

# An Analysis on the Competitiveness and Specialization Levels of the Countries in the Export of Wood and Articles of Wood

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## Abstract

The main aim of this study is to determine the export competitiveness and specialization levels of countries that export wood and wooden products. To do this, 10 countries with the highest export volume between 2010 and 2019 are determined under the HS-2007 product classification, using the "44-Wood and Articles of Wood" product group export data. The Relative Export Advantage (RXA) Index and Net Export Index (NEI) are used to measure export competitiveness. Moreover, for the product groups where countries gain competitive advantage, cross-country correlation is analyzed. With the analysis, efforts are made to determine whether there is a correlation between the countries' specialization coefficient. On the one hand, it is seen that, among 21 product groups under the 44-Wood and Articles of Wood group, Poland has a competitive advantage in the export of 16 product groups, followed by Malaysia in 13, Austria and Vietnam in 12, and Canada and Indonesia in 11, respectively. Germany and USA, on the other hand, have competitive advantages in six product groups which make them the least advantageous among all these countries. Countries that have had a competitive advantage have usually shown specialization in exports as well with respect to their own trade performance. According to the results of the correlation test, which is between specialization coefficient within a certain product group, a strong correlation and a positive relationship are found between the countries that have a competitive advantage in exports. Especially in the product groups coded 4409 (wood, including strips and friezes for parquet flooring, not assembled), 4411 (fiberboard of wood), 4415 (packing cases, boxes, crates, drums, and similar packings, of wood), and 4418 (builders' joinery and carpentry of wood), a high correlation exists between countries. To be specific, in the correlation test held for 10 countries and 21 product groups, Malaysia, matching in 40 categories with the other countries, has the greatest number of meaningful relationships. It is followed by Austria with 37 and Poland with 32. Therefore, it could be stated that this is a confirmation that these countries, in a high competition with the other countries, have a meaningful relationship in terms of specialization coefficient in the global market.

**Keywords:** Competitiveness, correlation, export, wood and timber industry

## Introduction

The export industry of Wood and Articles of Wood has comprised .64%, .65%, and .82% of the world's total export in 2010, 2015, and 2019, respectively. More than half of the export share of forest products, however, is held by only 10 countries in total, namely, 58.7% in 2010, 58.1% in 2015, and 55.8% in 2019. This raises a question about these 10 countries' competence and competitiveness level in the forest products industry. In this paper, therefore, the specialization and competitiveness level of the countries having a lion's share of the export of wood and forestry products is examined. To do so, the revealed comparative advantage (RCA) is preferred as a method to analyze the specialization level of the countries.

The first study in the field of specialization was conducted by Balassa (1965), entitled Trade Liberalization and Revealed Comparative Advantage. Earlier, measuring competitiveness had proven to be a troublesome issue since the products' prices could not be defined before the trade. Balassa initiated a new approach to measure competitiveness by considering the after-trade price for analysis. Somehow, trade analysis is to be done for comparison between countries. Thus, if the pre-trade price cannot be obtained, there is no harm in using the after-trade price for the analysis. Once the after-trade (revealed) data began to be used, it became possible to measure the specialization level of the international trade of countries.

## Cite this article as:

Sarıçoban, K., & Kaya, E. (2022). An analysis on the competitiveness and specialization levels of the countries in the export of wood and articles of wood. *Forestist*, 72(2), 199-211.

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## Received:

April 30, 2021

## Accepted:

September 27, 2021

## Available Online Date:

November 25, 2021



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It must be said that the terms of competitiveness differ between comparative advantage and specialization. The World Economic Forum (2021) defines it as “the set of institutions, policies and factors that determine the level of productivity of a country.” For Landau (1992), competitiveness is the ability to provide a reasonable growth rate and high living standards for all in a country to reach somewhere close to the full employment level, by applying the right economic policies, without impinging on the living standards of future generations and the potential of the country’s economic growth. The American Competitiveness Policy Council defines competitiveness as a capacity to provide goods and services according to demands of international markets as well as the enhancement of the living standards of a country’s citizens, and making it sustainable (Competitiveness Policy Council, 1992). As can be seen, various definitions of competitiveness exist. For an economist, competitiveness can mean a country’s performance relative to its competitors, as a result of an increase in national productivity and a rise in the standard of living. For a politician, it can mean that a new regulation can change their ability to compete in the market. For a business owner, it can mean changes in profitability by lowering the cost in producing goods and services (Saxena & Lozac’h, 2010).

Comparative advantage explains the specialization pattern of a country in the global market. In other words, comparative advantage is a concept used to measure the trade structure and specialization of countries in certain groups of goods, and to determine whether they have a competitive advantage in these groups (Prasad, 2004). This approach, rather than explaining the underlying factors of comparative advantage, shows whether the country has a comparative advantage in a certain product or product group (Aynagöz Çakmak, 2005). The comparative advantage approach basically relies on the idea of ‘specialization’ and asserts that countries can specialize in the production of certain goods and services, just like an individual specializes in a particular job (Utkulu, 2005).

As for specialization, it is used in the sense of producing at a low cost for international trade. The export competitiveness of countries depends on their comparative cost advantages. Comparative cost advantage is based on the opportunity cost of producing a good. The opportunity cost of a good is equal to the amount that must be given up on the production of another good in order to increase the production of the good by one unit. To put it differently, opportunity cost is the amount of production that is given up on another good to produce one more unit of one good. In this context, if a country can produce a particular good at a lower opportunity cost than any other country, it is safe to say that the country has a comparative advantage. This means that the country specializes in the relevant sector and gains a competitive advantage. In short, a comparative cost advantage is the ability to produce goods and services at a lower opportunity cost. In this way, a comparative cost advantage enables the national firm to sell goods and services to the country at a lower price than its competitors and provide stronger sales margins worldwide. Therefore, trading in a certain product or product group, that is, specialization, makes a country competitive in international trade. That is why specialization is equated with export competitiveness in this paper.

Based on these explanations, the research question of the study can be posed as follows: With more than half of the world’s exports of wood and wood products being realized by only 10 countries, have these countries demonstrated a specialization in the export of the wood and wooden goods sector above the world average in terms of sub-product groups? In other words, do these countries have a significant share in world exports because they specialize in the forest products industry

(cost advantage) and thus gain a competitive advantage? Also, is there a correlation between the specialization coefficients on the basis of product groups in which countries gain a competitive advantage? The study basically seeks answers to these two questions.

The literature on the subject has been reviewed, but no publications directly related to the “research questions” of this study have been found. Examples from the literature close to this study are given below.

Akyüz et al. (2020) tried to determine the comparative advantages of Turkey’s exports of forest products in their study. In the study, the foreign trade data of HS-44 wood sub-product groups between 2001 and 2017 have been used. The Balassa Index (RCA) and the Vollrath Index (RTA), which are also used in this paper, are used as a method. According to the findings, Turkey has a competitive advantage in the product groups coded 4410, 4411, 4413, and 4415 in the 2001–2009 period and in the product groups coded 4408, 4410, 4411, 4413, 4415, and 4418 in the 2010–2017 period, according to RCA. In accordance with the RTA, it has a competitive advantage in the product groups coded 4404, 4408, 4409, 4410, 4413, 4415, 4417, 4418, and 4421 between 2001 and 2009, and in the product groups coded 4408, 4409, 4410, 4411, 4413, 4415, 4417, 4418, and 4421 in the period of 2010–2017.

Magezi and Okan (2019) conducted a study to determine the competitiveness of forest products traded between Turkey and the countries of the European Union. Analyses are made with RCA and RTA indexes in the study, in which the 2006–2016 period and HS-44, HS-47, and HS-48 product groups are used. According to the results, it has been determined that Turkey has a competitive disadvantage against the European Union countries in the forest products sector.

Parobek et al. (2016) comparatively analyzed of the Trade of Wood and Semi-finished Wood Products of Slovakia and Central European Trading Partners for the period 2009–2013. The study, in which the RCA index was used, emphasized that Slovakia has a strong advantage in industrial roundwood.

In his study, Bashimov (2015) analyzed Russia’s forest product export competitiveness for the period 2001–2013 by using the Balassa Index. In the analysis made with the HS-44 forest main product group, it was found that Russia has a competitive advantage in all years. However, the author also emphasizes that there has been a significant decrease in the competitiveness coefficients in recent years.

Bojnec and Fertő (2014), in their study, divided the forest industry into three, namely raw wood, semi-finished, and finished wood products, to determine the competitiveness of the New Member States (NMS-11) of the EU in the forest industry. In the study, in which the RTA index is used, analyses are made for the period 1999–2010. The results reveal that Cyprus performed the best among them by gaining a competitive advantage in all three groups. Bulgaria, Cyprus, the Czech Republic, Lithuania, Poland, Romania, Slovakia, and Slovenia have a competitive advantage in finished wood products. Cyprus, the Czech Republic, Poland, Romania, and Slovenia have a competitive advantage in semi-finished wood products. In the trade of raw wood, Cyprus and Hungary have a competitive advantage.

Aini et al. (2010) analyze the comparative advantage of Malaysia’s exports of forest products to the EU market for the period 1999–2006. They determine that Malaysia has a significant competitive advantage in the EU market compared to other countries.

Abidin and Loke (2008), in their study, reveal Malaysia's level of specialization by sectors during 2001–2005. In the analysis for forest products, it has been determined that Malaysia had a comparative advantage above the world average for all years from 2001 to 2005.

To briefly summarize, these studies are handled at the country or regional level. Either the competitiveness of a particular country's wood products has been determined, or the subject has been discussed together with the other sectors of the country through the main export item. This paper, which differs from others, deals with the 10 countries that realize more than half of the world's forest products exports and compares the forest products export specialization levels of these countries with the world specialization. In addition, another point that distinguishes this study from others is that these countries also rival each other for their export shares. The study also investigates whether there is a correlation between the specialization coefficients of these countries, which are competitors in the global market. Thus, it has been revealed whether these countries move in a similar direction between the specialization coefficients in the export of forest products. With these aspects, the study offers a new perspective to the literature and the findings are expected to contribute to the literature.

Firstly, countries dominant in forestry trade from 2010 to 2019 are determined and the data obtained are compared against both the global and the countries' total exports. Secondly, the method and data to conduct the research are presented. Lastly, various indexes are used to analyze the data, and the findings are explained.

### An Overview of the World Wood and Wood Products Export

To determine the countries with the highest exports of products in the Wood and Articles of Wood group between 2010 and 2019, the United Nations International Trade Statistics, Harmonized Commodity Description and Coding Systems (HS) product classification is used. Hereby, based on Comtrade (2020) HS-2007 classification, export values of 44-Wood and Articles of Wood product group are used. The 44-Wood and Articles of Wood product group is the main group, and has 21 sub-product groups. In other words, all these 21 product groups in total are equal to the total of 44 product groups. The codes and names of these products are shown in the Table 1.

From here on, for convenience, only the codes are mentioned, instead of the product names.

In Table 2, based on the HS-2007 classification, the most exporting countries in the 44-coded product group are drawn from the Comtrade (2020) database, the top 10 countries are determined, and ranked according to years. When the table is examined, the countries in the top 10 mostly stay the same, only two more countries are included in the list in 2018 and 2019. Thus, the number of countries in the top ten in 10 years in total is 12, demonstrated in Table 2.

Column A in Table 2 gives the country's export share (%) of 44-coded products, within the total 44-coded products' export globally. For instance, in 2010, China alone realized 9.6% of the world's total exports of the 44-coded products group. With broad strokes, China is the leader in the export of this product group. Column B gives the share (%) of the 44-coded exports out of the respective country's own total exports. China's export of the products in the code 44, for example, constitutes .6% of its total exports. The remarkable data here belong to New

Zealand, since it is seen that the share of this product group among its own exports comprises 9.1%.

When we look at Total A, we can make an important inference: more than 50% of the world's total 44-coded product group exports are made by these 10 countries. For example, in 2010, these 10 countries realized 58.7% of the world's total 44-coded product exports, 58.1% in 2015, and 55.1% in 2019.

## Material and Methods

### Countries and Data

The countries analyzed in the paper, as mentioned earlier, consist of the top 10 countries in the export of Wood and Articles of Wood between 2010 and 2019. The 10-year data reveal that the top 10 countries have mostly stayed the same, and the ranks of only two countries have changed in the list. Thus, we have conducted our research on 12 countries in total. The list of these countries can be seen in Table 2.

The product groups are composed of 21 sub-groups under 44-Wood and Articles of Wood, Comtrade (2020), according to the HS-2007 classification, and their details can be seen in Table 1. The export and import data of these product groups for the countries have been pulled from the Comtrade (2020) database, in terms of US dollars.

### Analysis Method

#### Relative Export Advantage (RXA)

The study uses the Relative Export Advantage Index (RXA), developed by Thomas L. Vollrath to measure export competitiveness, in his article published in 1991, under the subtitle "Last Measurements of RCA." The index can be depicted as a ratio of a country's specialization in a good or a sector to the global specialization of the same good or sector. The index is calculated as follows (Fronberg & Hartmann, 1997; Vollrath, 1991):

$$RXA = \frac{X_{kt}^j / X_{-kt}^j}{X_{kt}^{-j} / X_{-kt}^{-j}} \quad (1)$$

Where,

$X_{kt}^j \rightarrow$  country  $j$  export of product (or sector)  $k$  in period  $t$ ,

$X_{-kt}^j \rightarrow$  country  $j$  total exports except product (or sector)  $k$  in period  $t$ ,

$X_{kt}^{-j} \rightarrow$  the world's total exports of product (or sector)  $k$ , except  $X_{kt}^j$  in period  $t$ ,

$X_{-kt}^{-j} \rightarrow$  the world's total exports, except  $X_{kt}^j$  and  $X_{-kt}^j$  in period  $t$ .

The interpretation of RXA can be demonstrated as;

- If  $RXA > 1$ , country  $j$  has a competitiveness in export of product  $k$ , or is at an advantage, which means its specialization level is above the world average.
- If  $RXA < 1$ , country  $j$  has a no competitiveness in the export of product  $k$ , or is at a disadvantage, which means its specialization level is below the world average.
- If  $RXA = 1$ , country  $j$  has a balanced competitiveness in the export of product  $k$ , which means its specialization level is equal the world average.

**Table 1.**  
**Sub-Groups of the 44-Wood and Articles of Wood, Based on the HS-2007 Classification**

| Commodity Codes | Commodity  |
|-----------------|--|
| 44              | Wood and Articles of Wood  |
| 4401            | Fuel wood, in logs, in billets, in twigs, in faggots, or in similar forms  |
| 4402            | Wood charcoal (including shell or nut charcoal), whether or not agglomerated   |
| 4403            | Wood in the rough, whether or not stripped of bark or sapwood, or roughly squared  |
| 4404            | Hoop wood  |
| 4405            | Wood wool  |
| 4406            | Railway or tramway sleepers (cross-ties) of wood   |
| 4407            | Wood sawn or chipped lengthwise, sliced or peeled, whether or not planed, sanded or end-jointed, of a thickness exceeding 6 mm   |
| 4408            | Sheets for veneering (including those obtained by slicing laminated wood), for plywood or for similar laminated wood and other wood, sawn lengthwise, sliced or peeled, whether or not planed, sanded, spliced or end-jointed, of a thickness not exceeding 6 m          |
| 4409            | Wood (including strips and friezes for parquet flooring, not assembled) continuously shaped (tongued, grooved, rebated, chamfered, V-jointed, beaded, molded, rounded, or the like) along any of its edges, ends or faces, whether or not planed, sanded, or end-jointed |
| 4410            | Particle board, oriented strand board (OSB) and similar board (e.g., waferboard) of wood or other ligneous materials, whether or not agglomerated with resins or other organic binding substances  |
| 4411            | Fiberboard of wood or other ligneous materials, whether or not bonded with resins or other organic substances  |
| 4412            | Plywood, veneered panels, and similar laminated wood   |
| 4413            | Densified wood, in blocks, plates, strips, or profile shapes   |
| 4414            | Wooden frames for paintings, photographs, mirrors, or similar objects  |
| 4415            | Packing cases, boxes, crates, drums, and similar packings, of wood   |
| 4416            | Casks, barrels, vats, tubs, and other coopers' products and parts thereof, of wood, including staves   |
| 4417            | Tools, tool bodies, tool handles, broom or brush bodies and handles, of wood   |
| 4418            | Builders' joinery and carpentry of wood, including cellular wood panels, assembled flooring panels, shingles, and shakes   |
| 4419            | Tableware and kitchenware, of wood   |
| 4420            | Wood marquetry and inlaid wood   |
| 4421            | Other articles of wood   |

Source: Comtrade, 2020.

While the RXA index values are expounded, we can divide the values into four groups for a more specific analysis (Hinloopen & Marrewijk, 2001):

1. Group →  $0 < RXA \leq 1$  Disadvantage
2. Group →  $1 < RXA \leq 2$  Weak Advantage
3. Group →  $2 < RXA \leq 4$  Moderate Advantage
4. Group →  $4 < RXA$  Strong Advantage

### Net Export Index (NEI)

The Net Export Index (NEI) is calculated by dividing the net trade by the total sum of export and import for a certain sector (Balassa & Noland, 1989a). The NEI provides an assessment of a country's trade as well as its trade with the rest of the world (Mikic & Gilbert, 2009). With a closer look at NEI from this perspective, it is possible to state that the index is more about the intra-industry trade and is only used to determine the country's own trading performance. The NEI is calculated as follows (Balassa & Noland, 1989b):

$$NEI_{kt}^j = \frac{X_{kt}^j - M_{kt}^j}{X_{kt}^j + M_{kt}^j} \quad (2)$$

where  $X$  stands for export,  $M$  for import,  $j$  for country,  $k$  for product group (or sector), and  $t$  for time. The NEI can take a value between  $-1$  and  $+1$ . If the value is negative, it means that the country has more import than export of the certain product (or sector) and that it has

a competitive disadvantage; if the value is positive, it can be said that the country has more export than import and that it is specialized in the product (or sector), and is more competitive than average. While  $NEI = -1$  denotes full import, indicating the highest comparative disadvantage,  $NEI = 1$  denotes full export, indicating the highest comparative advantage and specialization. If  $NEI = 0$ , there is a balanced trade and intra-industry trade is at its maximum level.

The RXA and NEI values from the findings are shown in the respective columns of the tables. The RXA demonstrates the export competitiveness advantage of a country, while the NEI shows the country's specialization level of import or export. Moreover, for easy tracking in the table, the results are classified as follows:

A: Weak Advantage (WA)

AA: Moderate Advantage (MA)

AAA: Strong Advantage (SA)

✓: Specialization "Yes"

X: Specialization "No"

It must be remembered that specialization and export competitiveness could be used to refer to the same meaning, throughout the paper. Here, however, they are similar, but with a small difference, in that the

**Table 2.**  
**Countries' Export Share (%)**

| 2010  | 2011 |      | 2012 |      | 2013 |      | 2014 |      | 2015 |      | 2016 |      | 2017 |      | 2018 |      | 2019 |      |      |     |     |      |     |
|-------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|-----|-----|------|-----|
|       | A*   | B**  | A    | B    | A    | B    | A    | B    | A    | B    | A    | B    | A    | B    | A    | B    | A    | B    |      |     |     |      |     |
| CHN   | 9.6  | .6   | CHN  | 10.9 | .6   | CHN  | 10.4 | .6   | CHN  | 12.1 | .6   | CHN  | 11.2 | .6   | CAN  | 10.5 | 3.3  | CHN  | 10.5 | .6  | CHN | 10.6 | .5  |
| DEU   | 8.6  | .7   | DEU  | 8.0  | .6   | CAN  | 8.9  | 2.2  | CAN  | 10.0 | 2.7  | CAN  | 10.8 | 3.4  | CHN  | 10.2 | .6   | CAN  | 10.0 | 3.2 | CAN | 9.2  | 2.6 |
| CAN   | 8.4  | 2.2  | CAN  | 7.9  | 2.0  | DEU  | 7.3  | .6   | USA  | 7.1  | .6   | USA  | 7.2  | .6   | USA  | 7.1  | .6   | DEU  | 6.9  | .6  | DEU | 7.5  | .6  |
| USA   | 6.7  | .5   | USA  | 6.6  | .5   | USA  | 6.8  | .5   | DEU  | 7.0  | .6   | DEU  | 6.7  | .6   | DEU  | 6.6  | .6   | USA  | 6.8  | .6  | RUS | 6.8  | 2.0 |
| RUS   | 6.1  | 1.5  | RUS  | 6.0  | 1.3  | RUS  | 6.0  | 1.3  | RUS  | 5.9  | 1.6  | RUS  | 5.5  | 2.2  | RUS  | 6.1  | 2.1  | RUS  | 6.3  | 2.0 | USA | 6.3  | .5  |
| AUT   | 4.8  | 3.3  | AUT  | 4.7  | 3.2  | AUT  | 4.2  | 3.0  | AUT  | 3.7  | 2.9  | AUT  | 3.7  | 3.1  | AUT  | 3.5  | 2.9  | POL  | 3.9  | 2.1 | AUT | 3.9  | 2.9 |
| SWE   | 4.3  | 2.8  | SWE  | 3.9  | 2.4  | MYS  | 3.9  | 1.9  | SWE  | 3.6  | 2.6  | SWE  | 3.6  | 2.8  | IDN  | 3.2  | 2.7  | POL  | 3.7  | 3.0 | SWE | 3.1  | 2.5 |
| MYS   | 4.3  | 2.2  | MYS  | 3.9  | 2.0  | SWE  | 3.8  | 2.5  | MYS  | 3.5  | 1.9  | MYS  | 3.3  | 1.9  | SWE  | 3.0  | 2.7  | IDN  | 3.1  | 2.5 | IDN | 3.0  | 2.3 |
| POL   | 3.0  | 1.9  | POL  | 3.0  | 1.8  | IDN  | 3.1  | 1.8  | POL  | 3.2  | 1.9  | POL  | 3.1  | 2.7  | IDN  | 3.0  | 2.4  | SWE  | 3.0  | 2.5 | POL | 2.7  | 1.4 |
| IDN   | 2.9  | 1.9  | IDN  | 2.9  | 1.7  | POL  | 2.9  | 1.8  | IDN  | 3.0  | 2.0  | IDN  | 3.1  | 2.3  | POL  | 3.2  | 1.9  | MYS  | 2.6  | 1.6 | NZL | 2.5  | 9.1 |
| Total | 58.7 | 56.9 | 57.7 | 57.8 | 57.8 | 57.8 | 57.8 | 57.8 | 58.1 | 58.1 | 57.6 | 57.6 | 55.9 | 55.9 | 56.8 | 56.8 | 55.8 | 55.8 |      |     |     |      |     |

Note: CHN=China; DEU=Germany; CAN=Canada; SWE=Sweden; MYS=Malaysia; USA=United States; RUS=Russian Federation; AUT=Austria; IDN=Indonesia; NZL=New Zealand; POL=Poland; Vietnam=VNM.

\*A=Share of the country's export of the code-44 in the world's total exports of that product (%).

\*\*B=The share of its own export code-44 in the total Exports of the respective country (%).

Source: Comtrade (2020) database, compiled by the authors in December 2020.



NEI points to the country's own specialization in export. The NEI value is related more to the country's export specialization, in that area in which it has a competitiveness in exports according to its trading performance.

### Statistical Method

Finally, in the paper, Spearman's correlation test is applied to see whether there are correlations among product groups in which the countries are competitive,

To be able to calculate the correlation coefficient, measurements should be obtained in the equal scale of sequence or ratio. In some cases, especially in the social sciences, data could be consecutive and non-parametric. If the data are measured with an ordinal scale, Spearman's rank correlation coefficient is used. For a correlation analysis, on the one hand, variables X and Y should exhibit normal distribution. On the other hand, if distribution is not normal or non-linear, Spearman's Rho (correlation coefficient for ranked data ( $r_s$ )) could be used for correlation analysis (Howell, 2013). The Spearman's Rho test statistic  $r_s$  can be calculated as follows (Newbold, 2000):

$$r_s = 1 - \frac{6 \sum_{i=1}^n d_i^2}{n(n^2 - 1)} \quad (3)$$

where  $d_i$  is difference between X and Y variables ranking;  $n$  is the total number of observations for two variables. The calculated correlation value between two variables for both the direction and the strength of the relationship can be illustrated in Table 3 (Dancey & Reidy, 2017).

### Results

By using the data of export and import by the countries, the RCA coefficients of the four-digit sub-product-groups under 44-Wood and Articles of Wood are calculated, and only those product groups with competitiveness find a place in the table. A country with a competitiveness in any product group is shown in the table, and accordingly, its competitiveness level, namely A for weak, AA for moderate, and AAA for strong competitiveness, is indicated.

In addition, the NEI values, which indicate export specialization, are a part of the same table in a separate column. According to the NEI values, a country with a specialization is indicated with a "✓" mark; otherwise, it is marked as "X."

The "Total" row in the table indicates how many product groups out of 21 a country has competitiveness in, while the Codes Total column shows how many countries have competitiveness in the product group.

According to the RXA results in Table 4, Poland in 16, Malaysia in 13, Austria and Vietnam in 12, Canada and Indonesia in 11, Sweden in 8, China and the Russian Federation in 7, and Germany and USA in 6 of the 21 forest product groups exported by countries achieved a comparative advantage by specializing above the world average. The advantageous situation of some of them is expounded below.

Poland displays strong advantage (AAA) in nine product groups as well as a weak advantage (A) in seven. It has a strong advantage by showing a specialization above the world average. Poland, moreover, has shown a specialization above the world average and achieved a strong advantage in the export of the following product groups: 4402 (wood

charcoal), 4409 (wood continuously shaped), 4411 (fiberboard of wood or other ligneous materials), 4413 (densified wood, in blocks, plates, strips, or profile shapes), 4414 (wooden frames for paintings, photographs, mirrors, or similar objects), 4418 (builders' joinery and carpentry of wood), and 4421 (other articles of wood).

Malaysia has shown specialization in 13 out of 21 product groups. Of these, only the 4412 (plywood, veneered panels, and similar laminated wood) product group has a strong advantage. Of the remaining 12 groups, it has a moderate advantage in 7 and a weak advantage in 5.

Austria has achieved a strong advantage in 4 of the 12 product groups in which it has a comparative advantage, a moderate advantage in 3, and a weak advantage in 5 of them. As for Vietnam, it has strong advantage in 2 of the 12 product groups it specializes in, a moderate advantage in 4, and a weak advantage in 6 of them. Similarly, the other values can be seen in the table.

When the RXA coefficients in Table 4 are analyzed horizontally on the basis of product groups, it shows whether the countries have achieved specialization in that product group. Additionally, such a comparison is important, since the countries that specialize in the relevant product group will be competitors in the export of that product in the global market. For example, in the 4401 (fuel wood, in logs, in billets, in twigs, in fagots, or in similar forms) product group, eight countries (Poland, Austria, Vietnam, Canada, Indonesia, New Zealand, Russia and USA) show a specialization above the world average. For this reason, it is possible to say that these eight countries are competitors in the export of the 4401 product group. The fact that only Vietnam has a strong advantage among these eight countries gives Vietnam an advantage over other countries in global competition.

In the 4408 (sheets for veneering (including those obtained by slicing laminated wood), for plywood or for similar laminated wood and other wood, etc.) product group, eight countries have gained a competitive advantage by showing a specialization above the world average. These countries are Malaysia, Austria, Vietnam, Canada, Indonesia, New Zealand, the Russian Federation, and USA. They are also in competition with each other in the export of products from the 4408 group, as they specialize above the world average and gain a comparative advantage. Among them, New Zealand has a strong advantage, and Malaysia, Austria, and Canada have a moderate advantage. Therefore, among the countries covered in this product group, it can be stated that New Zealand is the country that specializes the most in the export of the products in the 4408 product group, above the world average, and has gained a significant competitive advantage.

Similarly, eight countries are specialized in the 4418 (builders' joinery and carpentry of wood) product group, which are Poland, Malaysia, Austria, Canada, Indonesia, New Zealand, Sweden, and Germany. These eight countries have achieved a competitive advantage in the product group by showing a specialization above the world average. As all of them show a specialization above the world average, they are also in intense competition in the global market in the export of this product group. However, the strong superiority of Poland and Austria dominate the market, with an advantage over others.

In the 4402 (wood charcoal (including shell or nut charcoal), whether or not agglomerated) group, four countries (Poland, Malaysia, Vietnam, and Indonesia) have achieved a comparative advantage with specialization. Among these countries, Poland and Indonesia have a strong advantage, while Malaysia and Vietnam are moderate.

**Table 3.**  
*Illustration of the Strength of Positive and Negative Correlation Coefficients*

|          |    |    |
|----------|----|----|
| Perfect  | +1 | -1 |
| Strong   | +9 | -9 |
| Strong   | +8 | -8 |
| Strong   | +7 | -7 |
| Moderate | +6 | -6 |
| Moderate | +5 | -5 |
| Moderate | +4 | -4 |
| Weak     | +3 | -3 |
| Weak     | +2 | -2 |
| Weak     | +1 | -1 |
| Zero     | 0  |    |

In the 4405 (wood wool) group, only two countries (Vietnam and Germany) show a specialization above the world average. Both countries have a strong advantage in the group. It is possible to say that Vietnam and Germany are in intense competition due to their strong specialization in the export of products in the 4405 group.

In the product group 4416 (casks, barrels, vats, tubs, and other cooper's products and parts thereof, of wood, including staves, etc.), only Austria and USA have a comparative advantage. Austria is in a weakly superior position, while the USA is in a moderately advantageous one. In terms of global competition, it can be said these two countries, which specialize above the world average, are competitors in the export of products in the 4416 product group. However, the USA's medium level of specialization shows that it is in a more advantageous position than Austria.

Table 4 also includes the NEI results. While interpreting the NEI results here, a comparison with the RXA results is also made. As mentioned earlier, the RXA index measures whether the country achieved specialization in the relevant product group compared to the world average. The NEI measures the country's own (domestic) commercial performance and reveals whether the country specializes in exports or imports of a certain product group.

Poland, according to the RXA results, has a comparative advantage by specializing above the world average in 16 of 21 product groups. According to the NEI results, it has been determined that it specializes in the export of all product groups, except 4410, among which it has a competitive advantage. In terms of its commercial performance, Poland specializes in importing only the 4410 (particle board, oriented strand board (OSB) and similar board (e.g., waferboard) of wood or other ligneous materials) group of products.

Congruently, Malaysia specializes in the export of 12 of the 13 product groups in which it has a global competitive advantage, and the import only one (4408—Sheets for veneering, etc.) of the product groups. It has been observed that of the 12 product groups in which Austria specializes above the world average, seven are specializations in export and five are in import. It has been determined that 11 out of 12 product groups, in which Vietnam has a comparative advantage, are export specializations, while only one (4408—Sheets for veneering, etc.) is in imports.

If the NEI results in Table 4 are evaluated together with the results of RXA, it is obvious that there is a close relationship between the countries'

global export specializations as well as their domestic export specializations. In other words, there is a relationship between the export specialization of the relevant product group and the global specialization in that product group in terms of their own commercial performance. Of course, this needs to be tested in further studies with statistical tests.

In Table 4, we have mentioned that countries with a global competitive advantage in any product group will also compete among themselves due to their specialization in the relevant product group. Table 5 shows an analysis of whether there is a statistically significant relationship between the global specialization coefficients (RXA) of the countries in the relevant product groups. A meaningful and positive relationship will show that countries are in intense competition, as expected earlier. This reveals a situation where firms are interdependent, as in oligopoly markets, which is to say that they follow each other's policies. Hereby, of course, we do not safely state whether the companies are following each other's policies. This could be the subject of another study. However, here, the high correlation between two countries creates a relationship of interdependence, as it shows that when one country's specialization increases, that of the other also moves in the same direction, and it is a situation that should be taken into account. This may be due to the similar policies of countries/firms; such as R&D investments, quality of education, qualified workforce, tax policies, export incentives, technology, etc. Many factors affect specialization. Countries/firms might achieve similar levels of specialization when they implement similar policies.

In Table 5, the correlation between the product groups in which countries gain competitive advantage is calculated. To do this, Spearman's correlation test (Rho) is performed for the 10-year ( $n = 10$ ) RXA coefficients of the countries and the ones with significant correlations ( $p < .05$ ) are shown in the "Countries" column in the table.

It is already seen that eight countries have a global comparative advantage in the 4401 (fuel wood, in logs, in billets, in twigs, in faggots, or in similar forms) product group in the previous table (Table 4, Codes Total). With a closer look at the 4401 product group, four out of the eight countries show a meaningful relation as a result of the correlation test. There is, for instance, a strong and positive relationship between Austria and Canada, meaning that while the RXA value of Austria rises, that of Canada rises too, and vice versa. When both countries are considered to have a comparative advantage in the 4401 product group, it can easily be stated that Austria and Canada are in a high competition with each other. The same comment can be made for Austria and Poland or Austria and Vietnam as well. Indonesia and Vietnam also have a positive relationship in the same direction, but the relationship is rather moderate than strong. Therefore, it can be said that the two are in a modest competition in the global market. The highest correlation of the 4401 group is between Austria and Poland. It means that the highest correlation of specializations is between the countries in the 4401 group.

In the group 4402 (wood charcoal (including shell or nut charcoal), whether or not agglomerated), four countries, namely, Poland, Malaysia, Vietnam, and Indonesia, have a global competitive advantage. A significant and positive relationship is found between Malaysia and Poland and Vietnam and India. This shows that the specialization levels of these countries in the 4402 product group strongly move in the same direction. Vietnam and India are a match, with the highest correlation in this product group. Thus, the relationship between the two is the highest in terms of specialization in the trade of 4402 group of products.

Six countries specialize in the group 4403 (wood in the rough, whether or not stripped of bark or sapwood, or roughly squared) above the world

Table 4.  
 RXA and NEI Values

|       | Poland      |     | Malaysia |     | Austria |     | Vietnam    |     | Canada  |     | Indonesia |     | Codes Total |
|-------|-------------|-----|----------|-----|---------|-----|------------|-----|---------|-----|-----------|-----|-------------|
|       | RXA         | NEI | RXA      | NEI | RXA     | NEI | RXA        | NEI | RXA     | NEI | RXA       | NEI |             |
| 4401  | A           | ✓   |          |     | AA      | X   | AAA        | ✓   | A       | ✓   | A         | ✓   | 8           |
| 4402  | AAA         | ✓   | AA       | ✓   |         |     | AA         | ✓   |         |     | AAA       | ✓   | 4           |
| 4403  | A           | ✓   | AA       | ✓   |         |     |            |     | AA      | ✓   |           |     | 6           |
| 4404  | AAA         | ✓   | AA       | ✓   |         |     | A          | ✓   | A       | ✓   |           |     | 6           |
| 4405  |             |     |          |     | AAA     | ✓   |            |     |         |     |           |     | 2           |
| 4406  | A           | ✓   | A        | ✓   |         |     |            |     |         |     |           |     | 4           |
| 4407  | AAA         | ✓   | A        | ✓   | AAA     | ✓   |            |     | AAA     | ✓   |           |     | 6           |
| 4408  |             |     | AA       | X   | AA      | X   | A          | X   | AA      | ✓   | A         | ✓   | 8           |
| 4409  | AAA         | ✓   | AA       | ✓   | AA      | ✓   |            |     | A       | X   | AAA       | ✓   | 7           |
| 4410  | A           | X   | A        | ✓   | AAA     | ✓   |            |     | AAA     | ✓   |           |     | 7           |
| 4411  | AAA         | ✓   | AA       | ✓   | AAA     | ✓   |            |     | A       | X   |           |     | 7           |
| 4412  |             |     | AAA      | ✓   | A       | ✓   | A          | ✓   |         |     | AAA       | ✓   | 7           |
| 4413  | AAA         | ✓   |          |     |         |     | AA         | ✓   |         |     |           |     | 4           |
| 4414  | AAA         | ✓   | AA       | ✓   |         |     | AA         | ✓   |         |     | AAA       | ✓   | 5           |
| 4415  | AAA         | ✓   | A        | ✓   | A       | X   |            |     | A       | ✓   |           |     | 6           |
| 4416  |             |     |          |     | A       | ✓   |            |     |         |     |           |     | 2           |
| 4417  | A           | ✓   |          |     | A       | X   | A          | ✓   |         |     | A         | ✓   | 7           |
| 4418  | AAA         | ✓   | A        | ✓   | AAA     | ✓   |            |     | AA      | ✓   | AA        | ✓   | 8           |
| 4419  | A           | ✓   |          |     |         |     | AA         | ✓   |         |     | A         | ✓   | 4           |
| 4420  | A           | ✓   |          |     |         |     | A          | ✓   |         |     | AAA       | ✓   | 4           |
| 4421  | AAA         | ✓   |          |     | A       | X   | A          | ✓   | AA      | ✓   | A         | ✓   | 7           |
| Total | 16          |     | 13       |     | 12      |     | 12         |     | 11      |     | 11        |     |             |
|       | New Zealand |     | Sweden   |     | China   |     | Russian F. |     | Germany |     | USA       |     | Codes Total |
|       | RXA         | NEI | RXA      | NEI | RXA     | NEI | RXA        | NEI | RXA     | NEI | RXA       | NEI |             |
| 4401  | AA          | ✓   |          |     |         |     | A          | ✓   |         |     | A         | ✓   | 8           |
| 4402  |             |     |          |     |         |     |            |     |         |     |           |     | 4           |
| 4403  | AAA         | ✓   |          |     |         |     | AAA        | ✓   |         |     | A         | ✓   | 6           |
| 4404  | A           | ✓   | A        | ✓   |         |     |            |     |         |     |           |     | 6           |
| 4405  |             |     |          |     |         |     | AAA        | ✓   |         |     |           |     | 2           |
| 4406  |             |     |          |     |         |     | A          | ✓   |         |     | AAA       | ✓   | 4           |
| 4407  | AAA         | ✓   |          |     |         |     | AAA        | ✓   |         |     |           |     | 6           |
| 4408  | AAA         | ✓   |          |     |         |     | A          | ✓   |         |     | A         | X   | 8           |



|       |     |   |    |   |     |   |  |     |    |   |   |   |
|-------|-----|---|----|---|-----|---|--|-----|----|---|---|---|
| 4409  | AAA | ✓ | A  | ✓ |     |   |  |     |    |   |   | 7 |
| 4410  | A   | ✓ |    |   | A   | ✓ |  |     | A  | X |   | 7 |
| 4411  | AAA | ✓ |    |   | A   | ✓ |  |     | AA | ✓ |   | 7 |
| 4412  | AA  | ✓ |    |   | AA  | ✓ |  |     | AA |   |   | 7 |
| 4413  |     |   | A  | ✓ |     |   |  |     | A  |   | ✓ | 4 |
| 4414  |     |   |    |   | AAA | ✓ |  |     |    |   |   | 5 |
| 4415  |     |   | A  | X |     |   |  |     | A  | X |   | 6 |
| 4416  |     |   |    |   |     |   |  | AA  |    | X |   | 2 |
| 4417  |     |   | AA | ✓ |     |   |  | AA  |    |   | X | 7 |
| 4418  | A   | ✓ |    |   | AA  | ✓ |  |     | A  |   | ✓ | 8 |
| 4419  |     |   |    |   | AAA | ✓ |  |     |    |   |   | 4 |
| 4420  |     |   |    |   | AAA | ✓ |  |     |    |   |   | 4 |
| 4421  |     |   | A  | X |     |   |  | AAA |    |   |   | 7 |
| Total | 10  |   | 8  |   | 7   |   |  | 7   | 6  | 6 |   | 6 |

Note: A: Weak Advantage; AA: Moderate Advantage; AAA: Strong Advantage; ✓: Specialization "Yes"; X: Specialization "No."

average. Of these, a strong and positive relationship is found between the USA and Russia, Malaysia and the USA, and Malaysia and Russia. There is also moderate and positive relationship between Canada and the USA. The highest correlation in this group is between Russia and the USA. Thus, there is a high correlation between the specialization coefficients of these countries.

Moving onto the 4404 (hoop wood) product group, among six countries, five show a meaningful relationship. There is a moderate and negative relationship between Canada and Sweden, which means that when the RXA of Canada moves up, that of Sweden goes down, and vice versa. Unlike these two, the other countries present strong and positive relationships. Hence, there is no harm in saying that they all compete in the global market in terms of the trade of the product group. The highest correlation in this product group, for example, is between Sweden and Vietnam; these two countries are in intense competition in the global market.

In the 4406 (railway or tramway sleepers (cross-ties) of wood) group, four countries (Poland, Malaysia, Russia, and the USA) have a global competitive advantage. Nonetheless, only one of the matchings between these countries shows a significant and positive relationship, between Malaysia and the USA. The strengths of the relationships are moderate, meaning that there is a positive and moderate relationship between the specialization of Malaysia and the USA in the 4406 product group.

In the 4407 (wood sawn or chipped lengthwise, sliced or peeled, whether or not planed, sanded or end-jointed, of a thickness exceeding 6 mm) group, significant results are obtained, with nine matches from the correlation test between six countries with regard to a global competitive advantage. While there is a moderate and positive relationship between Malaysia and Russia, there is a strong and positive relationship in other pairs. The highest correlation, however, is between New Zealand and Sweden.

While seven countries have comparative advantage in the 74 409 (wood continuously shaped along any of its edges, ends or faces, whether or not planed, sanded, or end-jointed) product group, a significant relationship is found in 14 matches in the correlation test. Three of these matches are moderate and positive, and 11 are strong and positive. Therefore, it is possible to say that there is a positive relationship along with the high competition between countries in the 4409 product group. In this product group, the correlation between Malaysia and Sweden is considerably high.

Again, seven countries have a competitive advantage in the 4410 (particle board, OSB, and similar board (e.g., waferboard) of wood or other ligneous materials, etc.) group, while a strong and positive relationship is found in 11 matches in the correlation between these countries. It can be said that there is a high correlation between the specialization levels of the countries for the 4410 product group, similar to the other product groups. The high correlation between Austria and New Zealand is particularly striking.

In the 4411 (fiberboard of wood or other ligneous materials, etc.) group, seven countries have a comparative advantage, while a significant correlation is found in 13 matches in the correlation test. All of these pairings are strong and positive. The highest correlation is between Austria and Malaysia.

While six countries have a comparative advantage in the 4415 (packing cases, boxes, crates, drums, and similar packings, of wood) group, a

**Table 5.**  
*Correlation of the Countries' Export Competitiveness*

|         | Countries | Sig.    | Coef. | Str. |
|---------|-----------|---------|-------|------|
| 4401    | AUT-CAN   | .011    | .76*  | S    |
|         | AUT-POL   | .003    | .83** | S    |
|         | AUT-VNM   | .006    | .79** | S    |
|         | IDN-VNM   | .048    | .64*  | M    |
| 4402    | MYS-POL   | .009    | .77** | S    |
|         | VNM-IDN   | .000    | .94** | S    |
| 4403    | CAN-USA   | .048    | .64*  | M    |
|         | MYS-RUS   | .016    | .73*  | S    |
|         | MYS-USA   | .002    | .85** | S    |
|         | RUS-USA   | .000    | .90** | S    |
| 4404    | CAN-SWE   | .029    | -.68* | M    |
|         | MYS-NZL   | .011    | .76*  | S    |
|         | NZL-SWE   | .002    | .84** | S    |
|         | NZL-VNM   | .001    | .87** | S    |
|         | SWE-VNM   | .000    | .99** | S    |
| 4406    | MYS-USA   | .033    | .67*  | M    |
| 4407    | AUT-MYS   | .004    | .82** | S    |
|         | AUT-NZL   | .000    | .94** | S    |
|         | AUT-SWE   | .000    | .93** | S    |
|         | CAN-MYS   | .016    | .73*  | S    |
|         | CAN-RUS   | .022    | .71*  | S    |
|         | MYS-NZL   | .000    | .93** | S    |
|         | MYS-RUS   | .048    | .64*  | M    |
|         | MYS-SWE   | .002    | .84** | S    |
|         | NZL-SWE   | .000    | .95** | S    |
|         | 4408      | AUT-NZL | .013  | .74* |
| AUT-USA |           | .000    | .96** | S    |
| AUT-MYS |           | .002    | .85** | S    |
| CAN-RUS |           | .019    | .72*  | S    |
| IDN-NZL |           | .043    | -.65* | M    |
| IDN-RUS |           | .002    | .84** | S    |
| NZL-USA |           | .022    | .71*  | S    |
| NZL-MYS |           | .000    | .91** | S    |
| USA-MYS |           | .001    | .87** | S    |
| 4409    | AUT-CAN   | .038    | .66*  | M    |
|         | AUT-IDN   | .025    | .70*  | S    |
|         | AUT-MYS   | .019    | .72*  | S    |
|         | AUT-POL   | .011    | .76*  | S    |
|         | AUT-SWE   | .038    | .66*  | M    |
|         | CAN-IDN   | .003    | .83** | S    |
|         | CAN-MYS   | .048    | .64*  | M    |
| 4409    | CAN-SWE   | .006    | .79** | S    |
|         | MYS-NZL   | .002    | .84** | S    |
|         | MYS-POL   | .002    | .85** | S    |
|         | MYS-SWE   | .000    | .95** | S    |

|         | Countries | Sig.    | Coef. | Str.  |
|---------|-----------|---------|-------|-------|
|         | NZL-POL   | .011    | .76*  | S     |
|         | NZL-SWE   | .013    | .74*  | S     |
|         | POL-SWE   | .002    | .85** | S     |
|         | 4410      | AUT-DEU | .000  | .93** |
| AUT-NZL |           | .000    | .99** | S     |
| AUT-POL |           | .003    | .83** | S     |
| AUT-MYS |           | .000    | .95** | S     |
| CAN-RUS |           | .013    | .74*  | S     |
| DEU-NZL |           | .000    | .94** | S     |
| DEU-POL |           | .001    | .89** | S     |
| DEU-MYS |           | .002    | .85** | S     |
| 4411    | NZL-POL   | .002    | .85** | S     |
|         | NZL-MYS   | .000    | .94** | S     |
|         | POL-MYS   | .022    | .71*  | S     |
|         | AUT-CHN   | .005    | .81** | S     |
|         | AUT-DEU   | .000    | .93** | S     |
|         | AUT-MYS   | .000    | .98** | S     |
|         | AUT-NZL   | .011    | .76*  | S     |
|         | AUT-POL   | .001    | .89** | S     |
|         | CHN-DEU   | .025    | .70*  | S     |
|         | CHN-MYS   | .002    | .84** | S     |
| 4412    | DEU-MYS   | .002    | .85** | S     |
|         | DEU-NZL   | .009    | .77** | S     |
|         | DEU-POL   | .000    | .94** | S     |
|         | MYS-NZL   | .009    | .77** | S     |
|         | MYS-POL   | .005    | .81** | S     |
|         | NZL-POL   | .009    | .77** | S     |
|         | AUT-CHN   | .004    | .82** | S     |
|         | AUT-IDN   | .013    | .74*  | S     |
|         | AUT-MYS   | .011    | .76*  | S     |
|         | CHN-IDN   | .001    | .87** | S     |
| 4413    | CHN-NZL   | .022    | .71*  | S     |
|         | MYS-VNM   | .022    | -.71* | S     |
|         | RUS-VNM   | .025    | .70*  | S     |
|         | DEU-POL   | .033    | .67*  | M     |
| 4414    | POL-VNM   | .029    | .68*  | M     |
|         | CHN-IDN   | .008    | .78** | S     |
|         | CHN-MYS   | .011    | .76*  | S     |
|         | CHN-VNM   | .016    | .73*  | S     |
|         | IDN-MYS   | .002    | .85** | S     |
|         | IDN-VNM   | .048    | .64*  | M     |
|         | MYS-VNM   | .004    | .82** | S     |

(Continued)

**Table 5.**  
 Correlation of the Countries' Export Competitiveness (Continued)

|         | Countries | Sig.  | Coef.  | Str. |
|---------|-----------|-------|--------|------|
| 4415    | AUT-CAN   | .008  | .78**  | S    |
|         | AUT-MYS   | .009  | .77**  | S    |
|         | AUT-POL   | .006  | .79**  | S    |
|         | AUT-DEU   | .002  | .85**  | S    |
|         | AUT-SWE   | .000  | .93**  | S    |
|         | CAN-POL   | .025  | .70*   | S    |
|         | CAN-DEU   | .000  | .90**  | S    |
|         | CAN-SWE   | .002  | .84**  | S    |
|         | MYS-POL   | .029  | .68*   | M    |
|         | MYS-SWE   | .029  | .68*   | M    |
|         | POL-DEU   | .001  | .88**  | S    |
|         | POL-SWE   | .001  | .87**  | S    |
|         | DEU-SWE   | .000  | .95**  | S    |
| 4417    | AUT-CHN   | .002  | -.85** | S    |
|         | AUT-IDN   | .009  | .77**  | S    |
|         | IDN-USA   | .022  | .71*   | S    |
|         | IDN-SWE   | .043  | .65*   | M    |
|         | IDN-VNM   | .043  | .65*   | M    |
|         | POL-SWE   | .029  | .68*   | M    |
|         | POL-VNM   | .029  | .68*   | M    |
|         | SWE-VNM   | -     | 1**    | P    |
| 4418    | AUT-DEU   | .000  | .94**  | S    |
|         | AUT-MYS   | .000  | .95**  | S    |
|         | AUT-POL   | .008  | .78**  | S    |
|         | AUT-SWE   | .013  | .74*   | S    |
|         | CAN-IDN   | .000  | .90**  | S    |
|         | DEU-MYS   | .001  | .87**  | S    |
|         | DEU-POL   | .001  | .87**  | S    |
|         | DEU-SWE   | .001  | .88**  | S    |
|         | MYS-NZL   | .048  | .64*   | M    |
|         | MYS-POL   | .005  | .81**  | S    |
|         | MYS-SWE   | .025  | .70*   | S    |
| POL-SWE | .001      | .89** | S      |      |
| 4419    | CHN-POL   | .008  | .78**  | S    |
|         | CHN-VNM   | .022  | .71*   | S    |
|         | POL-VNM   | .000  | .91**  | S    |
| 4420    | IDN-VNM   | .003  | .83**  | S    |
| 4421    | CAN-CHN   | .009  | .77**  | S    |
|         | CAN-IDN   | .029  | -.68*  | M    |
|         | CAN-SWE   | .025  | .70*   | S    |
|         | CAN-POL   | .048  | .64*   | M    |
|         | SWE-VNM   | .000  | .90**  | S    |
|         | SWE-POL   | .000  | .98**  | S    |
|         | VNM-POL   | .002  | .85**  | S    |

Note: MYS (40), AUT (37), POL (32), SWE (26), NZL (23), CAN (20), VNM (19), IDN (18), DEU (18), CHN (13), USA (8), RUS (8).  
 \*Correlation is significant at the .05 level (two-tailed).  
 \*\*Correlation is significant at the .01 level (two-tailed).

significant correlation is found in 13 matches, as a result of the correlation test. Of these, the relationship between Malaysia and Poland, and between Malaysia and Sweden, are moderate and positive, while the others are strong and positive. We can say that there is intense competition within the 4415 group as well. In particular, the high correlation between Germany and Sweden as well as Austria and Sweden shows that the levels of specialization are strong and in the same direction.

A notable result emerges from the correlation analysis among seven countries for the 4417 product group. A perfect and positive relationship is confirmed between Sweden and Vietnam, that is, when Sweden's competitiveness increases, that of Vietnam also increases to the same degree, and when Vietnam's RXA value increases, Sweden's RXA value moves the same way to the same degree. It displays the highest competition between two countries in the 4417 product group within the global market

It was found that eight countries specialized above the world average and gained a competitive advantage in the product group 4418 (builders' joinery and carpentry of wood, including cellular wood panels, assembled flooring panels, shingles and shakes). In the correlation test between these eight, there is a significant relationship in 12 matches. Malaysia and New Zealand have a moderate and positive relationship, while the others have a strong and positive relationship. In the 4418 group, 12 matches show that there is a significant relationship in the levels of specialization. The highest correlation in this group is found between Austria and Malaysia, and Austria and Germany. Therefore, as revealed earlier, there is a strong relationship between the levels of specialization.

In the 4420 (wood marquetry and inlaid wood) group, four countries have a global competitive advantage, while a significant relationship is found in only one match—India and Vietnam. The relationship between India and Vietnam is strong and positive.

The basis of countries shows how many times a country is matched with other countries in different product groups, in Table A2, in the Appendix. Among others, Malaysia is outstanding, matching 40 times with other countries in different product groups. There is a positive relationship in 39 out of 40 matches and a negative relationship in one of them. Malaysia is the country with the highest number of meaningful correlations with other countries in terms of competitiveness. The result shows that Malaysia's specialization levels are meaningful with those of other countries. In other words, there is a significant correlation between Malaysia's specialization and that of other countries. This is a situation that needs to be taken into account for Malaysia.

Malaysia is followed by Austria with 37 matches, Poland with 32, Sweden with 26, New Zealand with 23, and Canada with 20. The least matching countries are the USA and the Russian Federation, with eight matches. In the correlation test for two countries, a strong and positive relationship is mostly found. For USA and Russia, the result shows that they are also in competition with other countries in the global market for Wood and Articles of Wood products, but not as much as Malaysia or Poland.

### Discussion, Conclusion, and Recommendations

This study has researched the competitiveness and specialization level of the countries with the highest exports of Wood and Articles of wood between 2010 and 2019. According to findings, Poland has the most advantages in terms of competitiveness in 16 product groups out of 21. It is followed by Malaysia in 13, Austria and Vietnam in 12, and Canada and Indonesia in 11 product groups. Germany and the USA come last,

with a comparative advantage in only 6 product groups. A review of the literature reveals that although there are different methods, indexes, and years, similar results have been achieved in terms of comparative advantages. Magezi and Okan (2019) reached a similar conclusion regarding Poland in the exports of forest products made by countries to the EU. Vu et al. (2019) have found that Poland has a high competitiveness on a global scale. Aini et al. (2010) also assert that Malaysia has a high comparative advantage over other countries in the exports of forest products to the EU market. Vu et al. (2019) and Abidin and Loke (2008) argue in their studies that Malaysia has a comparative advantage above the world average. In their paper, Verter and Grega (2019) show that Austria has a similar global competitive advantage in forest products. In short, the results supporting the general view in terms of comparative advantages have been reached in this paper.

The conclusion drawn from the NEI results, in which the countries' own commercial performances are determined, is as follows: There is a close relationship between the countries' domestic export specialization and their global export specialization. In other words, if countries specialize in the export of the relevant product group in terms of their own commercial performance, they also show a specialization in that group, above the world average. This is a general conclusion for the countries covered in this study. This relationship could be tested by increasing the number of samples for future studies.

Having determined the export competitiveness of the countries exporting forest products, a correlation test is conducted between countries that gain an advantage in a certain product group. Although the correlation test does not provide the reason behind the relationship, it is important in terms of showing its strength and direction because a strong relationship shows how competitive these countries can be in the global market. Not surprisingly, according to the results of the correlation test, a strong correlation and a positive relationship are mostly found between countries that have a competitive advantage. This supports the earlier determination which alleged that a strong relationship between countries having a competitive advantage in a certain product group also shows that those countries are in an intense competition in the global market. For example, in the 4401 product group, eight countries have a competitive advantage. In the correlation test conducted among them, the relationship between five countries—four matches, illustrated in Table 5—is found to be significant. Three of these matches show a positive and strong relationship while one demonstrates a positive and moderate relationship. Since no similar study is found in the literature with the correlation test, the obtained results could not be compared.

In terms of countries, Malaysia has 40 matches with countries gaining competitive advantage in 21 product groups in the correlation test, and most of them have a strong and positive relationship. This means that the country is in an intense competition with the relevant countries in the global market. Malaysia is followed by Austria, with 37 matches, Poland with 32, Sweden with 26, New Zealand with 23, and Canada with 27. In this context, the countries with the least matches are the USA and Russia, with eight matches. In the correlation test for the USA and Russia, it is seen they have a strong and positive relationship with others in general. These two are in competition with the other countries in the global market in wood and wooden products. However, it should be remembered that they are not as competitive in this sector as Malaysia, Austria, or Poland.

After a brief summary, we return to the research question: Do countries have an important share in world exports because they specialize in the

forest products industry (cost advantage) and thus gain a competitive advantage? As a result of the detailed analysis, it is an obvious yes (for a majority of the cases). For example, it is seen that Poland has a competitive advantage in the global market in 16 out of 21 product groups, and according to the NEI result, which shows its own performance, it is specialized in 15 of the 16 groups in exports. In the global market, Germany and the USA are the countries with the least competitive advantage, with six product groups. However, for such large economies, the global competitive advantage in six product groups is also considered as a remarkable result. Thus, it can be said that these countries have gained a significant specialization and competitive advantage in the forest products industry and thus have a say in the export of related products. Another question arises here: Is there a correlation between the specialization coefficients of the countries? The answer to this question is also yes at large. A generally positive and strong relationship is found with other countries in the product groups in which the countries have gained a competitive advantage. It shows that the countries are in high competition in the relevant product groups.

The benefits of the study can be briefly summarized as follows:

- The comparative advantages of the 10 leading countries in the export of forest products in 21 forest sub-product groups have been calculated separately. To do so, the specialization levels of the countries that have a say in the export of forest products are comparatively shown in a single table. It is noteworthy that Poland is the country that specializes in the largest number of product groups, with 16 product groups among the leading countries in the export of forest products.
- With the NEI, the domestic export or import specialization of the countries has been determined, thereby revealing whether the countries which lead the export of forest products specialize in the export or import of the relevant product group. For example, Poland specializes in the export of 15 of the 16 product groups in which it has a global competitive advantage. Although this seems to be an expected result, it is seen that there is a global competitive advantage in product groups with import specialization. In Table 4, where the results of the two indexes are compared, however, it is mostly deemed that countries have gained a global competitive advantage in the product groups that they specialize in exporting, in terms of their own commercial performance. This result is important in that it directs the countries to specialize in the export of that product group rather than the import of the relevant product group, as much as in implementing the policies for doing so.
- Finally, a correlation test is conducted between the specialization levels of countries with a global competitive advantage. As mentioned earlier, countries can implement similar policies and increase their specialization in the relevant sectors, and therefore, their competitiveness. In the correlation test performed here to determine that, a high correlation is found between the specialization coefficients of the countries in general. It leads countries to a kind of interdependence in oligopoly markets. If countries do not want to lag behind their competitors in the global market, they should follow every move/policy of their competitors. Here, too, the high correlation between the specialization coefficients proves this. For example, in the 4409 (wood continuously shaped along any of its edges, ends or faces, whether or not planned, sanded or end-jointed) product group, seven countries have a global competitive advantage, while a significant relationship is found in 14 matches in the correlation test. The strong correlation between Malaysia and Sweden is proof that these two countries should follow each other more for the 4409 product line.

- The findings highlight the following three points in the export of forest products: First, countries need to specialize (gain a cost advantage) in the export of the related product in order to get a larger share from the export of forest products in the global competitive environment. Second, more focus should be placed on export, instead of import, in domestic specialization. Last, but not the least, the correlation analysis shows that there is a generally strong and positive relationship between the specialization coefficients of the countries. That is, as the specialization of one country increases, the specialization of the other country also increases (and vice versa). This situation shows that countries/firms are interdependent.

As a final word, the findings of the study are expected to be effective in the economic policies to be implemented by both companies and governments. Likewise, with these results, countries can evaluate their position in the sector on a global scale, and develop policies by considering the product groups in which they are strong or have an advantage. Furthermore, it is extremely important for countries to be acquainted with the product groups in which they do not have a comparative advantage. Investing in sectors where there is no competitive advantage, or government funding for these sectors, inevitably results in inefficient use of scarce resources. The economic policies to be implemented considering both situations will protect and increase the competitive advantage of the country in the specialized product group, which will lead to survival in the competitive environment in the global market and to winning a greater share of the global trade. Moreover, it ensures that scarce resources are used effectively by considering the product groups with no competitive advantage, while determining the policies to be implemented.

**Peer-review:** Externally peer-reviewed.

**Author Contributions:** Concept – K.S., E.K.; Design – E.K.; Supervision – K.S.; Resources – K.S., E.F.; Materials – K.S.; Data Collection and/or Processing – K.S.; Analysis and/or Interpretation – K.S., E.F.; Literature Search – K.S., E.K.; Writing Manuscript – K.S., E.K.; Critical Review – E.K.

**Declaration of Interests:** The authors have no conflicts of interest to declare.

**Funding:** The authors declared that this study has received no financial support.

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Table A1.  
Countries' RXA and NEI Results

|                  |              | Vollrath Index |           |       | Net Export Index |      |                |
|------------------|--------------|----------------|-----------|-------|------------------|------|----------------|
|                  |              | 2010-2014      | 2015-2019 | RXA   | Advantage        | NEI  | Specialization |
| <b>Austria</b>   | <b>4401</b>  | 2.73           | 2.49      | 2.55  | MA               | -.15 | No             |
|                  | <b>4407</b>  | 4.72           | 4.26      | 4.34  | SA               | .42  | Yes            |
|                  | <b>4408</b>  | 2.20           | 2.08      | 2.14  | MA               | -.29 | No             |
|                  | <b>4409</b>  | 2.71           | 3.14      | 2.91  | MA               | .19  | Yes            |
|                  | <b>4410</b>  | 10.92          | 10.08     | 10.47 | SA               | .65  | Yes            |
|                  | <b>4411</b>  | 4.49           | 4.05      | 4.27  | SA               | .57  | Yes            |
|                  | <b>4412</b>  | 1.90           | 1.65      | 1.77  | WA               | .33  | Yes            |
|                  | <b>4415</b>  | 1.70           | 1.70      | 1.69  | WA               | -.36 | No             |
|                  | <b>4416</b>  | .87            | 1.32      | 1.08  | WA               | .26  | Yes            |
|                  | <b>4417</b>  | 1.25           | 1.02      | 1.16  | WA               | -.43 | No             |
|                  | <b>4418</b>  | 12.56          | 11.95     | 12.17 | SA               | .63  | Yes            |
|                  | <b>4421</b>  | 1.17           | 1.21      | 1.17  | WA               | -.36 | No             |
| <b>Canada</b>    | <b>4401</b>  | 1.88           | 1.86      | 1.81  | WA               | .53  | Yes            |
|                  | <b>4403</b>  | 1.96           | 2.16      | 2.06  | MA               | .39  | Yes            |
|                  | <b>4404</b>  | 1.03           | 1.40      | 1.18  | WA               | .92  | Yes            |
|                  | <b>4407</b>  | 8.44           | 10.59     | 9.52  | SA               | .88  | Yes            |
|                  | <b>4408</b>  | 3.23           | 4.36      | 3.82  | MA               | .32  | Yes            |
|                  | <b>4409</b>  | .86            | 1.28      | 1.06  | WA               | -.31 | No             |
|                  | <b>4410</b>  | 6.29           | 9.78      | 8.10  | SA               | .86  | Yes            |
|                  | <b>4411</b>  | .88            | 1.32      | 1.11  | WA               | -.22 | No             |
|                  | <b>4415</b>  | 1.09           | 1.15      | 1.09  | WA               | .27  | Yes            |
|                  | <b>4418</b>  | 2.50           | 3.63      | 3.08  | MA               | .45  | Yes            |
|                  | <b>4421</b>  | 2.36           | 2.36      | 2.36  | MA               | .35  | Yes            |
|                  | <b>China</b> | <b>4411</b>    | 1.21      | .88   | 1.07             | WA   | .83            |
| <b>4412</b>      |              | 3.30           | 3.19      | 3.26  | MA               | .95  | Yes            |
| <b>4414</b>      |              | 5.84           | 5.86      | 5.83  | SA               | .99  | Yes            |
| <b>4417</b>      |              | .90            | 4.17      | 2.46  | MA               | .94  | Yes            |
| <b>4419</b>      |              | 10.90          | 9.98      | 10.19 | SA               | .95  | Yes            |
| <b>4420</b>      |              | 6.35           | 8.66      | 7.64  | SA               | .97  | Yes            |
| <b>4421</b>      |              | 3.81           | 4.57      | 4.20  | SA               | .71  | Yes            |
| <b>Germany</b>   |              | <b>4405</b>    | 5.22      | 6.10  | 5.67             | SA   | .87            |
|                  | <b>4410</b>  | 1.27           | 1.01      | 1.11  | WA               | -.05 | No             |
|                  | <b>4411</b>  | 2.53           | 2.55      | 2.54  | MA               | .62  | Yes            |
|                  | <b>4413</b>  | 1.44           | 1.52      | 1.46  | WA               | .40  | Yes            |
|                  | <b>4415</b>  | 1.16           | 1.17      | 1.17  | WA               | -.26 | No             |
|                  | <b>4418</b>  | 1.19           | 1.15      | 1.18  | WA               | .09  | Yes            |
| <b>Indonesia</b> | <b>4401</b>  | 1.76           | 1.46      | 1.55  | WA               | .84  | Yes            |
|                  | <b>4402</b>  | 16.42          | 31.34     | 24.33 | SA               | 1.00 | Yes            |
|                  | <b>4408</b>  | 1.05           | 2.62      | 1.81  | WA               | .15  | Yes            |
|                  | <b>4409</b>  | 10.73          | 16.41     | 13.70 | SA               | .99  | Yes            |
| <b>Indonesia</b> | <b>4412</b>  | 14.46          | 15.90     | 14.97 | SA               | .96  | Yes            |
|                  | <b>4414</b>  | 6.32           | 5.94      | 5.95  | SA               | .98  | Yes            |

(Continued)



**Table A1.**  
Countries' RXA and NEI Results (*Continued*)

|                     | Vollrath Index |           |       | Net Export Index |     |                |     |
|---------------------|----------------|-----------|-------|------------------|-----|----------------|-----|
|                     | 2010-2014      | 2015-2019 | RXA   | Advantage        | NEI | Specialization |     |
|                     | <b>4417</b>    | 2.36      | 1.49  | 1.95             | WA  | .36            | Yes |
|                     | <b>4418</b>    | 2.38      | 3.11  | 2.78             | MA  | .97            | Yes |
|                     | <b>4419</b>    | .45       | 1.74  | 1.07             | WA  | .81            | Yes |
|                     | <b>4420</b>    | 8.99      | 4.17  | 6.08             | SA  | .97            | Yes |
|                     | <b>4421</b>    | .19       | 3.84  | 1.44             | WA  | .11            | Yes |
| <b>Malaysia</b>     | <b>4402</b>    | 2.35      | 2.15  | 2.22             | MA  | .61            | Yes |
|                     | <b>4403</b>    | 3.55      | 2.25  | 2.84             | MA  | .93            | Yes |
|                     | <b>4404</b>    | 3.00      | 2.24  | 2.75             | MA  | .98            | Yes |
|                     | <b>4406</b>    | 1.53      | 1.94  | 1.73             | WA  | .97            | Yes |
|                     | <b>4407</b>    | 1.78      | 1.88  | 1.82             | WA  | .71            | Yes |
|                     | <b>4408</b>    | 2.82      | 2.17  | 2.55             | MA  | -.04           | No  |
|                     | <b>4409</b>    | 3.38      | 3.54  | 3.43             | MA  | .72            | Yes |
|                     | <b>4410</b>    | 1.02      | .98   | 1.00             | WA  | .17            | Yes |
|                     | <b>4411</b>    | 2.67      | 2.30  | 2.44             | MA  | .80            | Yes |
|                     | <b>4412</b>    | 9.23      | 5.72  | 7.31             | SA  | .80            | Yes |
|                     | <b>4414</b>    | 3.25      | 2.65  | 3.00             | MA  | .88            | Yes |
|                     | <b>4415</b>    | 1.41      | 1.72  | 1.56             | WA  | .86            | Yes |
|                     | <b>4418</b>    | 1.83      | 1.63  | 1.74             | WA  | .87            | Yes |
| <b>New Zealand</b>  | <b>4401</b>    | 3.37      | 2.26  | 2.71             | MA  | .97            | Yes |
|                     | <b>4403</b>    | 56.02     | 88.87 | 73.71            | SA  | 1.00           | Yes |
|                     | <b>4404</b>    | 3.02      | .57   | 1.52             | WA  | .30            | Yes |
|                     | <b>4407</b>    | 8.50      | 7.89  | 8.02             | SA  | .83            | Yes |
|                     | <b>4408</b>    | 6.78      | 5.27  | 5.83             | SA  | .92            | Yes |
|                     | <b>4409</b>    | 8.08      | 6.83  | 7.33             | SA  | .56            | Yes |
|                     | <b>4410</b>    | 1.92      | 1.54  | 1.71             | WA  | .89            | Yes |
|                     | <b>4411</b>    | 8.27      | 9.13  | 8.68             | SA  | .91            | Yes |
|                     | <b>4412</b>    | 2.89      | 2.78  | 2.79             | MA  | .46            | Yes |
|                     | <b>4418</b>    | 2.53      | 1.02  | 1.76             | WA  | .31            | Yes |
| <b>Russian Fed.</b> | <b>4401</b>    | 1.10      | 1.35  | 1.23             | WA  | .97            | Yes |
|                     | <b>4403</b>    | 5.06      | 5.38  | 5.04             | GA  | 1.00           | Yes |
|                     | <b>4406</b>    | 2.16      | 1.33  | 1.68             | WA  | .75            | Yes |
|                     | <b>4407</b>    | 3.71      | 5.27  | 4.50             | GA  | .99            | Yes |
|                     | <b>4408</b>    | 1.26      | 2.14  | 1.69             | WA  | .42            | Yes |
|                     | <b>4410</b>    | .64       | 1.47  | 1.07             | WA  | .00            | Yes |
|                     | <b>4412</b>    | 2.15      | 3.39  | 2.76             | MA  | .93            | Yes |
| <b>Poland</b>       | <b>4401</b>    | 1.22      | 1.19  | 1.22             | WA  | .30            | Yes |
|                     | <b>4402</b>    | 9.31      | 7.71  | 8.62             | SA  | .38            | Yes |
|                     | <b>4403</b>    | 1.33      | 1.09  | 1.29             | WA  | .20            | Yes |

(Continued)

Table A1.  
Countries' RXA and NEI Results (Continued)

|                |             | Vollrath Index |           |       | Net Export Index |      |                |
|----------------|-------------|----------------|-----------|-------|------------------|------|----------------|
|                |             | 2010-2014      | 2015-2019 | RXA   | Advantage        | NEI  | Specialization |
| <b>Poland</b>  | <b>4404</b> | 11.82          | 11.38     | 11.48 | SA               | .58  | Yes            |
|                | <b>4406</b> | 1.37           | .84       | 1.07  | WA               | .55  | Yes            |
|                | <b>4409</b> | 4.18           | 4.31      | 4.30  | SA               | .70  | Yes            |
|                | <b>4410</b> | 2.18           | 1.83      | 1.99  | WA               | -.24 | No             |
|                | <b>4411</b> | 4.82           | 5.07      | 4.98  | SA               | .52  | Yes            |
|                | <b>4413</b> | 4.13           | 4.10      | 4.12  | SA               | .46  | Yes            |
|                | <b>4414</b> | 3.60           | 6.03      | 4.89  | SA               | .79  | Yes            |
|                | <b>4415</b> | 11.56          | 12.14     | 11.98 | SA               | .74  | Yes            |
|                | <b>4417</b> | 1.78           | 1.73      | 1.77  | WA               | .37  | Yes            |
|                | <b>4418</b> | 7.03           | 7.11      | 7.15  | SA               | .81  | Yes            |
|                | <b>4419</b> | 1.42           | .91       | 1.21  | WA               | .16  | Yes            |
|                | <b>4420</b> | 1.46           | 1.18      | 1.24  | WA               | .32  | Yes            |
|                | <b>4421</b> | 8.08           | 5.20      | 6.92  | SA               | .79  | Yes            |
| <b>Sweden</b>  | <b>4404</b> | 2.04           | .90       | 1.33  | WA               | .57  | Yes            |
|                | <b>4407</b> | 10.84          | 10.42     | 10.58 | SA               | .90  | Yes            |
|                | <b>4409</b> | 1.75           | 1.87      | 1.83  | WA               | .38  | Yes            |
|                | <b>4413</b> | 1.83           | .90       | 1.32  | WA               | .07  | Yes            |
|                | <b>4415</b> | 1.99           | 2.02      | 1.98  | WA               | -.04 | No             |
|                | <b>4417</b> | 2.05           | 1.96      | 2.02  | MA               | .16  | Yes            |
|                | <b>4418</b> | 3.81           | 3.52      | 3.68  | MA               | .13  | Yes            |
|                | <b>4421</b> | 1.33           | .99       | 1.16  | WA               | .00  | No             |
| <b>USA</b>     | <b>4401</b> | .80            | 1.34      | 1.07  | WA               | .74  | Yes            |
|                | <b>4403</b> | 1.96           | 1.99      | 1.99  | WA               | .87  | Yes            |
|                | <b>4406</b> | 6.98           | 10.05     | 8.40  | SA               | .95  | Yes            |
|                | <b>4408</b> | 1.31           | 1.23      | 1.25  | WA               | -.05 | No             |
|                | <b>4416</b> | 2.31           | 3.10      | 2.68  | MA               | -.13 | No             |
|                | <b>4417</b> | 1.43           | 1.08      | 1.17  | WA               | -.24 | No             |
|                | <b>4401</b> | 19.13          | 16.24     | 17.51 | SA               | 1.00 | Yes            |
| <b>Vietnam</b> | <b>4402</b> | 1.37           | 4.08      | 2.73  | MA               | .68  | Yes            |
|                | <b>4404</b> | 3.75           | .31       | 1.28  | WA               | .98  | Yes            |
|                | <b>4405</b> | 31.09          | 23.79     | 26.52 | SA               | .94  | Yes            |
|                | <b>4408</b> | 1.62           | 1.35      | 1.49  | WA               | -.37 | No             |
|                | <b>4412</b> | 1.23           | 2.15      | 1.66  | WA               | .30  | Yes            |
|                | <b>4413</b> | 2.05           | 3.71      | 2.67  | MA               | .03  | Yes            |
|                | <b>4414</b> | 3.49           | 2.32      | 2.87  | MA               | .96  | Yes            |
|                | <b>4417</b> | 1.17           | 1.06      | 1.12  | WA               | .84  | Yes            |
|                | <b>4419</b> | 3.95           | 3.23      | 3.54  | MA               | .97  | Yes            |
|                | <b>4420</b> | 2.34           | 1.35      | 1.72  | WA               | .95  | Yes            |
|                | <b>4421</b> | 2.00           | 1.31      | 1.63  | WA               | .88  | Yes            |

**Table A2.**  
Correlation Relations Based on Countries

|      | <b>MYS<br/>(40)</b>                                      | <b>AUT<br/>(37)</b>                                      | <b>POL<br/>(32)</b>                                      | <b>SWE<br/>(26)</b>                                      | <b>NZL<br/>(23)</b>                          | <b>CAN<br/>(20)</b>                          |
|------|--|--|--|--|--|--|
| 4401 |  | CAN (+S)<br>POL (+S)<br>VNM (+S)                         | AUT (+S)   |  |  | AUT (+S)                                     |
| 4402 | POL (+S)   |  | MYS (+S)   |  |  |  |
| 4403 | RUS (+S)<br>USA (+S)                                     |  |  |  |  | USA (+M)                                     |
| 4404 | NZL (+S)   |  |  | CAN (-M)<br>NZL (+S)<br>VNM (+S)                         | MYS (+S)<br>SWE (+S)<br>VNM (+S)             | SWE (-M)                                     |
| 4406 | USA (+M)   |  |  |  |  |  |
| 4407 | AUT (+S)<br>CAN (+S)<br>NZL (+S)<br>RUS (+S)<br>SWE (+S) | MYS (+S)<br>NZL (+S)<br>SWE (+S)                         |  | AUT (+S)<br>MYS (+S)<br>NZL (+S)                         | AUT (+S)<br>MYS (+S)<br>SWE (+S)             | MYS (+S)<br>RUS (+S)                         |
| 4408 | AUT (+S)<br>NZL (+S)<br>USA (+S)                         | NZL (+S)<br>USA (+S)<br>MYS (+S)                         |  |  | AUT (+S)<br>IDN (-M)<br>USA (+S)<br>MYS (+S) | RUS (+S)                                     |
| 4409 | AUT (+S)<br>CAN (+M)<br>NZL (+S)<br>POL (+S)<br>SWE (+S) | CAN (+M)<br>IDN (+S)<br>MYS (+S)<br>POL (+S)<br>SWE (+M) | AUT (+S)<br>MYS (+S)<br>NZL (+S)<br>SWE (+S)             | AUT (+M)<br>CAN (+S)<br>MYS (+S)<br>NZL (+S)<br>POL (+S) | MYS (+S)<br>POL (+S)<br>SWE (+S)             | AUT (+M)<br>IDN (+S)<br>MYS (+M)<br>SWE (+S) |
| 4410 | AUT (+S)<br>DEU (+S)<br>NZL (+S)<br>POL (+S)             | DEU (+S)<br>NZL (+S)<br>POL (+S)<br>MYS (+S)             | AUT (+S)<br>DEU (+S)<br>NZL (+S)<br>MYS (+S)             |  | AUT (+S)<br>DEU (+S)<br>POL (+S)<br>MYS (+S) | RUS (+S)                                     |
| 4411 | AUT (+S)<br>CHN (+S)<br>DEU (+S)<br>NZL (+S)<br>POL (+S) | CHN (+S)<br>DEU (+S)<br>MYS (+S)<br>NZL (+S)<br>POL (+S) | AUT (+S)<br>DEU (+S)<br>MYS (+S)<br>NZL (+S)             |  | AUT (+S)<br>DEU (+S)<br>MYS (+S)<br>POL (+S) |  |
| 4412 | AUT (+S)<br>VNM (-S)                                     | CHN (+S)<br>IDN (+S)<br>MYS (+S)                         |  |  | CHN (+S)                                     |  |
| 4413 |  |  | DEU (+M)<br>VNM (+M)                                     |  |  |  |
| 4414 | CHN (+S)<br>IDN (+S)<br>VNM (+S)                         |  |  |  |  |  |
| 4415 | AUT (+S)<br>POL (+M)<br>SWE (+M)                         | CAN (+S)<br>MYS (+S)<br>POL (+S)<br>DEU (+S)<br>SWE (+S) | AUT (+S)<br>CAN (+S)<br>MYS (+M)<br>DEU (+S)<br>SWE (+S) | AUT (+S)<br>CAN (+S)<br>MYS (+M)<br>POL (+S)<br>DEU (+S) |  | AUT (+S)<br>POL (+S)<br>DEU (+S)<br>SWE (+S) |
| 4417 |  | CHN (-S)<br>IDN (+S)                                     | SWE (+M)<br>VNM (+M)                                     | IDN (+M)<br>POL (+M)<br>VNM (+P)                         |  |  |
| 4418 | AUT (+S)<br>DEU (+S)<br>NZL (+M)<br>POL (+S)<br>SWE (+S) | DEU (+S)<br>MYS (+S)<br>POL (+S)<br>SWE (+S)             | AUT (+S)<br>DEU (+S)<br>MYS (+S)<br>SWE (+S)             | AUT (+S)<br>DEU (+S)<br>MYS (+S)<br>POL (+S)             | MYS (+M)                                     | IDN (+S)                                     |
| 4419 |  |  | CHN (+S)<br>VNM (+S)                                     |  |  |  |

(Continued)

**Table A2.**

Correlation Relations Based on Countries (*Continued*)

|      |                                  |  |  |                                  |                                  |  |
|------|----------------------------------|--|--|----------------------------------|----------------------------------|--|
| 4421 |                                  |  | CAN (+M)<br>SWE (+S)<br>VNM (+S)                         | CAN (+S)<br>VNM (+S)<br>POL (+S) |                                  | CHN (+S)<br>IDN (-M)<br>SWE (+S)<br>POL (+M) |
|      | <b>VNM<br/>(19)</b>              | <b>IDN<br/>(18)</b>                          | <b>DEU<br/>(18)</b>                                      | <b>CHN<br/>(13)</b>              | <b>USA<br/>(8)</b>               | <b>RUS<br/>(8)</b>                           |
| 4401 | AUT (+S)<br>IDN (+M)             | VNM (+M)                                     |  |                                  |                                  |  |
| 4402 | IDN (+S)                         | VNM (+S)                                     |  |                                  |                                  |  |
| 4403 |                                  |  |  |                                  | CAN (+M)<br>MYS (+S)<br>RUS (+S) | MYS (+S)<br>USA (+S)                         |
| 4404 | NZL (+S)<br>SWE (+S)             |  |  |                                  |                                  |  |
| 4406 |                                  |  |  |                                  | MYS (+M)                         |  |
| 4407 |                                  |  |  |                                  |                                  | CAN (+S)<br>MYS (+M)                         |
| 4408 |                                  | NZL (-M)<br>RUS (+S)                         |  |                                  | AUT (+S)<br>NZL (+S)<br>MYS (+S) | CAN (+S)<br>IDN (+S)                         |
| 4409 |                                  | AUT (+S)<br>CAN (+S)                         |  |                                  |                                  |  |
| 4410 |                                  |  | AUT (+S)<br>NZL (+S)<br>POL (+S)<br>MYS (+S)             |                                  |                                  | CAN (+S)                                     |
| 4411 |                                  |  | AUT (+S)<br>CHN (+S)<br>MYS (+S)<br>NZL (+S)<br>POL (+S) | AUT (+S)<br>DEU (+S)<br>MYS (+S) |                                  |  |
| 4412 | MYS (-S)<br>RUS (+S)             | AUT (+S)<br>CHN (+S)                         |  | AUT (+S)<br>IDN (+S)<br>NZL (+S) |                                  | VNM (+S)                                     |
| 4413 | POL (+M)                         |  | POL (+M)   |                                  |                                  |  |
| 4414 | CHN (+S)<br>IDN (+M)<br>MYS (+S) | CHN (+S)<br>MYS (+S)<br>VNM (+M)             |  | IDN (+S)<br>MYS (+S)<br>VNM (+S) |                                  |  |
| 4415 |                                  |  | AUT (+S)<br>CAN (+S)<br>POL (+S)<br>SWE (+S)             |                                  |                                  |  |
| 4417 | IDN (+M)<br>POL (+M)<br>SWE (+P) | AUT (+S)<br>USA (+S)<br>SWE (+M)<br>VNM (+M) |  | AUT (-S)                         | IDN (+S)                         |  |
| 4418 |                                  | CAN (+S)                                     | AUT (+S)<br>MYS (+S)<br>POL (+S)<br>SWE (+S)             |                                  |                                  |  |
| 4419 | CHN (+S)<br>POL (+S)             |  |  | POL (+S)<br>VNM (+S)             |                                  |  |
| 4420 | IDN (+S)                         | VNM (+S)                                     |  |                                  |                                  |  |
| 4421 | SWE (+S)<br>POL (+S)             | CAN (-M)                                     |  | CAN (+S)                         |                                  |  |