# Indonesian Plywood Export Competitiveness in Global Market

Leo R E Malau[1],[*] Tri Yulni[1], Nur A Ulya[1], Primawati Y Fauziah[2], Yunida S Lubis[2]

[1] *Environment and Forestry Research and Development Institute of Palembang, Jl. Kol. H. Burlian Km. 6,5 Punti Kayu, Palembang, South Sumatra*
[2] *Research and Development Institute of Forest Fiber Technology, Jl. Raya Bangkinang-Kuok Km 9, Kampar, Riau*
[*]*Corresponding author. Email:* [leoriomalau62@gmail.com](mailto:leoriomalau62@gmail.com)

**ABSTRACT**

Since the 1980s Indonesia and Malaysia have been the world main exporters of plywood with a dominant market share. However, in 2002 Indonesia plywood exports decreased. Even since 2007, the total exports of Indonesia and Malaysia have decreased significantly, and the position was replaced by China as the major exporter country with the largest market share. This change was thought to have an impact on the position of competitiveness. This study aims to analyse the position and relationship competitiveness of Indonesian plywood exports with other main exporting countries in the global market. This study used secondary data from 2001-2020, from six the world major exporter of plywood. Revealed Symmetric Comparative Advantage (RSCA), Trade Specialization Index (TSI) and Spearman rank correlation were used to answer the research objectives. The results showed that the volume and value of Indonesian plywood exports fluctuated with a downward trend. This condition was in line with the decline of Indonesia market share in the global market. The RSCA showed that the six exporting countries analysed have competitiveness on plywood commodities. Indonesia has the highest competitiveness, but with downward trend every year. The TSI showed that the plywood exports Indonesia, Malaysia, Russia, Finland and Brazil were in the maturity stage, while China was still in the growth stage. Based on Spearman rank correlation, Indonesian plywood export competitiveness was significantly correlated with Russia, Finland and Brazil. The correlation with Russia was strong and complementary. Meanwhile, the correlation with Finland was strong and Brazil was moderate correlation and competitive.

***Keywords:*** *Competitiveness, Export, Market Share, Plywood, RSCA*

## 1. INTRODUCTION

Indonesia is one of the countries with the largest tropical forest area in the world. This fact makes Indonesia one of the producers of various types of tropical logs in the world. World attentions increase to environmental damage due to use of logs has an impact on reducing the use of logs as industrial raw materials. Therefore, various wood products have come out, with one of the potential commodities being plywood. Plywood is a wood panel product made of a number of veneer sheets glued together, with the fibers perpendicular to each other [1]. Plywood or wood panels are produced due to high selling price and the limited raw material for solid wood [2]. The plywood using that varies makes demand increase.

Plywood has long been the main export product of Indonesia forestry industry and has contributed to increasing the country's income. Indonesia plywood exports increased significantly in the 1980 along with the issuance or a government regulation which requires every owner of Forest Tenure Rights (HPH) to establish a wood processing industry, and this was followed up with a wood export ban policy in 1985 and increasing the export tax on sawn timber [3] [4]. This policy has led to the emergence of various processed wood industries including plywood and has affected the rapid development of Indonesian plywood exports so that it can compete in the global market.

Indonesia's position in the plywood international trade was quite dominating. Together with Malaysia, Indonesia was a major exporter of plywood in the world, especially for tropical hardwood plywood. In the period 1988-2005, Indonesia was considered as a market leader for tropical plywood with Malaysia as the market follower [3]. The heyday of Indonesian plywood

occurred in the 1990s which was indicated by the export value which increased every year [5]. However, in 2002 a significant decrease in the potential of Indonesia natural production forests has led to reduction in the raw materials availability for the plywood industry. This condition has an impact on decreasing the production and export volumes of Indonesia plywood every year [3]. Furthermore, data in 2001-2020 shows that the volume and value of Indonesian plywood exports fluctuated with a downward trend [6]. In 2001 to 2009 there was a significant decrease in the volume and value of plywood exports, and then increased again until 2015, and decreased again until 2020 (Figure 1).
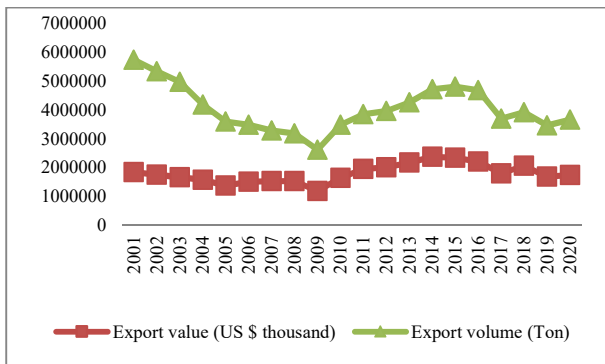


**Figure 1.** Volume and export value of Indonesian plywood in 2001-2020 [6]

Decreasing volume and value of Indonesia plywood exports caused Indonesia's position as the dominant tropical plywood exporter in the world to be replaced by Malaysia, which has an increasing export volume year by year. Even though in reality Malaysia plywood export volume was lower than Indonesia, but the export volume has consistently increased in the following years [5]. Even with the tight competition in domestic plywood production with other countries such as Malaysia and China, the competitiveness of Indonesian plywood products has decreased [4].

Based on data in 2001-2020, plywood exporting countries in the world are no longer dominated by Indonesia and Malaysia. Other countries such as China, Russia, Finland and Brazil are also exporters of plywood. The total market share of the six main plywood exporting countries was 67.93% [6]. Even since 2005, the value of China plywood export has been greater than Indonesia with an average market share from 2001-2020 of 25.38% or higher than Indonesia (15.11%). [3] explains that since 2007, the amount of plywood exports from Indonesia and Malaysia have significantly decreased, followed by the increasing position of China as the world's main exporter of plywood.

The downward trend of the volume and value of Indonesia plywood exports as one of the world's main exporters, along with changes in the market share of the world's main plywood exporters, was suspected to have an impact on the competitiveness position of the world

main plywood exporters. Fluctuation in plywood exports in several main exporter countries in the last 20 years was also expected to have an impact on the position of a country in facing competition with other exporter countries. Measurement or analysis of competitiveness was an approach that aims to provide an understanding of the position, performance, and capabilities of a country towards the export market, and the factors that affect its competitiveness [7]. An understanding of the competitiveness position of Indonesian plywood exports in the international market is important to know so that the strategic steps in the framework of developing plywood exports can be carried out more effectively and efficiently. Therefore, the aim of this study was to analyze the position and competitiveness relationship of Indonesia plywood exports and the other main exporter countries in the global market.

## 2. METHODS

### 2.1. Type and Data Sources

The type of data used in this study is secondary data in the form of panel data. The panel data was a combination of time series data from 2001-2020 from six main exporter countries of plywood in the world, namely China, Indonesia, Malaysia, Russia, Finland and Brazil. The data used from the International Trade Center (ITC) and the Central Bureau of Statistics of Indonesia (BPS). The type of plywood used in this study was plywood with 4-digit Harmonized System (HS) which was 4412 (plywood, veneer and laminated wood).

### 2.2 Data Analysis

This study used Revealed Symmetric Comparative Advantages (RCA), Trade Specialization Index (TSI) and Spearman rank correlation.

### 2.2.1 Analysis of Revelaed Symmetric Comparative Advantage (RSCA)

Revealed Comparative Advantages (RCA) was initiated by [8] which states that comparative advantage was a comparison between the share of exports of a commodity in a country's total export, compared to the share of exports in the same commodity in total world exports. This competitiveness analysis emphasizes on the market share of a country which was one of the indicators in measuring the level of competition between countries to a commodity, in international trade [9]. RCA can be calculated by the following formula:

$$RCAij = \frac{X_{ij}/X_{it}}{W_{ij}/W_t} \qquad (1)$$

Where:
RCA$_{ij}$: The competitiveness of j country on commodities i

$X_{ij}$: Export value of i commodity from j country (US $)

$X_{ij}$: Export value all of the commodities from j country (US $)

$W_i$: Export value of i commodity from whole country (US $)

$W_t$: Export value all of the commodities from the whole country (US $)

A country was declared to have a comparative advantage in commodities j if it has an RCA value of > 1, whereas if the value of RCA < 1 then the country i was declared not to have a comparative advantage. Furthermore, the greater RCA value indicates a higher level of comparative advantage. Determining the level of competitiveness using RCA has shortcomings due to the results of the index that are not symmetrical [10]. To overcome these limitations, Revealed Symmetric Comparative Advantage (RSCA) was used, which was modified from the RCA calculations that developed by [11]. RSCA can be calculated by the following formula:

$$RSCA = \frac{(RCA-1)}{(RCA+1)} \qquad (2)$$

The value obtained from the RSCA calculation is -1 to 1 (-1< RSCA <1). If the value of RSCA > 0 so that concluded the country i has a comparative advantage in commodity j, and if the value of RSCA < 0 so that the country i does not have a comparative advantage in commodity j.

### 2.2.2 Analysis of Trade Specialization Index (TSI)

Trade Specialization Index (TSI) is a comparison between the net trade difference value with the total trade value of a country. TSI is used to analyze the position or stage of commodity development and to analyze the tendency of a country to be an exporter or an importer [12]. TSI can be calculated by the following formula :

$$TSI = \frac{Xij - Mij}{Xij + Mij} \qquad (4)$$

Where:

Xij: Export value of i commodity from country j to the world

Mij: Import value of i commodity from country j from the world

The TSI value ranges from -1 to 1. If the TSI value is positive, assume the commodity has strong competitiveness or the country tends to be an exporter. Meanwhile, if the TSI value was negative, the commodity has low competitiveness or tends to be an importer. TSI can also to be used to identify the growth rate of a commodity in trade which is divided into 5 stages which is:

1. The introduction stage, if $-1.00 \leq TSI \leq -0.50$
2. The import substitution stage, if $-0.51 \leq TSI \leq 0.00$
3. The growth stage, if $0.01 \leq TSI \leq 0.80$
4. The maturity stage, if $0.81 \leq TSI \leq 1.00$

5. The re-importing stage, if TSI value decrease between 1.00 to 0.00

### 2.2.3 Analysis of Spearman Rank Correlation

Correlation analysis aims to measure the degree of linear relationship between two variables. Spearman rank correlation ($r_s$) is used when exact quantitative measurements are difficult or impossible to do. In measuring the correlation coefficient of rank Spearman, it is only required that the measurement of two variables be at least on a ordinal scale so that the observed individuals can be ranked in two sequence series [13]. Coefficient correlation can be used to see how strong the relationship between two variables (e.g., X and Y). Variable X used is the RSCA value of country A, and variable Y is the value of RSCA of country B. The Spearman's rank correlation ($r_s$) is formulated as follows [14]:

$$r_s = 1 - \frac{6\sum d_i^2}{n(n^2-1)} \qquad (4)$$

$$\sum d_i^2 = \sum_{i=1}^{n} [R(X_i) - R(Y_i)]^2 \qquad (5)$$

Where:

$r_s$: Correlation of coefficient

$R(X_i)$: Ratings for sample $X_i$

$R(Y_i)$: Ratings for sample $Y_i$

d: Difference between Xi and Yi (RSCA index of country $X_i$ – RSCA index of country $Y_i$)

n: Number of samples ranked (sequential)

The value of $r_s$ can be positive or negative, with an absolute value of a maximum 1 and a minimum 0 ($0 < r_s < 1$). A positive value means that the relationship between X and Y variables is unidirectional, whereas a negative value indicates that the variables X and Y are in opposite directions [13]. [15] stated that the positive value of the Spearman's rank correlation coefficient indicates that the competition between two countries in the export market (has almost the same competitiveness pattern). Its mean, if the correlation coefficient was close to 1 the shift in competitiveness was less dynamic. Meanwhile if the correlation coefficient value was negative, the commodity was complementary in product offering to the export market (has different competitiveness patterns). So that, if the correlation coefficient is close to -1, the shift in competitiveness is more dynamic.

## 3. RESULTS AND DISCUSSION

### 3.1 Competitiveness of Indonesian Plywood in the Global Market

Plywood is one of Indonesia's main export commodities from the forestry industry. Since the 1980s,

Indonesia has been one of the main exporters of plywood in international trade. Various policies issued by the government in the 1980s to 2003 have proven to be able to make Indonesia as the main plywood exporter [3]. However, many problems in plywood exports tend to decrease every year. One of the causes is the decrease in supply of raw materials to the Indonesian plywood industry [16] [17]. The reopening of log exports in 1998 as a result of the cooperation between Indonesia and the IMF for post-crisis economic recovery also contributed to the decline in the export performance of the national plywood industry.

In 2004, the export value of Malaysia plywood was higher than Indonesia. This condition also shifted the position of Indonesia as the main plywood exporter in the global market. On the other hand, since 2005 the export value of China plywood has increased significantly and has become higher than Indonesia and Malaysia, which are two dominant plywood exporters in the world for many years. [3] explained that the wood supply from Indonesia since the reform era and regional autonomy, both legal and non-legal, contributed to increasing the raw materials supply for the Malaysia and China plywood industries. This condition supports the plywood industry development in both countries. However, since 2010 Indonesia plywood export value has become higher than Malaysia, although it is still smaller than China (Figure 2).
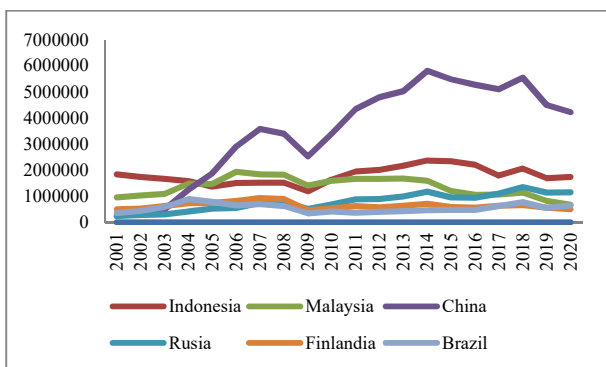


**Figure 2.** Plywood export value of major exporter countries in 2001-2020 [6]

Although currently still one of the world's plywood exporters, Indonesia export market share is below China. Data for 2001-2020 shows that China dominates the world plywood export market with a market share of 25.38%, followed by Indonesia with a market share of 15.11%, and Malaysia with 11.45%. Other plywood exporter countries are Russia with a market share of 5.89%, Finland with a market share of 5.43%, and Brazil with market share of 4.67%. The total market share of the six main plywood exporter countries is 67.93% of the total world plywood export value [6]. The cause of the decline in Indonesia's plywood market share are the difficulty to get raw materials for plywood industries, illegal logging activities allegedly used by the Malaysia

and China plywood industries have resulted in lower plywood production costs in both countries, and the continued development of the Japanese plywood industry which utilizes logs from Russia with lower prices. In this case, Japan was the main importer of Indonesian plywood [16]. Changes in the market share of the world's major plywood exporters are thought to have an impact on competitiveness positions. Competitiveness of the world's main plywood exporters will be analyzed using RSCA and TSI.

**Tabel 1.** RSCA value of plywood major exporter countries

| Year | INA | MLY | CHI | RUS | FIN | BRA |
|------|------|------|--------|------|------|------|
| 2001 | 0.938 | 0.825 | -0.066 | 0.105 | 0.832 | 0.712 |
| 2002 | 0.934 | 0.827 | 0.113 | 0.144 | 0.838 | 0.748 |
| 2003 | 0.930 | 0.828 | 0.070 | 0.145 | 0.849 | 0.783 |
| 2004 | 0.909 | 0.835 | 0.333 | 0.201 | 0.838 | 0.795 |
| 2005 | 0.880 | 0.820 | 0.411 | 0.273 | 0.835 | 0.731 |
| 2006 | 0.873 | 0.845 | 0.495 | 0.258 | 0.826 | 0.646 |
| 2007 | 0.862 | 0.828 | 0.497 | 0.369 | 0.826 | 0.631 |
| 2008 | 0.860 | 0.832 | 0.477 | 0.416 | 0.834 | 0.586 |
| 2009 | 0.858 | 0.841 | 0.459 | 0.332 | 0.811 | 0.487 |
| 2010 | 0.858 | 0.820 | 0.461 | 0.364 | 0.812 | 0.447 |
| 2011 | 0.850 | 0.808 | 0.491 | 0.424 | 0.820 | 0.304 |
| 2012 | 0.863 | 0.808 | 0.500 | 0.397 | 0.820 | 0.371 |
| 2013 | 0.874 | 0.803 | 0.478 | 0.396 | 0.828 | 0.393 |
| 2014 | 0.877 | 0.770 | 0.475 | 0.435 | 0.830 | 0.412 |
| 2015 | 0.887 | 0.731 | 0.441 | 0.335 | 0.828 | 0.460 |
| 2016 | 0.883 | 0.708 | 0.449 | 0.317 | 0.825 | 0.462 |
| 2017 | 0.846 | 0.696 | 0.435 | 0.388 | 0.830 | 0.527 |
| 2018 | 0.852 | 0.669 | 0.419 | 0.447 | 0.812 | 0.560 |
| 2019 | 0.855 | 0.628 | 0.390 | 0.460 | 0.815 | 0.514 |
| 2020 | 0.855 | 0.552 | 0.322 | 0.429 | 0.802 | 0.574 |
| Ave | 0.877 | 0.774 | 0.382 | 0.332 | 0.826 | 0.557 |

The results of the RSCA analysis show that China, Indonesia, Malaysia, Russia, Finland, and Brazil have a comparative advantage for plywood, as indicated by the RSCA value > 0 (Table 1). Indonesia has the highest average RSCA value in 2001-2020, with a value of 0.877, followed by Finland (0.826), Malaysia (0.774), Brazil (0.557), China (0.382), and Russia (0.332). The data shows that though the competitiveness has decreased every year, Indonesia's plywood commodity has a higher competitiveness than other countries. The results of [18] research also shows that Indonesia plywood exports have a comparative advantage in the three main importer countries, namely Japan, South Korea, and the United States in the period 2000-2017. On the other hand, [19] using data from 1990-2009 also found that plywood has competitiveness in nine main partner countries. Although having the highest RSCA value in the 2001-2020 period, Indonesia RSCA value fluctuates with a downward trend. This condition is in line with fluctuation in the value of Indonesia's plywood exports. In addition to the problem

of decreasing supply of raw materials, other factors such as Indonesian plywood commodities that do not complete the standard and technical requirements of importer countries are also the cause of the decreased competitiveness of Indonesia's plywood. Moreover, in the free trade area with various policies that were implemented by various countries, including the Non-Tariff Measures (NTMs) policy which was currently developing.

The downward trend in the volume and value of Indonesia plywood exports was confirmed by the decrease in the RSCA value. This matter can also be seen from the average growth of RSCA Indonesia for the period 2001-2020 with a value of -0.48. On the other hand, the increase in the value of China plywood exports can also be seen from the positive average growth of the RSCA (3.75%). The largest RSCA growth occurred in Russia, with a value of 9.34%. Meanwhile, the RSCA growth average for other exporter countries, that is Malaysia, Finland, and Brazil, was negative. The decline in Malaysia plywood export market share that has occurred since 2010 has had an impact on the decline in the value of Malaysia RSCA. In fact, the average growth of RSCA Malaysia is -2.04 or the lowest compared to other main exporter countries.

There is a positive relationship between market share and the competitiveness of the world's main plywood exporters. Export market share can also be used as an indicator of competitiveness, as [20] and [21] have done for coffee commodities, so that changes in market share will affect the level of competitiveness. Indonesia and Malaysia, which since the 1980s have been the two dominant plywood exporters, have now been replaced by China. The decline in the export value of Indonesia and Malaysia has an impact on the decline in market share and competitiveness of two countries. The average growth of Indonesia plywood market share in 2001-2020 is -3.84%. This decline is in line with the average competitiveness growth (RSCA) of -0.48. Malaysia also experienced a decline in market share by an average of 5.51% per year in the period 2001-2020 and had an impact on the decline in competitiveness by -2.04% per year. Meanwhile, China's market share tends to increase by 13.72% per year and has an impact on increasing competitiveness (RSCA) by 3.75% per year.

Although the export value of China plywood is higher than other main exporter countries, the average value of China RSCA is only 0.382 or lower than Indonesia, Malaysia, Finland, and Brazil. This is because the RSCA calculation begins with the RCA calculation that is by comparing the value of a country's commodity exports with the total value of that country. Therefore, a country whose export value is relatively same with the other countries but whose total export value is higher will lead to a lower RSCA value. Besides that, plywood is not China's main export commodity, or its proportion to the

total export value is relatively small. [22] stated that the top ten leading export products of China in 2010 were dominated by products from the technology-based secondary sector such as data processing machines and telecommunication equipment with very high competitiveness. Not only that, but China has also succeeded in encouraging exports of products, such as textiles, furniture, footwear, and children's toys, with high competitiveness.

Indonesia plywood competitiveness can also be seen from the Trade Specialization Index (TSI), by looking at the position or stages of industrialization. TSI calculation results show that the average TSI value of Indonesia plywood industry is in the maturation stage (0.968). Meanwhile, the average TSI for other plywood exporter countries are Malaysia (0.851), China (0.785), Russia (0.933), Finland (0.847), and Brazil (0.991) (Figure 3). The average value of Indonesian TSI in 2001-2020 is higher than other countries. This shows that Indonesia plywood commodity has strong competitiveness with a tendency as an exporter. This result also states that Malaysia, Russia, Finland, and Brazil are also in the maturity stage, while China is in the growth stage. Another implication of the TSI value is that the six main plywood exporter countries do the export and import plywood at the same time. Especially for Indonesia, about 80% of plywood production is exported, while the rest is for domestic needs. The import of plywood by Indonesia is very small [6].
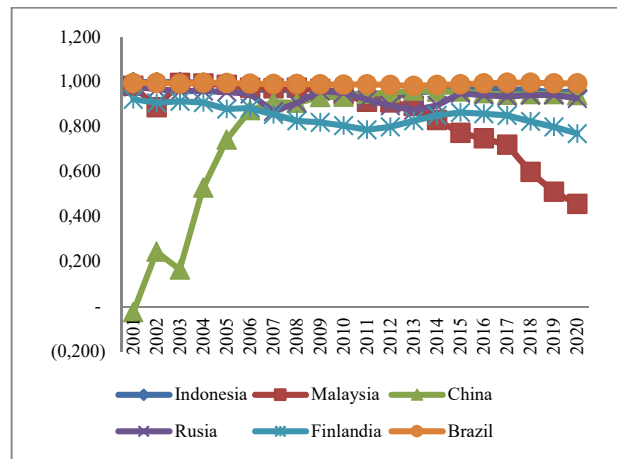


**Figure 3.** TSI value of main plywood exporter countries

The value of Indonesia TSI which is close to 1 (0.968) or the maturity stage implies that the government should start encouraging the development of plywood processing industries to produce greater added value. Based on the product life cycle, Indonesia plywood is at the maturity stage which indicates that Indonesia plywood export growth is at peak sales and quite stable. Therefore, Indonesia needs to find innovative strategies to increase the export growth so as not to experience a bigger decline or market saturation. On the other side, China is in a growth stage with an TSI value of 0.785.

This means that the supply in China's domestic market for plywood is higher than the demand. Another implication of China TSI value is that in addition to being an exporter, China is also an importer of plywood. The average value of China plywood imports for the 2001-2020 period was US$ 178,379,300 or 1.44% of the total world plywood import value [6].

## 3.2 Correlation of Competitiveness among the World Plywood Exporters Countries

The RSCA value that has been obtained is used to analyze the strength of competition among the world plywood exporter countries. The strength of competition is measured based on the correlation value between plywood exporter countries using Spearman rank correlation. The results of the analysis show that Indonesia has a correlation with Russia, Finland and Brazil. The correlation coefficient between Indonesia and Russia which is negative (-0.756) and significant, indicates that the plywood exports of the two countries

are complementary. This can be seen from the different patterns of competitiveness between the two countries, with Indonesia competitiveness tends to decrease while Russia tends to increase. The correlation coefficient between Indonesia and Finland (0.700) and Brazil (0.459) was positive and significant. Furthermore, the correlation coefficient is also quite strong. These results indicate that Indonesia plywood commodities with Finland and Brazil compete with each other for the same market. In addition, the pattern of competitiveness between Indonesia with Finland and Brazil tends to have the same pattern, which wis to increase and decrease simultaneously. Brazil's main export destination is the USA, which is also a main importer of plywood from Indonesia. Indonesia has also experienced a shift in export destination countries to European countries, even though the portion is still small. The market shift has the consequence of having to compete with Finland and Brazil because the export destinations of these two countries are mostly European countries.

**Tabel 2** Correlation of competitiveness among the world plywood exporter countries

| Country | Description | Indonesia | Malaysia | China | Russia | Finland | Brazil |
|---|---|---|---|---|---|---|---|
| Indonesia | Correlation coefficient | 1.000 | 0.389 | -0.367 | -0.756 | 0.700 | 0.459 |
| | Sig. (2-tailed) | - | 0.090 | 0.112 | 0.000** | 0.001** | 0.042* |
| Malaysia | Correlation coefficient | 0.389 | 1.000 | 0.164 | -0.624 | 0.418 | 0.466 |
| | Sig. (2-tailed) | 0.090 | - | 0.490 | 0.003** | 0.617 | 0.038* |
| China | Correlation coefficient | -0.367 | 0.164 | 1.000 | 0.368 | -0.339 | -0.618 |
| | Sig. (2-tailed) | 0.112 | 0.490 | - | 0.110 | 0.143 | 0.004** |
| Russia | Correlation coefficient | -0.756 | -0.624 | 0.368 | 1.000 | -0.576 | -0.609 |
| | Sig. (2-tailed) | 0.000** | 0.003** | 0.110 | - | 0.008** | 0.004** |
| Finland | Correlation coefficient | 0.700 | 0.418 | -0.339 | -0.576 | 1.000 | 0.577 |
| | Sig. (2-tailed) | 0.001** | 0.617 | 0.143 | 0.008** | - | 0.008** |
| Brazil | Correlation coefficient | 0.459 | 0.466 | -0.618 | -0.609 | 0.577 | 1.000 |
| | Sig. (2-tailed) | 0.042* | 0.038* | 0.004** | 0.004** | 0.008** | - |

Note: ** Significant at 1% level; * Significant at 5% level

Although not significant, the correlation coefficient between Indonesia and Malaysia was positive. This means that the plywood commodities of the two countries are competing for the same market. Based on Table 3, the importir countries targeted by Indonesia and Malaysia were the same, that was Japan with a very large portion of imports (more than 30%), so that Indonesia and Malaysia must implement an effective and efficient strategies in order to win the competition. Since 1988, Indonesia has been the country that dominates the export of plywood to Japan. However, this position was replaced by Malaysia and China in 2007. The decline in Indonesia exports to Japan was due to a decrease in production capacity due to lack of supply of wood raw materials [17]. In addition, the low standard and quality of Indonesian plywood makes Indonesia unable to compete with other countries [19]. The correlation coefficient between Indonesia and China was negative, which means that the plywood exports of the two countries were

complementary. The patterns of competitiveness of the two countries were opposite, Indonesia with a downward trend while China tends to increase. The correlation coefficient between Indonesia and China was not significant due to differences in the dominance of the destination market and the shift in export destination countries in recent years.

Malaysia, as one of the plywood exporters with a large market share, has a significant competitive correlation with Russia (-0.624) and Brazil (0.466). The correlation between Malaysia and Russia was complementary. Since 2010, the competitiveness of Malaysian plywood has tended to decline with the largest percentage decline compared to other exporter countries. In contrast, the competitiveness of Russian plywood tends to increase. The correlation coefficient of Malaysia and Brazil was positive, which means that both countries have the same competitiveness pattern. Another implication is that Malaysia and Brazil compete for the

same market. In addition to focusing on Asian countries, Malaysia also exports plywood to the USA and European countries which were importing countries for plywood from Brazil, or both of these countries have almost the same export destination market.

China was only significantly correlated with Brazil (-0.618). This shows that exports between the two countries are complementary. In addition, the export destination market between China and Brazil was relatively the same, that was the USA and European countries. The negative correlation coefficient has implications that the competitiveness patterns of China and Brazil tend to be opposite. Therefore, the increase in the competitiveness of China plywood will cause the competitiveness of Brazil to decrease because the two countries have relatively the same export destination markets.

**Tabel 3.** Destination country of plywood imports by major exporter countries

| Exporters country | Import destination country |
|---|---|
| Indonesia | Japan (34.30%), China (11.89%), USA (8.22%), South Korea (7.88%), Chinese Taipei (6.52%), Saudi Arabia (5.73%) |
| Malaysia | Japan (47.62%), South Korea (10.96%), USA (7.90%). Chinese Taipei (7.07%), United Kingdom (4.17%), Yemen (3.31%) |
| China | USA (16.41%), Japan (7.14%), United Kingdom (6.03%), United Arab Emirates (5.18%), South Korea (5.13%), Philippines (4.75%) |
| Russia | USA (16.66%), Egypt (11.52%), Germany (8.52%), Italy (4.80%). United Kingdom (4.76%), Latvia (4.59%). Finland (4.45%), Azerbaijan (4.13%) |
| Finland | Germany (20.31%), United Kingdom (14.74%), Netherlands (11.80%), Swedish (7.70%), France (5.89%), Denmark (5.17%), Italy (4.11%) |
| Brazil | USA (34.14%), United Kingdom (15.74%), Germany (10.55%). Belgium (9.80%), Italy (4.45%), Mexico (3.31%) |

Sources: [6]

Russia was negatively and significantly correlated with Indonesia (-0.756), Malaysia (-0.624), Finland (-0.576) and Brazil (-0.609). This negative sign indicates that exports among the five countries were more complementary than competitive. In addition, Russia has the opposite pattern of competitiveness with Indonesia, Malaysia, Finland and Brazil, that was in certain years Russia plywood exports will be high while the other four countries were low and otherwise.

Finland has a positive and significant correlation with Indonesia (0.700) and Brazil (0.577). This condition shows that the competitive relationship between Finland

with Indonesia and Brazil was competition for the same market. Finland's position on the European continent causes most of its plywood export destinations to be European countries. On the other hand, Indonesia and Brazil also export plywood to European countries. Even the plywood importers of Brazil are dominated by European countries. Indonesia also exports plywood to European countries, such as the United Kingdom, Germany, the Netherlands, and Italy, which were the main export destinations of Finland. Therefore, Finland and Indonesia must compete for the same market. Finland is negatively and significantly correlated with Russia (-0.576). This negative sign indicates that the competitiveness relationship between the two countries is more complementary than competition.

Brazil has a positive and significant correlation with Indonesia (0.459), Malaysia (0.466) and Finland (0.577). These results show that the relationship between Brazil and the three countries was a competition. Brazil export destination countries were European countries which were also export destinations for Finland and Malaysia plywood. It means that these countries were competing for the same market. Brazil is negatively and significantly correlated with China (-0.618) and Russia (-0.609). It indicates that the exports of Brazil and the two countries were more complementary than competition. The meaning of the complementary was that in certain years Brazil plywood exports will be high but China and Russia exports were low and otherwise.

## 4. CONCLUSION

Based on the analysis, several conclusions were obtained. First, during the period 2001-2020 the volume and value of Indonesian plywood exports fluctuated with a downward trend. The decline was in line with the decline in Indonesia plywood market share in the international market. In addition, the position of Indonesia and Malaysia as the dominant plywood exporters has now been replaced by China. Second, the RSCA analysis shows that all exporting countries, that was Indonesia, Malaysia, China, Russia, Finland and Brazil have competitiveness for plywood commodities. Indonesia has the highest competitiveness compared to other exporting countries, followed by Finland, Malaysia, Brazil, China and Russia. Although it has the highest RSCA value, Indonesia has a downward trend of 0.48% per year. The increase in China export market share was also in line with its average competitiveness growth (RSCA), which was growing at 3.75% per year. Third, TSI analysis shows that Indonesia plywood was in the maturity stage. Malaysia, Russia, Finland and Brazil were also in the maturity stage, while China was still in the growth stage. And the last one, Spearman rank correlation analysis shows that the competitiveness of Indonesian plywood was significantly correlated with Russia, Finland and Brazil. The correlation with Russia

was quite strong and complementary. Meanwhile the correlation with Finland was quite strong and Brazil was moderate and competitive.

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