Competitiveness of wood pulp in the international market

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Abstract

Currently, Brazil is the third largest exporter of wood pulp. The objective of present study is to analyze the market competition in the international market of wood pulp in terms of concentration and inequality during the period from 2002 to 2014. Monetary values of exports were collected on the UNCONTRADE database and deflated afterwards, considering 2012 as the base year. The Hirschman-Herfindahl Index (HHI) was used for measuring market concentration, while inequality was measured by the Gini Index (G). The world market for pulp showed a low concentration with HHI varying from 0.0918 to 0.1327, indicating an increasing participation of countries in the studied market. However, results showed that United States, Canada, Brazil, Sweden and Chile dominate the market as the Gini index number varied from 0.8874 to 0.9349.

Keywords: Gini Index; Hirschman-Herfindahl Index; chemical pulp.
Abbreviations: HHI_ Hirschman-Herfindahl Index; G_ Gini Index.

Introduction

In 2015, Brazil had 7.84 million hectares of planted forests, of which 34% belonged to pulp and paper companies (Ibá - Brazilian Tree Industry, 2016). The Brazilian pulp and paper segment stands out in the international market because of its competitive advantage in pulp production due to the rapid growth of forests, favorable soil conditions and the biotechnology that the country has been developing over the years (Dores et al., 2007).

Considering the use of wood in 2013, the segment held 35.2% of the total amount of natural wood derived from planted forests in the country (IBÁ - Brazilian Tree Industry, 2014). In 2014, pulp production reached approximately 16.5 million tons, which represented 8.8% more over the production in 2013. The volume of pulp exported was 10.61 million tons, accounting for 64% of the total production (Ibá - Brazilian Tree Industry, 2015). These results placed both pulp and paper as the tenth most exported products in the country (Mdic - Ministry of Development, Industry and External Trade, 2014).

Taking into consideration the first half of 2014, there was an increase in pulp production compared to the same period in 2013. The total production was 9.215 million tons, representing an increase of 6.1%, in which 65.8% was exported. This represented an increase of 13.6% over the previous year (Bracelpa - Brazilian Association of pulp and paper manufacturers, 2014). These results tend to improve because of the devaluation of the Brazilian currency (Real) against the U.S. dollar, which increases the competitiveness of Brazilian companies.

However, despite the positive scenario, the sector is below its potential for expansion and contribution to the Brazilian economy. Furthermore, the growing participation of new countries in the international scenario and both tariff and non-tariff trade barriers may negatively affect the pulp and paper sector in Brazil (Soares et al., 2010).

With the purpose of preserving the segment's competitiveness, concentration measures are widely used as a way of indicating the structure of a given market (Schmidt and Lima, 2002). Given the above, aiming at searching commercial partners, companies can plot trade strategies in order to negotiate their products better.

Moreover, since the pulp segment is important in the Brazilian balance of trade, study of structure of the main importing and exporting markets has become more significant as a starting point for strategic decision-making that focus on a market level in a less broad way. Within this context, the concentration and inequality analyses are important methodologies and these studies have been applied in several economic sectors (Soares et al., 2014).

Some researches were conducted by Noce et al. (2005), Noce et al. (2008) and Parapinski (2012), who studied the sawn wood, plywood and furniture segments, respectively. In addition, the wood panel market structure analyzes performed by Silva and Sousa (2010) and by Acre et al. (2012) in Paraná-SC, Brazil.

Considering the pulp and paper segment, concentration and inequality analyses have already been studied by Soares et al. (2014) who analyzed the US imports of pulp and highlighted the Brazilian participation in this market. In

addition, Silva et al. (1992) and Leite and Santana (1998) studied concentration and inequality analyses for the pulp and paper segment in former years.

Overall, due to the significant influence of this product in the Brazilian economy, this study had as objective to analyze the competitiveness of wood pulp in the international market in terms of its concentration and inequality in the period from 2002 to 2014, as a tool for defining business strategies.

Results and Discussion

Considering the analyzed period, the real value of world pulp exports increased from US $ 22.3 billion in 2002 to US $ 41.3 billion in 2014. In 2011, it exceeded US $ 50 billion. Thus, the average annual growth rate of the pulp international market was 7.1%. Considering the different kinds of cellulose, the trade of chemical pulp stands out. It represents about 70% of the total exported.

Export data

Among the largest exporters of pulp in the world, the United States, Canada, Brazil and Sweden are the four largest in descending order. Furthermore, Chile, Finland, Indonesia, Germany, the Netherlands and Russia are also major exporters of the product (Figure 1). These countries are consolidated and well-structured in the international pulp market. They have been achieving good results over the years, and currently, they follow the world's economic tendency of a slight annual growth. All of them have been affected by the economic crisis of 2009.

The United States and Canada dominate the market. The United States became the world's largest exporter of pulp in 2006, reaching values close to US $10 billion per year. The Canadian results can be explained by both the raw material substitution process and the higher prices for long fiber in the international market. According to Dores et al. (2007), Canada is a specialist country in the production of this type of input.

Mazzochin (2013) noted that both the United States and Canada have a high production and a good business organization. They stand out as important exporters to Europe and Asia. However, from 2011 they have been showing a drop in exports that may be explained due to the progressive Chinese economic development as China has been growing its domestic production. Moreover, this Chinese production growth coupled with the United States' production reduction, which boomed during the economic crisis in 2008 and caused a reduction in the sector's investments, caused negative impacts on both countries exports.

On the other hand, Brazil, with great forest production and productivity for the purpose of pulp production, has become the third largest exporter since 2005. The values are close to US $ 5 billion per year with chemical pulp standing out and representing 99% of the total exported.

In early 2010, the production and the Brazilian pulp exports increased (Ciflorestas - Intelligence Center of Forestry, 2012) with Europe being the main destination followed by China and North America (Bracelpa, 2014). The country took advantage of a market opportunity to supply short-fiber pulp, with lower marketing value. It is a new source which has not been exploited by North American countries.

Furthermore, another fact that benefits Brazil is the technological advancement of paper production processes that have generated greater demand for short fiber pulp in the international market. Thus, in competitive and globalized markets, lower raw material prices are reflected in low-cost final products. Therefore, the possibility of replacing long fiber with short fiber in the production of several types of paper has played a leading role in the segment (Soares et al., 2014). However, the highlight in the international pulp market is not achieved when the analyzed product is paper with higher value. Considering this market, Brazil occupied the ninth place among the largest producers in 2013 by exporting only 20% of the production, mainly to Latin America (Ibá, 2014). Hence, because this is an important segment for the country's economy, Brazilian companies should analyze the possibility of adding value to pulp in order to act in the international market.

In addition, some other countries have increased their market share during the analyzed period. Belgium and the Netherlands are already consolidated and Indonesia has been showing good results. Chile occupies the fifth place in pulp sales in the international scenario. For the period of study, there was an increase of 150% in raw material exports. Although China has a major market power in the world market as the United States, it imports a large amount of pulp. By adding value to the raw material, it has become the world's largest producer of paper (Ibá, 2015).

Measures of market concentration and inequality

For the period of study, the United States, Canada, Brazil and Sweden accounted for more than 50% of cellulosic pulp exports (Table 3).

The Hirschman-Herfindahl index (Table 3) showed a low concentration of global exports of pulp due to the large number of countries operating in the segment, considering the years 2002 to 2014. Additionally, a downward trend in concentration was observed. This decline may be related to market share gains of countries that in former years had a less significant share of exports, such as Indonesia, China and Germany. The market share gains of these countries resulted in a decrease of market share of the fourth and eighth largest exporters.

Overall, the HHI results corroborate Hoffmann's (2006) assertion that the index is inversely proportional to the number of entities in the case of exporting countries, which was observed in the periods from 2002 to 2007 and 2010 to 2011. However, this relationship was not observed during the entire period of analysis. In this instance, other factors such as the participation of nations have probably exerted a strong influence on the concentration index.

In the evaluation of inequality (Table 2) calculated by the Gini index, an oscillation was observed as the numbers varied with increasing and decreasing intervals along the years analyzed. In addition, the market of pulp exports showed a very strong to absolute inequality between 2002 and 2011, being reclassified from strong to very strong in 2012, according to the classification of Silva and Graça and Nojimoto (1992), presented in Table 1.

The opposite results for concentration and inequality (considered low and high, respectively) were explained by

Table 1. Classification of the market concentration by the Bain criterion (1959).

Kinds of Concentration	Description
Ia – Extremely high concentration	A few countries, exports are concentrated in only four of them
Ib – Very high concentration	Exports concentrated on the four major trading partners, however, there are more countries with relevant share in total exports
II – High concentration	85-90% of imports are concentrated on the eight major trading partners, 65-75% concentrated on the four major ones
III – Moderately high concentration	The eight major countries import 70-85% and the four biggest trading partners import 50-65%
IV – Low to moderate concentration	The eight major countries import 45-70% and the four biggest trading partners import 35-50%
V – Low grade oligopoly	The eight major countries import less than 45% and the four biggest trading partners import less than 35%
VI – Atomism	The four major countries import less than 10% with a large number of competitors in the market

Source: Adapted from Bain (1959) (as cited in Silva et al., 1992).
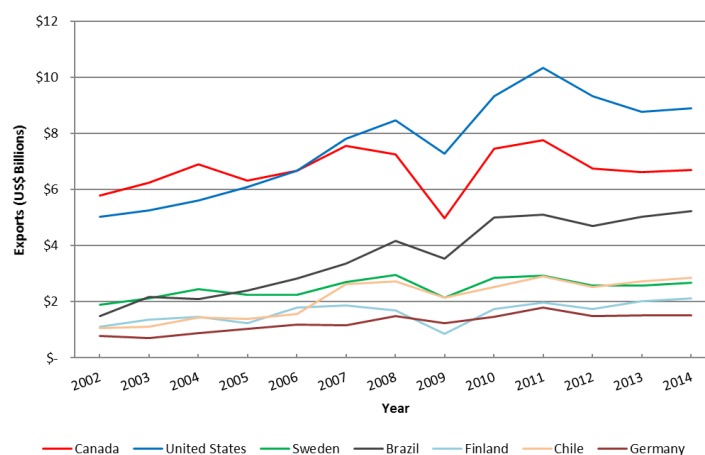
Fig 1. Nations exports data from 2002 to 2014. Source: Uncomtrade (2015).

Table 2. Classification of the Gini Index.

Gini Index	Classification
0.101 – 0.250	Zero to weak inequality
0.251 – 0.500	Weak to average inequality
0.501 – 0.700	Average to strong inequality
0.701 – 0.900	Strong to very strong inequality
0.901 – 1.000	Very strong to absolute inequality

Source: Câmara (1949) apud Silva et al. (1992).

Table 3. Measures of concentration and inequality of world cellulose exports.

Year	Participation of the 4 major exporters	Participation of the 8 major exporters	HHI	G	Number of Countries
2002	62.0	77.9	0.1327	0.9175	82
2003	60.5	75.6	0.1209	0.9269	99
2004	58.5	74.4	0.1162	0.9330	110
2005	57.8	73.3	0.1114	0.9316	111
2006	56.2	73.3	0.1070	0.9349	118
2007	54.5	73.0	0.1021	0.9336	119
2008	54.8	72.4	0.0997	0.9200	98
2009	56.3	72.8	0.1055	0.9315	113
2010	53.7	69.6	0.0956	0.9245	110
2011	51.6	68.4	0.0918	0.9251	115
2012	54.6	71.8	0.1017	0.8874	67
2013	52.5	70.5	0.0922	0.9327	127
2014	57.2	75.1	0.1057	0.9217	96

Hoffmann (2006). In the cases of countries and exports, the author noted that measures of inequality usually analyze proportions, while concentration measures determine the proportion of a variable (e.g., pulp exports) controlled by an absolute number of agents (e.g., nations).

These results, along with the devaluation of the Real against the U.S. dollar, indicate good prospects for Brazilian companies. The companies should take advantage of the growing share of domestic pulp in the international market replacing the product available in other countries with higher production costs, as described by Soares et al. (2014). According to the authors, the Brazilian pulp is replacing the Canadian one in North American imports.

Nevertheless, as presented by Ibá (2014), one of the major weaknesses that affect the competitiveness of the chemical pulp industry in Brazil is the continuous increase in forest production costs, which reaches percentages above the official Brazilian inflation. Besides, the recent decline of commodity prices should be considered a warning for the segment. Consequently, forest managers should seek strategies that can overcome such weaknesses and threats. One alternative would be the possibility of adding value to their products, but in order for it to happen, studies of economic viability and the paper world market are necessary and suggested.

Materials and Methods

In order to determine the market concentration and the market inequality indexes for the main exporters of pulp, annual series of data of the value of world exports (in U.S. dollar) were obtained for the period of 2002 to 2014. The source was the UN Comtrade Database (Uncomtrade – *United Nations Commodity Trade)* using the codes from Chapter 47 of the Harmonized System (HS) Classification of Goods, which includes "Pulp of wood or other fibrous cellulosic material; recovered (waste and scrap) paper or paperboard". The export prices were deflated by the US Consumer Price Index (CPI), considering 2012 as the base year. Currently, wood accounts for about 90 to 95% of the fiber used as raw material by the pulp industry. Pulp and paper are mainly made of cellulose fibers which are cellular elements of plants, such as tracheids, libriform fibers and fiber-tracheids. The two main sources of wood for pulp production in Brazil are commercial *Pine* and *Eucalyptus* plantations. Both species are responsible for more than 98% of the volume produced. Cellulose can also be obtained from agricultural residues and non-wood plants such as bamboo, babassu and sisal. Two kinds of pulp with different physical and chemical characteristics are used for paper production, long and short fiber pulps (Ibá - Brazilian Tree Industry, 2017).

Measures of market concentration

After collecting the data, the methods of Bain and Hirschman-Herfindahl were used for the determination of the concentration.

Hirschman-Herfindahl Index (HHI)

After collecting the data, the market concentration was estimated by the Hirschman-Herfindahl Index (HHI). As described by Schmidt and Lima (2002) and Hoffmann (2006), the HHI (Equation 1) is defined as the sum of squares of the market shares of the market participants.

$$HHI = \sum_{i=1}^{n} y_i^2 \qquad (1)$$

In which:
HHI = Hirschman-Herfindahl Index;
y_i = market share of nation i in total world exports.

The HHI coefficient value of one indicates a monopoly situation, while the more the value is close to zero the more equal the market participation is (Hoffmann, 2006).

Bain's criterion

As specified by Silva et al. (1992), this criterion consists in evaluating the market share of the four and eight largest plywood importers in Brazil. Hence, the Concentration Ratios (CR4 and CR8) were determined according to Hoffmann (2006). The market can be classified from the adaptation of Bain (1959) (as cited in Silva et al., 1992), shown in Table 1.

Measures of inequality

The Gini Index (G) was used to analyze the inequality of the world's imports of pulp. According to Hoffmann (2006), the Gini index is the most used to calculate inequality of income distribution and it can be used for any distribution. This index varies from zero to one. When there is no income inequality between nations its value is zero, but when its value tends to one, it indicates that only one country owns the entire income of exports Ishitani et al. (2006).

The Gini index is calculated by the following equation (Equation 2) presented by Nojimoto (1987) (as cited in Silva and Graça and Nojimoto, 1992):

$$G = 1 - \left(\sum_{i=1}^{n} \frac{C_{ij} + C_i}{n} \right) \qquad (2)$$

In which:
G = Gini Index;
n = Number of nations;
C_{ij} = Cumulative export share in ascending order;
C_i = Participation of nation i.

The classification proposed by Silva and Graça and Nojimoto (1992) was used to analyze the inequality in pulp imports (Table 2).

In addition to the Gini index, Lorenz curves were constructed for each of the years studied; thereby, illustrating the difference between the actual distributions of exports compared to an egalitarian scenario, as presented by Hoffmann (2006), based on the cumulative proportions of exports and pulp exporting countries.

Conclusion

The present study verified that Brazil is the third largest exporter of pulp in the international market, losing only to

the United States and Canada. However, there are still opportunities that can be taken by Brazilian companies. For example, adding value to the raw material. The analysis of concentration and inequality indexes showed different results. The Hirschman-Herfindahl Index showed a low concentration in world pulp exports, which can be explained by the number of countries and the growth in participation of some nations. On the other hand, Gini index values close to 1 were obtained, which indicates a high inequality in the international trade of pulp with a small number of exporting countries.

References

Bain J (1959) Barriers to New Competition. Harvard, UP.

Bracelpa- National Association of Pulp and Paper Manufacturers (2014) Trade balance of the sector: December 2013. Available from: http://www.bracelpa.org.br/bra2/sites/default/files/estatisticas/RM39BalancaComercial56-Dezembro2013.pdf. Accessed on 31 Jan 2014.

Bracelpa- National Association of Pulp and Paper Manufacturers (2014) Monthly Report. July. Available from: http://www.iba.org/shared/iba_2014_pt.pdf. Accessed on 05 Dec 2016.

Ciflorestas - Intelligence Center of Forestry (2012) Available from: <http://www.ciflorestas.com.br/conteudo.php?id=8183> Accessed on 20 Dec 2016.

Dores AMB, Chagas FB, Mattos RLG, Gonçalves RM (2007) Panorama setorial: setor florestal, celulose e papel Available from: http://www.bndes.gov.br/SiteBNDES/export/sites/default/bndes_pt/Galerias/Arquivos/conhecimento/liv_perspectivas/04.pdf. Accessed on 20 Dec 2016.

Eisfeld CL, Berger R (2012) Análise das estruturas de mercado das indústrias de painéis de madeira (compensado, MDF e OSB) no estado do Paraná. Floresta Maganize. 42(1): 21-34.

Hoffmann R. Estatística para economistas (2006) 4 ed. São Paulo: Pioneira.

Ibá- Brazilian Tree Industry (2014) Available from: <http://www.iba.org/shared/iba_2014_pt.pdf>. Accessed on 20 June 2017.

Ibá - Brazilian Tree Industry (2015) Available from: <http://iba.org/images/shared/iba_2015.pdf>. Accessed on 18 Dec 2016.

Ibá - Brazilian Tree Industry (2016) Available from: <http://iba.org/images/shared/Biblioteca/IBA_RelatorioAnual2016_.pdf. Accessed 20 June 2017.

Ishitani LH, Franco GC, Perpétuo IHO, França E (2006) Desigualdade social e mortalidade precoce por doenças cardiovasculares no Brasil. Revista Saúde Pública. 40(4): 684-691.

Leite ALS, Santana EA (1998) Índices de concentração na indústria de papel e celulose. In: Anais do encontro nacional de engenharia de produção. Niterói: Abepro; 1998. p. 18.

Mazzochin MS (2013) Dinâmica e espacialização das exportações de madeira do Brasil. CaderNAU – Cadernos do Núcleo de Análises Urbanas. 6(1): 5-8.

Mdic - Ministry of Development, Industry and External Trade (2014) Brazilian Balance of Trade – consolidated data – January - June. [cited 20 May 2015]. Available from: http://www.desenvolvimento.gov.br//arquivos/dwnl_1416482559.pdf. Accessed on 20 Dec 2016.

Noce R, Silva ML, Carvalho RMMA, Soares, TS (2005) Concentração das exportações no mercado de madeira serrada. Revista Árvore. 29(3): 431-437.

Noce R, Silva ML, Souza, AL.; Silva OM, Mendes LM, Carvalho RMMA, Valverde SR (2008) Competitividade do Brasil no mercado internacional de aglomerado. Revista Árvore. 32(1): 113-118.

Parapinski ML (2012) Desempenho das exportações brasileiras de móveis de madeira, 1991 a 2010 [master thesis]. Curitiba: University of Paraná.

Schmidt CA, Lima MA (2002) Índices de Concentração. Série de Documentos de Trabalho. Ministério da Fazenda, Brasília. 13; p. 8.

Silva ZAGPG, Sousa IZG (2010) Estrutura e conduta do mercado varejista de madeira serrada em Rio Branco-AC. Revista Floresta. 40(2): 355-371.

Silva JCGL, Graça LR, Nokimoto T (1992) Estrutura de mercado do setor de papel e celulose no Brasil. In: Encontro brasileiro de economia e planejamento florestal. Curitiba. Annals... Curitiba. 485-499.

Soares NS, Oliveira RJ, Carvalho KH, Silva ML, Jacovine LAG, Valverde SRA (2010) Cadeia Produtiva da Celulose e do Papel no Brasil. Revista Floresta. 40(1): 1-22.

Soares PRC, Cardoso MV, Almeida NA, Silva JCGL, Timofeyczyk Junior R, Angelo H (2014) Concentração e desigualdade nas importações norte americanas de celulose. Scientia Forestalis. 42(102): 173-179.

Uncomtrade - United Nations Commodity Trade (2015) Statistics database [05 June 2015]. Available from: <http://comtrade.un.org>. Accessed on 20 Dec 2016.