



## International competitiveness of exports of forest products

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**ABSTRACT:** This article analyzed the international competitiveness of exports of forest products from 2008 to 2018. The information is available in the Food and Agriculture Organization (FAO) and the indicators used were: revealed comparative advantage (RCA), trade openness index (Oi) and the contribution to trade balance index (CTB). Results showed that the exportation of forest products are competitive, in addition gains in competitiveness have been observed by the RCA and in Europe, countries had losses in detriment of the financial crises and austerity measures adopted. All countries showed a low degree of openness by the Oi and had a comparative advantage by the CTB, except for China and Germany. It is concluded that the countries with bigger comparative advantages in the exportation of forest products were the ones that had contributed more for its commercial balance.

**Key words:** forest economy, revealed comparative advantage, forest market.

## Competitividade internacional das exportações de produtos florestais madeireiros

**RESUMO:** Este artigo analisou a competitividade internacional das exportações de produtos florestais, de 2008 e 2018. As informações estão disponíveis na Organização das Nações Unidas para Agricultura e Alimento (FAO) e os indicadores utilizados foram: vantagem comparativa revelada (RCA), o índice de abertura do comércio (Oi) e o índice de contribuição ao saldo comercial (CTB). Os resultados mostram que as exportações de produtos florestais são competitivas, ademais foram observados pelo RCA ganhos em competitividade e na Europa, os países tiveram perdas em detrimento das crises financeiras e medidas de austeridade adotadas. Todos os países apresentaram baixo grau de abertura pelo Oi e teve vantagem comparativa pelo CTB, com exceção da China e Alemanha. Conclui-se que os países com maiores vantagens comparativas nas exportações de produtos florestais foram os que mais contribuíram para o seu saldo comercial.

**Palavras-chave:** economia florestal, vantagem comparativa revelada, mercado florestal.

## INTRODUCTION

The forests offer a diversified variety of goods and services, being able to generate more than 5000 types of products derived from wood and play an important role in the economy of many countries (THE WORLD BANK, 2020; ARCE, 2019). Thus, there is an appreciation of the price of forest products over the years, contributing to 1% of the world's GDP (Gross Domestic Product), in addition to the socioeconomic importance, so that more than 1.6 billion people are dependent on the forest sector for their livelihoods (THE WORLD BANK, 2020). Among the various characteristics of wood products, those who stand out are the are the

ecological and renewable capacities that, applied to its economic advantages of production, can widely be used in all the consumption sectors (CAO et al., 2018; COELHO JUNIOR, 2013; MARTINS et al., 2018). The demand for these products has increased year after year, exerting for the international trade a movement of US\$ 269.96 billion, in 2018, representing 1.07% of the world-wide exportation, displaying an important component for the global market of goods and services.

Competitiveness measures the advantages and disadvantages of an economy in the international trade of some good or service and can be influenced by a plurality of variables that allows it to be evaluated by different types of indicators. The

countries can be considered globally competitive when they export products of added value in greater quantity than they import. Different studies point to the structural changes that have occurred in the world market for forest products, mainly in Europe and North America. The factors of this transformation in the global competitiveness are correlated to the intense investments in the forest sector throughout the years, in addition to the fast growth of the Asian markets. Another factor that contributed to this change is the intensive forest activities in low productive cost regions such as South America (COELHO JUNIOR et al., 2018; HETEMAKI & HURMEKOSKI, 2016; SANTOS JUNIOR et al., 2022; VERTER & GREGA, 2019).

When considering the importance of the forest sector for the economy, for job creation and for global markets, as well as the current changes observed in these, the scope of research on forest product markets as a whole can be considered small (HETEMAKI & HURMEKOSKI, 2016). Studies carried out in competitiveness in the sector generally focus on product categories, such as the research of SOARES and SILVA (2013) on plant extractives, SOARES et al. (2010) on the eucalypts wood production chain, PETRAUSKI et al. (2012) addressing the international lumber market, NOCE et al. (2008) referring to the international particle board market and SANTOS et al (2022) analyzed Brazil's global competitiveness in the export of forest products.

Given the relevance of the forest products market for the global economy, there is a need to carry out research in this area of study, in addition to the various structural changes that the sector has presented over the years. Thus, the research was carried out so that the market perspectives could be observed from a less systematic focus, encompassing the entire sector of these products. Therefore, this article analyzed the competitiveness in the international trade of wood forest products, between the years of 2008 and 2018.

## MATERIAL AND METHODS

The study was carried out through the selection of a database obtained from FAO (Food and Agriculture Organization of the United Nations), by FAOSTAT's website (Food and Agriculture Organization of the United Nations - Statistics Division), in the sector focused on forest products, moreover, the website The World Bank Group was used. Annual data of all the exportation in monetary value (US\$) were applied, referring to the period between 2008 and 2018, in addition, only countries

that presented annual exports above US\$1000.00 were considered (FAO, 2022).

Thus, the countries considered in the analyses were Finland, Sweden, Indonesia, Canada, Australia, Brazil, Russia, Germany, United States and China. The index Revealed Comparative Advantage (RCA) was proposed by BALASSA (1965), which determined the sectors in which a country has comparative advantages, in addition to revealing the development of competitiveness through data and measurements performed after commercialization given by equation 1.

$$RCA_{kt} = \frac{X_{kp}/X_{tp}}{X_{km}/X_{tm}} \quad (1)$$

where: RCA<sub>kt</sub> = Revealed Comparative Advantage; X<sub>kp</sub> = the value of the exports of product "k" of the country in the period; X<sub>tp</sub> = the value of the total exports of country "p" in the period; X<sub>km</sub> = Value of the exports of product "k" in the world; X<sub>tm</sub> = Value of the total exports of the world in the period. It classified as not expressive ( $0 < RCA_{kt} \leq 1$ ), weak ( $1 < RCA_{kt} \leq 2$ ), average ( $2 < RCA_{kt} \leq 4$ ) and strong ( $RCA_{kt} > 4$ ).

It should be noted that the RCA has also been used in other analyzes for the forestry sector such as the study by PETRAUSKI et al. (2012) and SOARES & SILVA (2013).

The Trade Openness Index (O<sub>i</sub>), equation 2, translates the relation between the total volume of exportation and the gross domestic product (GDP), able to indicate the influence of the participation of the external sector on the internal product, the political orientation of a economy, the level of trade liberalization and the degree of opening of the economy (EDWARDS, 1993).

$$O_i = \left( \frac{X_i + M_i}{PIB} \right) \times 100 \quad (2)$$

where: X<sub>i</sub> = value of the exports of product i in the period; M<sub>i</sub> = Value of the imports of product i in period t; and GDP = Gross Domestic Product of the forest sector in Brazil in the period. The O<sub>i</sub> varies from 0% to 100%, which expresses the degree of openness of the economy analyzed. In case of O<sub>i</sub> with a low degree of opening ( $0\% \leq O_i < 30\%$ ), an intermediate degree of opening ( $30\% \leq O_i < 60\%$ ) and a high degree of opening ( $60\% \leq O_i \leq 100\%$ ) (SHIKIDA & BACHA, 1999).

The Contribution to Trade Balance Index (CTB), Equation 3, is based on the comparison between the theoretical trade balance of a given product and its observed balance, assisting in the identification of exports specialization (LAFAY, 1990).

$$CTB = \frac{100}{\frac{(X+M)}{2}} * \left[ (Xi + Mi) - (X - M) * \left( \frac{Xi + Mi}{X + M} \right) \right] \quad (3)$$

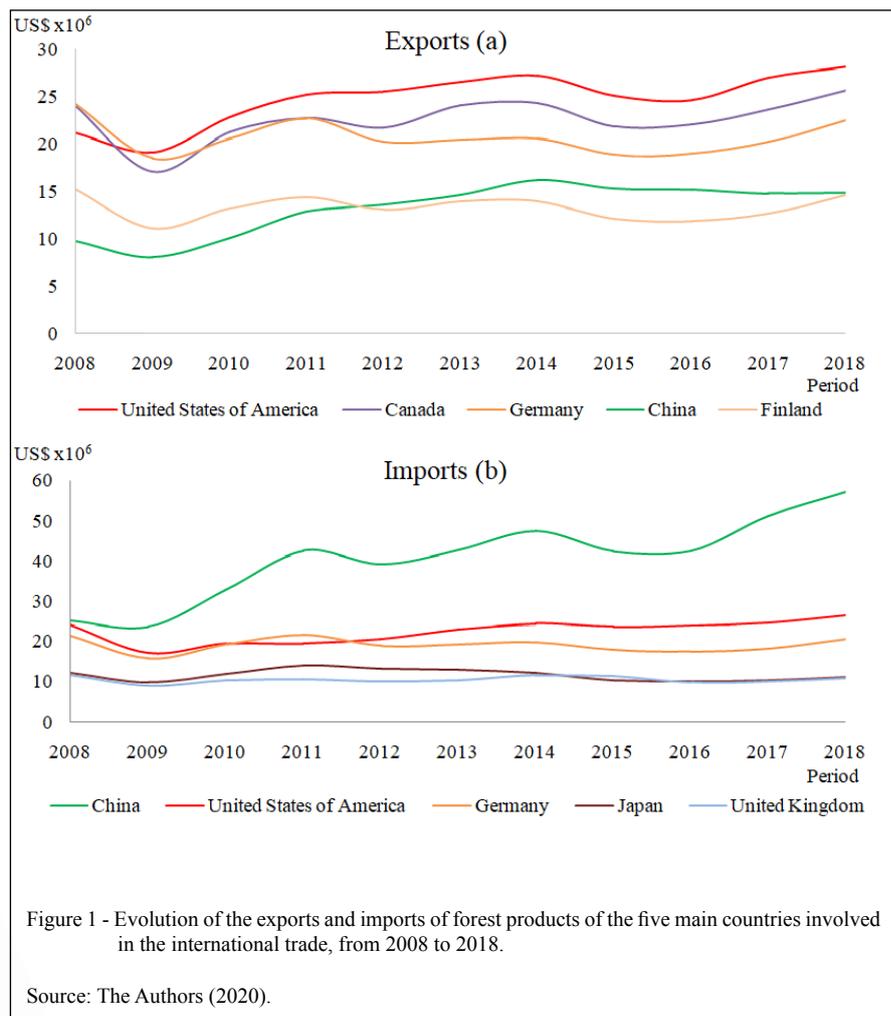
where,  $X_i$  = exports of good  $i$  of the country in the period;  $M_i$  = imports of  $i$  of the country in the period;  $X$  = total export of the country in the period;  $M$  = total import of the country in the period. The first term before the brackets represents the trade balance observed of product  $i$  and the second term, between brackets, the theoretical trade balance for product  $i$ . If it is positive, it has a CTB and if it is negative, the product does not have this advantage.

## RESULTS AND DISCUSSION

The international forest products market represents about 1.07% of world exports and 1.15% of world imports in 2018. Despite the increase in trade, the sector has lost representation in relation to others

in the world market and has decelerated an average rate of 0.01% per year for exports and 0.008% for imports. The products that lead the international trade of forest products are paper and cardboard, lumber and pulp, representing together approximately 70.87% of the sector's total commercialization value. The evolution of the exports and imports of forest products of the five main countries involved in the international trade, from 2009 to 2018, can be seen in figure 1.

In the case of Brazil, the most exported and produced forest product over the years was pulp, in view of the edaphoclimatic conditions favorable to the forest activity, as well as the a advanced silvicultural technology and fiscal incentives that occurred, mainly, in the 70s and 80s. The other countries under analysis in this research also stood out in the exports of sawn wood, in addition to pulp, according to FAO (2022). In the case of imports of



forest products, Brazil has imported in recent years, mainly paper, plywood, and some non-wood forest products such as natural rubber. The other countries under analysis imported, mainly, pulp (FAO, 2022).

The international forest products market suffered from the 2008 financial crisis, resulting in a deceleration in trade in 2009, which generated a decrease of approximately 21% in imports and exports worldwide in the sector. Like other sectors of the economy, the forestry sector is sensitive to public policies related to legislation, taxation, exchange rate and interest rate (NELSON & PANGGABEAN, 1991; MOHANTY et al., 2003; SOARES et al., 2010). The economic crisis of 2008 and 2009 added to the restrictive policies adopted by several countries negatively affected the competitiveness in exports of wood forest products (SOUZA, 2018). Thus, the market became increasingly demanding and selective, so that products of legal and reforested origin dominated the world trade scenario (SANTANA et al., 2010). The pandemic also negatively impacted the world market of forest products. From 2019 to 2020, world exports and imports of these products decreased by about 81%, compared to 2018 (FAO, 2022).

However, a steady recovery and substantial growth in trade began, with 0.04% in exports and 0.05% in imports. This fact can be elucidated through the evolution of exports and imports from the most relevant countries in the international trade of forest products from 2008 to 2018, given that these nations have increased their demands over the years. The United States remained among the largest exporters, followed by Canada, Germany, Finland and China. The main exporting countries showed growth in

exports of forest products from 2009 onwards, however, the ones that stood out were China and the United States between 2009 and 2018, with growth of 83% and 43% respectively (figure 1.a). China stood out as the most relevant importer, with a growth of 140%, followed by the United States, with a growth of 58% between 2009 and 2018 (figure 1.b). The RCA results are in table 1 for the 10 most prominent countries in forest exports.

Most countries had a revealed comparative advantage in the international forest products market, with the exception of the United States in 2008 and China in the entire period. These countries had a RCA lower than the unit, indicating loss of competitiveness in the segment, which may be related to the loss of efficiency in some industries such as the pulp industry (LYRIO et al., 2021). The US presented such performance in 2008 probably due to the prelude of the financial crisis, however, in the following year, its recovery was initiated, which, despite being the largest exporter in the segment, presented low RCA values, this is explained by being a large importer in the same sector. Germany and Russia presented weak comparative advantage in these exports, the latter improving their classification in the year of 2015, migrating to the average, along with Austria, Indonesia, Canada until the year of 2014 and to Brazil until the year of 2017. These american countries became strong in comparative advantage, accompanied by Sweden and Finland, with the same performance throughout the analyzed period.

Most countries achieved gains in competitiveness, especially Brazil with 56.49%, Russia with 33.53% and Finland with 29.16%. According to table

Table 1 - Revealed comparative advantage (RCA) and average annual variation (V %) of the world's largest exporters of wood forest products, from 2008 to 2018.

Country	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	V %
Finland	9.91	10.31	11.73	12.23	12.86	12.92	13.07	13.62	13.03	12.40	12.80	29.16
Sweden	5.65	6.31	5.88	6.04	6.04	6.08	5.57	5.55	5.16	5.27	5.31	-6.02
Indonesia	3.89	3.70	3.34	2.98	3.25	3.40	3.55	3.98	3.67	3.79	3.96	1.80
Canada	3.74	3.69	3.84	3.76	3.86	4.10	3.97	4.12	4.23	4.29	4.34	16.04
Austria	3.02	3.00	2.97	2.95	3.07	2.95	2.90	2.87	2.82	2.73	2.65	-12.25
Brazil	2.62	2.69	2.70	2.39	2.53	2.64	2.85	3.50	3.59	3.60	4.10	56.49
Russia	1.70	1.91	1.65	1.55	1.56	1.60	1.77	2.08	2.47	2.41	2.27	33.53
Germany	1.24	1.21	1.22	1.23	1.22	1.15	1.09	1.12	1.10	1.10	1.12	-9.68
USA	0.96	1.02	1.06	1.09	1.15	1.11	1.07	1.03	1.02	1.08	1.05	9.38
China	0.54	0.54	0.52	0.58	0.62	0.60	0.62	0.60	0.64	0.58	0.52	-3.70

Source: The Authors (2020).

1, Brazil increased the value of the index over the years, ceasing to be the sixth to reach the third highest RCA value in 2018, which can be attributed to efficiency and competitiveness gains in the Brazilian forest sector, especially in the pulp segment, the most exported forest product in the country since the 1970s, as observed by LYRIO et al. (2021). This gain in competitiveness can also be explained by the substantial increase in exports of all forest products, with a greater emphasis on pulp and lumber, in addition to the increase in sales prices. Concomitantly, the product that grew the most in exports was pulp, with an average annual growth of 7.1%, from 2012 to 2018, due to an increase in Chinese and European imports (IBÁ, 2019).

Developed countries, mostly European, which previously dominated the forest products market, suffered a more aggressive impact with the 2008 financial crisis, and later with the Euro crisis, drastically affecting trade in forest products goods and services (UNCTAD - UNITED NATIONS CONFERENCE ON TRADE AND DEVELOPMENT, 2010). Austria, Germany and Sweden were the countries integrating the European complex that presented high losses in competitiveness in the sector, mainly due to the crises, in addition to the slowdown in growth due to the implementation of the austerity measures adopted to reduce the public deficit (UNCTAD, 2012). This explains why European countries had losses in competitiveness in the forest market of 12% for Austria, 10% for Germany and 6% for Sweden.

Finland had the largest share in the export market of forest products in relation to the world total, compared to the other countries analyzed, indicating the highest RCA values in the entire period evaluated. Its

competitiveness in the sector comes from a consolidated commercial history, in which the forestry sector is characterized as a milestone in Finnish industrialization, trade and export. After the industrial and metallurgical sectors, the forest industry is the third largest, accounting for 20% of the volume of investments and business, in addition to corresponding to approximately 20% of all products exported. The Finnish tradition in the sector has been remarkable and important for the economy since its independence, which occurred in 1917, since then the sector has undergone several changes, but has remained competitive and prominent in the world market.

Table 2 shows the degree of openness of trade in wood forest products, which was classified throughout the period, and for all countries in question, as below. According to the results, the countries with the best developments in this index were Finland and Sweden; however, in practice, there are no fully open economies in the world, even those that adopt policies considered liberal to foreign trade, which end up adhering to some trade barriers, overtly or covertly (MESSA & OLIVEIRA, 2017). The economies analyzed remained stable throughout the period, although some presented low dynamism, such as the USA, Brazil, China and Russia.

It is inferred a constancy and relative stability in relation to the values of the trade openness index; however, when observing the evolution of the index, it was possible to verify that, in the period of the global financial and economic crisis, between 2008 and 2009, there was a decrease in the degree of openness for the vast majority of countries. In general, the index behaved in the same way, growing gradually and slowly

Table 2 - Trade openness index (Oi) in percentage and average annual growth (C %), from 2008 and 2018, of the world's largest exporters of wood forest products.

Country	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	C%
Finland	6.35	4.91	5.97	5.93	5.73	5.77	5.65	5.68	5.40	5.45	5.90	-0.028
Sweden	3.98	3.76	3.64	3.54	3.27	3.20	3.05	3.06	2.85	2.94	3.14	0.022
Austria	2.92	2.48	2.82	2.81	2.71	2.68	2.64	2.62	2.56	2.51	2.55	0.011
Canada	1.90	1.57	1.62	1.54	1.46	1.58	1.63	1.72	1.76	1.74	1.81	0.002
Indonesia	1.84	1.35	1.27	1.18	1.09	1.16	1.22	1.14	1.02	1.08	1.18	0.037
Germany	1.23	1.01	1.17	1.18	1.11	1.07	1.04	1.09	1.05	1.06	1.09	0.008
Russia	0.80	0.80	0.72	0.62	0.56	0.57	0.65	0.78	0.83	0.79	0.88	-0.015
China	0.76	0.62	0.71	0.74	0.62	0.60	0.61	0.53	0.52	0.55	0.53	0.031
Brazil	0.52	0.42	0.42	0.37	0.37	0.39	0.40	0.55	0.53	0.52	0.70	-0.043
USA	0.31	0.25	0.28	0.29	0.29	0.29	0.30	0.27	0.26	0.27	0.27	0.011
World	0.76	0.63	0.69	0.69	0.64	0.65	0.66	0.62	0.61	0.62	0.64	0.013

Source: The Authors (2020).

up to 2018. The crisis accentuated financial imbalances and exposed the economic and fiscal weaknesses of the countries involved in the main global economic transactions, and as a control device adopted restrictive policies and protectionist measures. Such austerity measures aimed to control public spending, requiring a large fiscal deficit (MESSA & OLIVEIRA, 2017).

The slow growth of the index is justified by the fragility of the global economy, which had a slow recovery, coming off the second biggest crisis ever seen, after the Great Depression (HOEKMAN, 2014). Most countries started an industrial to avoid income loss and rising unemployment, although they had a faster growth rate and were less affected by the crisis than developed countries, they also used, in their markets, mechanisms that protected them from foreign competition. Brazil stood out for presenting a low degree of openness to trade, a country with a development history characterized by relative economic protection, in addition to the high interventionist degree of the State, which presented, after the 2008 crisis, an industrial base and development model oriented to the domestic market focused on replacing imports, further expanding its protection measures (MESSA & OLIVEIRA, 2017). It observed the intensity of pulp trade between Brazil-China in recent years, mainly after the formation of BRICS (Brazil, Russia, India, China and South Africa). This may explain the considerable growth of the Oi index of Brazil since 2012.

The CTB index (Table 3) of contribution to trade balance of China and Germany assumed negative values for the entire period, indicating that they do not have a comparative advantage in the export of forest products.

The other countries, by presenting positive values, have a comparative advantage in the commercial sector. The Revealed Comparative Advantage (RCA) index presented similar behavior to that observed in the CTB index results. Thus, Finland and Sweden, which stood out for having large revealed comparative advantages, were also responsible for the highest contributions to the trade balance, in the same way that the countries with the worst performance in sector exports, with the lowest comparative advantages, also had lower contributions to the trade balance, such as China, Germany and the USA. In the course of specialization, economies enjoyed the commercial benefits and increased exports, contributing positively to the trade balance. Through econometric estimators, it was confirmed that countries that have natural advantages or have acquired comparative advantages over the years have contributed to generate positive balances (HERMIDA & XAVIER, 2011).

There has been a change in exports and in the share of economies in the international market, this is mainly due to structural changes in the demand of importing countries and the competitiveness of exporters. The 2008-2009 financial crisis impacted the worldwide import of forest products, resulting in its decline and indicating the susceptibility of nations to fluctuations in international demands. China was severely affected by the crisis, harming its competitiveness in the sector and the optimization of the export structure. This low contribution rate of technology-intensive products and natural disadvantages, which hindered their specialization in the sector (CAO et al., 2018; LI et al., 2017). China has grown substantially over the years in exports,

Table 3 - Contribution to trade balance (CTB) index and average annual growth (C %) of the world's largest exporters of wood forest products, from 2008 and 2018.

Country	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	C %
Finland	9.45	10.65	11.88	11.66	11.43	11.92	12.46	13.17	12.75	11.87	12.22	-0.028
Sweden	5.30	6.10	5.48	5.32	4.89	5.14	4.79	4.88	4.50	4.50	4.49	0.014
Canada	3.43	3.29	3.52	3.29	3.08	3.45	3.39	3.50	3.64	3.63	3.75	-0.010
Indonesia	3.11	2.99	2.48	1.94	2.17	2.28	2.49	3.15	2.57	2.61	2.93	-0.06
Brazil	2.49	2.54	2.53	2.07	2.04	2.28	2.54	3.31	3.48	3.47	4.08	-0.058
Austria	1.60	1.44	1.31	1.17	1.11	1.06	1.12	1.07	1.07	1.03	0.98	0.47
Russia	1.28	1.38	1.14	0.97	0.89	0.97	1.18	1.51	1.96	1.95	1.77	-0.46
EUA	0.20	0.34	0.40	0.46	0.41	0.33	0.29	0.25	0.23	0.29	0.27	-0.59
Germany	-0.05	0.02	-0.09	-0.09	-0.10	-0.10	-0.14	-0.16	-0.12	-0.08	-0.06	0.64
China	-1.52	-1.62	-1.67	-1.70	-1.39	-1.39	-1.46	-1.47	-1.50	-1.71	-1.68	-0.013

Source: The Authors (2020).

for this, it uses an artifice, granted by free trade. For this, materials are imported for production, with the purpose of processing in the basic industry, making them consumer goods, to consequently export them with added value, thus contributing to the allocation and use of global forest resources (CAO et al., 2018).

Brazil showed a reduction in growth of the CTB index in 2011 and 2012, due to the reduction in the GDP growth rate, which reached 0.9% in 2012. This deceleration generated consequences in most sectors and, in the forestry sector, resulted in the stagnation of the growth of forest plantations during these years. This was due to the reduction in the competitiveness of Brazilian export-oriented forest products in the international market, in addition to the consequent reduction in global economic activity, but mainly in the United States and the European Union, which are some of the main importers of Brazilian products. In addition to excessive bureaucratization and difficulties in carrying out environmental licensing processes, acquiring certain Brazilian government limitations for domestic companies with mainly foreign capital in the purchase of land.

## CONCLUSION

The international forest products market proved to be competitive and demanding between 2008 and 2018. The main exporting countries are the United States, Canada, Germany, Finland and China. Finland had the greatest comparative advantage, proving its competitiveness and the greater trade openness among other countries, this was achieved through a consolidated commercial history. The largest exporter, the United States had the lowest competitiveness in the segment after China.

Brazil has a low degree of trade openness, due to its protectionist economic history and state intervention. Gains in competitiveness were observed in most countries by the RCA index, with emphasis on Brazil, Russia and Finland, due to the increase in exports and sales prices of products. European countries such as Austria, Germany and Sweden have experienced losses in competitiveness in detriment of financial crises and the slowdown in growth due to the austerity measures adopted. The forest products market was classified with a low degree of openness for all countries in the period, with a decrease in 2008 and 2009, due to restrictive policies and protectionist measures adopted to overcome the crisis experienced.

Regarding the contribution to trade balance index, all countries, with the exception of China and Germany, had a comparative advantage in the export of forest products. Thus, it was possible to observe,

through the estimators, that countries such as Finland and Sweden, which had greater comparative advantages, contributing more significantly to the trade balance, and countries with less advantages, such as China, Germany and the United States, had the lowest contributions.

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## DECLARATION OF CONFLICT OF INTEREST

The authors declare no conflict of interest.

## AUTHORS' CONTRIBUTIONS

Design of methodology and data analysis: L.M.C.J., H.F.S. and M.L.S. prepared the draft of the manuscript. Writing-review and editing, L.M.C.J., N.S.S. and J.M.M. visualization, J.M.M., N.S.S. and L.M.C.J.; supervision, L.M.C.J. and M.L.S.; All authors critically revised the manuscript and approved of the final version.

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