**INDONESIA'S PULP EXPORT PERFORMANCE IN THE CHINA MARKET: *ALMOST IDEAL DEMAND SYSTEM APPROACH***

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**Abstract**. Indonesia is one of the pulp producing countries in the world. Indonesia's domestic pulp consumption is increasing every year as is world consumption. Indonesia is also trying to supply the world's demand for pulp. China is one of Indonesia's largest export destinations for pulp commodities. The objectives of this study were to assess the comparative advantage of Indonesian pulp export, and to determine price, cross-price, and expenditure elasticities of pulp demand in the Chinese market. The RCA method was then used to assess the former and the Linear Approximation-Almost Ideal Demand System (LA/AIDS) model was used to determine the latter using annual time series data on quantity and export value of chemical pulp (HS 470329) covering the period 2003-2022. The results showed that Indonesian pulp had a comparative competitive advantage in the Chinese market, but this competitiveness continues to decline. On the other hand, China's pulp consumption continues to increase. This showed a high competition among pulp exporting countries in the Chinese market. The estimation results with the LA/AIDS model showed that Japanese pulp was a complement to pulp from Indonesia, while pulp from Thailand and Brazilian was a substitute for pulp from Indonesia.

***Keywords****: Almost Ideal Demand System; Revealed Comparative Advantage; Pulp export.*

**INTRODUCTION**

 Indonesia's economic growth is strongly influenced by the performance of the non-oil and gas processing industry. According to the Ministry of Industry (2023), the non-oil and gas processing industry contributes 16.3% to Indonesia's Gross Domestic Product (GDP). The pulp and paper industry, one of the industries of the non-oil and gas processing industry group, also contributes positively to Indonesia's GDP. The export value of the pulp and paper industry until July 2023 was about USD 646.28 million, the eighth largest export value after the food, basic metals, chemicals, motor vehicles, apparel and electrical equipment industry groups. The pulp industry has grown rapidly since the 1990s and will continue to show positive growth until 2023.

 The installed capacity of the pulp industry increased from 8.25 million tons in 2014 to 11.255 million tons in 2017 (APKI 2019). This growth in installed capacity was driven by growth in Indonesia's domestic consumption, which increased from 7.05 million tons in 2014 to 7.54 million tons in 2019. Meanwhile, Indonesia's total pulp exports also experienced growth, from 3.5 million tons in 2014 to 4.7 million tons in 2019. This indicates an increase in world consumption of Indonesian pulp products.

Indonesia exports two types of pulp, namely chemical pulp including dissolving grades (HS 4702) and chemical pulp, resulted from soda or sulfate processes, but excludingdissolving grades (HS 4703). HS 4702 pulp is not exported every year, in contrast to HS 4703 pulp which is quite consistently exported with a large enough export value and quantity. This is the reason the pulp to be studied in this study is HS 4703 pulp.

 Further, Indonesia is one of the largest HS470329 pulp exporters in the world after Brazil. This is due to the Indonesian pulp industry that has a strong structure considering the non-dependence of the Indonesian pulp industry on raw material imports. The main raw materials for pulp production are woodchips and pulpwood, which can be produced abundantly in Indonesia. The reason is that the Indonesia's position on the equator which allows industrial forest plantations to harvest solar energy throughout the year, which in turn, gives Indonesia a comparative advantage over pulp producing countries from four-season countries (Wulandari F 2007).

China is the main export destination country for Indonesian pulp products (HS 470329). More than 50% of Indonesia's total exports to the world were consumed by China and around 20-30% were consumed by the Korean and Indian markets (Figure 1). The value of pulp imports from Indonesia in the Chinese market fluctuated and tend to increase in the period 2003-2022. On the other hand, the value of pulp imports from Brazil, Indonesia's main competitor in the Chinese market, was also fluctuated and tended to increase indicating competition between both countries in the Chinese market in the same period (Figure 2).

**Figure 1**. The value of China's pulp imports from Indonesia, Japan, Thailand and Brazil in the period 2003-2022 (Trade Map 2023)

**Figure 2**. Percentage of Indonesia's Export Volume to the World (Trademap 2023)

 Given that China is the main export destination country for Indonesian pulp, consumer behaviour in the Chinese market towards pulp originating from Indonesia needs to be studied because it will greatly determine the receipt of Indonesia's export revenue. Therefore, the objective of this study was to assess the comparative advantage of Indonesian pulp export, and to determine price, cross-price, and expenditure elasticities of pulp demand in the Chinese market.

**METHODS**

The methods used in this study consists of the Revealed Comparative Advantage (RCA) method, which analysed export comparative advantage; and the Almost Ideal Demand System (AIDS) model, which determined price, cross-price, and expenditure elasticities of pulp demand in the Chinese market.

**Comparative and Competitiveness Analysis**

 The basis of the theory of comparative advantage was first proposed by David Ricardo who stated that every country should focus on producing goods and services that country has a comparative advantage in its production compared to other countries. Bela Balassa then introduced the RCA method for the first time in 1989 to compare comparative advantages between countries producing similar types of commodities. A country is said to have a comparative advantage if the country has an RCA>1 index value, and a country is said to have a competitiveness below the world average if the RCA<1 index (Laursen K 2014). The RCA index value is calculated by the following equation:

Description:

Xad = Total exports of Indonesian pulp

 commodityto the Chinese market

Xa = Total exports of Indonesia to the

 Chinese market

Xwd = Total world exports of pulp

 commodities to China

Xw = Total world exports to the

 Chinese market

**Demand Analysis**

Demand analysis in this study used the AIDS method. The AIDS method is an econometric approach to model consumer behaviour towards goods and services. This method was first introduced by Canadian economists Angus Deaton and John Muellbauer in 1980. This method is considered the most flexible model in modelling consumer demand for goods and services. The advantage of this model is its ability to explain the nature of complement and substitution between goods and services. This model makes it possible to understand how price changes in a commodity can affect demand for the commodity itself and other commodities. This model has been widely used in various studies to understand consumer behavior, estimate price elasticity, and plan economic policies. Some studies that use this method such as research by Green and Alston (1990) on the import and export of agricultural products.

The earliest approach to the formation of AIDS models refers to the research of Deaton and Muellbauer (1980) who used a particular preference known as the price-independent generalized logarithmic (PIGLOG). This preference allows for exact aggregation over consumers and can represent market demand as if they were the outcome of decisions by rational representative consumers. The cost or expenditure function required to achieve a certain level of utility (u) at a certain price (p) denoted as c(u,p) is then formulated as follows:

(1)

To obtain a flexible form of the cost function, it is necessary to add sufficient parameters as shown in equations (2) and (3) so that at each point the derivative value of the function can be equated to any cost function.

(2)

(3)

Equations (2) and (3) are then substituted into equation (1) so that they obtain:

(4)

 +u

Where αi,βi and yij are parameters.

The demand function can be directly obtained from equation (4). This is a property characteristic of the cost function. The demand function can be obtained from the derivative of the cost function with respect to price: . The left and the right-hand sides of this demand function equation (*qi*) are then multiplied by so that equation (5) is obtained:

Where is the *budget share* of the i-th commodity. Logarithmic differentiation of equation (4) yields equation (5) budget share as a function of price and utility (6):

Where.

For consumers who maximize their utility, then total expenditure (*x*) will be equal to . Indirect utility functions are then obtained by inverting this equality. If the inverse is done to equation (4) and the result is then substituted into equation (5) then the budget shares are obtained as a function of *p* and *x* (equation 6), known as the AIDS demand function in the form of budget share.

(7)

Where *P* is the price index, which is defined as in equation (8). For linear approximation AIDS (LA/AIDS)*, P\** is formulated as in equation (9). This is known as Stone's geometric price index.

(9)

(8)

Three groups of restrictions must be met as required for LA/AIDS demand function to be a homogenous of degree 0 in price and total expenditure according to *Slutsky's symmetry*, namely adding-up (equation 10), homogeneity (equation 11), and symmetry (equation 12) as follows:

(10)

(11)

(12)

Besides Indonesia, Brazil, Japan and Thailand are the three pulp exporters in the Chinese market. Therefore, four demand functions were estimated in this study that represent the demand functions of Indonesia, Japan, Thailand and Brazil in the Chinese market. To satisfy the restrictions stated above which implying total budget share equals to 1 (), a rest of the world import pricewas included in the equation system, as formulated in equations (13-16) below:

Where ,, are parameters and

*w1* = Indonesia's share of pulp export value in the Chinese market.

*w2* = Japanese’s share of pulp export value in the Chinese market

*w3* = Thailand's share of pulp export value in the Chinese market.

*w4* = Brazilian’s share of pulp export value in the Chinese market.

*p1* = Price of pulp exports from Indonesia in the Chinese market (US$/ton)

*p2* = Price of pulp exports from Japan in the Chinese market (US$/ton)

*p3* = Price of pulp exports from Thailand in the Chinese market (US$/ton)

*p4* = Price of pulp exports from Brazil on the Chinese market (US$/ton)

*p5* = Price of pulp from *a rest of the world* (*ROW*) in the Chinese market (US$/ton)

*x* = Total value of pulp imports by China (US$)

*P\** = *Stone's geometric price index*

In this study three groups of parameter restrictions are presented in detail in Table 1. Based on the parameters that have been estimated*,* the own-price elasticity, cross-price elasticity, and expenditure elasticity are then obtained using formulas as expressed in equations (17), (18), and (19), respectively.

1. Adding up:
2. Homogeneity:
3. Symmetry:

The restrictions on this model can be seen in Table 1. After that, elasticity calculations were carried out consisting of uncompensated (own price), compensated (cross price), and expenditure (expenditure). The formula used is as follows.

1. Uncompensated elasticity
2. Compansated elasticity
3. Expenditure elasticity

**Table 1**. The restrictions on various version of the processed tuna product AIDS Model

|  |  |  |
| --- | --- | --- |
| Adding up | Homogeneity | Symmetry |
|  |  |  |

**Data**

The data used in this study are annual data on quantity (in Kg) and export value of chemical pulp (HS 470329; in 1000 US$) for the period 2003-2022. Data on *exchange rates* and *GDP deflators* from pulp exporting countries to China are also used. Those data were obtained from Trademap, Worldbank and Biro Pusat Statistik (BPS).

The nominal price of pulp exports was obtained by dividing the total export value by the total export quantity and expressed in US $ per ton. The obtained nominal price is then expressed in real value at the base year 2010. To do this, GDP deflator of pulp exporting countries to China, including Indonesia; should have the same base year. The base year chosen in the study was 2010. The real price is then obtained in the following way: ((nominal price x exchange rate)/*GDP deflator*)/exchange rate in 2010). Data was processed using Microsoft Excel 2016 and the demand function was estimated using *the Seemingly Unrelated Regression* (SUR) technique using STATA.

**RESULTS AND DISCUSSION**

Indonesia's pulp industry began to be recorded in the publication of industry statistics since 1990. The pulp industry grew significantly after the initiation of the Industrial Plantation Forest (HTI) program by the Government. In the period 2003-2022 Pulp exports (HS 470329) from Indonesia to the world ranged from 2.37 to 4.37 million tons per year, which contributed around 14-16% to the world's total pulp exports (Trademap 2023). The contribution of Indonesia's pulp exports to the world experienced a sharp decline in 2004 due to environmental issues raised by World Wildlife Fund for Nature (WWF) (Simangunsong 2016). The decline in Indonesia's export quantity continued to occur in the period 2005-2008 due to the world financial crisis.

**Comparative Advantage Analysis**

The results of RCA's analysis showed that pulp commodities (HS 470329) were commodities that have excellent competitiveness in the Chinese market. The value of the RCA index throughout the period 2003-2022 was greater than one (Fig 3). This means that the share of Indonesian pulp commodities in China's total imports was significantly large. This comparative advantage was resulted from a relatively low production cost, which was due to material costs and labor wages that were relatively low in Indonesia when compared to raw material costs and labor wages in other pulp exporting countries. However, this competitiveness has been gradually decreased as indicated by the smallest RCA index value found in 2022.

**Demand Analysis**

The LA/AIDS model used in this study analyzed consumer behavior towards Indonesian pulp commodities, including their relationship with pulp commodities originating from other exporting countries in the Chinese market. The resulted parameters of the LA/AIDS model in the Chinese market were presented in Table 2. Table 2 shows the diversity of the share of pulp export values from Indonesia, Japan, Thailand and Brazil in the Chinese market can be explained by export prices of 47%, 32%, 48% and 58%, respectively, as shown by the R-sq values of each country. Furthermore, the value of *wi* showed that the largest share of pulp export value in the Chinese market was pulp from Brazil (42%), followed by pulp from Indonesia (28%), while pulp from Japan and Thailand each only about 1% of the total value of pulp imports made by China. The coefficients in table 2 will be used to determine compensated, uncompensated and also expenditure elasticities.

**Figure 3**. RCA index values from Indonesia, Japan, Thailand and Brazil in the Chinese market during the period 2003-2022.

|  |  |
| --- | --- |
| Variable | Equation**Table 2**. Parameter estimates of *LA/AIDS* Model |
| Indonesia (1) | Japan (2) | Thailand (3) | Brazil (4) |
| Wi | 28% | 1% | 1% | 42% |
| Price of Ind | 0.0195 | -0.0532\*\*\* | 0.0060 | 0.0277 |
| Price of Jpn | -0.0532\*\*\* | 0.0300\*\*\* | 0.0107\*\*\* | 0.0124\*\*\* |
| Price of Thi | 0.0060 | 0.0107\*\*\* | -0.0123\*\*\* | -0.0044 |
| Price of Brz | 0.0277 | 0.0124\*\*\* | -0.0044 | -0.0357 |
| Price of ROW | -1.E-16\*\*\* | -8.E-17\*\*\* | 7.E-18\*\*\* | -8.E-18\*\*\* |
| X | -0.1060\*\*\* | -0.0102\*\*\* | -0.0170\*\*\* | 0.1332\*\*\* |
| R-sq | 47% | 32% | 48% | 58% |

 Note: \*\*\* significant at 1%, \*\* significant at 5%, \* significant at 10%

**Table 3.** Estimates of price, cross-price and expenditure elasticities derived from LA/AIDS model

|  |  |
| --- | --- |
| Equation | Countries |
|  Indonesia(1) | Japan (2) | Thailand (3) | Brazil (4) |
| Price |  |  |  |  |
| *Compensated* |  |  |  |  |
| Price Indonesia | -0.647520 | -0.174700 | 0.030237 | 0.516319 |
| Price Japan | -3.925220 | 1.390568 | 1.195896 | 0.042306 |
| Price Thailand | 0.949221 | 1.183266 | -2.352950 | -0.007330 |
| Price Brazil | 0.349789 | 0.083118 | -0.001460 | -0.666300 |
| *Uncompensated* |  |  |  |  |
| Price Indonesia | - | -0.221140 | 0.017820 | -0.059050 |
| Price Japan | -4.438160 | - | 0.839573 | 0.645934 |
| Price Thailand | 0.131968 | 1.159523 | - | -1.274180 |
| Price Brazil | 0.070027 | 0.033692 | -0.007630 | - |
| Expenditure | 0.626418 | 0.192469 | -0.879890 | 1.318007 |

Widarjono A (2016) explain that Compensated elasticities measure the compensating change in the quantity of a good demanded due to a change in the price of that good. Compensated owned price elasticity indicates that Indonesia, Thailand and Brazil will experience a decrease in demand for pulp if there is an increase in price. Indonesia will experience a decrease in demand of -0.64752 percent for every 1% increase in the price of Indonesian pulp in the Chinese market, as well as Thailand and Brazil will experience decreases of 2.3530 and 0.6663 percent respectively. This shows that conditions in Indonesia, Thailand and Brazil are in accordance with the law of demand, which reads that when prices increase, the demand for these goods will decrease.

Price is an important factor that affects demand. If prices rise, demand tends to fall, and if prices fall, demand tends to rise. A different condition was found in the pulp of Japanese origin, which showed a positive elasticity coefficient of 1.3906. The same condition also found in Da silva pinto j, *et al.* (2022) research. They was found that cloves from Comoros has positif compensated elasticity value. Theoritically this condition can describe as if there is an increase in price it also will cause an increase of Japanese’s pulp in Chinese market, which is not suitable with demand theory. This probably happen because Japan able to produce pulp with high quality.

The value of cross price elasticity (*uncompensated*) shows a negative relationship between Indonesia and Japan which means pulp from Indonesia was a complement of pulp from Japan in the Chinese market. The same thing was also found by Rifin A (2013) and Purnamasari *et al.* (2014) who states that if the value of cross-elasticity (*uncompensated) is* positive, it shows that there is a substitution relationship, while if the value of cross-elasticity is marked negative, it indicates a complementary relationship between related country export products.

In the Indonesian AIDS model, the cross-elasticity of Japanese pulp is negative, which means that for Indonesia, Japanese pulp are complements of Indonesian pulp. This also found in Japanese AIDS models that show pulp from Thailand and Brazil is subtitute for Japanese pulp but pulp from Indonesia is complement. For Thailand pulp from Indonesian and Japan is subtitute but pulp from Brazil is complement. For Brazil pulp from Indonesian and Thailand is complement but pulp from Japan is subtitute. Mahdi (2021) also found that in different equations is possible to result different complement or substitution conditions.

The value of expenditure elasticity for pulp from Indonesia, Japan and Brazil was positive, which indicated that pulp from these three countries was a normal good. This shows that if there is an increase in the total value of pulp commodity imports in China, it will increase the demand for pulp from the three pulp exporting countries in accordance with the value of the elasticity of expenditure obtained. This was also in line with what Da Silva Pinto *et al.* (2022) found in his research. The value of expenditure elasticityshows that if there is an increase in imports in the Chinese market by 1% *cateris paribus*, it would increase demand for pulp originating from Indonesia and Japan by 0.626 and 0.192 percent, respectively. The obtained value of Brazil’s expenditure elasticity of more than 1 indicated that pulp from Brazil was a luxury item. This implies if there is an increase in pulp demand in China market it would cause an increase in demand for pulp from Brazil, which is greater than the demand for pulp from Indonesia and Japan.

**CONCLUSION**

This research was conducted to analyse the performance of Indonesian pulp exports in the Chinese market. The results of RCA's analysis show that Indonesian pulp has a fairly strong competitiveness in the Chinese market, but the competitiveness has decreased as indicated by the smallest RCA index value that occurred in 2022. The right policy is urgently needed so that Indonesia will not lose one of the largest pulp export destinations. Although pulp exports from Japan and Thailand were not as large as pulp exports from Indonesia and Brazil, these two countries were included to study the cross-price elasticity that occurs in the Chinese market. The results of the LA/AIDS model showed that pulp from Japan was a complement of pulp from Indonesia, while pulp from Thailand and Brazil was a substitute for pulp from Indonesia.

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