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Competitiveness of Brazilian soybean exports

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The objective of this article was to analyze the indicators of competitiveness in the foreign trade of Brazilian soybean from the year 2004 to 2014. The problem under study deals with the competitiveness of this commodity in the international market. The applied methodology initially used the descriptive statistics, seeking to demonstrate through tables and graphs the evolution of the soybean exports in the international market. The data of the largest exporters worldwide were used to relate the volume (ton) and the value (US$) of this product. The economic indicators used to verify competitiveness were the Constant Market Share model and the Revealed Comparative Advantage Index. The main exporting countries are the United States, Brazil, and Argentina, respectively. The results indicated that the Brazilian soybean exports in the analyzed period have Revealed Comparative Advantages in comparison to other exporters. The Constant Market Share indicated that the main source of growth for soybean was the growth of world trade. It demonstrates that Brazil is strongly influenced by soybean’s international market price. It is concluded that Brazil has competitiveness in the market of soybean, presenting high standards of efficiency. Brazil also makes use of similar resources to those of leading producers, and has the potential to increase its participation through its technology, productivity and territorial capacity in order to increase production.

Key words: Competitiveness, constant market share, soybean.

INTRODUCTION

The soybean has been cultivated for five thousand years, and its origin is attributed to the central plains of China near lakes and rivers. About 3000 years ago, it spread throughout Asia and was used for human consumption. In the early twentieth century, this crop cultivation started in the United States and then spread into commercial cultivars worldwide (Sanches et al., 2004).

In Brazil, the grain arrived in 1882 in the state of Bahia, but its official introduction was in the state of Rio Grande do Sul. Since the 1970s, soybean production has become important for the agribusiness sector. This is confirmed by the increase in cultivated areas, mainly by increasing productivity using new technologies, improving the management as well as the efficiency of producers.
This process has increased the participation of soybean agro-industry chain in the economy, making it essential for income growth, employment and export currencies (Silva et al., 2011).

Caro et al. (2018) argues that soy is responsible for the emergence of Brazilian commercial agriculture, accelerating the mechanization of crops, modernizing transportation, and expanding the agricultural frontier. Soybeans' sector also collaborated for the emergence of new techniques that translated in increasing production of other crops, and it sponsored the development of poultry and swine breeding in Brazil.

Oliveira (2014) confirms this position, stating that the modernization process initiated in 1990 with the opening of the Brazilian economy and the introduction of new technologies allowed producers increase their productivity. These factors were decisive for Brazil to expand its production and become the second largest soybean producer in the world.

In the national context, the soy is economically inserted as one of the main crops produced. Data from the Ministry of Agriculture, Livestock and Food Supply (MAPA, 2016) confirms that soybeans are the fastest growing crop in the last decades and occupies 49% of the grain planting areas in Brazil. According to data from the National Supply Company - CONAB (2015), in 2013/2014 harvest, about 86.12 million tons of soy were produced in the country, accounting for 44.5% of all Brazilian grain production in the same harvest. The 2015 harvest reached 97000 tons, representing 48% of the 202.23 million tons of grains produced by the country.

The center-west region is the production leader, with approximately 44000 tons. In this region, the state of Mato Grosso is the largest producer with 28000 tons. The south region also established itself as the second largest producer, with approximately 35000 tons in the harvest of 2015. The state of Paraná is the largest producer with 17000 tons (Raucchi et al., 2015). According to the Agribusiness Projections Report of the Ministry of Agriculture, production could reach 117.8 million tons in the 2023/2024 harvest.

In the international context, in the last 50 years, the world production of soybean multiplied by ten and reached 269 million tons. The Food and Agriculture Organization (FAO, 2015a) predicts that by 2050, production will almost double, reaching 515 million tons. In the period from 2000 to 2009, China doubled the consumption of soybeans; 41 million tons were imported and the projections indicate a 59% increase by 2021 to 2022.

Brazil has intensified its trade relations with China, with the soybean being the highlight product. Together, China and the European Union are responsible for approximately 80% of the Brazilian exports of the soybean complex. Brazil is considered an important player and is currently considered the second largest producer and exporter of soybeans in the world (FAO, 2015b).

The prospects for the upcoming decades are favorable. Brazil has a dynamic structure capable of absorbing the growing demand for soybeans. Due to the importance of soybean export growth in the Brazilian economy and with a rising trend, the present study aims to analyze the soybean competitiveness indicators of the world main exporters: The United States, Brazil, and Argentina, from 2004 to 2014.

From these results, several other aspects can be examined, such as more advanced studies on the identification of factors related to the competitiveness of the soybean complex, analyzing Brazilian exports in comparison to the exports of the United States and Argentina, which are the main competitors of Brazil in this market.

MATERIALS AND METHODS

The current delineates the exports of soybeans from Brazil, United States, and Argentina in the period from 2004 to 2014. For the development of the study, a database of secondary data was used. The collected information was tabulated from several sources such as:

(a) UN COMTRADE, United Nations Commodity Trade Statistics;
(b) FAO, Food and Agriculture Organization of the United Nations;
(c) ALICEWEB, Analysis System of Foreign Trade Information;
(d) IBGE, The Brazilian Institute of Geography and Statistics;
(e) CONAB, National Company of Supply.

The period from 2004 to 2014 was evaluated as a time series, applying the methodology of descriptive statistics to demonstrate the evolution of exports in the international soybean market. Data were studied referring to the international soybean market as Brazil, the United States and Argentina.

Exploratory analysis of the major exporting countries and the main soybean importing countries, Brazil, the United States and Argentina, were made by the relative share of each, from 2004 to 2014. It was calculated by the mathematical expression (Parapinski, 2012):

$$P\% = \left(\frac{E_{Pi}}{E_T}\right) \ast 100$$  (1)

where $P\%$ = relative share of a country $i$; $E_{Pi}$ = soybean exports of a country $i$; $E_T$ = world soybean exports.

Descriptive statistics tools, such as tables and graphs, were used for these three exporting countries where it was possible to have an overview of the variation of values and participation of the main soybean exporting countries.

Data from 2004 to 2014 annual time series of the soybean commodity, collected in the UNCOMTRADE database, related to volume (tons) and value (US$) of US, Brazilian, Argentine and world exports. These data are expressed in millions of dollars and were deflated in the year 2014, based on the United States Consumer Price Index (CPI).
The analysis of the competitiveness of the main world exporters was carried out using the methodologies of Constant Market Share (CMS) and the Revealed Comparative Advantage Index (RCA).

**Constant Market Share (CMS)**

The widely disseminated model by Richardson (1971) has been used in studies on growth and performance in foreign trade as well as to analyze the factors that exert influence on a nation’s exports over a time horizon.

According to Coronel et al. (2008), the work based on CMS models aims to evaluate the participation of a country or region in the global or regional flow of trade and to disaggregate growth trends in exports and/ or imports according to their determinants. In this sense, the CMS model was used to examine the determination of the factors that contributed to the performance of the exports of a country or economic bloc in a given period.

In the CMS method, variations in world market share can be dissected into export growth sources and the elements responsible for this behavior can be identified. According to Horta (1983), these effects are expressed in:

1. The growth effect of world trade: growth in exports results from world growth;
2. The destination exports effect: represents the gains or losses in terms of growth rate, since the country exports to markets that grew at rates higher or lower than the average observed for all countries;
3. Composition effect of tariff: greater concentration on the export agenda of products whose world demands grow faster. This effect makes it possible to identify the gains or losses in terms of the growth rate due to the concentration of tariff in products that presented higher growth rates (or lower than the average of all products);
4. Competitive effect: It is determined on a residual basis and reflects the difference between the actual growth of exports and what would have happened to the country’s exports if the share of each good had been maintained for the buyer’s market. It means that an economy is competitive in the production of a given product when it can at least match the efficiency standards in the rest of the world, regarding the use of resources and the quality of the goods.

The basic assumption of the model is that each country or bloc keeps its share of the world trade constant. If there is a change in this share, it must be implicit in the model, and its performance is attributed to competitiveness, associated with relative prices (Leamer and Stern, 1970).

According to Ferraz et al. (1995), constant market share is the main indicator of competitiveness and is defined as the participation of a product, company or nation in a given market, and is expressed by:

\[
\Sigma V_{ij} - V_{ij} = \Sigma V_j + \Sigma \Sigma (r_{ij} - r_i) V_j + \Sigma (V_j - V_j - r_j V_j) \tag{2}
\]

where \( V_{ij} \) = monetary value of exports of merchandise \( i \) (soybean) from the country in focus to market \( j \), in period 2; \( V_{ij} \) = monetary value of exports of merchandise \( i \) (soybean) from the country in focus to market \( j \), in period 1; \( V_{ij} \) = effective growth of the value of the country’s soy exports to market \( j \); and \( r \) = percentage growth of the value of world exports of soybeans in period 1 to period 2.

The analysis based on the CMS model has its importance and interest, as it determines the weight of each effect on the exports of the country in question and shows the extent to which these are directed towards commodities and/or markets with greater potential for expansion. In this sense, the results can indicate alternative actions and signal distribution paths for exports, in order to pursue more dynamic “market-shares”.

Also, Machado et al. (2006) state that this model allows one to determine the factors that influence the performance of a country’s exports over the years. The favorable or unfavorable growth of the export sector is attributed to the structure of the country’s exports and its competitiveness. The main advantage of this method is to allow the analysis, by components and behavior, of the product in the destination market.

As a result, the CMS model has been used in several studies to analyze the determination of factors that contribute to the performance of a country’s exports in a given period. Such studies include Carvalho (1995), Figueiredo et al. (2004), Machado et al. (2006), Coronel et al. (2008), and Silva et al. (2011).

In this present study, the CMS calculation was performed from the year 2004 to 2014, studying the three main exporters, which represent approximately 77% of the world’s exports. It was possible to verify the effect of the world’s soybean market growth, the effect of the destination of the exports and the effect of the competitiveness of the world soybean market in the period, excluding the tariff factor as it is an analysis of a single product.

**Revealed comparative advantage index (RCA)**

The main definition of the RCA was conceptualized by Balassa (1965), cited by Fajnzylber et al. (1993) on the assumption that world trade among different nations is adjusted according to their comparative advantages.

The RCA measures the structure of exports while considering the export performance of a given product and the country’s commercial performance on the world market. Thus, the comparative advantage can be used to select the products with potential gains of trade. For its calculation, the mathematical expression used was (Oliveira, 2005; Pais et al., 2008):

\[
RCA_j = \frac{X_{ij}}{X_{wj}} \times \frac{X_i}{X_w} \tag{3}
\]

where \( X_{ij} \) = value of Brazilian soybean exports; \( X_i \) = total value of Brazilian exports; \( X_{wj} \) = total value of world exports of soybeans; \( X_w \) = total value of world exports; \( i \) = Brazilian exports; \( w \) = world exports; and \( j \) = soybean.

The RCA was qualified according to the criteria presented by Pais et al. (2008), being:

- (a) \( RCA_j > 1 \) = the country has a comparative advantage for soybean exports;
- (b) \( RCA_j < 1 \) = the country has a comparative disadvantage for soybean exports.

**RESULTS**

Global soybean production is concentrated in just three countries: The United States, Brazil, and Argentina, totaling 82%. In addition, the other four countries that stand out in the world production are: China, India, Paraguay and Canada. Together, these seven countries represent about 95% of the world’s oilseed production according to data from the United States Department of Agriculture (USDA, 2015). The world soybean crop of 2014/2015 was 317253 million tons, the United States share was 108.014 million tons, with a productivity of
3.213 kg/ha. Brazil, the second largest producer, participated in producing 95.070 million tons, with a production of 3.011 kg/ha (CONAB, 2015).

Soy is one of the most widespread crops in the world. Despite its great economic importance in the world market, the appreciation of soybeans is limited to a few countries. China and the European Union combined account for approximately 75.6% of world imports, according to USDA data from the 2014/2015 harvest. China participates with almost 65%, demonstrating its importance in the world oilseed market. Thus, any oscillation in the Chinese economy that compromises the flow of its demand for soybeans may jeopardize the global supply and demand of the commodity (USDA, 2015).

World exports totaled more than 927 million tons and approximately 432 billion dollars between year 2004 and 2014 (Table 1). They showed a constant evolution, from 57 million tons in 2004 to approximately 110 million tons in 2014.

World soybean exports have been growing in recent years, in line with the increasing world supply and consumption of oilseed. Around 40% of the world production of the crop, during the 2013/2014 harvest, was exported according to data from the Department of Agriculture of the United States (USDA, 2015). Despite the growth, the average price showed oscillations due to world supply and demand, but it has remained relatively constant since 2012 as shown in Figure 1.

The main exporters of value and quantity are: the United States, Brazil, and Argentina. In value (US$), the United States stands out as the largest exporter with 38% of total world exports of soybeans, followed by Brazil with 30%, and Argentina with only 9%. The other countries participate with 23%.

Figures 2 and 3 show data on quantity (kg) and value (US$) from 2004 to 2014. They show the evolution of the main world exporters. Brazil assumed the position of largest exporter in terms of quantity (kg) in 2013 and 2014, but in most of the years studied the United States was the world's largest producer and exporter. The data in Table 2 confirm the concentration between the United States, Brazil and Argentina since these three countries account for 87% of the world's soy exports.

The United States is the world's largest producer and exporter, followed by Brazil and Argentina. The United States and Brazil, the main producers and exporters of soybeans, may have an impact on the world supply should any change in the size of the soybean crop occur in these two countries (USDA, 2015).

Figure 2 shows the evolution of exports in quantity from the United States, Brazil and Argentina. Similarities can be seen in the first years, up to 2008, when Argentina suffered a sharp fall due to political and economic problems. During this period, there was an increase in exports from the United States. As of 2009, the United States showed a fall and Argentina an increase in exports. On the other hand, Brazil has been in constant evolution throughout the years, with a slight decline appearing between 2011 and 2012.

Figure 3 shows the evolution of exports in value (US$) of the United States, Brazil and Argentina. Argentina suffered a fall between 2008 and 2009. In 2010, the United States had a fall, followed by a rise in values in 2011. However, in 2012, there was a decrease again. Brazil continues to grow steadily in most years, with a slight decline occurring between 2009 and 2010.

Brazil participated in the international market with a total of 326 million tons from 2004 to 2014. It exports to several countries, and the main are, China, the Netherlands, Spain, Germany, part of Asia (Taiwan and others), and Italy in that order (Table 2).

China is considered the largest partner of Brazil, negotiating more than 190 million tons (Table 2),

### Table 1. Total world soy exports in the period of 2004-2014.

<table>
<thead>
<tr>
<th>Year</th>
<th>Quantity (Ton)</th>
<th>Actual Amount (US$ million)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2004</td>
<td>57,454,434</td>
<td>19,445,847</td>
</tr>
<tr>
<td>2005</td>
<td>65,924,837</td>
<td>18,971,515</td>
</tr>
<tr>
<td>2006</td>
<td>67,782,565</td>
<td>18,905,248</td>
</tr>
<tr>
<td>2007</td>
<td>74,163,760</td>
<td>26,099,991</td>
</tr>
<tr>
<td>2008</td>
<td>79,971,937</td>
<td>38,621,250</td>
</tr>
<tr>
<td>2009</td>
<td>81,278,119</td>
<td>36,459,550</td>
</tr>
<tr>
<td>2010</td>
<td>97,367,137</td>
<td>43,121,572</td>
</tr>
<tr>
<td>2011</td>
<td>90,943,573</td>
<td>48,094,679</td>
</tr>
<tr>
<td>2012</td>
<td>96,472,609</td>
<td>54,839,990</td>
</tr>
<tr>
<td>2013</td>
<td>106,505,216</td>
<td>58,377,280</td>
</tr>
<tr>
<td>2014</td>
<td>109,219,501</td>
<td>59,005,889</td>
</tr>
<tr>
<td>Total</td>
<td>927,083,692</td>
<td>421,942,810</td>
</tr>
</tbody>
</table>

Source: UN COMTRADE (2015).
accounting for 40% of soybean imports from this country during the study period. According to the Secretariat of Foreign Trade, China presents itself as the country with the greatest potential for Brazilian agribusiness products given its diversity of imports, growing market and consumption (SECEX, 2013).

In the last ten years, the United States has led soy exports seven times and Brazil three. Brazilian participation in production and exports has increased from 28.49 to 31% (production) and from 32.66 to 40.79% (export). You can see that the country grows above the international average (USDA, 2015).

The United States is the largest soybean producer and exporter in the world. They totaled in their exports approximately 384 million tons in the analyzed period. Exports to China, Mexico, Japan, Indonesia, part of Asia (Taiwan and others) and Germany totaled approximately 310 million tons for these destinations in the analyzed period shown in Table 4. For its main market, China imported approximately 200 million tons, accounting for approximately 42% of soybean imports from this country (Table 3).

Argentina, the third largest producer and exporter, sent approximately 86 million tons to the market in the study period; the value was below Brazil and the United States. It exported to China, Egypt, Thailand, Turkey, Chile, and

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**Figure 1.** Average price (US$/Kg) of world exports in the period 2004-2014. Source: UN COMTRADE (2015).

**Figure 2.** Evolution of soy exports in quantity (kg) in the period of 2004-2014. Source: UN COMTRADE (2015).
Malaysia (Table 4). Its main market is China, which imported approximately 77 million tons (Table 4), representing approximately 16% of soybean imports from this country in the analyzed period. Table 4 shows Argentina exports data.

Despite some disadvantages regarding the United States, Brazil is currently considered the world's second-largest producer of soybeans. In the 2014/2015 harvest, 31.3 million hectares were cultivated and the Americans 34.31 million hectares. Brazilian production was close to 86 million tons in the 2013/2014 harvest. OECD-FAO (2015) data indicate that soybeans are the most profitable export product for Brazil. Data from the Agribusiness Projections Report of the Ministry of Agriculture estimates that Brazilian production of 117.8 million tons in the 2023/2024 harvest, will generate 22.8 US$ billion in 2024 (OECD/FAO, 2015).

The results show that the period from 2004 to 2014 was characterized by the growth of exports and the prospect of increased demand in the international market. They show that the market demands an increase in the production of the main exporting countries, and for that, efforts in technologies are relevant.

Another factor to note is that the southern hemisphere, due to the availability of areas for future expansion, is expected to be the major soy producer in the world. The main portion of the soybean surplus that will be produced in the world will come from Brazil and Argentina. In the Northern Hemisphere, if there is any expansion of production, this will be much more a result of technological gains than of physical expansion of production (MAPA, 2016).
Table 3. Main destinations of soy exports from the United States for the period 2000 to 2014.

<table>
<thead>
<tr>
<th>Country</th>
<th>Quantity (Ton)</th>
<th>Nominal Value (US$ million)</th>
</tr>
</thead>
<tbody>
<tr>
<td>China</td>
<td>200 453 764</td>
<td>91 767 227</td>
</tr>
<tr>
<td>Mexico</td>
<td>36 863 479</td>
<td>15 234 221</td>
</tr>
<tr>
<td>Japan</td>
<td>27 680 653</td>
<td>11 446 891</td>
</tr>
<tr>
<td>Indonesia</td>
<td>16 107 650</td>
<td>7 179 442</td>
</tr>
<tr>
<td>Asia</td>
<td>16 745 702</td>
<td>7 027 148</td>
</tr>
<tr>
<td>Germany</td>
<td>11 956 884</td>
<td>5 092 255</td>
</tr>
</tbody>
</table>

Source: UN COMTRADE (2015).

Table 4. Main destinations of Argentine's soy exports in the period 2000 to 2014.

<table>
<thead>
<tr>
<th>Country</th>
<th>Quantity (Ton)</th>
<th>Nominal Value (US$ million)</th>
</tr>
</thead>
<tbody>
<tr>
<td>China</td>
<td>77 237 786</td>
<td>29 256 022</td>
</tr>
<tr>
<td>Egypt</td>
<td>4 080 233</td>
<td>1 648 159</td>
</tr>
<tr>
<td>Thailand</td>
<td>2 717 267</td>
<td>858 231</td>
</tr>
<tr>
<td>Turkey</td>
<td>1 807 595</td>
<td>612 216</td>
</tr>
<tr>
<td>Chile</td>
<td>1 052 563</td>
<td>337 813</td>
</tr>
<tr>
<td>Malaysia</td>
<td>896 530</td>
<td>294 034</td>
</tr>
</tbody>
</table>

Source: UN COMTRADE (2015).

Constant market share (CMS)


The model was widely disseminated by Richardson (1971) and has been used in studies on growth and performance in foreign trade and to investigate the factors influencing a nation's exports over a time horizon. Using CMS method, the favorable or unfavorable growth of an export sector is assigned to the structure of its exports and competitiveness. The main advantage of this method is the component analysis and the behavior of the product in the destination market (Machado et al., 2006).

According to Carvalho (1995), research and studies based on Constant Market Share models aim to assess the participation of a country or region in the global or regional flow of trade and to disaggregate growth trends in exports and/or imports according to their determinants.

The basic assumption of the model is that each country or block keeps its share in the world trade constant. If there is a change in this part, it must be implicit in the model, its performance attributed to competitiveness and associated with relative prices (Leamer and Stern, 1970).

According to Leamer and Stern (1970), the factors that deprive a country's exports from following the world's average are a concentration of exports in goods whose demand grows more slowly than the average products; exports to stagnant regions; and lack of willingness or conditions that enable the country compete with its suppliers in the international market.

The CMS aims to evaluate the effects and influences on the development of exports of a product in a considered period, in addition to revealing the performance of a firm or country from its main competitors. Through the use of CMS, the favorable or unfavorable growth of the export sector is attributed to the structure of the country's exports and its competitiveness. The main advantage of this method is to allow component analysis and product behavior in the destination market (Valverde et al., 2006).

The increase in exports results in gains for the country, which cannot determine that it is competitive in a given sector of the market alone. Thus, it is necessary to
analyze the factors that influence the behavior of exports, to verify the competitiveness of the country in the international market (Machado et al., 2006). Based on this assumption, the constant market share was calculated, which was expressed as a percentage, in that the higher its value, the greater the intensity of the country’s participation as an exporter in international trade (Oliveira, 2005). The constant market share was calculated in the period between 2004 and 2014 when a significant increase in soybean exports was observed in comparison with the previous decade, and the main world exporters were evaluated: the United States, Brazil and Argentina (Table 5).

The growth effect of world trade represents the observed growth if the exports of the examined countries evolved at the same rate of growth with world exports. The main soybean exporting countries presented positive percentages in the growth factor (Table 6; Figure 1). Brazil had the lowest value (83.28%), followed by the United States (109.93%); while Argentina was the most expressive country, with 277.97%. In general, the results of this effect demonstrate the existence of a worldwide increase in the soybean trade.

According to Table 5, the growth effect of world trade, which in this period was positive, can be explained by the following factor: a significant increase in grain demand by China, which prioritizes the importation of in natura products, with lower added value as a way of valuing internal processing (Coronel et al., 2008). Another factor that may have contributed to this result was an increase in world exports of soybeans; indicating that, throughout the study period, the largest importers of the product were China and the European Union.

The destination factor provided negative percentage values (Table 6), except for Argentina that presented a positive value. The lowest and closest to the positive was obtained by Brazil (-62.85%), followed by the United States (-807.68%). Argentina presented a positive and expressive value of 277.97%.

The effect of exports represents the gains (or losses) in terms of growth percentage, considering whether the country exports to markets that grow at higher (or lower) rates than those observed in all countries. According to Machado et al. (2006) and Grams et al. (2013), the export effect will be positive if a given country concentrates its exports in markets that have experienced greater dynamism in the period under review, while negative if concentrated in more stagnant regions.

In the present study, negative values (Table 6) indicate that Brazil and the United States are shifting their exports to less dynamic markets, meaning that their exports are concentrated in markets with growth rates lower than the average observed for all countries. The lower negative index of the target effect (Table 6) obtained by Brazil made it possible to infer that Brazil’s exports were concentrated in markets with greater dynamism, while the United States concentrated its exports to less dynamic markets.

It is considered that the competitiveness effect reflects the improvements in prices, quality of the product, and reduction of production costs, or in the conditions of investments. Competitiveness can be observed as an effect of supply since it depends on the change in the relative efficiency of the countries in the world market (Machado et al., 2006). In terms of competitiveness, the United States had the highest percentage (Table 3), with 797.75%, followed by Brazil (79.57%).

Residual is attributed to the failure or success of the country in international trade. Argentina presented a negative index (-293.79%), showing that it did not maintain its share in the world market, and its competitiveness effect became negative; indicating the failure of the country to maintain its constant participation. This effect demonstrates that importers tend to substitute the consumption of commodities whose prices were increased by the consumption of those products with relatively lower prices (Grams et al., 2013).

The competitive effect indicates that an economy is competitive in the production of a particular commodity when it can at least match the efficiency standards of resources and quality (Grams et al., 2013). Thus, the

### Table 5. The share of sources of growth in soy exports from 2000 to 2014.

<table>
<thead>
<tr>
<th>Country</th>
<th>Growth (%)</th>
<th>Destination (%)</th>
<th>Competitiveness (%)</th>
<th>Total (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>United States</td>
<td>109.93</td>
<td>- 807.68</td>
<td>797.75</td>
<td>100</td>
</tr>
<tr>
<td>Brazil</td>
<td>83.28</td>
<td>- 62.85</td>
<td>79.57</td>
<td>100</td>
</tr>
<tr>
<td>Argentina</td>
<td>277.97</td>
<td>115.82</td>
<td>-293.79</td>
<td>100</td>
</tr>
</tbody>
</table>

### Table 6. Revealed comparative advantage index (RCA) of Brazilian soybean, 2004-2014.

<table>
<thead>
<tr>
<th></th>
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<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>RCA</td>
<td>13.26</td>
<td>13.82</td>
<td>18.09</td>
<td>11.56</td>
<td>11.55</td>
<td>22.74</td>
<td>25.88</td>
<td>24.75</td>
<td>27.84</td>
<td>27.92</td>
<td>30.20</td>
</tr>
</tbody>
</table>
results (Table 6) indicate that Brazil presented greater competitiveness in the world soybean market and similar standards of efficiency and resource utilized in the world.

**Revealed comparative advantage index (RCA)**

The RCA allows the identification of the importance of a given product in the Brazilian export agenda in relation to the world. In the Brazilian forestry and agricultural sector, the RCA was used by several researchers, such as Figueiredo et al. (2004), Ropke and Palmeira (2006), Maia et al. (2008), Coronel et al. (2009), Almeida (2010), etc.

The RCA was analyzed in accordance with the classification provided by Pais et al. (2008), in which, (a) \( RCA > 1 \) means the country has revealed a comparative advantage for soybean exports; and (b) \( RCA < 1 \) means the country has revealed comparative disadvantage for soybean exports.

According to Table 6, the values found for the RCA of the Brazilian soybean are higher than the unit in the studied period. This indicates that the Brazilian soybean crop is a dynamic sector with great importance to the Brazilian export agenda.

The calculated RCA values from 2004 to 2014 were higher than the unit, indicating that Brazil has comparative advantage or competitiveness in the exports of this commodity. The RCA presented increasing values over the studied period, confirming the competitiveness of the Brazilian product.

The RCA analysis indicates that the soybean complex is a dynamic and competitive sector of the Brazilian economy, being this oleaginous plant one of the products responsible for the growth of Brazilian agribusiness. It was verified that there was growth of soybean production to meet international demand.

**DISCUSSION**

Brum et al. (2005) state that soy was one of the main factor responsible for the introduction of the concept of agribusiness in the country, not only for the physical and financial volume, but also for the need of activity management by the producers, suppliers of inputs, premiums and dealers. Casarotto (2013) adds that the generation of technologies was one of the fundamental factors for Brazil to increase its soybean production, becoming the first among the largest soybean producers in the world.

Brum et al. (2005) argue that the United States has advantages in the production and commercialization of soybeans compared to Brazil in terms of lower production and storage costs, in addition to greater investments in research and adequate infrastructure. Argentina has comparative advantages compared to Brazil due to lower transport costs, lower tax burden and ease of production flow. According to these authors, Brazil has advantages over the United States and Argentina regarding the availability of area for significant increases in production.

The United States has great productive and export capacity due to the wide power it has in the international market. This presence rests on tripod infrastructure, the efficiency with large-scale productivity, and official subsidies. The infrastructure comes in several aspects: high-performance equipment and implements, facilities for fleet renewal, specific strategies for the vast regions of a hostile climate. In addition, it has efficiency in its processes and transportation logistics. In the case of logistics, this country uses rail and water transport, with integration between modes; a model to be followed by other exporting countries (Ripoll, 2012).

From the analysis the three main exporting countries, there are differences regarding the logistics issue of the commodity in each of them. When analyzing the transport matrixes of soybeans in Argentina and the United States, it can be observed that in the former, although 80% of the soybean flow is carried out by road transport, average distances between producing regions and ports are close to 300 km, thus reducing cost of transportation. In the United States, which has high distances between producing regions and ports, the average distance ranges between 1,000 and 2,000 km, from which about 60% of the matrix is formed by waterways. According to Ripoll (2012), the transportation cost of the waterway model is 61% lower than road and 37% lower than rail. Thus, the transportation costs of grain in the United States are lower compared to Brazil.

Brazil has bottlenecks in their ports, which affect the competitiveness of Brazilian soybeans. The most detrimental port factors to the competitiveness of Brazilian exports are: high cost of port tariffs; higher demand than the installed capacity of terminals and warehouses; lack of investments in the expansion of port facilities, causing queues of trucks and ships during the harvest period; and the limitation of depth, preventing the mooring of larger ships in some ports. Another factor that raises costs in Brazil is that road transport is the main modal, which ends up affecting the prices received by producers negatively (IEAG, 2015).

The expansion of the product's participation in the foreign market requires guidance aimed at overcoming bottlenecks in infrastructure and logistics that affects the national agricultural sector. Another issue is to seek mechanisms that can help reduce the influence of international prices, since the prices of the Brazilian product oscillate according to the demand and supply of the product in the international market currently. Despite being a characteristic that governs the trade of primary products and commodities, this factor imposes some obstacles to the growth of export revenue.

In addition to the importance of technology, the adaptation of soybeans to the regions of the country
encouraged the increase of cultivated areas. Another factor was the growing demand from domestic and foreign markets. Data from the Brazilian Association of Vegetable Oil Industries (ABIOVE, 2016) indicates that the soy complex is responsible for approximately 1.5 million jobs in 17 Brazilian states.

According to Brum (2005), for Brazil to expand its participation in the world soybean market, it must face some challenges, such as greater integration among the agents of the production chain, investment in biotechnology, availability of credits, and a reinforcement aimed at actions of crops' sanitary quality. In addition, several factors can contribute to the expansion of production and exports, especially the fact that it has large unexplored or insufficiently exploited areas that could be incorporated into production and potential for the technological evolution in research companies.

It is important to point out that Brazil is facing a situation where the boundaries for the expansion of agricultural productions are given by logistics, and not by the availability of land suitable for agricultural production (Martins et al., 2005). However, as Colonel et al. (2009) argue, to continue as an important exporter, Brazil needs to overcome several internal obstacles such as reduction of transportation and logistics costs, better infrastructure conditions and greater investments in research. It also needs to seek alternatives to the World Trade Organization (WTO) to reduce the tariff and non-tariff barriers that the main importers imposed on soybean agribusiness.

The results of the current study explore the knowledge of international soybean market, identify the main internal and external obstacles that must be overcome, the factors that contributes the most to the soybean agribusiness exports, and the markets to which the soybean is exported. In this way, the study contributes suggestions related to the implementation of trade policies and the redirection of soybean products in the markets that show greater dynamism in their imports.

**Conclusion**

In the last years, the international market has been affected by an increasing demand due to the growth of exports and imports. This market has great economic importance for Brazil; it presents them opportunities like prominence in their exports for products such as soybean. Therefore, the current study sought to know the participation in the world market and evolution of soybean exports from the main exporters: the United States, Brazil and Argentina.

In relation to the United States, it proved to be the largest producer and exporter in the study period. Its position is due to the power it exerts in the international market because of the quality of its infrastructure, equipment of high performance, efficiency and transportation logistics.

Argentina presented potential for growth in its production and exports as it has the capacity for territorial expansion. However, it is necessary that economic and technological incentives take place. It ranks third among the world's largest producers and exporters.

Brazil stood out in the world market, occupying the second place among the biggest producers and exporters during the analyzed period. Its potential has been proven by the evolution of its share in the world's soybean exports, with significant and constant growth rates. It has the capacity to remain at the top positions in the ranking of the largest exporters in the world. This fact has positive consequences, with social and economic contributions, to the development of the country.

It is concluded that the Brazilian soybean exports are competitive in the international market based on the indicators of competitiveness, Constant Market Share and RCA. The results show that the destination of the exports and competitiveness represent a significant position in the world market, since it indicates that Brazil exports to countries that present dynamic forces in the foreign market, and has competitiveness in the world soybean market and standard efficiency and uses resources like those of the world force.

**CONFLICT OF INTERESTS**

The authors have not declared any conflict of interests.

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