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COMPETITIVE PERFORMANCE OF BRAZILIAN SOYBEAN EXPORTER AGRO-INDUSTRY IN THE PERIOD 2000 TO 2016

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ABSTRACT

The objective of this study was to analyze the competitive performance of soybean processing agro-industry based in Brazil during the period from 2000 to 2017, in order to demonstrate the Brazilian competitive capacity to expand markets and to remain a leader in the oilseed market. For this, the methodology used was to measure indicators such as Market Share and the Herfindahl-Hirschman Index. The database was obtained from the United States Department of Agriculture. The results showed that the soybean production chain in Brazil increased during the analyzed period. It was possible to confirm Brazil's growing insertion in the oilseed market. It was also possible to verify that the soybean production chain made important progress, and Market Share allowed identifying the percentage market share of power in two major countries, the United States (45.25%) and Brazil (46.71%). The Herfindahl-Hirschman Index measured the high concentration of the market in Brazil and the econometric model of the growth rate allowed to identify that the increase of the exports of Brazil grew at a geometric rate of 8.34% per year. Finally, the hypothesis was confirmed that the Brazilian soybean exporting industry is outperforming and leading the oilseed market.

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INTRODUCTION

The oilseed in Brazil represents a source of protein and vegetable oil, being the basic input for the feed that feeds poultry, swine and cattle, as well as the use of human food in response to the various industry advances (Costa and Santana, 2013). The competitiveness of Brazilian soybeans in the international market reflects the influence of many factors over time, from the available natural resources and agro-climatic conditions in which the country is rich, even the conditions under which they were built over the years, such as infrastructure, support institutions, macroeconomic and sectoral policies. In addition to the important advances in technologies and investments in research (Sampaio *et al*, 2012). Thus, studies such as the authors Coronel *et al* (2008) indicate that the main sources of growth for soy were initially the competitiveness, and subsequently the growth of world trade. In the same context, authors Dorneles and Caldarelli (2013) reflect that the effects of competitiveness and the growth of world trade in the Brazilian soybean production chain contributed to the performance of exports of the soybean complex as a whole. In recent years, according to the Brazilian Ministry of Agriculture, Livestock and Supply (BRAZIL, 2017a), the soybean complex is the leader in Brazilian exports, and soybeans have been the main commodity exported, representing an important role for agribusiness. In addition, Brazil was the second largest soybean producer in 2017, represented by 114.9 million tons, surpassed only by the US with a production of 117.2 million tons. The states that best represent this potential are in order of higher production, Mato Grosso, Paraná and Rio Grande do Sul, which accounted for 26.8%, 17.2% and 16.4% of Brazilian production in the year 2017 (EMBRAPA, 2017). Given the evolution of culture in Brazil and the role assumed by soy in agribusiness, the study has as a research problem: Does soybean processing agro-

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industry, based in Brazil, have the competitive capacity to expand markets and remain as one of the leaders in the trade of the oilseed? To achieve the proposed goal, the paper was structured in four sections, the first section presents the introduction and purpose of the study. The second section exposes the materials and methods. The third section looks at the results and discussions on the competitive potential of the soy processing agroindustry to expand markets and remain a leader in the oilseed market. And finally the fourth section presents the final considerations.

MATERIALS AND METHODS

This research is characterized as exploratory, of quantitative character. Exploratory, because it aims to improve knowledge about the soybean production chain, in order to characterize it. Descriptive, because it seeks to describe its characteristics through data collection (Gil, 2002). The collection of data that supports the analysis will be through bibliographical research, which Gil (2002, p.44) is "developed from material already elaborated", that is, concentrated in secondary sources as articles, books, technical opinions of state and national public agencies, reports, magazines, and other publications that have aggregated relevant information. The research has a quantitative character, because it uses mathematical techniques to verify the competitiveness of Brazilian soy exports in grain, bran and oil, through the indicators of competitiveness: Index of Comparative Advantages Revealed (IVCR); Relative Market Position (PRM); Market Share (MS); Herfindahl-Hirschman Index (IHH);The research is divided into two stages, the first will characterize the soybean production chain from the descriptive statistics, the second stage will be calculated competitive indicators to measure the competitiveness of exports of the Brazilian soybean production chain and meet the objective of verifying the capacity of the soybean agro-processing industry based in Brazil in the international oilseed trade.

Data Source

Figure 1 shows the respective variables considered in the composition of the indicators. There are four indicators and nine variables obtained from the various data sources.

Figure 1. Variables selected for calculation of Indicators

Indicator	Variables	Source
Revealed Comparative Advantages Index (IVCR)	X_{PP} is the value of the country's $_P$ product exports $_E$;	Foreign Trade Information Analysis System (BRAZIL, 2017b) linked to the Foreign Trade Secretariat of the Ministry of Development for the years 1997 to 2014, expressed in dollars.
	X_{TP} is the total value $_T$ of the country's exports $_E$;	
	X_{PM} is the value of exports of the product $_P$ of the world $_P$;	Food and Organization of the United Nations (FAO, 2017a) for the years 1997 to 2014, expressed in dollars.
	X_{TM} is the value of total exports $_T$ of the world $_P$.	
Relative Position of Market (PRM)	X_{PP} is the value of exports of the product $_P$ from the country $_P$;	AGROSTAT (BRAZIL, 2017a) linked to the Ministry of Agriculture, Livestock and Supply for the period from 1997 to 2016.
	M_{PP} is the total value $_T$ of imports of the product $_P$ from the country $_P$;	
	C_{MP} is the value of World Trade;	United States Department of Agriculture (USDA, 2017a) for the years 1997 to 2016
Market Share (MS) and Herfindahl Index Hirschman (IHH)	Γ_j is the capacity of the industry Γ ;	United States Department of Agriculture (USDA, 2017a) in 1000MT for the period 2000 to 2016
	γ_i is the production capacity of the firm's i-th industry i (i = 1, 2, 3...n);	United States Department of Agriculture (USDA, 2017a) in 1000MT for the period 2000 to 2016

DESCRIPTIVE STATISTICS

Descriptive statistics refers to the collection, observation, tabulation, presentation, analysis, interpretation, graphical representation and description of data obtained in order to make them manageable for the best interpretation (Escotet, 1973). It is necessary to use descriptive statistics to verify variations. The mean, median and fashion were analyzed.

COMPETITIVENESS INDICATORS

The following are the indicators used for the analysis of the research.

Revealed Competitive Advantages Index (IVCR)

The revealed comparative advantage index (IVCR) affects the relationship between the percentage participation of a product in the total exports of the country and the percentage share of the world exports of the product in the overall flow of exports (Macedo, 2007).

This index (I_p) is defined by the following equation:

$$I_p = \frac{\frac{X_{pp}}{X_{TP}}}{\frac{X_{PM}}{X_{TM}}} \quad (1)$$

According to contributions by Waquil *et al*. (2004), the Index of Comparative Advantages Revealed (IVCR) I_P is a ratio of proportions, in which the result is obtained by dividing the share of exports of the product in the country's export agenda by the participation of exports of the same product in the world export list, that is, the result shows if the country has comparative advantages, and can vary from zero to infinity.

Values above the unit indicate comparative advantage revealed for the country product and values below the unit present revealed comparative disadvantage.

Relative Market Position (PRM)

The Relative Market Position (PRM) is measured from the volume of exports and imports and has the purpose of verifying the participation of the commercialization of the product in the total of the trade (Silva, 2005). The indicator reveals the position of a nation in the market for a product, that is, it is about competitiveness among nations.

This index $(PRM_{\square})$ is defined by the following equation:

$$PRM_p = \frac{X_{pp} - M_{pp}}{CM} \quad (2)$$

The Relative Market Position (PRM) is expressed as a percentage, positive values reflect the relative market position of the country in relation to the product, while negative values represent the loss of market position and loss of competitiveness (Gasques and Conceição, 2002).

Market Share (MS)

Market Share aims to reveal the market share of firm i in industry j.

$$\Gamma_j = \sum_{i=1}^{n} \gamma_{ij} \quad (3)$$

In this sense, the market share of the individual firm P_{ij} is explained by an indicator ranging from 0 to 100. Given that:

$$P_{ij} = \frac{(100 \times \gamma)_{ij}}{\Gamma_j} \quad (4)$$

The result of the index reveals the percentage of market that each company owns. For Brazil, it is considered a market dominance of 20% by the company, so that it is considered relevant, according to Law 8,884 / 1994 (Costa, 2012).

Herfindahl-Hirschman Index (IHH)

The Herfindahl-Hirschman Index (IHH) expresses the concentration of the market under analysis from the sum of the squares of the market share of each country in the exports (Resende and Boff, 2002), expressed by:

$$IHH = \sum_{i=1}^{n} P_{ij}^2 \quad (5)$$

The results of the IHH can vary from 0 to 10,000, and extreme values represent perfect competition and monopoly. According to Mendes (1998) values below 1,000 determine a highly competitive market, while values between 1,000 and 1,800 the concentration is evaluated as low and above 1,800 is understood as highly concentrated. The countries with the largest Market Share participate more heavily in this index. In order to better visualize the interpretation to the IHH, three ranges of decision making are assumed by the Horizontal Mergers Guideline (UNITED STATES OF AMERICA, 2010b):

IHH<1.500: unconcentrated market

Entre 1.500 ≤ IHH ≥ 2.500: market with a moderate level of concentration

IHH> 2.500: highly concentrated market

In this case, the higher the HHI of the country, the less competition will be and the greater the concentration of that market, in other words, the smaller the number of countries negotiating.

RESULTS AND DISCUSSION

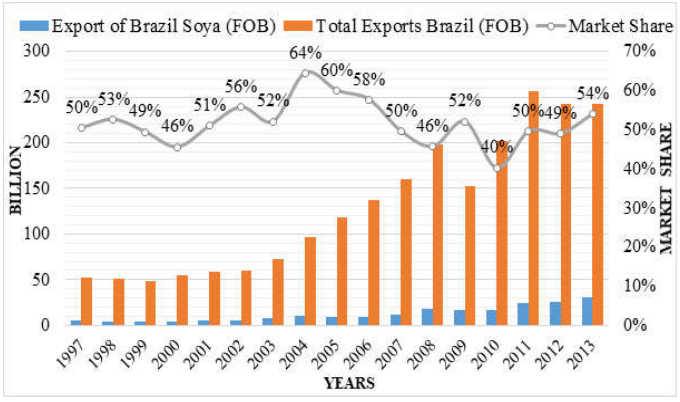
The results of this research will be presented in two stages, the first will address the soybean production chain in Brazil, and the second stage will be presented the indicators of competitiveness of Brazilian soybean exports.

Production chain of soybeans in Brazil

According to Brum (2002) soybean production was one of the main crops responsible for the strengthening of Brazilian agribusiness, involving a considerable high physical and financial volume of production and exports. It has a participatory chain of suppliers, processors, dealers, farmers, etc. and allowed a significant increase in production over the years, in which it provided chain growth in all areas, such as mechanization, storage structures, processing, transportation, exports, cultivated areas, among others. For Costa (2012) the soybean production chain occurs from the succession of activities that allow adding value to each stage, such as production, grain transformation and final product for human and animal use. Among these activities, it is possible to verify the input supply industry for soybean production, soybean cultivation, seed production, support, post-harvest grain and processing industry (Rhoden *et al*., 2017). In the last years, bran, oil and soybeans were the main products exported by Brazil, and in the year 2016 represented 29.9% of exports, making it the most exported agribusiness complex (BRAZIL, 2017a).

The growth in planted area, production, and export make Brazil an important player in the international soybean market, presenting itself as an example of vitality of the country's agriculture. The soybean complex presented significant increases in revenue throughout the expansion, increasing its value added (Brum, 2002).

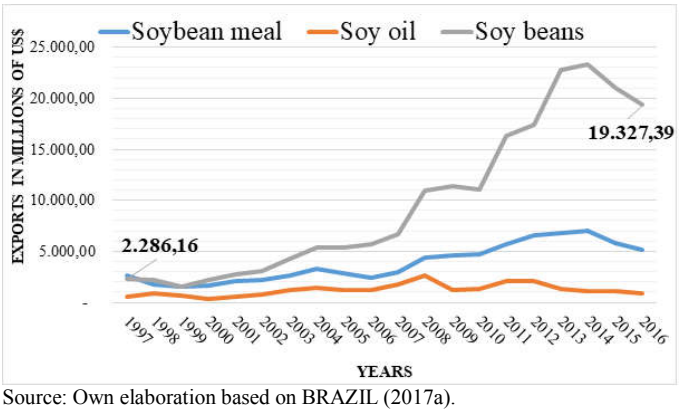
The soybean complex in Brazilian exports, since 1997, has increased its share. Figure 2 shows the increase in the share of soybean exports in total agribusiness exports, with a percentage of 43.2%, reflecting even greater socioeconomic importance. Soybeans in the lead of Brazilian exports of the soybean complex have been presented over the last 20 years, with a high growth of 11.83%. This can be explained by the geometric growth rate of 8.34% per year that Brazil possessed when estimating the econometric model of growth (statistically significant result at the 1% probability level, F = 354.00 and R^2 = 0.96). Despite the upward trend in exports, there have been many declining years, as in 1999, 2015 and 2016, figure 3.Soybean oil, other than soybean meal, was followed without much variation in exports and indicated a steady behavior, except for the year 2008 that stood out in exports, Figure 3. The factors that may have caused this structure in the exports of soils and soy oils are the barriers and tariffs imposed by the main markets, which declined after the WTO (Coronel *et al*, 2008).



Source: Own elaboration based on data from BRAZIL (2017a).

Figure 2. Brazilian exports of the soybean complex in US$: 1997 to 2016

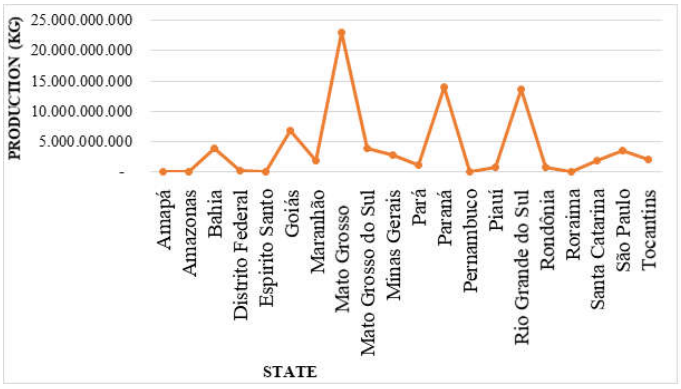
For Brum (2002) Brazil has the preference to export the soybean grain, without adding value to the product, which leads to lower prices to the rural producer. This situation is explained by the effects of the Kandir Law of 1996/97 exempting ICMS from grain exports and also by the difficulties encountered in the consumption of oil and bran on the world market. The situation has become almost the rule, during the whole period the grain leads the Brazilian exports, which is demonstrated in Figure 3.



Source: Own elaboration based on BRAZIL (2017a).

Figure 3. Exports of soybean meal, soybean oil and soybean in grain: 1997 to 2016

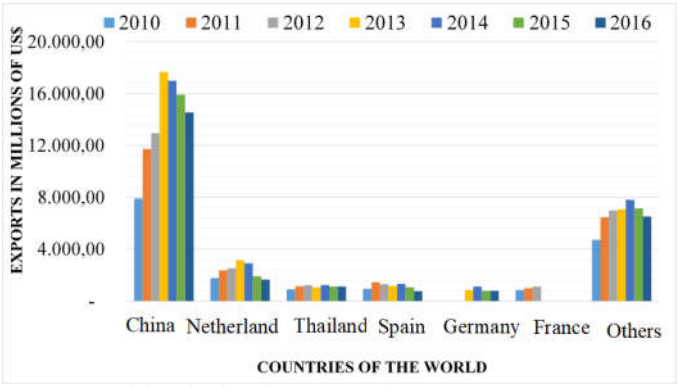
Exports of Brazilian soybeans totaled US $ 30,527,884,538.00 million in the 2016/2017 harvest with a total of 80,586,973,783 kg of product, and according to data from BRAZIL (2017a), the states of Amapá (0), Bahia (4.62%), Federal District (0.32%), Espirito Santo (0.09%), Goiás (8.57%), Maranhão (2%), Amazonas, 33%), Mato Grosso do Sul (4.65%), Minas Gerais (3.50%), Pará (1.42%), Pernambuco (0.04%), Piauí (1.04%), Roraima (0.07%), Santa Catarina (2.36%), São Paulo (4.27%), Tocantins (2.46%) and more expressively than the other states, the exports of the states of Mato Grosso (28.69%), Paraná (17.78%) and Rio Grande do Sul (16.59%), Figure 4.Brazilian exports of soybeans over the years, had as main destination China, which in 2010 to 2017 represented an important market share. The Netherlands, during the same period, were important, representing the second destination of exports, followed by Thailand, Spain, Germany and France, which imported a similar share of soybeans over the years.



Source: Own elaboration based on BRAZIL (2017a).

Figure 4. Brazilian production by state in the 2016/2017 harvest in kg

In addition, these countries have many others that import much smaller quantities, but which together represent a considerable portion of exports, Figure 5. Figure 5 shows that the soybean complex for exports to China in 2010 had a lower participation in imports and 2013 represented a maximum volume of imports of the product, in the following years the imported portion decreased, but remained the main destination. China was a major soybean producer and exporter in the world, lost the position of a world leader and became a net importer of grain, bran and oil in 1980, and then established important investments in the milling industry, which made it a loss of power of its own production. The destabilization of the soybean chain significantly influenced the production of other countries such as Brazil (Brum, 2002).



Source: Own elaboration based on BRAZIL (2017a).

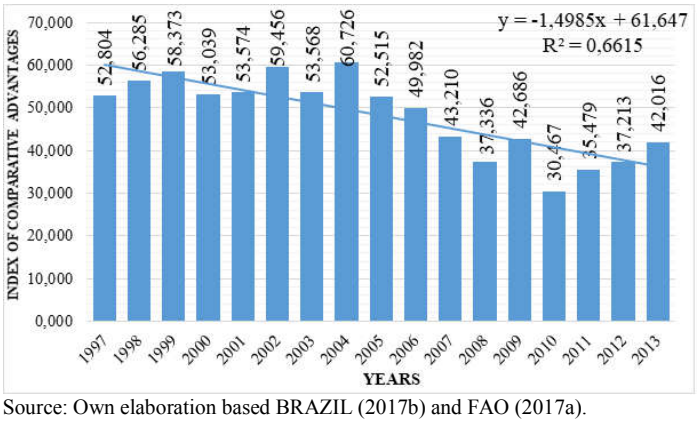
Figure 5. Exports of the soybean complex by destination in US $: 2010 to 2016

Competitiveness of Brazilian exports

One of the precise ways of measuring the competitiveness of a product in the market, is through the construction and evaluation of indicators, which allow the analysis of the condition of the product in the market, over a period studied.

Revealed Competitive Advantages Index (IVCR)

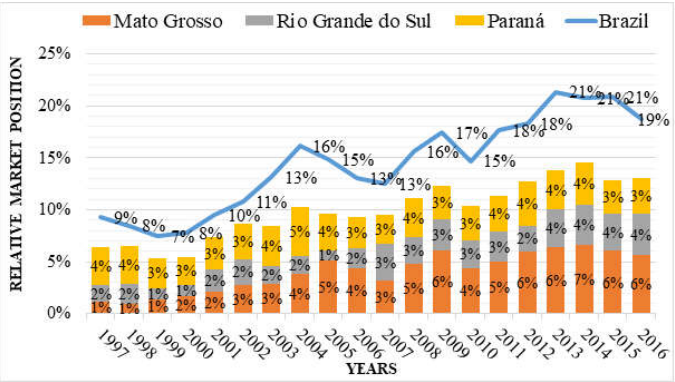
The Revealed Comparative Advantage Index calculated for the period from 1997 to 2013 represents the performance of Brazilian exports in the world soybean market. Countries are most important in geographic location and climatic conditions, which are considered to be the country's power.



Source: Own elaboration based BRAZIL (2017b) and FAO (2017a).

Figure 6. IVCR of exports of the soybean complex in Brazil: 1997-2013

A geographical location, representation in large part of the distance of production in large trading centers (markets), such as access and transportation routes, transportation costs, ground transportation services (Montán *et al*, 2002). After calculating equation (1), it was identified that the organizations operating in Brazil have a competitive advantage in the exports of the soybean complex. During the years from 1997 to 2005 the revealed comparative advantage was above 50, in the following years from 2006 to 2013 Brazil obtained a lower comparative advantage, however it means that there is a relatively significant performance of Brazil according to the results of the index, Figure 6.In the analyzed period the mean was 48.16, the median was 52.51, the standard deviation was 9.30, the minimum value was 30.46 and the maximum value was 60.72. Even with a small drop in performance up to 2013, Brazilian soybean exports are competitive, Figure 6. Manipulated data showed growth of Brazilian soybean exports over the analyzed period, but exports of other exported agricultural products increased with greater representativeness compared to the growth of exports of the soybean complex, which led to a smaller comparative advantage for the product in question. This revealed advantage can be attributed to the diverse natural resources that exist in Brazil. The aspects that still represent a delay and can increase the competitiveness refers to the equation of logistics and transportation, since it is a factor that costs the national production cost, even more because it has great distances between the agricultural frontiers to the export shipment. In addition to this delay to increase competitiveness, there are still port expenses, export taxes, harvest losses, losses during transportation and obstacles that hamper the soybean crushing process (Brum, 2002).Melo *et al*. (2004) attributed that 93% of crop losses occur because of drought, stagnation of average productivity, or elevation of costs among others. Factors that are linked to the comparative advantages of each country and producing region.



Source: Own elaboration based on BRAZIL (2017a) and USDA (2017a).

Figure 7. Relative Market Position of Brazilian soybeans in total world trade in agricultural products: 1997-2016

Relative Market Position (PRM)

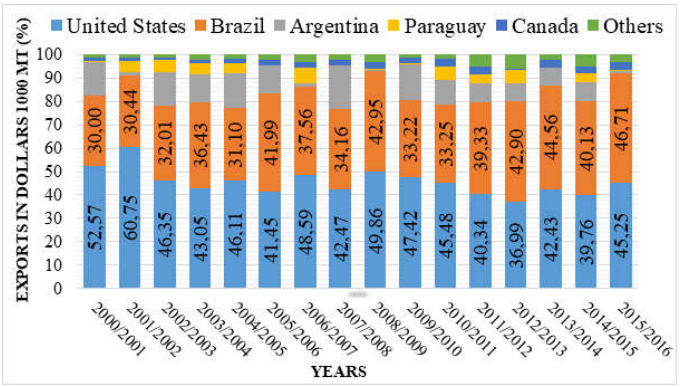
After calculating equation (2), it was identified that the relative market share of Brazilian soybean exports was in constant growth from 1997 to 2016, despite fluctuating in increases and decreases during the period, which tended to follow growth. The lowest relative share was in 1999 with 7%. Given that Brazil had less than 10% of its share, until 2001, it increased its participation until 2016, reaching a market share of 21% in the years 2013, 2014 and 2015. The main producing and exporting states of Brazil are Mato Grosso, Rio Grande do Sul and Paraná. Mato Grosso and Rio Grande do Sul, as well as in Brazil, followed a trend of growth. Mato Grosso in 1997 and 1998 had the lowest participation of the period, with only 1%, and in 2014 the highest point of participation of 7%, Figure 7.In 1999 and 2000, Rio Grande do Sul had the lowest participation of 1% and the highest points in 2016 with a 4% participation.

Paraná, unlike the other two states, remained in a constant trend, with the lowest points being 1999, 2000 and 2007 with 3% participation and the highest point was in 2004 with a 5% share. The state of Paraná up to 2004 led the relative market share, in 2005 the state of Mato Grosso initiated leadership in the relative market share. And Rio Grande do Sul in most years remained the third place in the participations, Figure 7.There are numerous factors responsible for the oscillations of Rio Grande do Sul's relative market share, such as climatic variations, it is estimated that 93% of crop losses occur due to drought (Melo *et al*., 2004), stagnation of average productivity, cost increase among others. Despite the challenges, it has remained in its position as the third largest producer and exporter of soybeans in Brazil. This was only possible thanks to research, new technologies, modified seeds among other essential aspects to increase production and export (Brum and Silveira, 2010).What reflects the results of the relative market share is in fact the competitive potential of the country and the states in relation to the increase of exports, with a greater proportion than the costs and mainly by the productivity achieved throughout the period. In this sense, Brazil has a position considered as having a high and growing share of exports in the world market, obtained by the potential of its main soybean producing and exporting states, in addition to the conditions that have occurred over the years.

Market Share (MS)

Market Share revealed the market power of five major countries, the United States, Brazil, Argentina, Paraguay and Canada, considering the share of the market dominated by other countries. The United States leads the market, has a significant share of power. Over the period up to 2012, the United States led the market, reaching a peak of 60.75% power, from 2012, declined in 2013 reaching a minimum market power point of 36.99% and in the of the period disputing the market with Brazil, Figure 8.Brazil is the second largest country in the soybean export market, ranking in the majority of the years below only the United States, but in dispute with only this one in the market, alternating, sometimes, the first place in the ranking with its main competitor. Brazil in 2001 to 2012 had less market power, reaching a minimum domain level of 30% in 2001. Over the period, Brazil increased its share and from 2012 increased market power, surpassing the United States and reaching a maximum market share of 46.71% in 2016, Figure 8.The behavior of the market power model in the studied period can be explained by numerous conditions that, given the limitations of this model, are beyond the scope of work, but some inferences based on variables that may have influenced the behavior of the market power in Brazil. Conditions can be positive or negative. Among the positive considerations are factors such as the country's economic stability in the period of study may have reflected the greater performance of Brazil in the market, the strong effect of the Kandir Law, exempting the Tax on Circulation of Goods and Services on exports of primary products , stimulating exports of soybeans to grain, increased soybean competitiveness due to the exchange

devaluation in 1999, internal Brazilian conditions such as the improvement of the Rural Finance Producer's Certificate, providing liquidity and ensuring prices to producers, also the Tractors Fleet Modernization Program (Moderfrota) created in 2000, the new seed technologies developed by institutions such as the Brazilian Agricultural Research Corporation (Embrapa), among other technologies developed along the chain of production and mainly by increasing production and productivity of last years, allowing Brazil to establish itself in the position of greater market power of the oilseed (Coronel *et al*., 2009).



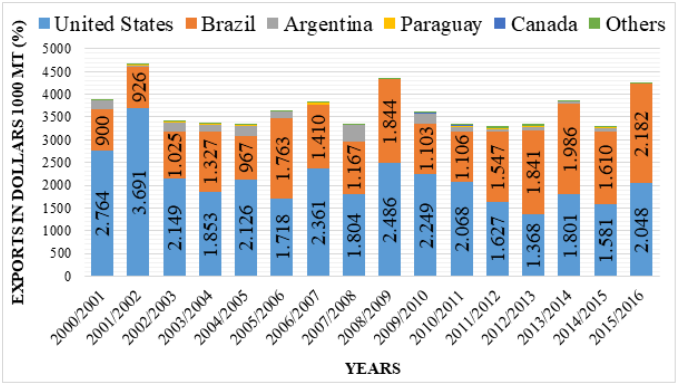
Source: Own elaboration based on USDA (2017a).

Figure 8. Market Share of soy exports in the world: 2000 to 2016

In relation to the negative points that may have retracted the greater market power of Brazil in the period can be explained by the low concentration of exports in dynamic markets, the increase of American subsidies to soybeans causing distortions in world trade, which despite being negative does not reflect in very high effects (Coronel *et al*., 2009). The United States and Brazil lead the export market power of soybeans, while Argentina, Paraguay, Canada and the rest of the countries have a smaller share of the market, where during the whole study period they represent a smaller share of 20% market power, considering that Brazil does not require more than 20% of the market share to be considered relevant. In this sense, it is understood that the share of these are almost irrelevant in relation to two main countries that dominate the market, are not more common are responsible for a considerably larger market share, more than 20% over the period, reflecting greater importance to them. According to Brum (2002), during the expansion of soybeans in Brazil over the years, in the world context, the United States remained present benefiting and conquering the market at all times, while Argentina appeared more slowly, but today represents part of this market with exports mainly in soybean oil. Thus, the Figure demonstrated that Brazil used the opportunities and potential to expand the market, reaching almost half of this and becoming competitive.

Herfindahl-Hirschman Index (IHH)

The Herfindahl-Hirschman Index (IHH) revealed the market concentration of soybean exports from the main exporting countries. Among these countries, the ones that presented the highest result in the Herfindahl-Hirschman index were the United States and Brazil, as a result also of having a larger Market Share. The two countries accounted for the market concentration in relation to the others, representing a highly concentrated market for having a result higher than 2500 in the IHH, and being in only two countries, according to the interpretations of the Horizontal Mergers Guidelines.



Source: Own elaboration based on USDA (2017a).

Figure 9 - Herfindahl-Hirschman Index (IHH) for soy exports in the world: 2000 to 2016

For most of the initial period, the United States led the market with the highest concentration, especially in the early years, when the country alone was highly competitive and concentrated, with values above 2500. Brazil in the early years was moderate market, but over the period it raised the IHH, becoming the country with the largest market concentration, surpassing even the United States. In the year of 2002, the United States led the year with the largest market concentration, and Brazil had the largest market concentration in 2016, Figure 9.In this sense, market power is determined by two main countries, namely the United States and Brazil, while the rest of the countries obtained values, almost uncontroversial in the results of the IHH. It can be interpreted as being a highly concentrated market, with two main countries dominating the market, making competition difficult. A possible merger by means of agreements between the two countries would lead to serious competition problems, but it is not the aspect of this market that occurs because of the different countries.

Final Considerations

The competitiveness of the Brazilian soybean processing industry in the international market was a reflection of the innumerable positive changes, such as the increasing rise of the planted area, production, productivity and exports of both soybeans and processed soybeans. These factors have made the soybean production chain an important growth vector of Brazilian agribusiness over the years, which has raised Brazil's competitive capacity and especially the soybean processing industry to expand markets and maintain a leading position in international oilseed trade. It was evidenced that the soybean production chain has undergone numerous changes over the years, involving aspects such a global population changes, the search for alternative sources to meet human needs, and mainly the research trajectory, investments in technologies and mechanization for increase the productivity of Brazilian soybeans. In Brazil, the soybean production chain is made up of many agents, who refer to important players such as suppliers, processors, dealers, farmers and other intermediaries until their arrival to the final consumer. The insertion of the agents in the chain reflects in a set of determinants that interact in the connections of the productive chain of the soybean, aiding and intervening in the competitiveness of the chain. The constant evolution of the soybean production chain has

elevated Brazil's leadership in the international oilseed market, making Brazil a strong country in the market and only contesting with the United States the leadership. In spite of this position, Brazil still has many challenges, in order to support itself in the position it has achieved, for this it is necessary to maintain investments in research, technologies, and policies that act in the promotion and increase of productivity. It is also necessary to be concerned with the market inserted, to look for alternatives with the intention to guard against possible supply and demand mismatches, to diversify and to seek other markets in order to remain leader and competitively sustainable. The identified aspects confirm the competitiveness of Brazilian exports in international trade and show that Brazil has a sustainable export competitiveness due to its competition with only one country, as a result of the increasing global changes and mainly of investments in research, better planting techniques, increased productivity, increased search for efficiency along the productive chain and several aspects that may have favored Brazil to become competitive and remain in the market leadership.

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