EVALUATION OF THE EFFECTS OF PRICE, EXCHANGE, AND VOLUME ON THE GROWTH OF REVENUES FROM BRAZILIAN EXPORTS OF WOOD PRODUCTS

Jose Sawinski Junior[2*], João Carlos Garzel Leodoro da Silva[3], Vitor Afonso Hoeflich[3] and Ademilson de Souza Maciel[2]

[1] Received on 03.06.2022 accepted for publication on 26.10.2022.
[2] Universidade Federal do Paraná, Programa de Pós-Graduação em Engenharia Florestal, Curitiba, PR - Brasil. E-mail: <juniorsawinski@gmail.com> and <ademilsonmaciel@gmail.com>
[3] Universidade Federal do Paraná, Departamento de Economia Rural e Extensão, Curitiba, PR - Brasil. E-mail: <garzel@ufpr.br> and <vitor.ufpr@gmail.com>.
*Corresponding author.

ABSTRACT – Brazil has advanced in export volume but has not been able to increase prices over the last decade for wood products. This work seeks to contribute to the understanding of this conflicting scenario, evaluating the growth in the revenue of Brazilian exports of these products during two periods: 2011-2015 and 2016-2020, as well as decomposing its effects in price, exchange rate, and volume. The method applied was the *shift-share*, widely used to identify determinants of sectoral and regional economic growth, being a precursor to the approach in the analysis of forest sector exports. Historical series for 5 (five) categories of wood products were analyzed, with export data from the Ministry of Economy. The historical series of nominal exchange rates from the Institute of Applied Economic Research (IPEA) was used. The real effective exchange rate (RER) followed the methodological note of the IPEA. All product categories analyzed had positive effects in terms of volume, for both periods, with a greater proportion in the second being driven by the exchange rate, although with a loss in real price, failing to offset inflation. The only exception was wood manufacturers, a product with higher added value, which presented gains in volume, exchange rates, and price. The volume effect was the most relevant, followed by the exchange rate as a result of the appreciation of the dollar against the real against the exchange rate and control of inflation in terms of the divergent effects on the national and international scenario. The price presented negative variations in export revenue, with a decline over the period. In addition to the added value of exported products, world stocks and levels of consumption may have contributed negatively to this scenario, affecting all categories of exported products, except for manufactured wood products, the only category that did not reflect such justifications.

Keywords: Export; *Shift-share*; Wood.

AVALIAÇÃO DOS EFEITOS PREÇO, CÂMBIO E VOLUME NO CRESCIMENTO DAS RECEITAS DE EXPORTAÇÕES BRASILEIRAS DE PRODUTOS DE MADEIRA

RESUMO – O Brasil avançou em volume de exportação, mas não conseguiu aumentar preços ao longo da última década para os produtos de madeira. Este trabalho busca contribuir com o entendimento deste cenário destoante, avaliando o crescimento na receita das exportações brasileiras desses produtos durante dois períodos: 2011-2015 e 2016-2020, bem como, decompondo seus efeitos em preço, câmbio e volume. O método aplicado foi o ***shift-share****, amplamente utilizado para identificar determinantes do crescimento econômico setorial e regional, sendo precursora a abordagem em análise de exportações do setor florestal. Foram analisadas séries históricas para 5 (cinco) categorias de produtos de madeira, com dados de exportação do Ministério da Economia. Utilizou-se a série histórica de taxa de câmbio nominal do Instituto de Pesquisa Econômica Aplicada (IPEA). A taxa de câmbio efetiva real (TCR) seguiu a nota metodológica do IPEA. Todas as categorias de produtos analisadas apresentaram efeitos positivos em volume, para ambos os períodos, com maior proporção no segundo, sendo impulsionado pelo câmbio muito embora com perda em preço real, não conseguindo compensar a inflação. A única exceção foi com manufaturas de madeira, produto de maior valor*

agregado, que apresentou ganhos em volume, câmbio e preço. O efeito volume foi o mais relevante, em seguida o câmbio como reflexo da valorização do dólar frente ao real em face da taxa de câmbio e controle de inflação em termos dos efeitos divergentes no cenário nacional e internacional. O preço apresentou variações negativas na receita de exportação com queda ao longo do período. Além de valor agregado dos produtos exportados, estoques mundiais e níveis de consumo podem ter contribuído negativamente com este cenário, afetando todas as categorias de produtos exportados, exceto produtos manufaturados de madeira, única categoria que não refletiu tais justificativas.

Palavras-Chave: Exportação; ***Shift-share***; *Madeira*.

1. INTRODUCTION

Exports of wood products have been consolidating and presenting constant growth in recent years, placing Brazil as an important global player in various wood segments. As of 2014, in the midst of the downturn in the Brazilian economy, the wood industry expanded its sales to the international market. Brazil benefited from the gradual recovery of the North American economy and real estate market, the growth of the Asian market, specifically China, and the appreciation of the US dollar against the Brazilian currency (ABIMCI, 2019). According to Quéno (2015), two main factors favor the growth of Brazilian wood production: a) in the internal market - competitiveness compared to other energy sources; b) in the export market - the favorable exchange rate.

Rossi and Mello (2017) point out that in 2015, given the fragility of the Brazilian economy that occurred after the 2014 elections, the government opted for a recessive shock, in other words, it resorted to a set of economic austerity policies in which one of the main elements of this recessive shock was the exchange rate. Thus, between January 2014 and January 2015, the exchange rate represented a devaluation of the real of more than 50%, contributing to the increase in the rate of inflation and, therefore, to the reduction of real wages, negatively impacting consumption, in addition, in the short term, this change makes the basket of products that make up the investments more expensive.

The devaluation of the real against the dollar benefited Brazilian exports, but factors such as the reduction in global demand and the increase in production, energy, raw materials, and labor costs within Brazil harmed industries. In addition, with the opportunity offered by the exchange rate, several companies that only worked in the domestic market started to export, which caused an increase in supply and, consequently, a decrease in international sales prices (Gaio and Miske, 2016).

The forest-based industry in Brazil has been characterized by investing in exports of low-added value products, such as sawn wood, which, from an economic point of view, has become an increasingly less profitable activity in view of the factors linked to the performance of this industry (Andrade, 2014).

In order to contribute to a better understanding of the growth in revenues from Brazilian exports of wood products from planted forests during the last decade, specifically in relation to the effects of price, exchange and volume, In the present work, the *shift-share* method was applied, widely used to identify drivers of sectoral and regional economic growth, in a precursory approach to the analysis of exports from the forest-based sector.

The behavior of exports of 5 products was analyzed: wood manufacturers, veneers, raw wood, chipped wood and partially worked wood, dividing the analysis into two periods: 2011-2015 and 2016-2020.

The importance of this type of analysis lies in the fact that the market commonly assesses the performance of exports in a linear fashion, based on volume and revenue. This generates a bias in the interpretation, and the most common error is related to price since the effects are not properly segregated and real prices are not considered.

2. MATERIAL AND METHODS

2.1 Analytical Model

For this study, the *shift-share* method was used to decompose export revenue into the effects of exchange, volume, and price in the analysis of variations in Brazilian wood export revenue. According to Souza et al. (2007), in this approach, the effects are captured

by the variations of their components over time, and the interaction between the sources is not considered, that is, when one of the effects is analyzed, the other is assumed to be constant.

Some applications of the *shift-share* method stand out in the works of:

(i) Souza et al. (2007) analyzed the effects of the exchange rate, the volume exported and the international price of soybeans on its export revenue, in the period from 1994 to 2005, verifying the isolated effect of each of the variables studied on the referred revenue;

(ii) Carvalho et al. (2012) studied the effect of area and productivity on the production of eucalyptus hardwood pulp;

(iii) Soares et al. (2013), evaluated the influence of the exchange rate and the dollar on the prices of Brazilian natural rubber;

(iv) Othman et al. (2018) analyzed the export competitiveness of Malaysian processed palm oil in ten major importing countries in the period 2001 to 2016, identifying the potential for export growth in selected major importing countries;

(v) Santos et al. (2019) decomposed the sources of export earnings from Brazil nuts, with an analysis of the main variables: price, volume, and exchange rate;

(vi) Wu and Jiang (2019) explored forestry economic growth and the evolution of industrial structure in Heilongjiang, China, demonstrating that the economic growth rate of the forestry industry is higher than the national average;

(vii) Pasarib et al. (2020) identified changes in the agricultural sector in Bengkulu, Indonesia, from 2010 to 2016, in a descriptive analysis survey with secondary data;

(viii) Montenegro and Costa (2021) analyzed exports from the mesoregions of Minas Gerais in the period 2008-2020;

(ix) Blanco et al. (2021) evaluated the renewable energy plan in Spain for 2011-2020 with the objective of evaluating the effects of regional production of clean energy, and identifying the employment generated in the renewable sector.

Analyzes on the growth of exports of wood products were segregated into two periods (0 and t), the first being 2011-2015, when the average nominal exchange rate was R$2.20/US$1.00, and the second 2016-2020 was characterized by the devaluation of the Brazilian real against the dollar, with an average nominal rate of R$3.88/US$1.00. The average annual rates were used, which, compared to the rates of December 31 of each year proved to be very close, with differences around 5%, more or less.

The *shift-share* application models, used by the authors mentioned above, served as a basis for the model of this work, especially the one used by Souza et al. (2007). Thus, the revenue from the export of wood is defined as follows:

$$R = Q \times P_{R\$} \quad \text{Eq-1}$$

Where:

R: Revenue in Reals from wood exports;

Q: Quantity (in volume) of exported wood in tons; and

$P_{R\$}$: Price in Reals received by the Brazilian exporter.

The international price of wood in dollars is converted to the price in Reals by the product of the real exchange rate and the price in dollars:

$$P_{R\$} = \lambda \times P_{US\$} \quad \text{Eq-2}$$

Where:

$P_{US\$}$: Price in dollars received by the Brazilian exporter, and

λ: Real exchange rate (*R$/US$*).

Substituting (2) into (1) presents that revenue from wood exports is the result of the exported volume, the exchange rate, and the international price of wood, that is:

$$R = Q \times (\lambda \times P_{US\$}) \quad \text{Eq-3}$$

The analysis was performed by the annual growth or decrease rate of revenue from wood exports, resulting from the variation that occurred between the analyzed year (t) and the previous year (t-1). Expressions (4) and (5) present the variation in revenue from wood exports in Reals, respectively, for the initial period “0” and the final period “t”:

$$R_0 = Q_0 \times (P_{US\$0} \times \lambda_0) \quad \text{Eq-4}$$

$$R_t = Q_t \times (P_{US\$t} \times \lambda_t) \quad \text{Eq-5}$$

In expression (6), there is the price effect, which indicates the change in revenue in Reals that occurred due to the change in the price in dollars, and in expression (7), the exchange effect, which captures the effect of exchange rate changes on revenue. When calculating each effect, the others will always be considered constant:

$$R_t^P = Q_0(P_{US\$t} \times \lambda_0) \quad \text{Eq-6}$$

$$R_t^\lambda = Q_0(P_{US\$t} \times \lambda_t) \quad \text{Eq-7}$$

The total effect or the total change in revenue from wood exports, in Reals, from the initial period to the end, is defined by:

$$R_t - R_0 = (R_t^P - R_0) + (R_t^\lambda - R_t^P) + (R_t - R_t^\lambda) \quad \text{Eq-8}$$

Where:

R_t-R_0: Total change in revenue in Reals;

(R_t^P-R_0): Contribution of the international price effect;

(R_t^λ-R_t^P): Contribution of the exchange rate effect; and

(R_t-R_t^λ): Contribution of the exported volume effect.

In expression (8), it is possible to observe each of the three effects individually or added together as the expression presents, being, in this case, the annual growth rate of export earnings. To find the share of each of the effects in the total change in export earnings, multiply both sides of expression (8) by1/ (R_t-R_0):

$$1 = \frac{(R_t^P - R_0)}{(R_t - R_0)} + \frac{(R_t^\lambda - R_t^P)}{(R_t - R_0)} + \frac{(R_t - R_t^\lambda)}{(R_t - R_0)} \quad \text{Eq-9}$$

It is also possible to represent each of the effects studied as a percentage of the total effect, multiplying the two sides of the identity (9) by:

$$i = \left(\sqrt[t]{R_t - R_0} - 1\right).100$$

and with t = 1:

$$i = \left[\left(\frac{R_t}{R_0}\right) - 1\right] \times 100$$

Where *i* represents the average annual rate (in %) of change in export revenue (the total effect).

Thus, the effects that act on export revenue, in percentage, are:

$$i = \frac{(R_t^P - R_{t-1})}{(R_t - R_{t-1})}i + \frac{(R_t^\lambda - R_t^P)}{(R_t - t - 1)}i + \frac{(R_t - R_t^\lambda)}{(R_t - R_{t-1})} \quad \text{Eq-10}$$

Where the three terms represent the three effects, in percentage, in the same sequence of expression (8).

2.2 Data Source

Databases from the Ministry of Economy (ME, 2021) were used through the Excel spreadsheet CUCI - Uniform Classification for International Trade, which includes export and import for all products on the Brazilian export agenda, since 1997.

Subsequently, for information on exports of forest-based products, the category "wood" was selected, which considers: a) manufactured items with 2 (two) subcategories: wood and veneer manufacture; b) raw materials with three (3) subcategories: raw wood; chipped wood and partially worked wood.

For each product, a file was created contemplating monthly values from Jan/11 to Dec/20 – 5 models with 120 observations each, comprising the following elements and units:

- TIPO – in this column the options are EXP and IMP, for export and import respectively. The EXP option was selected;

- CO_ANO – column that includes the years of the series, since 1997. The range 2011 to 2020 was selected;

- CO_MES – selected months from January to December;

- NO_CUCI_POS – this column represents the description of all the products exported by Brazil. The 5 products were selected as previously described;

- NO_CUCI_SEC – represents macro categories. In this case, the following were selected: manufactured articles and raw materials;

- US$ VL_FOB – FOB (Free On Board) dollar value monthly for each product line;

- KG_LÍQUIDO – expresses the weight in kilograms of the exported product, which is later converted to tons;

- Column1 – indicates the unit value of each product and period.

2.3 Nominal and real exchange rate

The nominal exchange rate is the ratio that expresses the price of a unit of the national currency against the foreign currency or vice versa. Exchange rates fluctuate all the time and are called nominal appreciations or depreciations (Branchieri, 2002). The nominal exchange rate (R$/US$) was obtained from the website of the Institute of Applied Economic Research (Ipeadata, 2021).

The real exchange rate (RER) is defined as the price ratio between the national product and the foreign product. In this way, a devaluation of the RER means that the national product became cheaper than the foreign one, stimulating domestic demand for national products, both by increasing exports and decreasing imports (Branchieri, 2002). The RER for exports followed the IPEA methodological note, updated in May 2018, and is the weighted arithmetic average of Brazil's bilateral real exchange rates with 24 selected trading partners. The real bilateral exchange rate is defined by the quotient between the nominal exchange rate (in R$/unit of foreign currency) and the relationship between the National Consumer Price Index (INPC/IBGE) of Brazil and the Consumer Price Index (CPI) of the country considered. The weightings considered in the study vary from year to year, being obtained by the shares of each partner in the total of Brazilian exports to the countries considered in the 2 immediately previous years. The calculation methodology was updated and revised in October 2015, involving the recalculation of the entire historical series (Ipeadata, 2021).

3. RESULTS

When starting the analysis of the effects of the dollar and the exchange rate, it was observed that the prices in dollars in the category of wood manufactures were the only ones that presented a stable behavior over the period, with +0.9% p.a. (*per annum* – per year). All the others presented a drop in real price: veneers -5.2% p.a.; raw wood -11.0% p.a.; chipped wood -1.4% p.a.; partially worked wood -4.2% p.a. The consolidated result, adding the 5 categories analyzed, pointed to a drop of -4.6% p.a. in prices.

To verify the variability of the real exchange rate (R$/US$), the coefficient of variation (CV), which is the result of dividing the standard deviation by the average, was evaluated. In the 2011-2015 period

Source: ME (2021) – elaborated by the authors.
Fonte: ME (2021) – elaborado pelos autores.

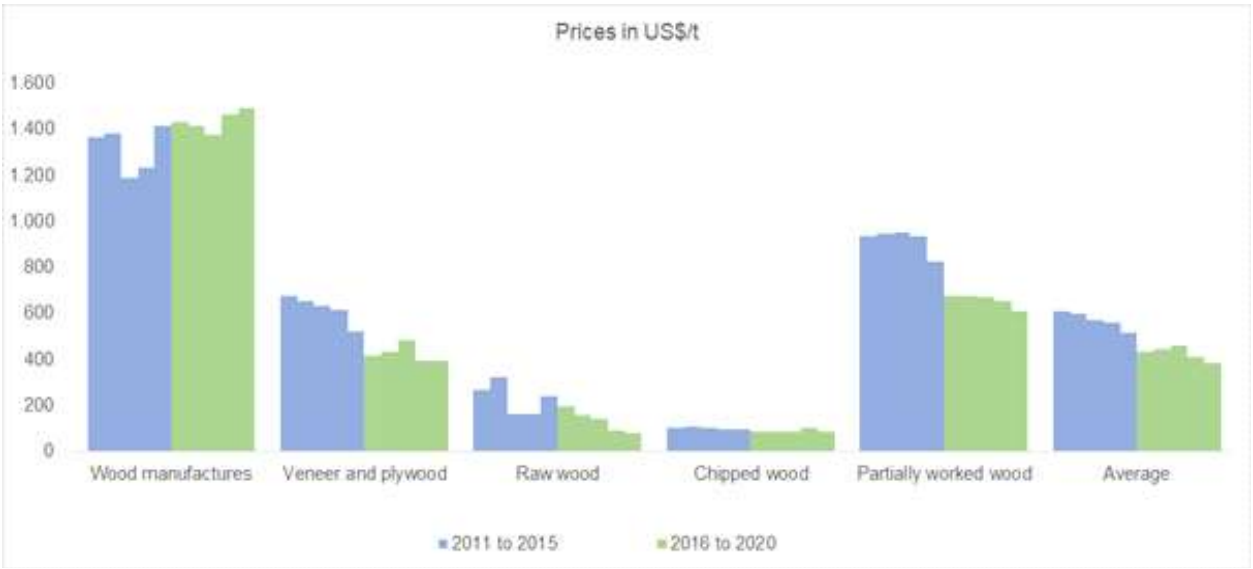

Figure 1 – Prices in US$/t for the 5 categories of products and average, highlighting 2011-2015 and 2016-2020.
***Figura 1** – Preços em US$/t para as 5 categorias de produtos e média, destacando 2011-2015 e 2016-2020.*

Source: ME (2021) – elaborated by the authors .
Fonte: ME (2021) – elaborado pelos autores.

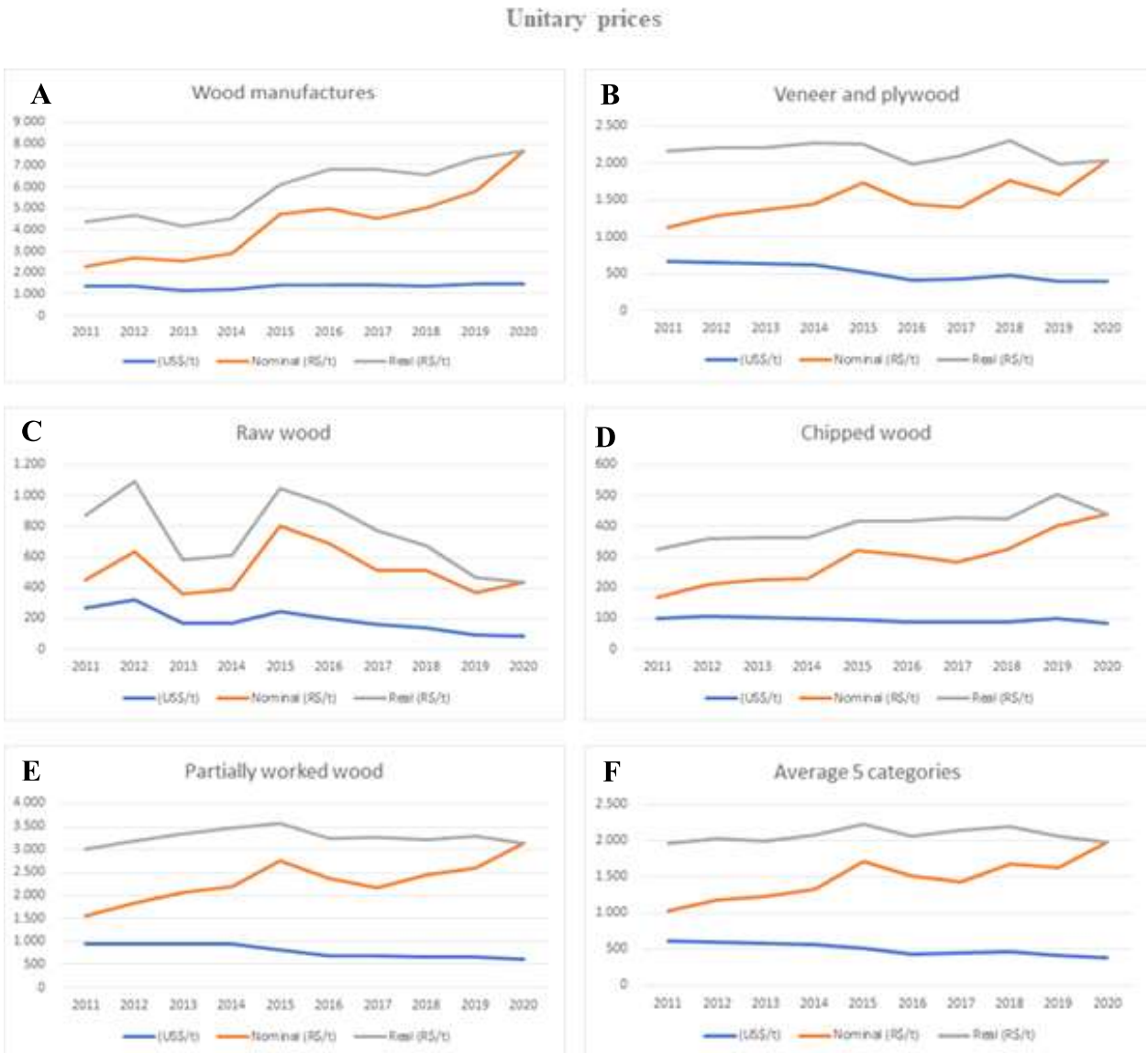

Figure 2 – Comparison of the evolution of unit prices in US$/t; R$/t nominal and R$/t real.
Figura 2 *–Comparação da evolução dos preços unitários em US$/t; R$/t nominal e R$/t real.*

the CV was 12% with an average exchange rate of 3.62, while in the 2016-2020 period the exchange rate was more stable, with a CV of 3.5% and an average of R$4.90/US$1.00. In this way, the second period proved to be more challenging for increasing or even maintaining prices, with a decline in most categories (Figure 1).

The market normally analyzes prices on a nominal basis, therefore, it is important to point out that the analysis of revenues and exports in nominal terms is incorrect, not just a bias because it does not consider inflation variations over time, being incorrect, above all, when expressed in Reals. In nominal prices, it is observed that only the raw wood

Source: ME (2021) – elaborated by the authors.
Fonte: ME (2021) – elaborado pelos autores.

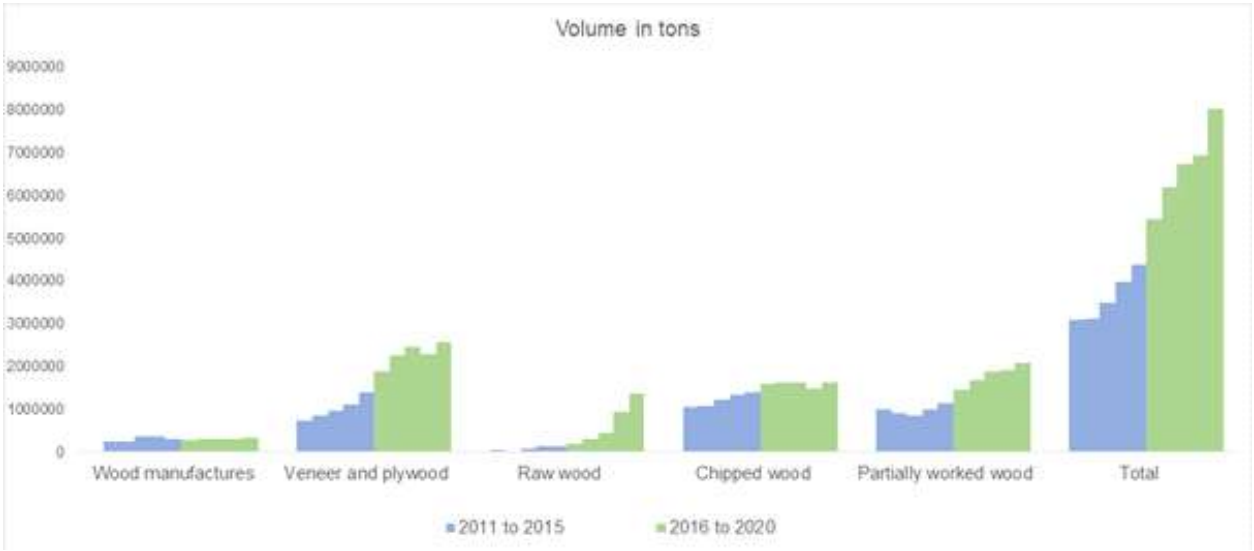

Figure 3 – Volume in tons for the 5 categories of products and total, highlighting 2011-2015 and 2016-2020.
***Figura 3** – Volume em toneladas para as 5 categorias de produtos e total, destacando 2011-2015 e 2016-2020.*

category presented a price drop in the period, with a negative result of -0.4% p.a., as presented in the curve in (Figure 2C), with all the others presenting increases: wood manufacturers +12.9% p.a.; veneers +6.1% p.a.; chipped wood +10.0% p.a.; partially worked wood +7.2% p.a. (Figure 2A, 2B, 2D, and 2E). On average for the 5 categories, the balance was positive at +6.8% p.a., based on nominal prices. When observing the curves in the real base price, all (except wood manufacturers) present a decrease, indicating that most of the analyzed products did not manage to increase their real price above inflation.

The analysis of the results for the absolute volume exported in tons per year indicated an increase in all categories, with wood manufacturers +3.4% p.a.; veneers +13.2% p.a.; raw wood +42.42% p.a.; chipped wood +4.4% p.a. and partially worked wood + 7.7% p.a. In the total volume of the 5 categories, the increase was +10% p.a., starting the decade with 3.1 million tons exported, ending with 8.0 million tons. In 2011-2015, there was an increase of 1.3 million tons, while the 2016-2020 was 3.6 million tons (Figure 3).

The results of the *shift-share* analysis highlight the wood manufacturers' category (Figure 4A) as the only one with positive results, in 2011-2015 and 2016-2020 for all intents and purposes, totaling R$1.6 billion in contribution over the decade. This contribution represents 16.5% of the total value of growth in revenue from wood exports, which was R$9.66 billion, however, the volume of this category represents only 6% of total exports. All other categories had the same result: positive for volume and exchange, and negative for the price (Figure 4).

The veneer category, which represents 32.2% of the volume, added up to a contribution of R$3.52 billion to the total revenue from exports (Figure 4B), corresponding to 36.4% of the total, with a loss of R$1.47 billion in price. Wood manufacturing, a product that differs from the others, adding value in all analyzed effects, represents 6.0% of the volume. A similar result happened with the other categories of raw wood, chipped wood, and partially worked wood, which together represented 61.8% of the total volume exported, contributing R$4.55 billion or 47.1% of the value, with a loss of R$1.85 billion in price (Figures 4C, 4D and 4E).

Manufactured articles (wood products + veneers), which together correspond to 38.2% of the exported volume in the period, or 19.6 million tons, generated 50.1% of the value, while raw materials (raw wood

Source: ME (2021) – elaborated by the authors.
Fonte: ME (2021) – elaborado pelos autores.

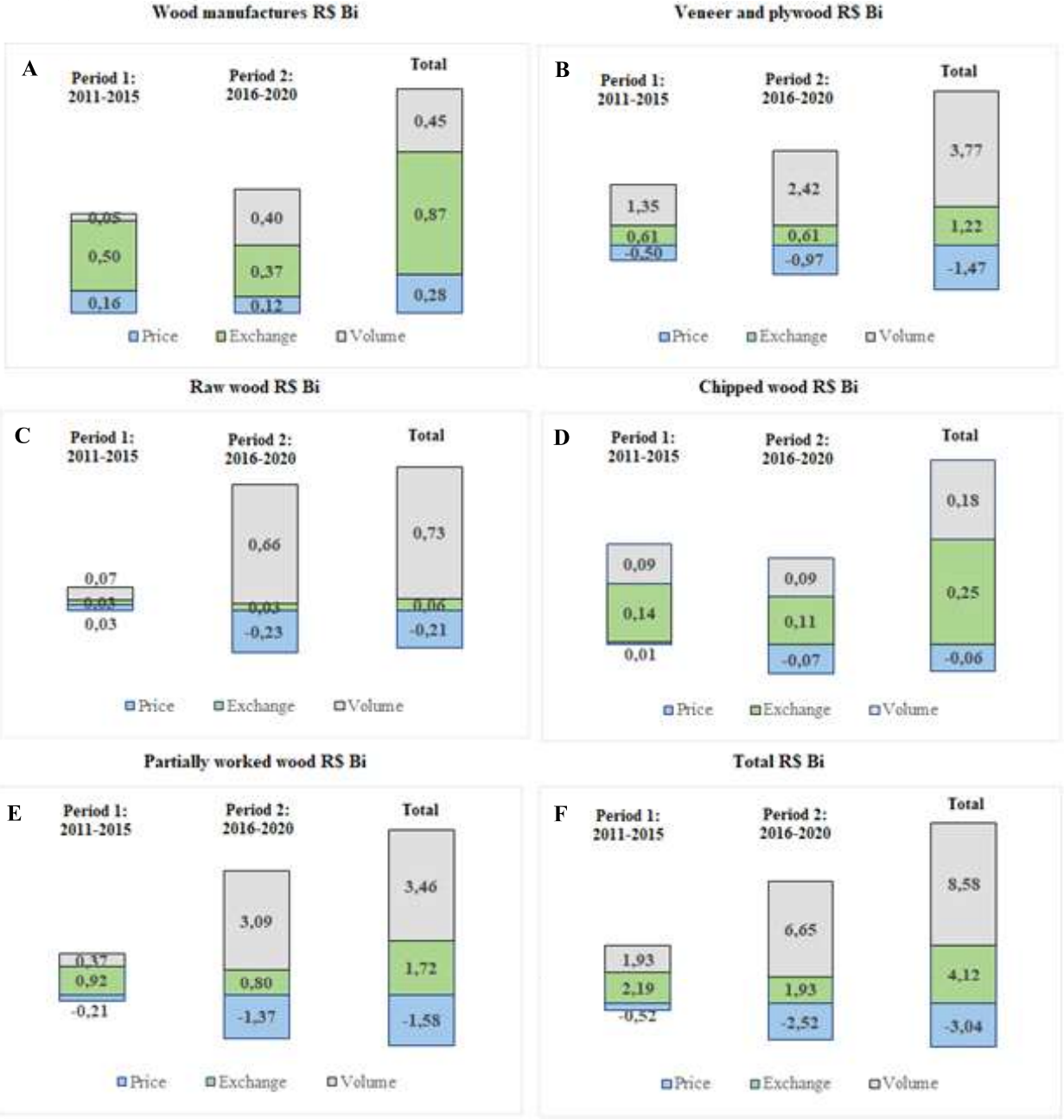

Figure 4 – Results of *shift-share* analysis in R$ Bi for the 5 product categories and total, highlighting 2011-2015 and 2016-2020.
Figura 4 *– Resultados da análise shift-share em R$ Bi para as 5 categorias de produtos e total, destacando 2011-2015 e 2016-2020.*

+ chipped wood + partially processed wood), which together accounted for 62.8% or 31.8 million tons, generated the remaining 49.9% of the exported value with wood (Figure 5A). The volume of manufactured articles reached a peak of 41% of participation in the years 2017 and 2018, presenting an average of 38%

Source: ME (2021) – elaborated by the authors.
Fonte: ME (2021) – elaborado pelos autores.

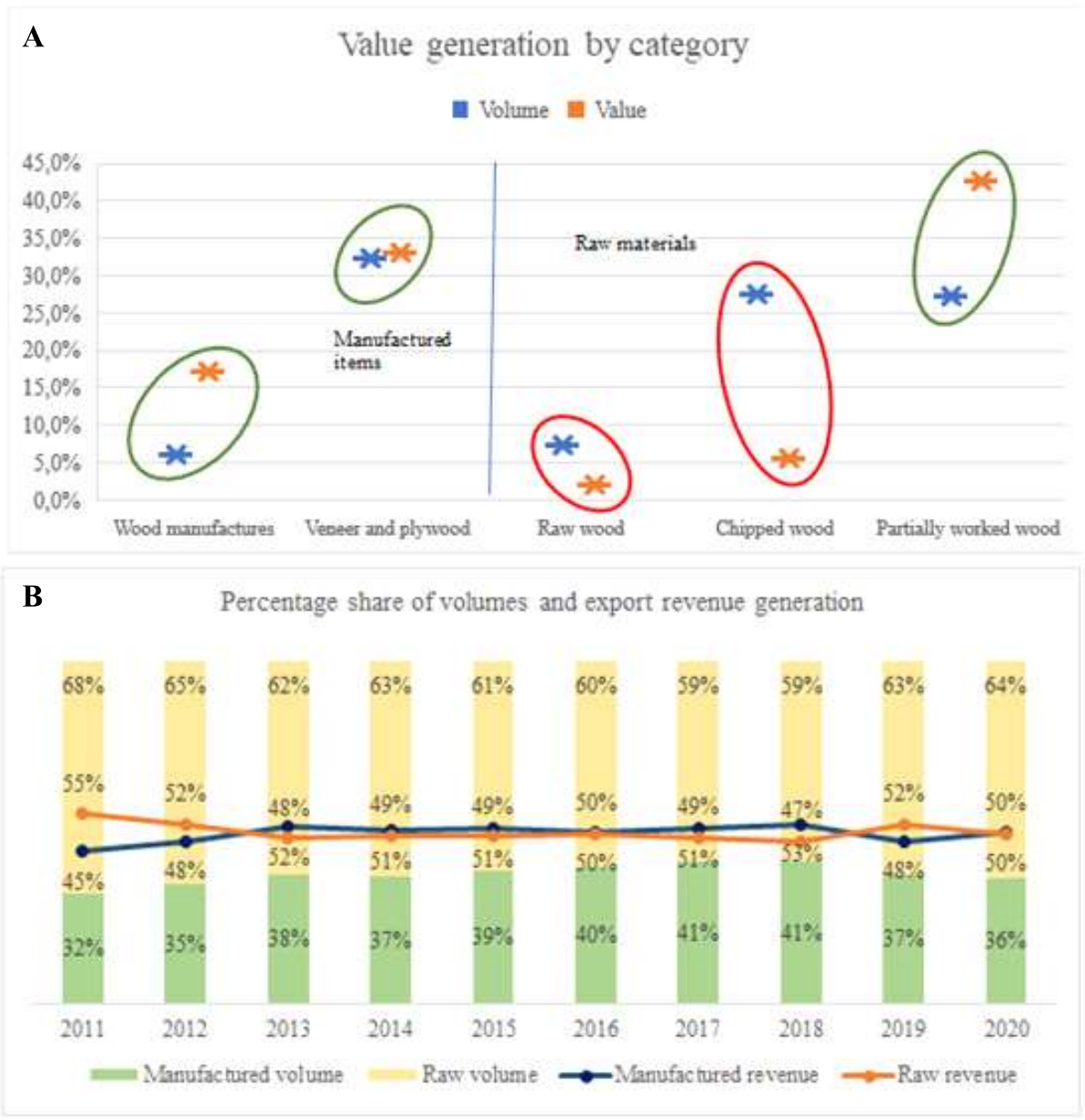

Figure 5 – Value creation by category and percentage share of volumes and revenue generation.
Figura 5 *– Criação de valor por categoria e percentual de participação nos volumes e geração de receita.*

in the period, while the average value creation in the period was 50% for manufactured articles and 50% for raw materials (Figure 5B).

4. DISCUSSION

Sousa Filho et al. (2018) studied the behavior and dynamics of exports from Brazilian states,

taking as a regional basis the total Brazilian exports, for the periods before and after the world financial crisis, which had its apex in the years 2008/2009, thus composing two analyses, the first for 2000-2007 and the second for the years 2010-2016. The authors considered the division of exports into three types: manufactured goods, semi-manufactured goods, and primary goods, using the *shift-share* method, applied to the information base of the Ministry of Development, Industry, and Foreign Trade for the sectorial analysis of the goods.

The *shift-shar*e method applied in this work, allowed us to verify the difficulty faced by Brazil in adding value to wood products for export, after all, among the 5 (five) analyzed categories, only one of them, wood manufacturers, managed to increase the real price over the analyzed period, and this category represents a small volume, only 6% of the total exported. However, it is not limited to just that, it is also necessary to consider tax issues, logistics aspects, industrial bottlenecks, and more recently the sustainability, ESG, climate change, and carbon agenda.

The high productivity of planted forests in Brazil is a condition that has generated opportunities for export growth over the last decade, reinforcing Brazil's share in the international market. According to IBÁ (2020), the adoption of good management practices, genetic improvement, and the country's edaphoclimatic conditions have led to the worldwide recognition of Brazil's high productivity, compared to other countries, considering the volume of wood produced per area per year and for one of the smallest cycles between planting and production in the world.

The veneers category presented in the years 2015 and 2016 the greatest variations in all effects. It was the segment that grew in volume in the order of 13.2% p.a., with an average price of US$523/t, only lower than the wood manufacturers' US$1,376/t.

Reis and Campos (1998) analyzed the relationship between the effects of the exchange rate adopted by Brazil and the prices of cocoa on the New York Stock Exchange on cocoa prices in Brazilian currency, between 1975 and 1995, noting that changes in prices in Brazilian currency were more influenced by changes in prices in dollars than by changes in the exchange rate.

The works of Silva and Carvalho (1995), Reis and Campos (1998), and Zugaib and Santos Filhos (2021), although applied to products other than wood, and at different moments over time, converge with the results obtained in the present work, by indicating the dependence between price formation and the exchange rate. The devaluation of the real against the dollar boosted Brazilian exports of wood in the international market, especially in the second period of 2016-2020, which represented a significant volume growth.

It is important to point out that this volume growth occurred mainly in categories of low-added value, such as chipped wood, which represents 27.5% of the total volume of wood products exported. This category has the lowest added value among all, with a weighted average price of US$96/t in the period analyzed. There were 14.1 million tons exported between 2011 and 2020, with a 1.7% drop in dollar prices.

Despite not being on the list of products studied in the present work, it is worth mentioning the pulp sector in Brazil, which began its phase, considered "modern", in the 1960s with the tax incentive program implemented by the government, and was a great success both in the planting of conifers (*Pinus elliotiii* and *Pinus taeda*) and the genus Eucalyptus. This sector, by the way, supplies wood industries today. There was great growth in the sector, high investments mainly in Eucalyptus short fiber, the emergence of companies with a vision focused on the foreign market, high standards of administrative governance, and state-of-the-art technology both in forestry and industrial production, which placed Brazil as the main pulp exporting country (Da Silva and De Souza Maciel, 2022).

An interesting aspect about the added value of pulp exports, which at first could be a disadvantage, is starting to bring other advantages. This industry has been dedicating investments, according to IBÁ (2020), to the development of the economy, with a vision of sustainability, which together guides production models through the use of natural resources in a conscious way so that they can provide: clean energy sources, mitigation of the effects of climate change, food, renewable products, among other necessities for survival today and for future generations. Looking to the future, this industry has been investing in research

and innovation to increasingly offer bioproducts or biomaterials from the circular economy, biodegradable and recyclable, in line with the new mentality of a conscious consumer concerned with sustainability.

The partially worked wood category, the most representative in terms of export value of wood products, with 42.5% of this, had the second highest weighted average price, with US$788/t, with price drops in 2011-2015, which was accentuated at the beginning of 2016-2020. The positive exchange rate effect of R$1.72 billion in the total period offset the loss in the real price of R$1.58 billion, while the increase in volume generated an increase of R$3.46 billion, the most important effect in this category.

5. CONCLUSION

Brazil's share of the wood export market grew during the period analyzed, starting the decade with 3.1 million tons per year, and ending with 8.0 million tons, highlighting the competitiveness of products from high-productivity planted forests. On the other hand, the difficulty to increase prices on a real basis was evident, which may have several causes such as limitations in the differentiation of products on a large scale, interference of world stocks and consumption levels, and difficulties in operating in new markets, among others.

The 2016-2020 period, characterized by the devaluation of the real against the dollar, was the most favorable for the volume effect, totaling R$6.65 billion in growth, while the previous period totaled R$1.93 billion. The effects of price and exchange with opposite and equivalent signs, together resulted in an increase of R$1.08 billion in the total period, with the biggest losses in price occurring in the second period. It is worth noting that the devaluation of the real has an impact on the composition of what is exported in terms of categories of wood production, and in terms of value added.

Despite the exchange rate effect reflecting gains in export earnings in this momentarily favorable scenario, this macroeconomic advantage may not be sustainable in the medium-long term.

Losses in the price effect were only possible to observe due to the method used with real prices, because with nominal prices, as the market normally analyzes variations, the negative effects of the period would not be observed.

Even with the application of the *shift-share* technique and its respective assumptions made for the accomplishment of this work on the effects on Brazilian exports of wood, there are limitations in not being able to explain all the movements that influenced export performance during the analyzed period. There is also an expressive influence of the exchange rate policy.

For better performance of Brazilian wood exports in the next decade, so as not to become overly dependent on volume, it is important that the business sector continues to organize itself to work with products with greater added value, discussing market trends and perspectives, improving its production practices to continue serving the increasingly demanding foreign market.

As recommendations, this work opens a space for continuity in 3 lines: a) Post-pandemic update, to have comparative parameters (before and after) the performance of Brazilian exports of wood products and their price, volume, and exchange effects; b) Evaluate the GDP of the countries importing the products analyzed, in order to understand their respective economies, whether they were/are heated or not, and their conjectural points such as tax, logistics, industrial policy, among others; c) Segregate forest products into manufactured goods, semi-manufactured goods, and primary goods, and apply the *shift-share* method in this sectoral analysis of goods.

AUTHOR CONTRIBUTIONS

José Sawinski Júnior wrote the paper, obtaining, analysing and discussing the economical results. João Carlos Garzel Leodoro da Silva supported the data analysis, methological approach, concepts definitions and overall reviews. Ademilson de Souza Maciel supported the data analysis and reviews. Vitor Afonso Hoeflich supported scientific methodology.

6. REFERENCES

Andrade AA. certificação como estratégia para a melhoria da qualidade de pisos de madeira [tese].

Piracicaba: Escola Superior de Agricultura "Luiz de Queiroz", Universidade de São Paulo; 2014. 128 p.

Associação Brasileira da Indústria de Madeira Processada Mecanicamente – ABIMCI. Estudo setorial. 2019. [cited 2022 february 20]. Available in: https://abimci.com.br/wp-content/uploads/2021/08/Estudo-_Setorial-_Abimci-_2019_versao_portugues.pdf

Blanco M, Ferasso M, Bares L. Evaluation of the effects on regional production and employment in spain of the renewable energy plan 2011–2020. Sustainability. 2021; 13(6): 1-14. https://doi.org/10.3390/su13063587

Branchieri CM. Taxa de câmbio: um estudo sobre os determinantes, taxa de câmbio real e efetiva e crises cambiais [dissertação]. Porto Alegre: Programa de pós-graduação em economia da Faculdade de Ciências Econômicas da UFRGS; 2002. 141 p.

Carvalho KHA, Silva ML, Soares NS. Efeito da área e da produtividade na produção de celulose no Brasil. Revista Árvore. 2012; 36(6): 1119-1128. doi: https://doi.org/10.1590/S0100-67622012000600012

Da Silva, JCGL.; De Souza Maciel, A.; International trade standards and competitiveness of the Chemical wood Pulp and conifer sawn wood sectors from Brazil and Chile front of major world exporters. Forest Policy and Economics, v. 137, p. 103706, 2022.

Gaio MGR, Miske ASW. Impactos da variação do dólar no mercado brasileiro de exportação de madeira de junho de 2010 a junho de 2015 – Memorial TCC; FAE, Centro Universitário, Núcleo de Pesquisa Acadêmica – NPA 2016. [cited 2022 November 08]. Available https://memorialtcccadernograduacao.fae.edu/cadernotcc/article/view/163

Indústria Brasileira de Árvores – IBÁ. Relatório anual 2020. Ano base 2019. [cited 2022 November 08]. Available in: https://iba.org/datafiles/publicacoes/relatorios/relatorio-iba-2020.pdf

Instituto de Pesquisa Econômica Aplicada – IPEADATA. Dados macroeconômicos. Taxa de câmbio nominal. [cited 2021 December 03]. Available in: http://ipeadata.gov.br/exibeserie.aspx?serid=38389

Ministério da Economia – ME. Balança Comercial Brasileira: exportação e importação brasileira. [cited 2022 January 12]. Available in: https://www.gov.br/produtividade-e-comercio-exterior/pt-br/assuntos/comercio-exterior/estatisticas/balanca-comercial-brasileira-acumulado-do-ano

Montenegro RLG, Costa SAT. Dinâmica das exportações no Estado de Minas Gerais: uma análise de *shift-share* (2008-2020). Geosul. 2021; 36(79): 219-248. https://doi.org/10.5007/2177-5230.2021.e73466

Othman N, Yusop Z, Mansor M. Identifying export competitiveness of Malaysia's processed palm oil: using *shift-share* technique. International Journal of Accounting, Finance and Business. 2018; 3(12): 1-11.

Pasaribu E, Anitasari M, Gunawan R. A *shift-share* analysis on regional competitiveness: a case of Bengkulu province, Indonesia. International Journal of Social Science Research. 2020; 2(1): 1-10.

Quéno LRM. Produção de pellets de madeira no Brasil: estratégia, custo e risco do investimento [tese]. Cidade: Universidade de Brasília; 2015. 162 p.

Reis SM, Campos, RT. Efeitos da taxa de câmbio sobre os preços do cacau. In: Congresso Brasileiro de Economia e Sociologia Rural, 17, 1998. Poços de Caldas. Anais, Brasília, DF: SOBER, 1998. v. 2, p. 89-100

Rossi P, Mello G. Choque recessivo e a maior crise da história: a economia brasileira em marcha à ré. Centro de Estudos de Conjuntura e Política Econômica - IE/UNICAMP [internet]. 2017; [cited 2022 November 08]. Available: https://www3.eco.unicamp.br/images/arquivos/NotaCecon1_Choque_recessivo_2.pdf

Santos MAS, Yared JAG, Rebello FK. Production evolution and export performance of Brazil nut in the brazilian amazon. International Journal of Food and Agricultural Economics. 2019; 7(3): 215-228. doi: http://dx.doi.org/10.22004/ag.econ.292486

Silva CRL, Carvalho MA. Taxa de câmbio e preços de *commodities* agrícolas. Revista Informações Econômicas. 1995; 25(5): 23-35.

Soares NS, Silva ML, Rossmann H. Influence of exchange rate and dollar over the brazilian natural rubber price. Revista Árvore. 2013; 37(2):

339-346. doi: https://doi.org/10.1590/S0100-67622013000200015

Sousa Filho JF, Menezes VB, Silva LA. A dinâmica das exportações brasileiras nos períodos pré e pós-crise financeira mundial de 2008/2009: uma análise *shift-share*. Revista de Desenvolvimento Econômico. 2018; 2(40): 28-51. http://dx.doi.org/10.21452/rde.v2i40.5667

Souza SSS, Lamera JA, Bonjour SCM. Mudanças cambiais e o efeito dos fatores de crescimento das receitas de exportações brasileiras de soja. Revista de Economia e Agronegócio. 2007; 5(1): 1-24 https://doi.org/10.25070/rea.v5i1.95

Wu P, Jiang, Y. Dynamic *shift-share* analysis of forestry industry structure and competitiveness in Heilongjiang province. Journal of Forests. 2019; 6(1): 15-22. https://doi.org/10.18488/journal.101.2019.61.15.22

Zugaib ACC, Santos Filho LP. Efeitos dos preços internacionais e da taxa de câmbio sobre os preços domésticos de cacau em amêndoas. Revista Agro trópica. 2021; 33(3): 59-172.