

# What Market Structures and Factor Influencing Tuna Exports? (Case Study: Indonesia)

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**Abstract.** Tuna is one of the main exports of fish from Indonesia and has great potential for export. Despite having great potential, Indonesia only ranks second as a tuna producing country in ASEAN. This study aims to (1) examine the structure of Indonesia's international tuna market, and (2) analyze the factors affecting Indonesia's tuna exports in the international market. The research method is secondary data. The methods of analysis are the Herfindahl Hirschman Index (HHI) and Concentration Ratio (CR4), Revealed Comparative Advantage (RCA) and Export Product Dynamic (EPD) and panel data regression. Novelty of this research that the market structure of fresh and frozen tuna is a perfectly competitive market, while canned tuna is an oligopoly. Indonesia's fresh, frozen and canned tuna has strong export competitiveness in the America and Japan as well as Indonesia is a rising star in the America, France and Bulgaria markets for canned tuna products. Analysis of panel regression data proves the variable which affects the value of Indonesia's tuna exports is the export price of tuna fish.

According to [1], Indonesian fisheries are dominated by the export value of five main commodities, namely shrimp, tuna, skipjack, crab, and seaweed. Skipjack, Shrimp and Tuna (SST) are superior commodities that have high export value among other commodities. According to [4], the decline in the value of tuna exports was caused by a decline in tuna production. Decreasing tuna production has an impact on reducing the volume of tuna exports. Tuna fish is one of Indonesia's leading export commodities that has great potential in Indonesia, both in fresh, frozen and processed form. Consumers demand for tuna are quite high due to the shift in world consumer tastes from red meat to white meat [13]. Low fat content and calories rich in protein and omega-3 make tuna very popular [5]. The high demand for tuna in the global market causes the selling price of tuna to be quite high.

Indonesia is the country with the largest tuna production in the world [4]. The Director General of Capture Fisheries at the Ministry of Maritime Affairs and Fisheries noted that Indonesia produced 16% of the total global tuna production in 2015-2017 [5]. About 70% of Indonesian tuna production is exported to potential tuna markets in the form of fresh, frozen and processed products [13]. Specifically, the destination country for Indonesian tuna exports is Japan (54%), followed by the United States (24%) and the European Union (23%) [6].

Indonesia has a big potential as a tuna exporting country, tuna exports can compete on the international market. Thus, it is necessary to carry out research regarding the analysis of the competitiveness of tuna exports to support the increase in exports of tuna commodities. Examine the market structure of Indonesian tuna in the international market and the factors that influence tuna exports in the international market.

## **2 Methodology**

### **2.1 Research methods**

This research uses secondary data analysis methods. The secondary data analysis method is a method of researching an object/phenomenon using data originating/data sources from institutions that have credibility in collecting data [7]. The secondary data analysis method was carried out by looking for data on the value of world tuna exports and Indonesian tuna production which were available from trusted sources.

### **2.2 Data Types and Sources**

The type of data used in this research is secondary data in the form of time series and cross section data for the period 2011-2020. Secondary data is data obtained from the relevant agency or service from literature related to the study topic. Secondary data needed in this research includes tuna production, tuna export volume, tuna export value.

This data can be obtained from the Central Statistics Agency (BPS), Ministry of Maritime Affairs and Fisheries of the Republic of Indonesia (KKP RI), World Bank, UN Comtrade (United Nations Commodity Trade Statistics Database), Trade Map, the internet and other relevant literature institutions. The commodities that are the object of research are fresh SST with HS codes 030231, 030232, 030233, 030234, 030235, 030236, 030239. Next, frozen SST with HS codes 030341, 030342, 030343, 030344, 030345, 030346, 030349 and processed SST with code HS 160414.

### **2.3 Method of collecting data**

Data was obtained through various trusted sources as recorded in Table 4 including the Ministry of Maritime Affairs and Fisheries (KKP), UN Comtrade, Trade Map, and World Bank. Data collection is also obtained from books, annual statistics and scientific journals issued by relevant official bodies or institutions that are relevant to the research. The data that has been collected is then grouped based on the parameters to be tested.

### **2.4 Data analysis method**

The data obtained will then be processed and analyzed qualitatively and quantitatively according to the objectives to be achieved. Herfindahl Hirschman Index (HHI) data analysis is used to analyze the structure of the Indonesian tuna market in the international market. The Herfindahl Hirschman Index (HHI) data analysis processing was carried out using Microsoft Office Excel 2019.

**Herfindahl Hirschman Index (HHI) and Concentration Ratio (CR4)**

*Herfindahl-Hirschman Index* (HHI) and Concentration Ratio (CR4) are analytical tools used to determine the market structure faced by tuna fish commodities as well as measure the market control of each country involved in the tuna fish trade. HHI is used to see the size of a particular market proportion of an industry. Apart from looking at market proportions, HHI can be used to look at the market concentration of a commodity which will influence the market structure of tuna fish commodities. The following is the HHI formula [2]:

$$HHI = 10.000 \sum_{i=1}^N w_i^2 \dots\dots\dots(1)$$

Where:

w<sub>i</sub> = market share Tuna fish exporting countries on the international market

The HHI value ranges from 0 to 10,000 [2]. An HHI value equal to 10,000 means that the market share is 1 or there is one country that controls the world tuna fish market, while an HHI value close to 0 indicates that there are many countries that control the tuna fish industry. The CR4 concentration ratio (Concentration Ratio) is used to measure the concentration of the four largest tuna producing countries in the tuna industry. The CR4 calculation formula is:

$$CR_4 = w_1 + w_2 + w_3 + w_4 \dots\dots\dots(2)$$

Where:

w = tuna exporting country which has the largest market share in the international market

Table 1 Level of market concentration

Tiers	CR4	IHL
Tall	80% - 100%	HHI = 1
Currently	50% - 80%	0.1 < HHI < 1
Low	0% - 50%	0 < HHI < 0.1

Source: [8]

In general, the comparison of the Herfindahl Hirschman Index (HHI) and Concentration Ratio (CR4) is as follows [3]:

1. Low market concentration tends to be a perfectly competitive market or tends to be a monopolistic competitive market.
2. Medium market concentration has oligopoly market tendencies.
3. High market concentration has a tendency towards monopoly markets.

Panel data regression data analysis is used to determine the influencing factors Indonesian tuna exports on the international market. Data analysis processing was carried out using E-views 9.

Panel data regression is used to analyze factors that influence Indonesian tuna exports to export destination countries. The variables used refer to research by Fadhila (2019) and Immanuel (2021) by making several adjustments. The following is the equation of the research model used:

$$\text{LnEXPVALUE}_{jt} = \alpha + \beta_1 \text{LnGDPCAP}_{jt} + \beta_2 \text{LnEXRATE}_{jt} + \beta_3 \text{LnEXPRICE}_{jt} + \beta_4 \text{LnPOP}_{jt} + \epsilon_{jt} \dots\dots\dots(6)$$

Information:

EXPVALUE<sub>jt</sub>: Value of Indonesian tuna exports to destination country j year t (US\$)

GDPCAP<sub>jt</sub> : GDP riil per capita destination country j year t (US\$)

EXRATE<sub>jt</sub> : Ri exchange rateil destination country j year t (LCU/US\$)

- EXPPRICE<sub>jt</sub> : Indonesian tuna export price to destination country j year t (US\$/ton)  
 POP<sub>jt</sub> : Population of destination country j year t (people)  
 $\alpha$  : Intercept  
 $\beta_n$  : Slope (n=1, 2, ...,5)  
 Ln : Natural logarithm  
 $\epsilon_{jt}$  : error

### 3 Results and Discussion

A country's economic growth can be seen from the value of that country's Gross Domestic Product (GDP). GDP is defined as the total value or market prices of all final goods and services produced by an economy during a certain period of time (Nanga 2001). If GDP shows an increase, it can be said that the country's economy is doing better than the previous year. Agricultural sector GDP based on 2010 constant prices according to business fields (billions of rupiah) for 2017-2021 can be seen in Table 2.

Table 2 Gross Domestic Product (GDP) of the agricultural sector based on 2010 constant prices according to business fields (billions of rupiah) in 2017-2021

Business field	Value (billions of rupiah)					Average increase (%)
	2017	2018	2019	2020	2021	
Plantation crops	373,194.0	387,497.0	405,148.0	410,570.4	425,042.6	3.31
Crops	293,858.0	298,027.0	292,883.0	303,453.7	298,733.3	0.44
Fishery	226,833.0	238,616.0	252,279.0	254,112.3	267,966.6	4.27
Farm	148,689.0	155,540.0	167,638.0	167,057.7	167,629.1	3.10
Horticultural plants	135,649.0	145,131.0	153,158.0	159,539.3	160,429.6	4.31
Forestry and logging	61,279.6	62,981.8	63,217.6	63,195.9	63,236.4	0.80
Agricultural and hunting services	18,872.9	19,459.9	20,076.7	20,402.1	20,672.4	2.31

Source: BPS 2023

Table 2 shows that fisheries contributed the third largest GDP for five consecutive years. The GDP value of fisheries has a positive trend from 2017 to 2021. Fisheries commodities have a significant contribution to national economic growth, as indicated by the average increase in GDP of 4.27%. The high increase in fisheries GDP every year proves that fisheries have potential opportunities. The export value of Indonesia's main fishery commodities in 2012-2021 can be seen in Figure 1.

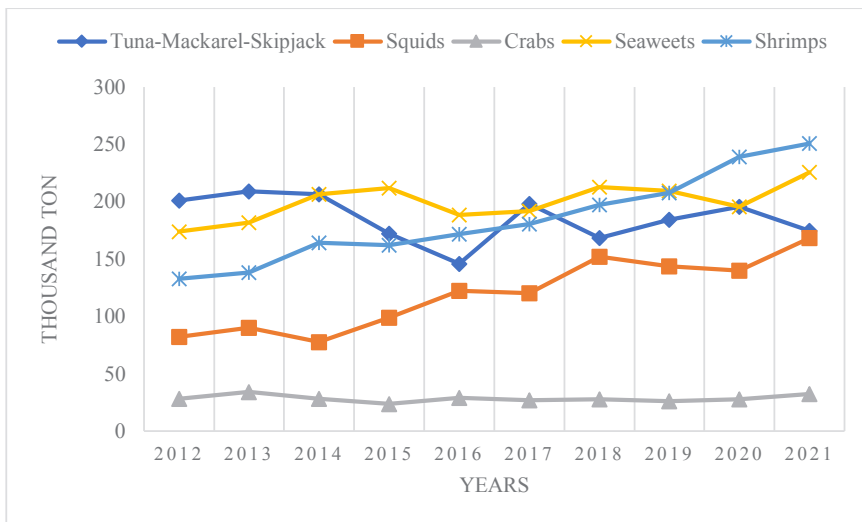


Figure 1 Export value of Indonesia's main fishery commodities in 2012-2021 (KKP 2023)

Figure 1 shows the development of the export value of Indonesia's main fishery commodities in 2012-2021. SST is a commodity with the second largest export value after shrimp (Figure 1). During the 2012-2021 period, SST's export value fluctuated and always ranked 2nd after shrimp commodities. The highest export value occurred in 2013, namely US\$ 764.8 million. The lowest export value occurred in 2016, namely US\$ 566.2 million. From 2014 to 2016 the value of SST exports continued to decline. The export volume of Indonesia's main fishery commodities in 2012-2021 can be seen in Figure 2.

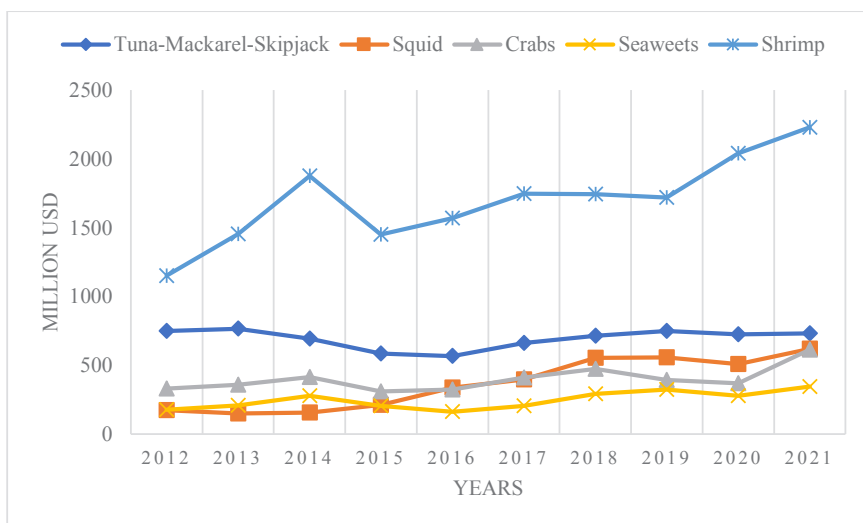


Figure 2 Export volume of Indonesia's main fisheries commodities in 2012-2021 (KKP 2023)

Figure 2 shows the development of the export volume of Indonesia's main fishery commodities during 2012-2021. In 2012 and 2013, SST commodities were ranked first with the largest export volume among other commodities, amounting to 201,143 tons and 209,070 tons respectively. The large volume of tuna exports indicates that Indonesian tuna is well received on the international market (Putri et al 2016).

The lowest export volume for SST commodities occurred in 2016, namely 145,900 tons. Overall, the value of SST exports is directly proportional to the volume of SST exports. The decline that occurred in the value and volume of Indonesian tuna fish export commodities shows that further efforts are needed in managing these fishery export commodities.

### 3.1 Analysis of Tuna Fish Commodity Market Structure in International Markets

The market structure and market control of tuna fish commodities in the international market can be measured using the Herfindahl Hirschman Index (HHI) and Concentration Ratio (CR4) formulas. Market control is obtained from detailed market share calculations which can be seen in Appendix 4, Appendix 5 and Appendix 6. In this study, HHI and CR4 calculations are grouped based on the form of product traded, namely fresh tuna, frozen tuna and processed tuna. The results of the HHI and CR4 calculations are presented in Table 3.

Table 3 Herfindahl Index (HHI) and Concentration Ratio (CR4) values for tuna commodity exporting countries in 2011-2020

Year	Fresh			Frozen			Processed		
	Number of Exporters	IHL	CR4 (%)	Number of Exporters	IHL	CR4 (%)	Number of Exporters	IHL	CR4 (%)
2011	76	300	28	84	384	32	77	1530	58
2012	80	256	24	76	345	32	89	1450	57
2013	75	545	34	84	356	31	79	1344	57
2014	77	267	25	79	401	36	77	1285	56
2015	82	534	37	87	391	34	81	1256	54
2016	74	376	31	86	357	33	77	1308	56
2017	74	340	32	85	366	34	77	1242	57
2018	73	436	34	82	264	28	75	1123	55
2019	80	686	43	75	251	27	72	1118	54
2020	61	542	38	71	332	31	68	1155	55
Average	75	428	33	81	345	32	77	1281	56

Source: 2022 Data Analysis Results

Based on the calculation results obtained, the HHI value for world fresh tuna fish commodities in 2011-2020 ranged from 256 to 686 ( $0 < \text{HHI} < 1,000$ ). The concentration level ratio indicated by the CR4 value shows a trend where the four largest producing countries control 24% - 38% of the market from 2011 to 2020 (CR4 0% - 50%). The results of HHI and CR4 calculations show that fresh tuna fish commodities on the world market have a low concentration.

The average number of countries exporting fresh tuna fish in the world for the period 2011 to 2020 is 75 countries. During this period the four countries that dominated the market were Spain, Mexico, Indonesia and Croatia. Indonesia had the highest market share in 2011-2012. The results of the HHI and CR4 analysis on fresh tuna fish commodities show that fresh tuna fish commodities on the world market have a low concentration so that the resulting market structure is a perfectly competitive market. As one of the main exporting countries, Indonesia needs to adjust its competitive strategy in maintaining and even increasing the market for Indonesian fresh tuna on the world market.

Frozen tuna fish commodities in 2011-2020 had a small HHI value ranging from 251-401 ( $0 < \text{HHI} < 1,000$ ). The concentration level ratio indicated by the CR4 value shows a trend where the four largest producing countries controlled 27% - 36% of the market during 2011-2020 (CR4 0% - 50%). The results of HHI and CR4 calculations show that frozen tuna fish commodities on the world market have a low concentration.

The average number of countries exporting frozen tuna fish in the world for the period 2011 to 2020 is 81 countries. The countries that dominated the frozen tuna fish commodity market during this period were Spain, Korea, China and France. Indonesia is not included in the 4 main countries exporting frozen tuna fish in the world during the 2011-2020 period. The results of the HHI and CR4 analysis on frozen tuna

fish commodities prove that frozen tuna fish commodities on the world market have a low concentration so that the resulting market structure is a perfectly competitive market.

Processed tuna fish commodities in 2011-2020 had an HHI value ranging from 1,118-1,530(1,000 < HHI < 10,000). Concentration level ratio indicated by CR4 shows a trend where the four largest producing countries control the market by an average of 56% from 2011 to 2020 (CR4 50% - 80%). The results of the HHI and CR4 calculations show that the processed tuna fish commodity on the world market has a moderate concentration.

The average number of countries exporting processed tuna fish in the world for the period 2011 to 2020 is 77 countries. The countries that dominate the processed tuna fish commodity market during the 2011-2020 period are Thailand, Spain, Ecuador and China. Thailand is the country with the highest market share from 2011 to 2020. Indonesia is not included in the 4 largest countries that dominate the market. The results of the HHI and CR4 analysis show that processed tuna fish commodities on the world market have moderate concentration so that the resulting market structure is an oligopoly market.

Based on the results of the HHI and CR4 analysis, it was found that the market structure of fresh tuna fish commodities and frozen tuna fish commodities in the world market is a perfectly competitive market. Meanwhile, the results of the HHI and CR4 analysis on processed tuna fish commodities on the world market show an oligopoly market. The oligopoly market produced by processed tuna fish commodities means that Indonesia needs to develop a strategy to continue to compete in the world processed tuna fish market.

### **3.2 Analysis of Factors Affecting Indonesian Tuna Exports in Export Destination Markets**

Based on the comparison of the estimation results, the estimation results in E-views 9 are better to use because they meet the classical assumption test, namely that the data is normally distributed, free from multicollinearity, heteroscedasticity and autocorrelation problems.

#### **3.3 Real exchange (LNEXRATE)**

The real exchange rate of the destination country has a positive relationship, with a coefficient of 1.7825. The resulting probability value is 0.3557, which means it is greater than the real level of 5% so that the real exchange rate variable does not have a real or significant influence on Indonesian tuna exports.

#### **3.4 Export Price (LNEXPRICE)**

Export prices have a positive relationship to the value of Indonesian tuna exports with a coefficient of 0.1619. The resulting probability value is 0.0086. This value is smaller than the 5% real level so that export prices have a real or significant influence. These results are in accordance with [11] hypothesis and research regarding the analysis of the potential of Indonesian sardines. This research explains that increasing export prices will increase the value of exports.

#### **3.5 Economic Distance (LNECODIST)**

Economic distance has a positive relationship with the value of Indonesian tuna exports with a coefficient of 0.6470. The resulting probability value is 0.3228, which means it is greater than the 5% real level so that the economic distance variable does not have a real or significant influence on Indonesian tuna exports.

Thus, the results of the regression estimation using E-views are better results, this is shown by the classical assumption test being met. The estimation results have a coefficient of determination of 18.17%. This value shows that 18.17% of changes in the value of Indonesian tuna exports to export destination markets can be explained by the variables of real exchange rate, export prices and economic distance. 81.83% is explained by other factors outside the model. The independent variable in the model that has a significant effect at the 5% real level is export prices.

## **4 Conclusion**

Perfect competition market is market for fresh and frozen tuna fish commodities, while processed tuna fish commodities are an oligopoly market. Seeing the existence of market opportunities for processed tuna fish commodities, Indonesia needs to increase export competition for processed tuna fish by

developing strategies to continue to compete in the world processed tuna fish market. The variable that significantly influences the value of Indonesian tuna exports in export destination markets is the export price of tuna fish. Therefore, government should see the price of tuna because it is a variable that significantly influence value of tuna exports. Implication of the result is needed to continue a research about sustainable management for tuna export in order that it will provide much beneficial for Indonesia.

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