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COMPETITIVENESS ANALYSIS OF BRAZILIAN ETHANOL EXPORTS FROM 2004 TO 2018: A CONSTANT MARKET SHARE APPROACH

Análise da competitividade das exportações brasileiras de etanol de 2004 a 2018: Uma abordagem de constant market share

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ABSTRACT
Foreign trade has become increasingly important in countries' economies. In a realistic view, one can consider that there is a tendency to increase Brazil's participation in international trade in agribusiness products. In parallel with other major world food producers, Brazil has good relative conditions for expanding its production base. The country leads the world in sugar production and exports and is second in ethanol production and exports after the United States. Global demand for biofuels has risen sharply since the 2000s due to rising oil prices and fossil fuels' impact on the environment. In this context, in terms of competitiveness, the question that arises is "How competitive is Brazil regarding its biofuel production," considering not only the ability of biofuel to be an important ally in the environmental issue, but also an alternative to the oil derivatives market. Based on this context, the objective of this article was to analyze the panorama of the Brazilian competitiveness of biofuel, highlighting the performance of exports, evaluating the effect of world trade, the destination effect of exports, and the competitiveness effect in the period from 2004 to 2018, using the constant market share method. The main results found demonstrate that the Brazilian biofuel is competitive due to the increase in world exports. Despite the competitiveness presented, Brazil is losing its share in the fuel market in recent years.

Keywords: Biofuel. Bioeconomics. Constant market share.

RESUMO
O comércio exterior tem se tornado cada vez mais importante para as economias dos países. Numa visão realista, pode-se considerar que há uma tendência de aumento da participação do Brasil no comércio internacional de produtos do agronegócio. Ao lado de outros grandes produtores mundiais de alimentos, o Brasil apresenta boas condições relativas para expandir sua base produtiva. O país é líder mundial na produção e exportação de açúcar e é o segundo na produção e exportação de etanol, depois dos Estados Unidos. A demanda global por biocombustíveis aumentou acentuadamente desde os anos 2000 devido ao aumento dos preços do petróleo e ao impacto dos combustíveis fósseis no meio ambiente. Nesse contexto, em termos de competitividade, a pergunta que se coloca é "Quão competitivo é o Brasil na produção de biocombustíveis", considerando não só a capacidade do biocombustível ser um importante aliado na questão ambiental, mas também uma alternativa no mercado de derivados de petróleo. Com base nesse contexto, o objetivo deste artigo foi analisar o panorama da competitividade brasileira do biocombustível, destacando o desempenho das exportações, avaliando o efeito do comércio mundial, o efeito destino das exportações e o efeito competitividade no período de 2004 a 2018, usando o método de quota de mercado constante. Os principais resultados encontrados demonstram que o biocombustível brasileiro é competitivo devido ao aumento das exportações mundiais. Apesar da competitividade apresentada, o Brasil vem perdendo participação no mercado de combustíveis nos últimos anos.

Palavras-chave: Biocombustível. Bioeconomia. Constant Market Share.

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1. INTRODUCTION

With globalization, external trade has become increasingly important in countries' economies. The development of the world economy in the last decades has been increasing the interdependence of the countries' economies, mainly in the issue of food production and in the formation of the prices of these commodities. International competitiveness has its relevance in the dynamics of economic development of countries and in raising the standard of living of their population (Baibulekova, Sauranbay, Kenzhebaeva, Beimbetova, & Kenzhlina, 2017).

Throughout history, several authors have discussed international competitiveness. The term appears in researches since Adam Smith (1776), Ricardo (1817), Heckersher (1919), and Ohlin (1933). In a contemporary approach, Leontief (1953), Linder (1961), Vernon (1966), Grubel and Lloyd (1971), Helpman and Krugman (1985), and Porter (1993) stand out.

International trade has been growing in recent years as a result of the trend of the new economic dynamics since the 1990s. In this context, world agricultural trade grew on average almost three times from 2000 to 2016, with an annual growth rate of more than 6%, from USD 570 billion in 2000 to USD 1.6 trillion in 2016 (FAO, 2018). In a realistic view, one can consider that there is a tendency to increase Brazil's participation in international trade of agribusiness products.

In comparison with other major world food producers, Brazil has good relative conditions for expanding its production base (Contini, Pena Júnior, Santana, Martha Júnior, 2012). Brazil leads the world in sugar production and exports, and after the United States, it is the second in ethanol production and exports (UN Comtrade, 2019).

Brazil's high potential for the production of biofuels resulted in its ranking as the world's second-largest producer of biofuels in 2017, according to data from the National Agency of Petroleum (Agência Nacional do Petróleo, Gás Natural e Biocombustíveis [ANP], 2017). In addition, according to the ANP, Brazil produced 28 billion liters of ethanol this year (2017). Sugarcane production is the third most cultivated crop in Brazil after soy and corn. Part of the increase in sugarcane cultivation reflects the increase in demand for automotive fuels over the years (Leal, Nogueira, & Cortez, 2013; Rodrigues, Losekann, & Silveira Filho, 2018).

Global demand for biofuels has increased sharply since the 2000s due to rising oil prices and fossil fuels' impact on the environment (Strassburg et al., 2014). Ethanol (produced from several raw materials) is the main biofuel used globally, and its consumption is likely to increase in the future. Its energy balance is generally positive, which means that growing sugarcane absorbs more carbon than is emitted when ethanol is burned as fuel (Martinelli & Filoso, 2008).

In this context, the question arises: How competitive is Brazil regarding its biofuel production (ethanol)? Furthermore, what are the main markets for Brazilian biofuel? This study sought to answer these questions, highlighting the capacity of biofuel to be not only an important ally for the environmental issue but also an alternative to the oil products market. As Brazil is one of the protagonists in the context of biofuels, this work analyzes its current position in the world amid global competitiveness.

Based on this context, this article's objective was to analyze the panorama of the Brazilian competitiveness of biofuel (ethanol), emphasizing exports' performance. The effect of world trade, the destination effect of exports, and the competitiveness effect between 2004 and 2018 were evaluated using the constant market share (CMS) method, which analyzes market share.

Many studies have been carried out on this biofuel competitiveness theme, such as the one

presented by Tosto, Alves, Torres, and Lima Filho (2014), who made their analysis using the political analysis matrix (MAP) methodology. With the same objective, Franck, Coronel, Ziani, Oliveira, and Trevisan (2018) analyzed competitiveness but using the revealed comparative advantage index. However, no study focusing on biofuel competitiveness analysis using CMS has been found.

The CMS method has often been used to measure the competitiveness of different products in different studies, such as those by Armando, Flores, Liliana, and Arce (2015), Shuai and Wang (2018), Valenciano, Uriarte, and Battistuzzi (2017), Olavo, Camara, Sereia, and Caldarelli (2015), Macedo and Soares (2015), and Penha and Alves (2019). The method presents data on the growth of competitiveness by analyzing whether the growth in exports can be explained by the growth in world exports, the structure of the exports, and their destination.

This article consists of five sections, including this introduction. Section two addresses a review of competitiveness. Sections three and four explore the constant market share method and the research results and discussions, respectively. Finally, in the fifth section, the final considerations are presented.

2. LITERATURE REVIEW

2.1. Measuring competitiveness

This section refers to a bibliographic review on competitiveness and biofuel exports. The focus is on bioeconomics and biofuel (ethanol), in their context of production and consumption, both globally and nationally.

Competitiveness is analyzed by several authors throughout the history of economic theory, both explicitly and implicitly, starting with classical theory — Adam Smith (1776), with the absolute advantages, and David Ricardo (1817), with the comparative advantages.

Subsequently, competitiveness would be studied by neoclassical theory, with the Heckscher-Ohlin (HO) model, also known as the "model of factor proportions" (Dieter & Englert, 2007). The HO model incorporates the factor of production and attributes the different factor endowments as a cause of comparative advantage, explaining that each country is relatively abundant in at least one factor of production (Gonçalves, 1997; Paiva, Alcantra, Campos, and Santos, 2019).

Competitiveness can be characterized as the ability of a product, a company, or an economy to maintain or increase its market share quotas (Kupfer, 2012). For economic and business science, 'competitiveness' is generally the term used to designate the intensity with which companies compete with each other in a given market or sector of activity, between one region and another, or between one country and another. The globalization of the economy is a reality. It requires that different economies between countries or between states be competitive.

The term 'competitiveness' is often used in discussions and economic policy documents. However, there is no clear definition of precisely what competitiveness is and how it is measured in quantitative terms (Dieter & Englert, 2007). Competitiveness can be defined as a company's ability to produce goods or services with the quality of the specific standard, which is demanded by the target market, using the number of inputs equal to or less than that used by the market (Kupfer, 2012).

For the economy to be competitive, it is necessary to increase the productivity of a country, and for that, it is necessary to identify a production according to the characteristics of a nation to increase efficiency and, consequently, the quality of the products. Thus, citizens' quality of life will be improved with national competitiveness (Porter, 2007).

Krugman & Obstfeld (2001) points out that the possibilities of gains from trade are the most important in the international economy. The author also mentions that international trade produces an increase in products because it allows each country to specialize in producing the good in which it has a comparative advantage.

A model that permeates competitiveness analysis is the constant market share (CMS), used in Germany to analyze competitiveness in the global forest industry sector (Dieter & Englert, 2007), and in China to investigate the factors influencing the fluctuation in export trade of the new Chinese energy industry and fluctuations in export trade (Wang, Zheng, Pei, & Jin, 2017).

2.2. The competitiveness of biofuel

Competitiveness has intensified in Brazil, mostly since the 1980s and 1990s, influenced by the increase in world trade and the port reforms carried out in this period, which aimed to improve the logistics for the export of goods and services to other continents (Silva, Zilli, & Toe, 2013).

With the new global dynamics, the performance and analysis of competitiveness become essential. In this search, to demonstrate competitiveness, Tosto et al. (2014) analyzed the competitiveness of Brazilian ethanol using the political analysis matrix (MAP), developed by Monke and Pearson (1989). The authors show that private and social profitability was positive, which indicates the competitiveness and economic efficiency of these chains, respectively.

Franck et al. (2018), in order to analyze the competitiveness of ethanol produced in Brazil compared to the production in the United States, France, and the Low Countries, used the export performance indicator (DES) and the competition index (IC). In addition, the authors also used the revealed comparative advantage index with data from 1999 to 2016. The study concluded that Brazilian ethanol exports have the capacity to increase their share in the world market for the product, in addition to having comparative advantages.

As demonstrated by Franck et al. (2018), Brazil has stood out in the world biofuel market. Until reaching this level, the country went through several periods, as will be presented below.

With the oil crisis in the 1970s, Brazil sought alternatives to overcome the global problem, creating the Proálcool Program. Its objective was to encourage the production of biofuel through the production of sugarcane. Another important fact in the Brazilian history of biofuel use occurs in March 2013, when the flex car appears, with the objective of reducing the use of oil in the country. The flex car was developed and popularized mainly because of the Brazilian experience of 30 years of exploration of sugarcane ethanol (Samanez, Ferreira, & Nascimento, 2014).

In this context, according to the United Nations Comtrade — International Trade Statistics Database (UN Comtrade, 2019), Brazil appears among the largest producers and consumers of biofuel in the world. In 2008, the country obtained its largest export volume (in millions of liters) of biofuel, exporting around 4 billion liters.

Brazil, the United States, the Low Countries, and France are the world's leading exporters of biofuels. Thus, between 2004 and 2018, biofuel exports grew by 435% (UN Comtrade, 2019).

It should be noted that the European government had taken on a commitment (a renewable energy target) stipulating the use of 10% of renewable energy in the transport sector by 2020. Thus, in 2010, the European Union set a target of 5.75% of biofuels mix (as in the example of Brazil), but the target was not reached, and it is necessary to resort to imports (Diverio, Fragoso, Silva, 2016), enabling Brazilian participation in a market in which Brazil has a high production when compared to its share in the world and, therefore, creating the possibility of insertion in exports.

3. METHODOLOGY

3.1. The method

The constant market share (CMS) method, which was developed by Tyszynski (1951), has been applied in several studies that discuss competitiveness and exports (Kumar & Muraleedharan, 2007). It is a model widely disseminated by Richardson (1971), which can be used to analyze foreign trade's growth and performance. The main advantage of this method is that it allows the analysis by components and the product's behavior in the target market (Valverde, Soares, & Silva, 2006).

The works that use the CMS method aim to evaluate a country or region's share in the world or regional flow of international trade (Coronel et al., 2011). The CMS assumption is that each country or bloc maintains the same level of world trade. If there is a change, it must be implicit in the model, and its performance is attributed to competitiveness (Leamer & Stern, 2006).

The competitiveness measured by the CMS has a direct relationship with exports. Leamer and Stern (2006) argue that the factors that contribute to alterations in exports have three origins: the first is due to the concentration of goods that have their slowest increase in demand; the second is related to exports to regions where there is no increase in demand; and, finally, the third is the lack of interest or incentive to export the product.

Thus, the basic and general model of the CMS method, according to Maranhão and Viera Filho (2016), consists of the definition of the market share of a country, which is given by the quantity exported in values divided by the total of world exports, being a function of relative competitiveness:

$$S \equiv \frac{q}{Q} = f\left(\frac{c}{C}\right)$$

where S represents the market share of the country in question; q-value refers to the total value exported by the country; Q refers to the quantity exported worldwide; and c and C represent the competitiveness of the country and the world, respectively. Readjusting and deriving taking time into account, we have that:

$$\frac{dq}{dt} \equiv S\frac{dQ}{dt} + Q\frac{dS}{dt} = S\frac{dQ}{dt} + Qf'\left(\frac{d\left(\frac{c}{C}\right)}{dt}\right)$$

where:

$q^{\cdot}$ = total variation in quantity exported from country A;

S$Q^{\cdot}$ = world exports; and

$S^{\cdot}$Q = competitiveness effect.

Based on equation (2), the total variation in the quantity exported from country A is explained by the growth effect of world exports and the competitiveness effect. However, the country could concentrate its exports on a specific product (as it can happen in the Brazilian case of commodities); thus, the identity (2) would assume a new equation.

$$S_{ij} \equiv \frac{q_{ij}}{Q_{ij}} = f_{ij}\left(\frac{c_{ij}}{C_{ij}}\right), where\ f_{ij}'(.) > 0$$

where:

i = product commercialized by country A; and

j = target market.

Thus, as Maranhão and Viera Filho (2016) presented, the total export growth is given by three factors that take into account the goods and their destination. According to Richardson (1971), we have that:

$$\dot{q} \equiv S\dot{Q} + \left[\sum_i S_i\dot{Q}_i - S\dot{Q}\right] + \left[\sum_i\sum_j S_{ij}\dot{Q}_{ij} - \sum_i S_i\dot{Q}_i\right] + \sum_i\sum_j Q_{ij}\dot{S}_{ij}$$

a b c d

The term (a) indicates the effect of market growth, (b) the effect of the product, (c) the effect of the market, and (d) the effect of competitiveness. According to Maranhão and Viera Filho (2016), there is a "decomposition based on the growth of world

exports, favorable or unfavorable, associated with the structure of goods or markets and changes in relative competitiveness." Considering the time in equation (4), the differentiation by product *i* and by destination *j*, it is possible to write the following identity:

$$\Delta q_{ij} \equiv \left(\frac{q_{ij}^1 - q_{ij}^0}{q_{ij}^0} \right) q_{ij}^0 + \left[q_{ij}^1 - q_{ij}^0 - \left(\frac{q_{ij}^1 - q_{ij}^0}{q_{ij}^0} \right) q_{ij}^0 \right]$$

$$being \quad \left(\frac{q_{ij}^1 - q_{ij}^0}{q_{ij}^0} \right) = g_{ij}$$

The expression can be grouped as follows:

$$\Delta q \equiv g q^0 + \sum_i (g_i - g) q_i^0 + \sum_i \sum_j (g_{ij} - g_i) q_{ij}^0 +$$

$$(i) \qquad (ii) \qquad (iii)$$

$$+ \sum_i \sum_j (q_{ij}^1 - q_{ij}^0 - g_{ij} q_{ij}^0)$$

$$(iv)$$

According to Maranhão and Viera Filho (2016), the identity (5.1) "expresses the variation in exports of the country or region in question, from the initial period to the end, decomposing the growth rate of these exports into four effects." The effects are presented below:

> (i) growth effect of world trade: represents the percentage growth in exports of Brazilian ethanol in relation to the world growth in exports of the biofuel;
> (ii) agenda composition effect: is related to the growth between two or more goods in the export agenda; this analysis is left out of this study since we are analyzing only one product;
> (iii) destination effect of exports: represents the gains and losses, as a percentage of growth, and this may show growth or a stagnant market; and
> (iv) residual effect: it is a proxy for competitiveness; when a country loses market share, this relationship is directly linked to values that are not competitive with the world market.

3.2. Data sources

Data on biofuel exports (ethanol) and total world exports and imports used for the method were obtained from the following databases from 2004 to 2018. For the calculation of the constant market share, data from the Comex Stat of the Secretariat of Foreign Commerce (SECEX) were collected, which has information on the Brazilian export Free on Board (FOB) in dollars, using the code CUCI for the item (2207 — ethanol above 80%). For international information, data from the UN Comtrade (HS-92) were used, with code 51215.

3.3. Analysis period and scope

The period from 2004 to 2018 was analyzed for the method, being divided into five periods (period after flex cars, between 2004 and 2006; USA/ world crisis, between 2007 and 2009; increase in corn production in the USA, between 2010 and 2012; a significant increase in internal biofuel consumption, between 2013 and 2015; and the current period, between 2016 and 2018). Each sectorial analysis requires a definition of which trades the sector is composed of and what the respective products are.

4. RESULTS AND DISCUSSION

4.1. Destination of Brazilian biofuel exports

In recent years, Brazil has exported around USD 890 million in biofuel to the world (UN Comtrade, 2019). The main consumers of Brazilian biofuel are the USA, the Republic of Korea, and Japan, respectively. Table 1 presents data of the last three years of Brazilian exports of biofuel (ethanol) and their destination.

The USA stands out as the largest importer of Brazilian biofuel, with 57% in 2018, followed by the Republic of Korea and Japan, with 29% and 6.5%, respectively, in the same year. For the USA, between 2016 and 2018, there was a 21% increase in exports. Figure 1 shows data on Brazilian ethanol exports.

As shown in Figure 1, since 2003, there have been significant increases in biofuel exports until 2008, when they reached the largest exported quantity (4 billion liters). However, in 2008, reflected in the

global crisis, there was a drop in exports, although in the previous five years exports had remained at the same level. Figure 2 presents data from the world's largest biofuel exporters in 2018.

TABLE 1 – Countries of destination for Brazilian biofuel (ethanol) exports, in the period from 2016 to 2018, in USD

Destination	2016	2017	2018
World	896,495,630	806,856,922	892,099,659
USA	421,801,756	578,078,831	511,377,540
Rep. of Korea	300,266,933	136,863,571	260,416,725
Japan	44,618,702	50,298,740	57,119,559
Low Countries	37,181,495	22,887,618	24,026,343

Source: Authors' elaboration based on data from UN Comtrade (2019)

As shown in Figure 2, the USA is the largest exporter of biofuel (2018), followed by Brazil and the Low Countries. However, Brazil is also one of the largest importers. Thus, Figure 3 shows the largest importers of biofuel (ethanol) in the world. Germany stands out as the largest biofuel importer globally in 2018, followed by Brazil and the United States.

Brazil is the second-largest exporter of biofuel (2018). However, the country has a high consumption of the product, due to both its considerable fleet of flex vehicles (about 76%) and the percentage of alcohol added to the mixture of gasoline (Law No. 10,203/2001).

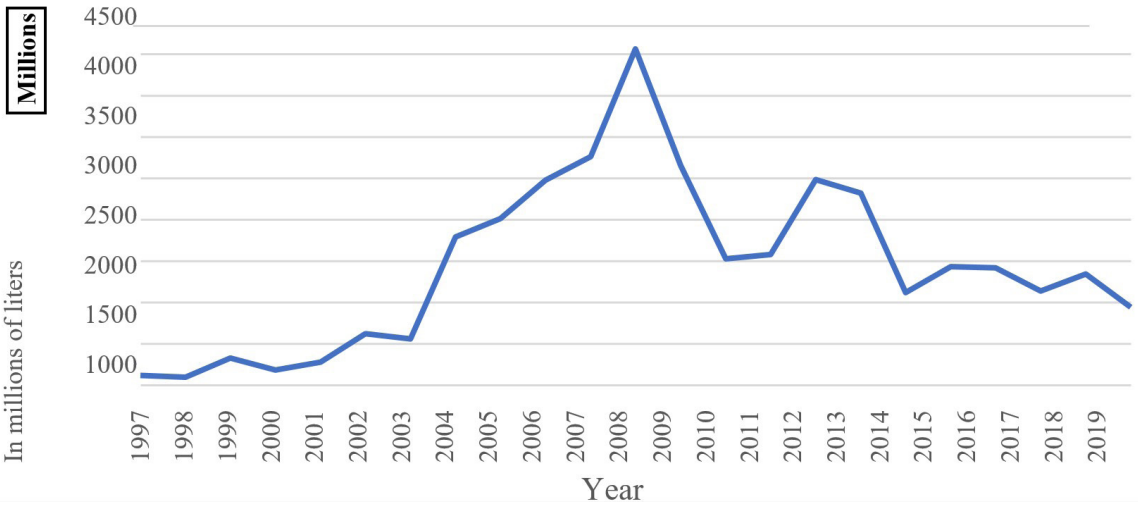

FIGURE 1 – Exports of Brazilian biofuel (ethanol) in millions of liters, from 1997 to August 2019
Source: Authors' elaboration based on data from Comex Stat (2019)

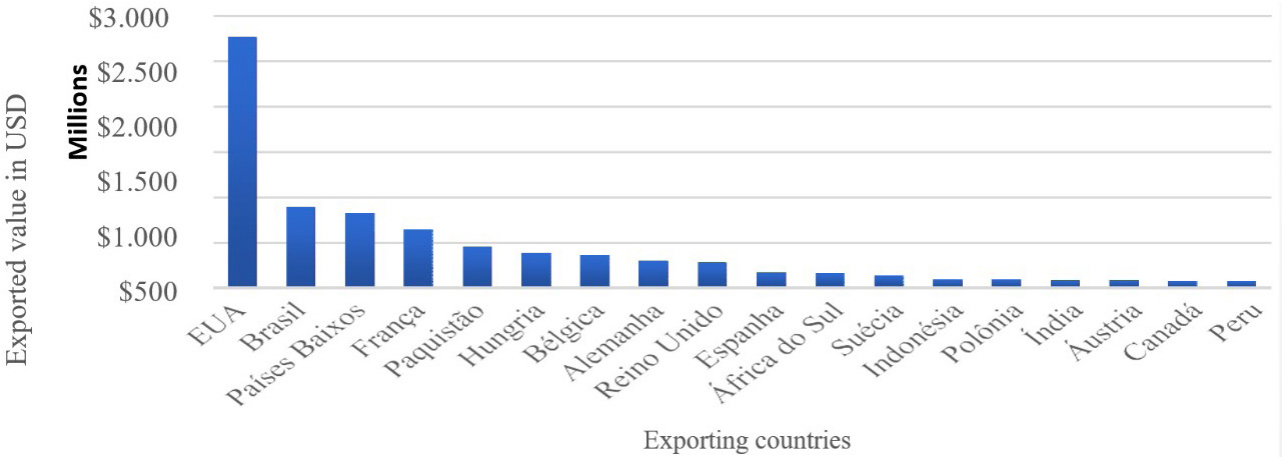

FIGURE 2 – Biofuel export values in USD by the largest exporters in 2018
Source: Authors' elaboration based on data from UN Comtrade (2019)

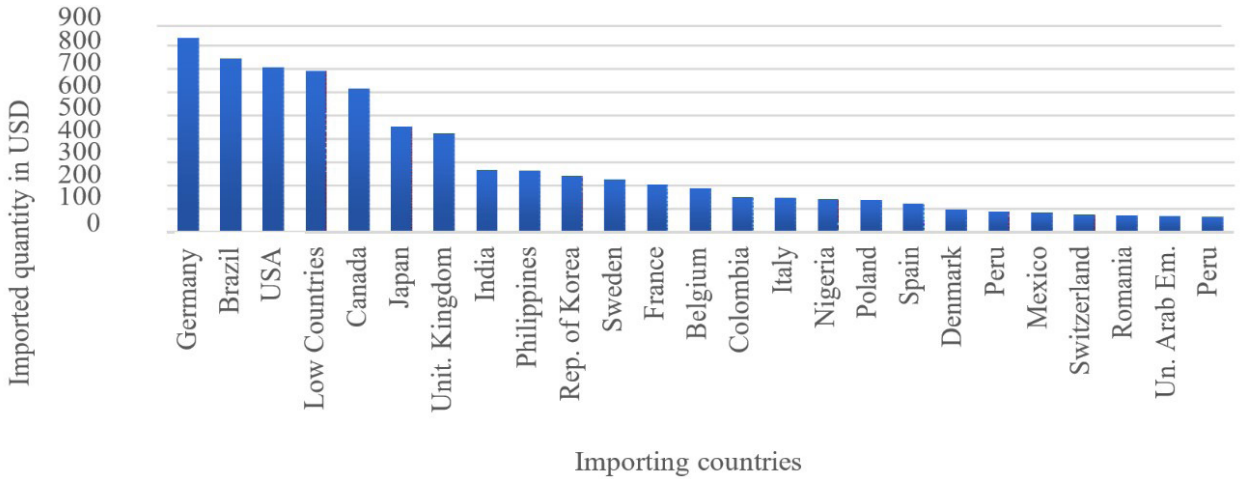

FIGURE 3 – Import values of biofuel in USD by the largest consumers in 2018
Source: Authors' elaboration based on data from UN Comtrade (2019)

In order to highlight the worldwide commercialization of ethanol biofuel in the world and the Brazilian participation, Table 2 presents the export values in dollars of ethanol commercialization in the world and Brazil.

As shown in Table 2, in 2011, the ethanol export obtained its highest value globally and, in 2012, its highest import value. Thus, as in 2008, Brazilian ethanol exports had their highest value in the analyzed period.

4.2. Constant market share for biofuel (sugarcane ethanol)

The CMS method, founded on the premise of the analysis in periods, based on alterations in the values exported and imported of a given product in the world, and a country or region in question. Thus, Table 3 shows the values of ethanol export and import, analyzed through periods.

As shown, between P1 and P2, there is an increase of about 100% in the export and import of biofuel in the world. Similarly, Brazilian ethanol exports have almost doubled. Between P2 and P3, there is still an increase globally. In the Brazilian case, there is a drop in exports. In the next periods (P4 and P5), there are declines in world exports and imports, in addition to the Brazilian ones, in relation to P3. Table 4 presents the results obtained from the analysis in the period using the CMS methodology.

According to Table 4, in the first period between 2004 and 2009, Brazil represented 33% of the ethanol market share. In the following period, there was a drop to 24%. Thus, as in the following periods, there were decreases in Brazilian participation, reaching the last period at 13.25% of the market share. The CMS analysis of the periods will be presented below.

- (P2-P1) Period II in relation to period I. When analyzing the decomposition of the sources of ethanol's growth from period II (2007-2009) in relation to period I (2004-2006), as shown in Table 3, it is possible to verify that the effects of growth in world trade and competitiveness were positive. However, the destination effect of exports shows negative values. Thus, the results indicate that Brazil is competitive in the international ethanol market, with growth in world trade being its main factor. The analyzed period occurs right after the creation of the flex car (2003), with the beginning of internal consumption on a larger scale (Barbosa & Shikida, 2019).

- (P3-P2) In this period of analysis, there was an increase in the growth of the global ethanol trade, and in the Brazilian ethanol competitiveness. Nevertheless, the destination of export decreased even more, considering the previous period, which can be characterized as a decrease in world imports

of the product. In 2008, the international crisis established after the USA's crisis caused a drop in exports. However, there was a recovery in the biofuels trade two years after the crisis.

TABLE 2 – Values (FOB), in USD, of world export, world import, and Brazilian ethanol export from 2003 to 2018

Year	World export	World import	Brazilian export
2004	1,600,991,449	1,707,511,987	497,814,430
2005	2,416,855,065	2,433,867,125	765,630,177
2006	4,030,080,374	4,487,413,033	1,604,806,503
2007	4,335,280,489	4,991,804,136	1,477,685,195
2008	6,712,444,933	6,598,681,711	2,390,246,803
2009	5,186,650,533	5,136,648,445	1,338,205,283
2010	5,974,994,812	5,483,956,839	1,014,284,969
2011	9,593,986,246	9,067,593,950	1,491,843,202
2012	9,090,649,770	9,747,626,622	2,186,207,266
2013	8,560,481,420	8,935,673,320	1,868,942,234
2014	7,537,776,663	7,134,828,022	898,030,959
2015	7,040,180,466	6,901,107,167	880,618,435
2016	7,184,440,354	7,137,122,211	896,495,601
2017	8,245,455,265	8,070,592,810	806,856,922
2018	8,541,944,742	8,511,931,889	894,242,033

Source: Authors' elaboration based on data from UN Comtrade (2019) and Comex Stat (2019)

- (P4-P3) In the period between 2010 and 2015, there was a significant decrease in ethanol imports. However, it was the period in which the competitiveness of Brazilian ethanol had its highest index, thus evidencing the competitiveness of biofuel in the face of the stagnation of the global ethanol market. World ethanol prices increased by more than 30% in 2010, in the context of an increase in the prices of commodities that serve as raw material for ethanol production, and with the prices of other forms of energy (fossils) remaining at the same level (Biodiselbr, 2011).

- (P5-P1) The indicator takes into account the initial and final periods of the analysis. Two indicators stand out in the period: the growth of exports and competitiveness. When considering the last period compared to the first, there is an increase in world trade, a decrease in the destination of imports, and an increase in the competitiveness of Brazilian ethanol in the market.

Two crucial factors stand out in world exports in the analysis period (2004-2018): the first is the

TABLE 3 – World ethanol export and import and Brazilian export

Periods	World export	World import	Brazilian export
P1 (2004-2006)	8,079,626,828	8,628,792,145	2,868,251,110
P2 (2007-2009)	16,234,375,955	16,727,134,292	5,206,137,281
P3 (2010-2012)	24,659,630,828	24,299,177,411	4,692,335,437
P4 (2013-2015)	23,138,438,549	22,971,608,509	3,647,591,628
P5 (2016-2018)	23,971,840,361	23,719,646,910	2,597,594,556

Source: Authors' elaboration based on data from UN Comtrade (2019) and Comex Stat (2019)

TABLE 4 – CMS for the analysis period of Brazilian ethanol

	P2 (2007-2009)	P3 (2010-2012)	P4 (2013-2015)	P5 (2016-2018)
	P1 (2004-2006)	P2 (2007-2009)	P3 (2010-2012)	P1 (2004-2006)
Period	P2-P1	P3-P2	P3-P4	P5-P1
Growth of world trade	55.60	57.58	(7.93)	5.1
Destination of exports	(3.9)	(7.35)	0.9	(0.5)
Competitiveness	48.3	49.8	107	95.4
Market share	33.20	24.2	17.45	13.25

Source: Research result

Note: Negative values are shown in parentheses

crisis in the USA in 2008, which can be observed in the period P3-P4, with the decrease in world trade of the product; the Brazilian share between 2008 and 2009 presented a significant decrease, but recovered in the following years, until 2012, when an overproduction of corn in the USA (the main raw material for ethanol in the country) caused the competitiveness of Brazilian ethanol to lose space in the world market.

The overproduction in the USA affects Brazil in several ways. In exports, there is a dispute for the countries' market. However, both countries are the main importers of ethanol as well. Thus, the 2008 crisis and the USA corn production in recent years affected Brazilian ethanol exports and their competitiveness, as can be seen in P3-P4, and the destination of exports. Finally, similar to the results by Tosto et al. (2014) and Franck et al. (2018), Brazil is competitive in the export of ethanol; using the constant market share methodology, the country also presents competitiveness.

In addition, the results found for biomass are similar to those presented by Wang et al. (2017) for China, in particular for the years after the 2008 crises, in which there was a post-crisis recovery. Differently from that, taking into account the competitiveness of Brazilian products, the study by Penha and Alves (2019) shows that the amount exported has not yet been recovered. Thus, the results presented in the literature reaffirm the capacity of Brazilian production and, mainly, its competitiveness in the international biofuel market.

CONCLUDING REMARKS

The world market for biofuels is necessary for the sustainable development of the world. In this sense, this work sought to analyze the trade of Brazilian fuel in the world market. The results of the study show that in the first period, between 2004 and 2009, Brazil represented 33% of the ethanol market share. In the following period, there was a drop to 24%, which continued in the following periods, reaching the last period with 13.25% of the market share.

Studies involving bioeconomics and its use in the most diverse fields (such as bioenergy) are essential to achieve the Sustainable Development Goals (ODS), with biofuels being one of the ways to achieve these objectives.

In this sense, Brazil presents itself as one of the leading producers and consumers of biofuel (ethanol) in the world. Based on the results of the study, Brazil is competitive in all analyzed periods. It is mainly characterized by the expanding world market in the first periods. However, despite the participation of Brazilian ethanol in the world market, it has been decreasing over time.

It is worth highlighting the Brazilian domestic consumption of biofuels, since the country is one of the main consumers, and in 2017, for the first time in history, Brazil imported more ethanol than it exported. This type of analysis was left out of the study. Thus, the study has the limitation that the model does not take into account the imports, this being a suggestion for further studies: to compare the import of ethanol by Brazil with its export.

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