source: Author's calculation (2024).

Table (3) shows that, on average, the RCA values of Indonesian shrimp commodities for major importing countries have an RCA > 1, indicating high competitiveness. These countries include China (3.32), France (8.36), Japan (5.74), the United States (13.59), and Italy (1.65). Conversely, countries with an RCA < 1, where Indonesian shrimp has low competitiveness, are South Korea (0.76) and Spain (0.32). The RCA calculation for Indonesian shrimp generally exhibits fluctuations, which are driven by the dynamic nature of Indonesia's trade with major shrimp-importing countries. Among the countries, the United States records the highest RCA value at 13.59, indicating that Indonesian shrimp exports have a strong comparative advantage in the U.S. market. This can be attributed to the fact that shrimp is a staple food widely consumed by Americans **(He *et al.*, 2013)**. The second-highest RCA value is found in the French market, with an average RCA of 8.36. One of the main reasons for this is that approximately 73% of France's seafood consumption depends on foreign trade **Lucas *et al.* (2021)**, and Indonesia is one of the world's largest seafood producers **(UN Comtrade, 2024)**. Japan ranks third in terms of the RCA value for Indonesian shrimp, with an average RCA of 5.74. This indicates a strong comparative advantage in the Japanese market. Moreover, Indonesia and Japan have established trade cooperation under the Indonesia-Japan Economic Partnership Agreement (IJ-EPA), through which Indonesia has gained expanded market access to Japan, particularly for agricultural, fishery, industrial, and forestry products **(Cabinet**

Secretariat of the Republic of Indonesia, 2023). This cooperation has contributed to maintaining the competitiveness of Indonesian shrimp exports in the Japanese market.

The fourth-highest RCA value for Indonesian shrimp is found in China, with an average RCA of 3.32. Since the late 1990s, China has experienced high shrimp consumption demand and a gap between domestic shrimp production and demand, leading to an increase in shrimp imports **(N'Souvi & Sun, 2025)**. However, as shown in the Table (3), during the final period of the study (2021–2023), the RCA value for Indonesian shrimp exports to the Chinese market fell below 1, indicating weak competitiveness. One of the main causes is the impact of the COVID-19 pandemic, which weakened Indonesia-China trade performance, with China's role as the epicenter of the pandemic further contributing negatively. The last RCA value greater than 1 is observed in Italy, with an average RCA of 1.92, showing that Indonesian shrimp has a good comparative advantage in the Italian market. This is due to Italy's high dependence on imported shrimp to meet its domestic demand, particularly from major shrimp-exporting countries **(Allegra *et al.*, 2012)**. Furthermore, compared to other European countries, Italy has a higher average per capita consumption of seafood products, especially shrimp **(Pulcini *et al.*, 2020)**. On the other hand, for the case of Indonesian shrimp exports to the Spanish and South Korean markets, the average RCA values are less than 1, at 0.32 for Spain and 0.76 for South Korea. This indicates that Indonesian shrimp exports to these two countries lack strong comparative advantages and do not exhibit high competitiveness.

2. The dynamics of Indonesia's shrimp export competitiveness in major import markets with export product dynamic (EPD)

Next, the results of the Export Product Dynamic analysis. EPD is used to determine the level of competitiveness of a country's commodity exports. In this case, EPD is divided into a four-quadrant matrix, namely rising star, failing star, lost opportunity, and retreat. Table (4) shows the results of the estimation of Indonesian shrimp commodities in the markets of major importing countries. It can be seen that the rising star position of Indonesian shrimp commodities is in China and Spain, which is marked by positive X-axis and Y-axis values. This condition is very ideal and shows that the competitiveness of Indonesian shrimp commodities in China and Spain is very competitive where the growth of Indonesia's export market share (Y-axis) is able to be followed by the growth in demand for Indonesian shrimp commodities (X-axis) in China and Spain.

Next, the failing star position of Indonesian shrimp commodities is in Japan and the United States, which is marked by positive X-axis and negative Y-axis values. This indicates that Indonesian shrimp commodity exports have experienced an increase in the market share of shrimp commodities (X-axis), but all Indonesian export commodity products are stagnant and tend to experience a decrease in demand (Y-axis) in the Japanese and United States markets. Furthermore, the retreat position of Indonesian shrimp

commodities is in three countries, namely South Korea, France, and Italy, which are marked by negative values of the X and Y axes. This means that Indonesian shrimp commodity export products have decreased both in product market share and export market share.

Table 4. EPD calculation results

Country	X-Axis	Y-Axis	EPD
China	0.018	0.043	Rising Star
Korea	-0.092	-0.022	Retreat
France	-0.143	-0.007	Retreat
Japan	0.067	-0.061	Failing Star
USA	0.183	-0.004	Failing Star
Spain	0.005	0.002	Rising Star
Italy	-0.004	-0.012	Retreat

Source: Author's calculations (2024).

3. The export potential of Indonesian shrimp in major import markets with X-model analysis

In the X-model analysis, the RCA and EPD results would be formulated to determine the potential and prospects for Indonesian shrimp exports in the international market. In the X-model, there are four clusters of export market potential, namely optimistic, potential, less potential, and not potential.

Table 5. X-model formulation results

Country	RCA	EPD	X-MODEL
China	3.320	Rising Star	Optimistic
France	8.360	Retreat	Less Potential
Japan	5.740	Failing Star	Potential
Korea	0.760	Retreat	Not Potential
Usa	13.590	Failing Star	Potential
Spain	0.320	Rising Star	Potential
Italy	1.650	Retreat	Less Potential

Source: Author's calculations (2024).

Table (5) shows that the position of Indonesian shrimp exports has an optimistic market potential in China. This indicates that Indonesian shrimp exports in the Chinese market have strong competitiveness and favorable market share conditions. This is reflected in an RCA value greater than 1 and the EPD position classified as a rising star. Since the late 1990s, China has experienced high shrimp consumption demand, with a gap between domestic shrimp production and demand, leading to increased shrimp imports **(N'Souvi & Sun, 2025)**. Next, the export position of Indonesian shrimp in Japan, the United States, and Spain is categorized as potential. For Japan and the United States, the

RCA values are greater than 1, but the EPD positions are classified as failing stars. This indicates that while the competitiveness and comparative advantage of Indonesian shrimp exports in these markets are strong, they are not accompanied by growth in Indonesia's export market share. Meanwhile, in the case of Spain, the RCA value is less than 1, but the EPD position is classified as a rising star. This means that Indonesian shrimp's comparative advantage in Spain is weaker compared to other major shrimp exporters, but the market appeal and the growth potential of Indonesia's shrimp exports to Spain are high, making it a promising market despite the lack of strong comparative advantage.

In contrast, the export position of Indonesian shrimp to France and Italy is considered less promising. Both countries have RCA values greater than 1, but their EPD positions are classified as retreat. This shows that while Indonesian shrimp exports have a good comparative advantage, they are experiencing a decline in both product market share and export market share in these countries. Lastly, for the case of South Korea, the position is categorized as non-potential. The RCA value is less than 1, and the EPD position is classified as declining. This indicates that Indonesian shrimp exports in South Korea lack comparative advantage and are experiencing a decline in both product and export market share.

4. Determinant factors of Indonesian shrimp exports in major import markets with gravity model analysis

The next step in this analysis is to identify the factors influencing Indonesian shrimp exports to major importing countries using panel data regression with a gravity model approach. Table (6) provides a summary of the model selection process, indicating the most appropriate econometric model adopted in this study.

Table 6. The results of the model selection tests

Test	Result	Model Decision
Chow Test	Probability = 0.000 (< 0.05)	Fixed Effect Model
Hausman Test	Probability = 0.912 (> 0.05)	Random Effect Model
Lagrange Multiplier Test	Probability = 0.000 (< 0.05)	Random Effect Model

Source: Author's calculations (2024).

The first step involves conducting the Chow test to determine whether the model should use Pooled Least Squares (PLS) or the Fixed Effect Model (FEM). The results of the Chow test in this study indicate a probability value smaller than the 0.05% significance level, specifically 0.0000, which suggests that FEM is the preferred model. The next step involves conducting the Hausman test to determine whether the best model is FEM or the Random Effect Model (REM). The Hausman test results show a probability value greater than the 0.05% significance level, specifically 0.9126, indicating that REM is the better model. Subsequently, the Lagrange Multiplier (LM) test is conducted to decide whether

the best model is REM or PLS. The LM test results reveal a probability value smaller than the 0.05% significance level, specifically 0.0000, indicating that REM is the best model. For the REM model using the Generalized Least Squares (GLS) approach, classical assumption testing is not necessary because the GLS approach ensures that the estimator meets the criteria for Best Linear Unbiased Estimate (BLUE) **(Porter & Gujarati, 2009)**.

Table 7. The estimation results of the Random Effect Model (REM) model

Variable	Coefficient	Std Eror	t-stats	Prob
Cons	-277.614	49.012	-5.660	0.000***
Lngdpjt	1.344	0.299	4.500	0.000***
Lngdpit	-2.609	0.407	-6.410	0.000***
Lnreerjt	-0.554	0.192	-2.880	0.004***
Lnreerit	0.042	0.135	0.310	0.756
Lnpet	2.604	0.286	9.090	0.000***
Lnpopjt	1.884	0.552	3.410	0.001***
Lnpopit	13.717	2.726	5.030	0.000***
Lndistijt	-0.208	0.513	-0.410	0.684
R-Square (R2)	: 0.7127			
Prob Chi Square	: 0.0000***			
Note:	* Significance at 10% level			
	** Significance at 5% level			
	*** Significance at 1% level			

Source: Author's calculations (2024).

From Table (7), it can be explained that the R-Square (R^2) value is 0.7127, meaning that 71% of the independent variables can explain the dependent variable, while the remaining 29% can be explained by other variables outside the model. The Prob Chi-Square value of 0.0000 indicates that all independent variables simultaneously have a significant effect on the dependent variable at a 1% significance level. The panel data regression results show that the per capita GDP of importing countries has a positive and significant relationship, with a coefficient of 1.344 and a probability of 0.000 < 0.05, so the null hypothesis is accepted. This variable indicates that a 1% increase in the per capita GDP of the importing country will increase Indonesia's shrimp exports to that country by 1.34% (ceteris paribus). Meanwhile, Indonesia's per capita GDP has a negative relationship of -2.609 at a significance level of 0.000 < 0.05, so the null hypothesis is accepted. This variable suggests that a 1% increase in Indonesia's real per capita GDP will lead to a 2.6% decrease in shrimp exports (ceteris paribus).

The results also show that Indonesia's Real Effective Exchange Rate (REER) has a positive but insignificant relationship, with a coefficient of 0.042 and a probability of 0.756 > 0.05, so the null hypothesis is accepted. This variable indicates that a 1% depreciation in Indonesia's REER would lead to a 0.042% increase in shrimp exports (ceteris paribus). Meanwhile, the REER of importing countries has a negative and significant relationship,

with a coefficient of -0.554 and a probability of 0.004 < 0.05, so the null hypothesis is accepted. This means that a 1% depreciation in the importing country's REER would decrease Indonesian shrimp exports by 0.55% (ceteris paribus). This is because a country experiencing a depreciation in its Real Effective Exchange Rate (REER) will face a decrease in export prices, thereby increasing competitiveness and boosting import demand. Conversely, if the REER appreciates, it will lead to higher export prices and reduce competitiveness in trade, thus decreasing import demand. This is crucial because the exchange rate significantly impacts international trade **(He *et al.*, 2013)**.

The variable for the export price of Indonesian shrimp to importing countries shows a positive and significant relationship, with a coefficient of 2.604 and a probability of 0.000 < 0.05. Thus, the null hypothesis is rejected, and Hypothesis 1 is accepted. This variable suggests that a 1% increase in the export price of Indonesian shrimp to major importing countries would lead to a 2.6% increase in shrimp exports (ceteris paribus). Although this contradicts demand theory, which states that higher prices generally reduce demand, similar findings were reported by **He *et al.* (2013)** and **Muryani *et al.* (2019)**. In markets like the United States, where shrimp imports are heavily dependent on external suppliers, key exporters such as China, Vietnam, Thailand, and Indonesia dominate the supply. Regarding population, the results show that the population of importing countries has a positive and significant relationship, with a coefficient of 1.884 and a probability of 0.001 < 0.05, so the null hypothesis is accepted. This indicates that a 1% increase in the population of an importing country would lead to a 1.8% increase in Indonesian shrimp exports (ceteris paribus), reflecting higher demand due to larger populations and higher purchasing power.

Additionally, Indonesia's population has a positive and significant relationship, with a coefficient of 13.717 and a probability of 0.000 < 0.05. Thus, the null hypothesis is rejected, and Hypothesis 1 is accepted. This variable indicates that a 1% increase in Indonesia's population would increase shrimp exports by 13.7% (ceteris paribus). The strong positive correlation between Indonesia's population and shrimp exports is likely due to its geographical conditions, where vast water territories support around 3.03 million fishermen and 2 million aquaculture farmers **(BPS, 2023)**. The fisheries sector is labor-intensive and absorbs significant labor **Destiningsih *et al.* (2020)**, contributing to the high production of fishery products, particularly shrimp. This is because the sector relies heavily on human resources, especially in capture fisheries and aquaculture, ultimately boosting the volume and competitiveness of Indonesian shrimp exports.

Finally, the economic distance variable between Indonesia and importing countries shows a negative but insignificant relationship, with a coefficient of -0.208 and a probability of 0.684 > 0.05, so the null hypothesis is accepted. This variable suggests that a 1% increase in economic distance would reduce shrimp exports by 0.20%. Empirical findings indicate a negative relationship between economic distance and exports, as longer

distances lead to higher transportation costs, affecting price competitiveness and overall export performance.

CONCLUSION

Based on the research results, the Indonesian RCA index for shrimp exports during 1993-2023 shows a comparative advantage (RCA > 1) in five countries: China, France, Japan, the United States, and Italy. Exports to South Korea and Spain lack this advantage (RCA < 1). EPD analysis places Indonesian shrimp as a rising star in China, a failing star in Japan and the United States, and in retreat in South Korea, France, and Italy. In the X-model, shrimp exports to China are optimistic, indicating strong competitiveness, while Japan, the United States, and Spain are potential markets. Exports to France and Italy are less potential, and South Korea is not potential. Factors such as Indonesia's GDP per capita and the importing country's real exchange rate have significant negative effects, while GDP per capita, export price, and population positively influence shrimp exports. Distance shows a negative but insignificant effect.

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