ANALYSIS OF BRAZILIAN EXPORTS OF CONIFER WOOD MOLDINGS THROUGH GRAVITY TRADE MODEL[1]

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ABSTRACT – *This study aimed to analyze Brazilian exports of softwood moldings between the years 1997-2013, by means of a gravity trade model. The main explanatory variables used were GDP of Brazil, importing country´s GDP, and distance between Brazil and its trade partner. The results showed that all variables had the expected behavior. The variables´ coefficient of GDP of Brazil and the importing country's GDP presented a positive influence on trade flow of softwood moldings. The distance coefficient presented a negative influence on trade flow, which showed to be a barrier to Brazilian exports of this product. Results also show that the level of trade is more influenced by the GDP in Brazil than at the importing country's GDP.*

Keywords: International trade; Wood exports; Brazil.

ANÁLISE DAS EXPORTAÇÕES BRASILEIRAS DE MOLDURAS DE MADEIRA DE CONÍFERAS POR MEIO DO MODELO GRAVITACIONAL

RESUMO –O presente estudo teve por objetivo analisar as exportações brasileiras de molduras de madeira de coníferas entre os anos de 1997 e 2013 por meio do modelo gravitacional. As variáveis explicativas utilizadas neste estudo foram: Produto Interno Bruto – (PIB) do Brasil, PIB do país importador e a distância deste em relação ao Brasil. Os resultados mostraram que todas as variáveis apresentaram o comportamento esperado. As variáveis PIB do Brasil e PIB do país importador apresentaram influência positiva no fluxo de comércio de molduras de madeira de coníferas. A variável distância, por sua vez, apresentou influência negativa no fluxo comercial, demonstrando ser uma barreira às exportações brasileiras deste produto. Os resultados também apontam que o nível de comércio é mais influenciado pelo PIB do Brasil do que pelo PIB do país importador.

Palavras-Chave: Comércio internacional; Exportação de madeira; Brasil.

1. INTRODUCTION

Over the years, trade among nations has become one of the key factors for the growth and development of economies. However, the existence of natural barriers such as language, geographical distance and artificial barriers such as: tariffs, import quotas, among others, collaborate to reduce the level of trade between countries (Jesus, 2010).

In recent years, the Brazilian forestry sector has become one of the most relevant in the world scenario, standing out for its high productivity and less time of rotation. Currently, the planting area occupies 7.8 million hectares, accounting for 91% of all wood produced for industrial purposes in the country (IBÁ, 2015).

Regarding the performance in the world market, in 2014, the revenue from exports of forest products reached US $ 8.49 billion, an increase of 2.5% compared to the year 2013 (IBÁ, 2015).

In relation to the solid wood products segment, in 2014 exports totaled US $ 2.24 billion, representing growth of 12% compared to 2013 (ALICEWEB, 2015). This segment includes the frames, originated from the tertiary processing of wood (ABRAF, 2010). They are used mainly for interior finishes, with decorative purpose in civil construction (Pereira, 2003; ABIMCI, 2013).

According to the sector study of the Brazilian Association of the Mechanically Processed Wood Industry - ABIMCI (2013, 2016), in the period from 2000 to 2014 there was a growth of the internal production of frames in the order of 225%. The Brazilian production of wooden frames has as main focus the external market, with the United States being the main target market (ABIMCI, 2013).

The timber frames of conifers represent only 2.3% of the total exported by the Brazilian forestry sector. However, analyzing the total world exports of this product, it is observed that Brazil is the second largest exporter in the world, with a participation of 12%. The main exporting country is Chile, which accounts for 15% of world exports (UNCOMTRADE, 2014).

Despite their low participation in the exports of the forestry sector, conifer wood frames are one of the main products of higher added value exported by the sector. In addition, Brazil has the conditions to become the leading exporter of wood frames for the world market.

Therefore, it is of great importance to analyze how the variables involved in the dynamics of international trade influence the flow of this product in the external market, since this information can provide subsidies to improve competitiveness and the insertion of forest-based companies in the world market. In addition to promoting the development of new markets, adding diversity and quality to the production of the country's forest-timber sector, thus reducing the concentration of exports in primary goods (Valerius, 2016).

To explain and estimate the flow of trade between countries, a methodology that has been widely used is the gravity trade model. This method makes an analogy to Isaac Newton's Law of Gravity, relating trade between two countries in a positive way to their incomes and negatively to the distance between them (Cheng and Wall, 2005; Baldwin and Taglioni, 2006; Souza and Burnquist, 2011).

In the forest area, some authors have used this methodology to analyze trade in products of forest origin, among them Salles et al. (2011), which analyzed the dynamics of paper and pulp exports by Brazil in the period from 1997 to 2005, using as explanatory variables Brazil GDP, importing country GDP, GDP per capita of the importing country and distance between the importer and Brazil.

Cardoso et al. (2010) used this methodology to evaluate the interference of some variables on the international trade of wood, wood articles and charcoal, as well as Mercosur's importance in the Brazilian exports of these products. The authors evaluated the interference of the variables: distance of importers in relation to Brazil, GDP per capita, territorial area; the population of importing countries and trade preference through the trade blocs, represented by a dummy variable.

Pereira and Almeida (2015), on the other hand, used this method to analyze the effects of the technical measures on exports of the Brazilian pulp and paper sector in the period of 1997 and 2012, the authors used as explanatory variables the GDP of the importing countries, the tariffs applied to the products affected, the bilateral distances, the official language of the partners considered and the existence of common borders.

Based on the above considerations, this study main goal is to analyze the export flows of coniferous wood frames by Brazil through the adaptation of the gravity equation, evaluating its behavior in relation

to the Brazilian GDP, the GDP of the importing countries and the distance of the countries importers in relation to Brazil.

2. MATERIAL AND METHODS

The gravity model assumes that trade between two countries is directly proportional to their income, using as proxy of this variable the Gross Domestic Product (GDP) of the countries, and inversely proportional to the distance between them. Thus, it is expected that the greater the GDP of the countries and the smaller the distance between them the greater the trade flow between the two (Azevedo et al., 2006).

A simple form of representation of the gravity equation to estimate bilateral trade is presented by Azevedo (2004).

$$ln\ M_{ij} = \beta_0 + \beta_1 lnY_i + \beta_2 \ln\left(\frac{Yi}{Ni}\right) + \beta_3\ lnY_j + \beta_4 \ln\left(\frac{Yj}{Nj}\right) + \beta_5\ lnDist_{ij} + \varepsilon_{ij} \quad \text{Eq 1}$$

On that:

$M_{ij:}$ is bilateral trade, whether in nominal imports or exports or the sum of both, from country i to country j;

$Y_{w:}$ is the nominal GDP of countries i and j;

N_w: is the population of countries i and j;

$Dist_{ij}$: is the distance in km between countries i and j;

β_0 a β_5: are parameters of elasticity;

ε_{ij}: is the error admitted in the estimation, with normal distribution.

The model used in this study involved the analysis of the variables of the exporting country (Brazil) GDP, GDP of the importing countries and the distance of these in relation to Brazil, being expressed by:

$$lnW_{ij} = \beta_0 + \beta_1\ lnM_i + \beta_2 lnM_j + \beta_3 lnD_{ij} + \varepsilon_{ij} \quad \text{Eq 2}$$

On that:

W_{ij}: represents the Brazilian exports of coniferous wood frames to the countries in real terms;

M_i: is the Brazil nominal GDP;

M_j: is the importing countries nominal GDP;

D_{ij}: is the distance in km between countries i and j;

β_0 a β_3: are parameters of elasticity;

ε_{ij}: represents the error term.

As a dependent variable, annual data were used, from 1997 to 2013, referring to the export values of coniferous wood frames by Brazil. Also for the same period, data were obtained on Brazil's GDP, the importing countries GDP, and the distance in kilometers of these in relation to Brazil.

The annual export values of conifer wood frames were obtained from the UN-Uncomtrade Database (UNCOMTRADE, 2014) and deflated using data from the Consumer Price Index (CPI), base year 2014.

The importing countries considered in the analysis of the market for conifer timber were: Angola, Argentina, Australia, Germany, Austria, South Africa, Belgium, Bolivia, Canada, Cape Verde, China, Colombia, Costa Rica, Korea South Africa, Croatia, Cuba, Denmark, Spain, Slovenia.The United States, France, the Russian Federation, Georgina, Greece, Guatemala, Guinea Bissau, Haiti, Honduras, Indonesia, Ireland, Israel, Italy, Jamaica, Japan, Lebanon, Mexico, Namibia, Netherlands, New Zealand, Norway, Panama, Paraguay, Dominican Republic, Peru, Poland, Portugal, Saint Lucia, Senegal, Suriname, Sweden, Switzerland, Thailand, Trinidad and Tobago, Uruguay, Venezuela, Vietnam, United Kingdom.

The importing countries GDP data, as well as Brazil, were collected from the United States Department of Agriculture - USDA (2014). The distance between Brazil and its trading partners was obtained from the database of the Center D'etudes Prospectives et D'informations Internationales - CEPII (2014).

3 RESULTS

The model presented in equation (2) showed better adjustment using the panel data technique, with 1003 observations. The results for the estimates of the model in the form Pooled, Random Effects and Fixed Effects are shown in Table 1.

The *Hausman* test indicated that the random effects model is inconsistent, validating the hypothesis of fixed effects. The model of the Ordinary Least Squares

Table 1 – Estimates of Brazilian coniferous wood molding export model (1997-2013).
Tabela 1– *Estimativas do modelo de exportação de molduras de madeira de coníferas pelo Brasil (1997-2013).*

Explanatory variable	Coefficients		
	Pooled	Random effects	Fixed Effects
Constant	1.604 {0.841}	1.631 {0.870}	21.083{0.001}
Ln PIBBr	2.062 {0.033}	1.979 {0.014}	3.150 {0.024}
Ln PIBimp	1.489 {0.000}	1.447 {0.000}	0.284 {0.803}
Ln Dist	- 2.305 {0.000}	- 2.215 {0.011}	-
R^2	0.2498	-	-
Nº of observations	1003	1003	1003
Hausman Test	-	0,4176	-
Prob>F	0.0000	0.000 chi^2	0.0001

Note: Between square brackets the p-value of each variable is reported.

(*pooled*) OLS presented similar results to those obtained by the random effects model, which, except for the constant, all coefficients estimated were significant at 5% of significance and showed similar magnitudes of the impacts of the variables on exports.

According to the results of the pooled model, the variables of Brazil GDP, GDP of the importing country and its distance from Brazil, explain 24.98% of the Brazilian exports of coniferous wood frames to the world.

This result can be considered low when compared to that found by other authors. However, it is important to note that the countries' GDP, used in the model, is general and not sectoral. Therefore, since the income obtained by exports and imports of this product represents a very low value in the GDP of the countries involved, a low R^2 in the pooled estimation was expected. In addition, data panels estimated in the form of pooled also usually produce a low R^2, when compared with estimates of time series, for example.

4. DISCUSSION

All the variables used in the model presented results as expected, indicating a relation between them and the value of Brazilian exports of conifer wood frames.

Brazil's GDP elasticity was 2.062, indicating that a 10% increase in Brazilian GDP would lead to a 20.62% increase in the volume of Brazilian exports of conifer timber, demonstrating that Brazilian exports of this product are elastic to GDP. The result for this variable was as expected, since according to Azevedo (2004), the larger the economy of a country, represented by GDP, the greater its output and, therefore, the greater its quantity exported (Azevedo, 2004).

In the same way, a positive coefficient was also expected for the GDP variable of the importing country. For this represents the economic size of the importing country, so it is assumed that the larger the economy of a country, the greater will be the consumption power and, consequently, the larger the imports (Azevedo, 2004). In this study, the elasticity found for this variable was 1.489, suggesting that if there is a 10% increase in the importing country GDP, it is expected a 14.89% increase in imports of the Brazilian product by this country.

Authors such as Salles et al. (2011), Carmo and Bittencourt (2012) and Cardoso et al. (2010) also find positive influence of the countries' GDP on the flow of trade in their studies. This reinforces the theory that with the growth of the countries' economies, the higher their export levels (Azevedo, 2004). The opposite is also true, if there is a slowdown in the growth of the economy of a country, or the world as a whole, there will be a reduction in the level of trade between countries.

According to Buainain and Batalha (2007), the consumption of wood products is more concentrated in the developed economies mainly due to the construction market. Data from Brazilian exports of conifer wood frames confirm this assertion, as they show that the main importers of coniferous timber are countries with developed economies: the United States (91.74%), Canada (3.91%) and Australia (2.58%) (UNCOMTRADE, 2014).

In the case of the distance variable, as predicted in the literature, its impact was negative and statistically significant. That is, the greater the distance between Brazil and its importers of coniferous timber frames, the smaller the trade of this product. This result indicates

that the distance presents itself as a barrier to the Brazilian exports of this product, meeting with the theories of commerce.

The increase in distance reduces the level of trade between countries due to transport costs, insurance, tariffs, among other expenditures. Thus, the greater the distance, the greater the final cost of the product (Jesus, 2010).

Krugman and Obstfeld (2005) found this relationship, the authors report that in a commercial transaction, if the transport costs are considered, the exporting country will only send its product to the country of destination if the difference between the value received by the commercial transaction between the two countries is at least equivalent to freight costs.

Likewise, if the importing country is responsible for the transport of the product, it will only import when the price of the product in that market is cheaper than the other markets, offsetting the costs transportation.

Since 2005, Brazil has been standing out in the world market of conifer wood frames. In the last 16 years, while the average annual growth rate of world exports of this product was 3.6%, Brazil grew by an average of 25.94% per year (UNCOMTRADE, 2014). This growth has made the country in the last two years (2012 and 2013) the second largest exporter of this product, losing only to Chile.

Although it performs well in the world market for conifer wood frames, the Brazilian timber sector has the potential for even greater growth. To that end, it is fundamental to map the market to identify opportunities and define strategies, as well as constantly seek improvements in productive processes, investing in new equipment and facilities with the purpose of increasing productivity and being more competitive (Almeida, 2014).

The analysis of the variables that affect international trade and the way in which they impact the exports of specific products can serve as a subsidy for the elaboration of commercial strategies of companies that export such products. In addition, the results of these analyzes can also promote the elaboration of public policies aimed at improving the insertion of these products in the external market.

5. CONCLUSIONS

The analyzed model proved to be efficient to explain the flow of Brazilian exports of conifer wood frames, where all the variables presented the expected behavior.

Brazil's GDP variable has shown a positive influence on exports of this product, demonstrating that the higher the country's economic growth, theoretically, the higher its production levels will be and consequently the greater the quantity exported.

The GDP of the importing country has a positive influence on the bilateral trade volume of the product concerned. This result shows that the greater the economic power of the importing country with which Brazil trades, the greater its import level.

The distance, in turn, showed a negative influence on the exports of coniferous wood frames to the countries analyzed. This result suggests that logistic costs act as a barrier to Brazilian exports of the product in question, making it less competitive in the international scenario.

6. REFERENCES

ABRAF. Anuário estatístico da ABRAF 2010. Ano base 2009/ABRAF. Brasília, DF: 2010.

ABIMCI. Estudo Setorial da ABIMCI 2013. Ano base 2012/ABIMCI. Curitiba: 2013.

ABIMCI. Estudo Setorial da ABIMCI 2016. Ano base 2015/ABIMCI.- Curitiba, 2016. 127p.

ALICEWEB. Sistema de Análise das Informações de Comércio Exterior - Consulta – Exportações, 2015. [acesso em: 25 de set. 2015].

Almeida ED. Evolução da produção da indústria da madeira no Brasil. Celulose [Online], 2014. [acesso em 20 de jan. 2015]. Disponível em:http://celuloseonline.com.br/setor-madeireiro-ederson-dealmeida-evolucao-da-producao-da-industria-da-madeira-no-brasil/.

Azevedo AFZ, Portugal MS, Barcellos Neto PCF. Impactos comerciais da Área de Livre Comércio da Américas: uma aplicação do modelo gravitacional. Revista de Economia Contemporânea. 2006;10(2):237-67.

Azevedo AFZ. O efeito do Mercosul sobre o comércio: uma análise com o modelo gravitacional. Pesquisa e Planejamento Econômico. 2004;34(2):307-39.

Baldwin RE, Taglioni D. Gravity for dummies and dummies for gravity equations. Working Paper, n. 12516, 2006.

Buainain AM, Batalha MO. Cadeia produtiva de madeira. Brasília, DF: Ministério da Agricultura, Pecuária e Abastecimento: IICA, 2007. (Agronegócios, v. 6).

Cardoso MV. et al. Aplicação do modelo gravitacional na análise das variáveis envolvidas na exportação de madeira, produtos de madeira e carvão vegetal. In: Anais do 48ª Congresso da Sociedade Brasileira de Economia, Administração e Sociologia Rural. Campo Grande: 2010. [acesso em 16 de out. 2014]. Disponível em: http://www.sober.org.br/palestra/15/1153.pdf

Carmo ASS, Bittencourt MVL. O efeito da volatilidade da taxa de câmbio sobre a diversificação geográfica da pauta de exportação: uma investigação empírica com painel de dados não-linear. In: Anais do 18º Fórum BNB de Desenvolvimento/17º Encontro Regional de Economia. Fortaleza: 2012. [acesso em 20 de nov. 2014]. Disponível em: http://edi.bnb.gov.br/content/aplicacao/eventos/forumbnb2012/docs/sim2_mesa4_o_efeito_volatilidade_taxa_cambio.pdf

Centre D´Etudes Prospectives et D´Informations Internationales - CEPII. [acesso em 27 de out. 2014]. Disponível em:http://www.cepii.fr/anglaisgraph/bdd/distances.htm.

Cheng I, Wall HJ. Controlling for heterogeneity in gravity models of trade and integration. Federal Reserve Bank of St. Louis Review. 2005;87(1):49-63.

Indústria Brasileira de Árvores - IBÁ -. Relatório anual 2015 ano base 2014. Brasília, DF: 2015. 80p.

Jesus LAD. O impacto da volatilidade cambial nas exportações brasileiras para o Mercosul: uma análise em painel dinâmico [dissertação]. Curitiba: Universidade Federal do Paraná; 2010.

Krugman PR, Obstfeld M. Economia internacional: teoria e política. 6ª ed. Tradução: Eliezer Martins Diniz. São Paulo: Pearson Addison Wesley; 2005. 558p.

Pereira MCS. Produção e consumo de produtos florestais: perspectivas para a região sul com ênfase em Santa Catarina. 2003. [acesso em: 20 de out. 2014]. Disponível em: http://www.brde.com.br/media/brde.com.br/doc/estudos_e_pub/Producao%20e%20Consumo%20de%20Produtos%20Florestais.pdf

Pereira FO, Almeida AN. O impacto das medidas técnicas sobre as exportações brasileiras de papel e celulose. Revista de Economia e Agronegócio–REA. 2015;12(1-3).

Salles TT, Silva, MLS, Soares, NS, Moraes AC. Exportação brasileira de papel e celulose: sua dinâmica pela equação gravitacional. Revista Árvore. 2011;35(3):573-80.

Souza MJP, Burnquist HL. Facilitação de comércio e impactos sobre o comércio bilateral. Estudos Econômicos, 2011;41(1):91-118.

UNCOMTRADE. UN Commodity Trade Statistics Database. Statistical Division of the United Nations. New York: Disponível em: http://comtrade.un.org/>. Acesso em: 16 de out. de 2014.

United States Department of Agriculture - USDA. [acesso em 03 de nov. 2014]. Disponível em: http://www.usda.gov/wps/portal/usda/usdahome.

Valerius J. Dinâmica do mercado mundial de molduras de madeira de coníferas e a competitividade brasileira nas importações dos Estados Unidos [dissertação]. Curitiba: Universidade Federal do Paraná; 2016.