

# REVEALED COMPARATIVE ADVANTAGE OF SOY EXPORTATION BETWEEN THE MAIN EXPORTS IN BRAZIL

Vantagens comparativas reveladas da exportação de soja entre os principais exportadores no Brasil

Daniele Sedorko Haliski  
Renato Alves de Oliveira  
Jeronimo Alves dos Santos

## **REVEALED COMPARATIVE ADVANTAGE OF SOY EXPORTATION BETWEEN THE MAIN EXPORTERS IN BRAZIL**

Vantagens comparativas reveladas da exportação de soja entre os principais exportadores do Brasil

Daniele Sedorko Haliski  
Renato Alves de Oliveira  
Jeronimo Alves dos Santos

**Resumo:** O objetivo desta pesquisa é verificar a existência de Vantagens Comparativas Reveladas para a exportação de grãos de soja produzidos nos Estados de Mato Grosso, Paraná, Rio Grande do Sul, Goiás e Mato Grosso do Sul, em relação ao Brasil, nos anos de 2006 a 2016. Foram utilizados o Índice de Vantagem Comparativa Revelada (IVCR) e o Índice de Vantagem Comparativa Revelada Simétrica (IVCRS). Os resultados indicam que todos os estados estudados apresentaram vantagem em exportar soja. No entanto, foi observado que os estados da região Sul apresentaram um período de aumento e posteriormente redução no IVCR, e os outros estados sofreram somente uma redução, possivelmente devido aos produtos do complexo soja estarem perdendo um pouco de sua representação no total exportado. Concluiu-se que embora existam incentivos governamentais destinados à exportação, o Brasil ainda enfrenta problemas com o escoamento da produção agrícola, baixa capacidade de armazenagem e ineficiências portuárias.

**Palavras-Chave:** soja, exportação, vantagem comparativa, Brasil.

**Abstract:** We verified of this work the existence of Revealed Comparative Advantages for the export of soybeans produced in the states of Mato Grosso, Paraná, Rio Grande do Sul, Goiás and Mato Grosso do Sul, in relation to Brazil, in the years 2006 to 2016. Used the Revealed Comparative Advantage Index (RCA) and the Symmetric Revealed Comparative Advantage Index (RSCA). The results indicate that all the states studied had an advantage in exporting soybeans. However, observed the southern states presented a period of increase and later reduction in the RCA, and the others states suffered only a reduction, possibly because soy bean products were losing a few of the representation in total exported. Concluded that though there are government incentives to export, Brazil still faces problems with the flow of agricultural production, low storage capacity and port inefficiencies.

**Key words:** soy, export, comparative advantage, Brazil.

**Resumen:** El objetivo de esta investigación es verificar la existencia de Ventajas Comparativas Reveladas para la exportación de soja producida en los estados de Mato Grosso, Paraná, Rio Grande do Sul, Goiás y Mato Grosso do Sul, en relación con Brasil, en los años 2006 a 2016. Se utilizó el Índice de Ventaja Comparativa Revelada (VCR) y el Índice de Ventaja Comparativa Revelada Simétrica (VCRS). Los resultados indican que todos los estados estudiados tenían una ventaja en la exportación de soja. Sin embargo, observó que los estados del sur presentaron un período de aumento y posterior reducción en el VCR, y los otros estados sufrieron solo una reducción, posiblemente porque los productos de soja estaban perdiendo parte de la representación total exportada. En conclusión, aunque existen incentivos gubernamentales para exportar, Brasil aún enfrenta problemas con el flujo de producción agrícola, la baja capacidad de almacenamiento y las ineficiencias portuarias.

**Palabras clave:** soja, exportación, ventaja comparativa, Brasil.



## **INTRODUCTION**

The food production around the world presented a wide growth due to the great demand of food of the population. Among the cultures that had an elevated growth, the soy production stands out. The soy is considered the key for the world supply of food. In Brazil the production of soy is in constant raising, not being produced only in the southern states of the country nowadays, but also in the Cerrado regions (BRANDÃO et al. 2006).

According to the study of Perobelliet al (2016) the soy was the agricultural commodity that presented the bigger area effect with 59,25% of the total, suggesting an existence of an expansion process of land available to soy and improvement of its productivity.

A way to evaluate the competition of a determined country in relation to others can be realized of the indicators as an index of Revealed Comparative Advantages, in which a country has the comparative advantage in production of a good if the cost of opportunity of production of this idem in relation to the others is lower in this country than in the others; this kind of analysis can be verified starting from the authors Figueiredo and Santos (2005), Oliveira and Schlindwein (2015) and Dorneles et al. (2013). In addition, the usage of these indicators is important for allowing the evolution from the external commercial flux of products, over time, for being important guidelines in detection of positive impacts and/or negation of realizing politics.

Some studies about Revealed Comparative Advantages have been showing favorable results in commerce of Brazilian agricultural products, mainly soy and derivatives, Orange juice, chicken, sugar, and coffee (WAQUIL et al., 2004). Diniz (2017) also affirms that Brazilian soy holds a great advantage in the international commerce.

In this context, the general objective of the research is to verify the existence of Revealed Comparative Advantages for exportation of grains produced in the States of Mato Grosso, Paraná, Rio Grande do Sul, Goiás and Mato Grosso do Sul, in relation to Brazil in the years of 2006 to 2016.

The present work has five sections. The first section contextualizes the importance of soy culture in the Brazilian economy, as well as the Brazilian production of soy. In the second section the theories used to analyze the Revealed Comparative Advantages for exportation of soy grain about the main producer states are presented. In the third section defined the methodology used. In the fourth section are analyzing the results, as well as an analysis of production, productivity and evolution of the price of soy culture and in the fifth and last section the final considerations about the obtained results are presented.

## **2 LITERATURE REVIEW**

### **2.1 BRAZILIAN PRODUCTION OF SOY**

Soy is the main product of Brazilian agriculture, fortification the position of the country as one of the most important players from the worldwide agricultural commerce. The strength of the soy productive chain allows, including Brazil, to have geopolitical pretensions and geoeconomics and the capacity to influence the world market of agricultural commodities (HIRAKURI and LAZZAROTTO, 2014b).

In the last two decades the soy presented an elevated growth in the area, the production and productivity in Brazil. The growth in soy production in Brazil is a result both from the spread of the cultivated area and productivity (EMBRAPA, 2017b).

Brazil is the second biggest soy producer referent to the 2016/2017 crop, and occupies about 2,7% (33,89 million of hectares) from the total area of the country. What differs Brazil from the other countries which are big food producers and of bio-energy, is its potential to enlarge the agricultural production. According to Food and Agriculture Organization of the United Nations –FAO Brazil could dispose of up to 549 million of hectares for the agricultural activities. However, the usage of areas to agricultural practice is too below this value (DALL’AGNOL et al., 2010).

In the chart the main soy producing States in Brazil and the produced quantity between the crops of 2012/13 to 2016/2017 are found in million of tons.

Chart 1 – The Main Producer States – Crop 2012/13 to 2016/17 (in million t).

States	2012/13	2013/14	2014/15	2015/16	2016/17
MT	23,53	26,44	28,02	26,03	30,51
PR	15,91	14,78	17,21	16,84	19,59
RS	12,53	12,87	14,88	16,2	18,71
GO	8,56	8,99	8,63	10,25	10,82
MS	5,81	6,15	7,18	7,24	8,58
Others	15,15	16,89	20,32	18,87	25,87
Total	81,5	86,12	96,23	95,44	114,08

Source: Elaboration based on CONAB, 2017.

According to CONAB (2017a), the main producer states are Mato Grosso, Paraná, Rio Grande do Sul, Goiás and Mato Grosso do Sul, these states being responsible for 77,3% in the gains of soy production of the country in the 2016/17 crop. These five main stated produce approximately 88 million of tons of soy and the biggest of them is Mato Grosso responsible for 27% of production.

The national production of soy in grains for the crop 2016/17, was of 114,08 million of tons. The good climatic conditions favored the development of crops, and consequently elevated the medium yield in 1,8%. The State of Paraná, the second biggest Brazilian producer, with estimated production of 18,63 million of tons, had raised his production estimates and medium yield in 2,3%. With this, the medium yield of soy was 3.593 kg/ha (59,9 sacks/ha), the biggest of the country and of the world, overcoming in 4% the harvested medium of the United States, who harvested 3.500 kg/ha this year (IBGE, 2017).

It is important to note that the development of soy specially in the Brazilian cerrado is due to credit programs positive impact on production, from which will provide a greater volume of resources for the acquisition of inputs, allowing producers increase their production. Technological advancement has promoted the cerrado region with high productivity, (SILVA, 2018).

### 3 METHODOLOGY

#### 3.1 DATA SOURCE

The Brazilian exportation data and the exportations from the States of Mato Grosso, Paraná, Rio Grande do Sul, Goiás and Mato Grosso do Sul were collected along the Information Analysis System of the Exterior Commerce (ALICE) were collected together with the CONAB, for the years of 2006 to 2016<sup>1</sup>, with this period being used as a reference to understand the competition of the soy produced from the Brazilian main producers of the oleaginous in the last years.

#### 3.2 COMPARATIVE ADVANTAGES

There are many theories about international commerce that look forward to explain the commercial interactions among countries. The first in them was the Absolute Advantage Theory, created by Adam Smith, who preached that the country which produced more of a merchandise with less cost, being this measured in terms of working hours, could realize exchanges with other countries, in a beneficial way (FIGUEIREDO and SANTOS, 2005).

Being so, David Ricardo realized advances in Adam Smith's theory by exposing in the Principles of Political Economy, the Comparative Advantages Law. According in Ricardo, even if a nation has an absolute disadvantage in the production of both the commodities, there would be still a possibility of commerce, since the nation became specialized in the production of its commodity of lesser absolute disadvantage (CORONEL and DESSIMON, 2007). A country has a comparative advantage in production some good if the cost of opportunity of this production related to the others is lower in this country than in the others (KRUGMAN and OBSTFELD, 2001).

Following the classic theory of international commerce from David Ricardo, in 1965, Bela Balassa used the Revealed Comparative Advantages Index (RCA) in a country (RCA) to measure the competitive level or the a comparative advantages of a country (SIQUEIRA and PINHA, 2011).

##### 3.2.1 Índice de Vantagens Comparativas Reveladas - RCA

The Revealed Comparative Advantages Index looks forward to identify the products in which the country has comparative advantage, the model proposed by Balassa (1965). The Revealed Comparative Advantages Index can be defined in the following way:

$$RCA_{ij} = \frac{\frac{X_{ij}}{X_j}}{\frac{X_{iz}}{X_z}} \text{ equation (1)}$$

In which:

$X_{ij}$  = is the value of the  $i$  product exports from the region  $j$ ;

$X_{iz}$  = is the value of the  $i$  product exports from the region  $z$ ;

$X_j$  = is the total value of exports from region  $j$ ;

$X_z$  = is the total value of exports from region  $z$ ;

If  $RCA_{ij} > 1$ , then, the product  $i$  presents revealed comparative advantage and if  $RCA_{ij} < 1$ , then, the product  $i$  presents revealed comparative disadvantage.

According to Hidalgo and Mata (2004), the RCA is a revealed measure, calculations are based on data observed after the trade is done. These indexes do not consider the presence of distortions that exist in the economy, such as tax restrictions, subsidies, commercial deals and Money Exchange misalignments that can affect the

results obtained from the index. However, they serve to delineate the commercial patterns of a determining economy.

Many researchers have been realizing studies using the RCA. Dorneles et al. (2013) realized an analysis of the competitiveness of the soy complex of the State of Mato Grosso do Sul on relation to Brazil to the period of 1997 to 2011, and verified what refers to the production of grains and of soybean meal that the State has revealed comparative advantages. The production of soy oil the results show that during all the period analyzed Mato Grosso do Sul did not present comparative advantages.

In a study of comparative advantages for the Brazilian Midwest region, realized of Oliveira and Schlindwein (2015), in the period of 2002 to 2011, the authors concluded that the Midwest region presents comparative advantage for exportation of the soy complex.

### 3.3 METHOD

To verify the existence of the competition of the soy of the States of Mato Grosso, Paraná, Rio Grande do Sul, Goiás and Mato Grosso do Sul compared to Brazil, we used the Revealed Comparative Advantages Index (RCA). Balassa (1965) proposed The Revealed Comparative Advantages Index, flagged in the Law of Comparative Advantages, formulated by Ricardo, in 1817.

According to Maia (2002), the RCA gives an indicator for the relative structure of the actions for determining commodity, from a country or region during a period. Below we have the equation of The Revealed Comparative Advantages Index:

$$RCA_{ij} = \frac{\frac{X_{ij}}{X_j}}{\frac{X_{iz}}{X_z}} \text{ equation (2)}$$

In this study,  $i$  represent the analyzed product (soy);  $j$  represent the analyzed State; and  $z$  is the reference zone, in this case, Brazil. Therefore  $X_{ij}$  is the value of the exportations from each state of the product  $i$ ;  $X_j$  is the total value of the state exportations;  $X_{iz}$  is the value of Brazilian exportations of the product  $i$ ; and  $X_z$  is the total value of the Brazilian exportations. When  $RCA_{ij} > 1$ , the analyzed state presents revealed comparative advantage for the exportations of the product ( $i$ ); in contrary, the state presents revealed comparative disadvantage for the product exportations ( $i$ ).

Though, this index presents a limitation by the fact of being asymmetric, with the comparative disadvantage varying between 0 and 1 and the comparative advantage between 1 and the infinite. To overcome this limitation, Laursen (1998) proposed the Symmetric Revealed Comparative Advantage index (RSCA):

$$RSCA_{ij} = \frac{RCA_{ij} - 1}{RCA_{ij} + 1} \text{ equation (3)}$$

In which:

$RSCA_{ij}$ = Symmetric Revealed Comparative Advantage index of the product  $i$  from region  $j$ .

$RCA_{ij}$ = Revealed Comparative Advantage index from the product  $i$  for region  $j$ .

The values from this index can vary between -1 and +1. If the values of RSCA if the result found is between 0 and +1, then the region has revealed comparative advantage in the product  $i$ . By the other side if the values from RSCA are found between -1 and 0, the region presents revealed comparative disadvantage in the product  $i$ .

The analysis of correlation between the RCA from the States, we used the free software GRETl (2017).

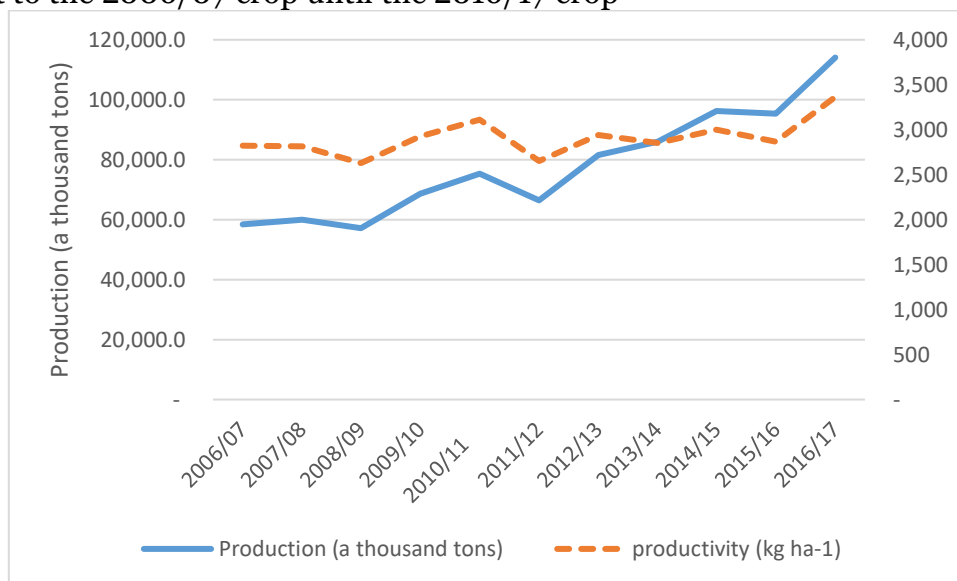
## 4 RESULTS

### 4.1 SOY PRODUCTION IN BRAZIL

The volume of soy produced in Brazil has been rising each year, with a Record production of 114 million of tons of soybeans produced in the 2016/17 crop (Figure 1). Only in the period of this study, the production of Brazilian soy raised 95,4%, leaving the 58,4 million of tons in the 2006/07 crop to 114,1 million of tons in 2016/17 (SEAB/DERAL, 2017).

The production growth of the soy is because of the big expansion in the agricultural are that has been occurring in Brazil in the last years with evidence of the expansion by the Center-Northwest rout of the country, with projection turned to the south and occidental from the North region (FREITAS and MENDONÇA, 2016). This rising of production is also because of the productivity growth (BALBINOT JUNIOR et al., 2017) and the weather conditions, the genetic the gains in productivity, the agricultural credit, the technology evolution and the entrepreneurial character in the produces class directed the soy production in the Brazilian Cerrado region in the last decades (FRANCISCO and CÂMARA, 2013).

Figure 1 - Production (a thousand tons) and productivity (kg ha<sup>-1</sup>) of Brazilian soy referent to the 2006/07 crop until the 2016/17 crop



The productivity of the soy culture has been increasing during the years as well, thanks to the technologies evolution of the cultivation in the Cerrado that happened in the years 1990, to the development of varieties adapted to low altitudes and resistant to the main illnesses, the discovery of more efficient and less toxic insecticide and fungicide molecules, to the development of more efficient strains of *Bradyrhizobium japonicum* and to the advance in information of soil fertility management that created as indispensable technology package for the culture (FRANCISCO and CÂMARA, 2013).

However, analyzing figure 1, we observed that along the years 2006/07 to 2015/16 the medium productivity of the soy culture was close to 3000 kg/ha, though



it has presented a small variation between the analyzed years, and the total grain production presented a growth during all the studied period. In that way it is evident that a raise of new areas for agricultural exploration happened and the productivity of the soy culture did not follow this raise. That may have happened because the waves of advance in soil usage are not homogeneous in productivity if compared to the regions with cycles already established in their respective agricultural cultures (FREITAS and MENDONÇA, 2016).

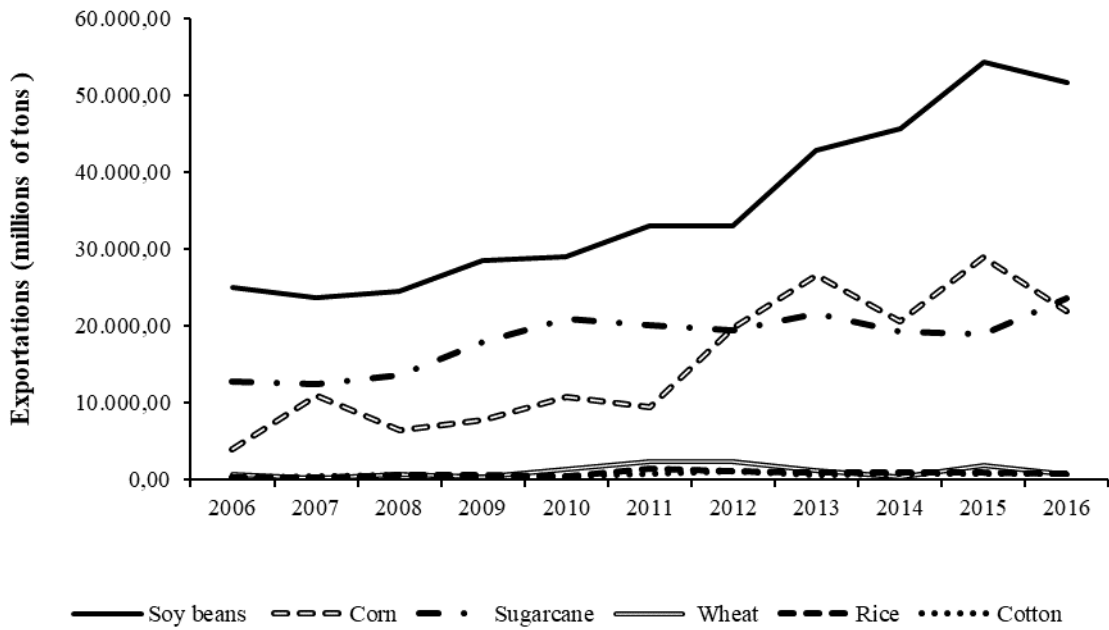
Among the agricultural cultures, the soy has not being the main culture cultivated in the country and from its profitability, it has been occupying the space in other cultures, but mainly it has its advances over pasture areas aimed at grain cultivation. During the crop of 2006/07 the area destined for soy cultivation was of 22,8 million of hectares, passing to 33,89 million of hectares in the 2016/17 crop, being the biggest area cultivated with the oleaginous in the country and equivalent to 56% of the total seeded area in the country (CONAB, 2017b).

The soy culture as presents the biggest cultivated area and the bigger production of grains, it leads the ranking of agricultural products exported by the country. In the year of 2016, Brazil exported 51,6 million of tons of soybeans, approximately 50% of the total agricultural products exported by the country (Figure 2). In the same year 23,7 million of tons of sugarcane were exported and 21,8 million of tons of corn. We analyzed the figure 2, this year was atypical, because since 2012 the exportations of corn surpassed the sugarcane exportations. The other cultures, wheat, rice and cotton, sum together 2,2 million of tons of exported products.

Of the total of 51,6 million of tons of Brazilian soy exported in 2016, China appears as the main importing country (74,8%). European Union on the other side absorbed 10,2% of Brazilian exportations (ALICEWEB, 2017).

Thus, in 2016 the Brazilian agribusiness closed the year with a reduction in shipping in relation to 2015, reflecting the appreciation of the Real compared to the Dollar and the fall in the national agricultural production, specially the production of grains, because of the unstable weather. In 2016, the exported volumes from the majority of products considered in the Cepea indexes of importation decreased in relation to the year before, highlighting the soy oil (24,9%) and corn (24,4%). The shipping of coffee also retreated (8,3%), soybeans (5,2 %), fruits (4,7%), ethanol (3,7%), feathered cotton (3,5%), soybean meal (2,6%) and bovine meat (0,3%).

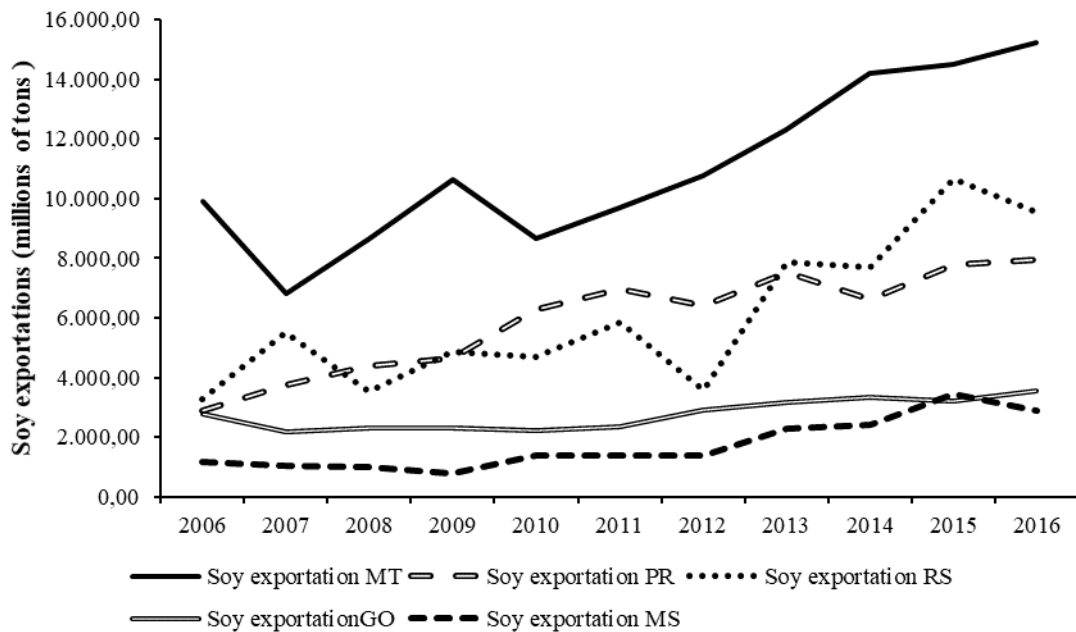
Figure 2 - Main agricultural products exported by Brazil in million of tons in the years of 2006 to 2016.



Source: Elaborated from COMEX VIS (2017)

Decomposing the Brazilian soy exportations in the year of 2016 in levels by state, of the 51,6 million of tons of exported soybeans, 15,2 million of tons were exported by the state of Mato Grosso, being so, the state responded for about 30% of the total Brazilian exportations of soy (Figure 3). On the other hand the states of Paraná, Rio Grande do Sul, Goiás and Mato Grosso do Sul exported 8,0, 9,5, 3,6 and 2,9 million of tons of soy respectively. These five States together responded for about 76% of the Brazilian soy exportations in the year of 2016.

Figure 3 - Main soy exporter states in Brazil between 2006 and 2016



Source: Elaborated from ALICEWEB, 2017.

Taking as reference the years of this study (2006 to 2016), the states of Rio Grande do Sul, Paraná and Mato Grosso do Sul were the states that increased the most their soy exportations in this period, with a raise of 190,5%, 175,7% and 144,7% respectively. On the other hand, the state of Mato Grosso increased in 53,4% their soy exportations followed by the state of Goiás with a growth of 26,8%.

However, when the subject is exportation, the most visible bottleneck of the agricultural industry relates to logistics. It is known that the precarious transport of feedstock between primary production sources and industry, or even directly in exportation represent an enormous financial damage for the country (OMETTO, 2006).

In that way, in the world market, Brazil presents comparative advantages in soy production in relation to other producers worldwide, but loses in logistics costs. So improvements in infrastructure logistics are looking forward to reduce costs and time (MEREGE and ASSUMPÇÃO, 2002).

By the inefficiency of soy transportation, mainly in regions far from the ports, the Brazilian producer has a medium loss of 25% in its incomes with flow cost, where these costs with shipping end up being included in the final price of the Brazilian agricultural products (CORREA and RAMOS, 2010).

Even though soy is a commodity, with the global market well defined and structured, the prices of grain, soybean meal and oil tend to present great volatility. This behavior comes of the related uncertainties, as well as questions involving the offer and demand, also with the market of agricultural derivatives (including soy), nowadays under strong pressure of speculative investment funds (DALL'AGNOL et al., 2010).

## 4.2 COMPARATIVE ADVANTAGE

This study proposes verifying the soy RCA from the main soy producer states from Brazil between the years of 2006 and 2016, considering the exportations of soy in grains. For doing it the soy exportations from the states of Mato Grosso, Paraná, Rio Grande do Sul, Goiás and Mato Grosso do Sul, we compared in relation to Brazilian exportations of soy grains.

The chart with the results from the Revealed Comparative Advantage Index for the state of Mato Grosso (Chart 3).

Chart 3 - Revealed Comparative Advantage index and Symmetric Revealed Comparative Advantage index of soy in the state of Mato Grosso for the years of 2006 and 2016

	Mato Grosso			
	RCA	RSCA	RCA	RSCA
2006	11,5286	0,8404	2012	6,8038
2007	8,8877	0,7977	2013	4,7490
2008	10,1778	0,8211	2014	5,7983
2009	8,1097	0,7805	2015	4,7831
2010	7,2725	0,7582	2016	5,2787
2011	7,4974	0,7646		

Source: Research results.

According to Chart 3, it is possible to verify that the State of Mato Grosso presented comparative advantage in exporting soy in the period of 2006 to 2016, because according to the methodology described by Laursen (1998), the values are between 0 and +1 according to the RSCA and above 1 for RCA with a medium value of 7,35. This high value is mainly due to the large export volume of soybeans making the RCA so significant.

Pereira et al. (2009) also observed that the State of Mato Grosso presented comparative advantage in the exterior commerce in the period of 1996-2007, mainly because of the exportation of commodities. The results show that the state has several competition advantages on revealed comparative advantage index, in products and is dependent on the import of others.

Mota et al. (2013) in the study of comparative advantage of soy in the state of Mato Grosso in the period of 2003 to 2012, also verified that the production of soy in the state presented comparative advantage used Revealed Comparative Advantage of Vollrath Index and contributed to the total of the Brazilian Commercial Balance significantly and concluded that the adoption of public politics that involve the investment in infrastructure is necessary to ease the production flow and practices that reduce production costs and also work as a way to increase the exported product value.

The RCA and RSCA for the State of Paraná, we presented in chart 4. We observed that the state of Paraná also presented comparative advantage for soy exportation in relation to Brazil in the period of 2006 to 2016, with a medium RCA of

4,20. According to Chart 4, we are able to conclude that in the year of 2010 the state of Paraná presented a bigger comparative advantage in exporting soy.

Chart 4 - Revealed Comparative Advantage index and Symmetric Revealed Comparative Advantage index of soy in the state of Paraná for the years of 2006 to 2016

	Paraná				
	RCA	RSCA	RCA	RSCA	
2006	2,5909	0,4430	2012	4,6352	0,6451
2007	3,4888	0,5544	2013	4,2128	0,6163
2008	4,4012	0,6297	2014	3,8220	0,5852
2009	4,2310	0,6177	2015	3,6993	0,5744
2010	5,5300	0,6937	2016	4,1752	0,6135
2011	5,4143	0,6882			

Source: Research results.

Rosa and Alves (2004) in a study about the exterior commerce of agricultural products of the state of Paraná in the period of 1989 to 2001, concluded that the State of Paraná also presented comparative advantage in soy grain exports in this period. In other study Campos and Lago (2016) identified that Paraná has an the economic specialized in the soy complex, which presented revealed comparative advantage in every year analyzed (2000-2011) and being so, presents competitive in this sector in front of the national scenario.

The other state that we analyzed, was the state of Rio Grande do Sul, in which the revealed comparative advantage indexes are presented in Chart 5. We observed that the chart the state of Rio Grande do Sul also presented comparative advantage in exporting soy grain during all the analyzed period (2006 – 2016), so, the RCA values above 1,0, or the RSCA values between 0 and 1 indicate the favorable comparative advantage of Rio Grande do Sul's soy in relation to Brazil.

Chart 5 - Revealed Comparative Advantage index and Symmetric Revealed Comparative Advantage index of soy in the state of Rio Grande do Sul for the years of 2006 to 2016

	Rio Grande do Sul				
	RCA	RSCA	RCA	RSCA	
2006	4,3880	0,6288	2012	3,8485	0,5875
2007	6,5135	0,7338	2013	5,0910	0,6716
2008	4,6114	0,6436	2014	5,1680	0,6757
2009	5,0962	0,6719	2015	5,3289	0,6840
2010	5,5750	0,6958	2016	5,5005	0,6923
2011	5,2436	0,6797			

Source: Research results.

In a study realized from Silva et al. (2016), in the period of 1999 to 2012, verified that soy exportations from Rio Grande do Sul presented revealed comparative advantages what corroborated with the importance of this sector in the state, because soy is a competitive product in the agricultural business in the state.

When Feix and Zanin (2013) studied the growth sources in agriculture in the State of Rio Grande do Sul between 1990 and 2010, observed a tendency marked by the generalized growth in the cultivated area of soy and wheat starting from the turn

of the century. It is notoriously the importance of soy, which area represented less than 45% of the total area of temporary and permanent cultivation in 1990, passing the 50% in 2010.

Other state in the study was the state of Goiás, at Chart 6, in which are presented the comparative advantages indexes for the state. According to the chart, we observed that the RCA is above one unit and the RSCA is found between 0 and +1, showing that the state of Goiás has comparative advantage in exporting soy in relation to the Brazilian soy exportation in the studied period (2006 – 2016).

Chart 6 - Revealed Comparative Advantage index and Symmetric Revealed Comparative Advantage index of soy in the state of Goiás for the years of 2006 to 2016

Goiás					
	RCA	RSCA		RCA	RSCA
2006	9,9233	0,8169	2012	4,8987	0,6609
2007	7,8533	0,7741	2013	4,3086	0,6233
2008	8,1341	0,7810	2014	4,4455	0,6327
2009	6,8514	0,7453	2015	3,6684	0,5716
2010	6,7328	0,7414	2016	4,5472	0,6395
2011	6,0334	0,7156			

Source: Research results.

Souza et al. (2011), in a study about competitive of the main agricultural product analysis in the state of Goiás, confirmed that soy is the product with the biggest comparative advantage in relation to Brazil and the World, what matches the production and exportation values. The author noticed a high RCA for soy (varying between approximately 120% and 326%) during all the analyzed period (1996 and 2009), indicating that soy is responsible for a considerable part of exportations from Goiás.

In other study Souza et al. (2009) also verified indexes superior to 200 when they analyzed the competitive from the state of Goiás in relation to the world in the period of 1990 to 2007. According to the authors, this occurred because soy has a bigger participation in Goiás's exportations that the world exportations, concluding that soy planting is extremely important for Goiás's exportations, having insight that it is a dynamic and competitive sector, nationally and internationally.

In the comparative advantages field Goiás presents its best density in agriculture and pecuary, preponderantly in commodities that historically has been showing a very volatile commercial relation. A relevant point is the sector reversion of derivatives primary products along the studied period it passes from disadvantage to comparative advantage (MESQUITA, 2006).

The last state analyzed, was the state of Mato Grosso do Sul, where Chart 7 presents the result from the comparative advantages analysis for the state. We observed that the State of Mato Grosso do Sul presented comparative advantages in exporting soy grains in the period of 2006 to 2016.

Chart 7 - Revealed Comparative Advantage index and Symmetric Revealed Comparative Advantage index of soy in the state of Mato Grosso do Sul for the years of 2006 to 2016

Mato Grosso do Sul					
	RCA	RSCA		RCA	RSCA
2006	3,4610	0,5517	2012	2,1481	0,3647
2007	3,6117	0,5663	2013	2,1939	0,3738
2008	2,8068	0,4746	2014	1,9793	0,3287
2009	2,1072	0,3563	2015	2,5874	0,4425
2010	2,7252	0,4631	2016	2,6956	0,4588
2011	2,1625	0,3676			

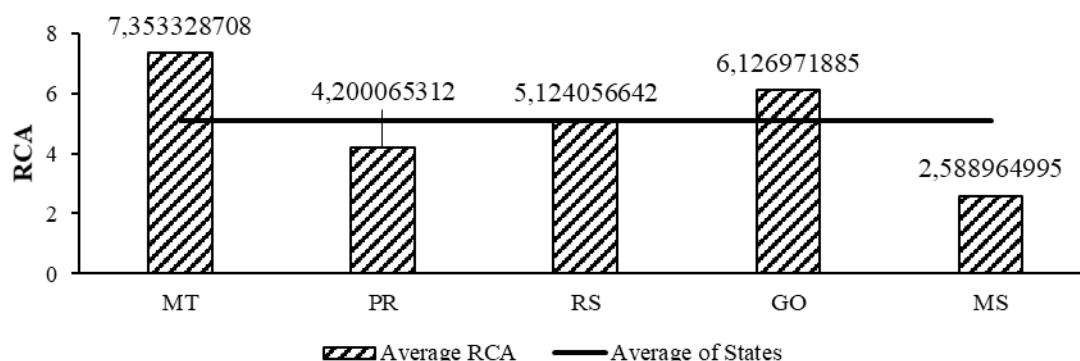
Source: Research results.

Dorneles et al. (2013) when analyzed the obtained RCA for soy grains for the state of Mato Grosso do Sul between the years of 1997 and 2011 observed that the values found are bigger than the unity during all the analyzed period. This result indicated that soy grains production the State of Mato Grosso do Sul has competitive and exportation advantages and that this commodity presents itself as a sector of great importance in the state exportation schedule.

Therefore there is a strong predominance of the agribusiness sections in the exportations from Mato Grosso do Sul, however reduced in the last years with the growth of the participation in other economic sectors. Even with the participation falling, the agribusiness keeps itself as the main exporting sector of the state, being responsible for about more than 80% of annual exportations (CASAROTTO, 2013).

This fall of the soy exportation in the State of Mato Grosso do Sul in relation to Brazil can also be observed in Figure 5. When the RCA medium of the State of Mato Grosso do Sul, we compared with the other five states medium, we observed that the State of Mato Grosso do Sul, with the medium RCA of 2,59 stayed bellows the medium RCA from the other states in the present study, that is of 5,08. This low RCA can be because of the fact that exportation products like soy grain, oil and soybean meal, obtained a reduction in their representation in exportations of the Brazilian Midwest region. (OLIVEIRA AND SCHLINDWEIN, 2015).

Figure 5 - Comparative between the RCA medium of each State and the Brazilian RCA for the period of 2006 to 2016.



Source: Research results.

Still observing the Figure 5, it can see that the State of Paraná is also found a few bellows the Brazilian medium of RCA in soy exportation, with an RCA of 4,20. This index bellows the Brazilian medium can be because of a structural modification in the

exportation schedule of agribusiness in the State. In 2000 the main product exported from Paraná was soy in grains and soybean meal that together represent 45% of the total exported by the agribusiness. On the other hand in 2013 soy grains and soybean meal lost relative importance and represent about 41% of the total exported, while the products with bigger aggregate value elevated their relative importance to 45% (SCHNEIDER and ARAÚJO, 2014). The states of Mato Grosso, Rio Grande do Sul and Goiás are found above the medium RCA of the selected states.

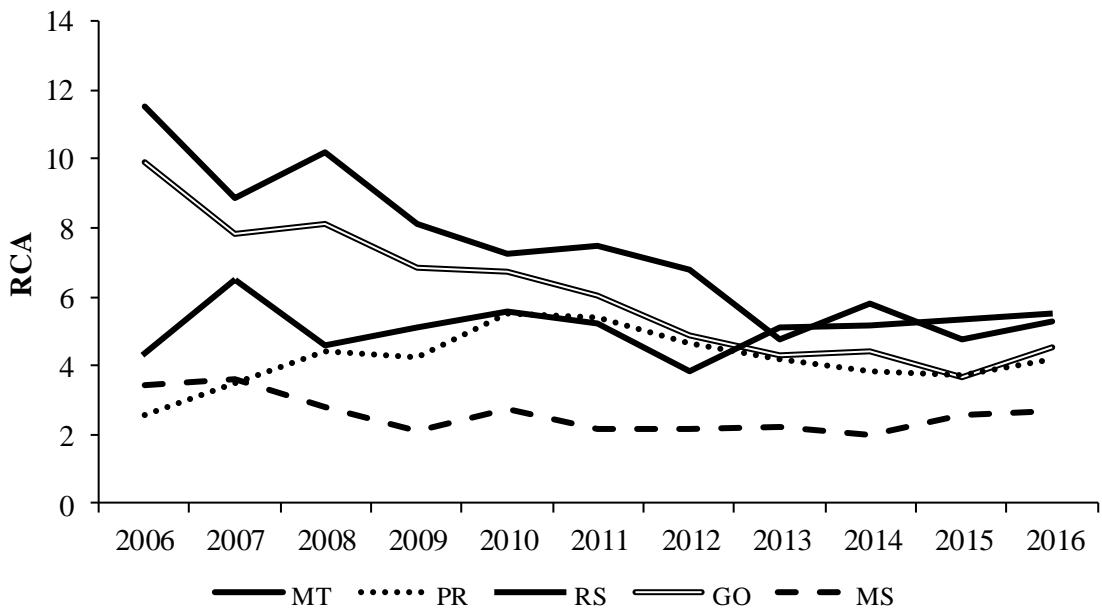
However, in a general way, all the Brazilian states in this study presented comparative advantage in exporting soy. Brazil has a significant importance in exportation of soy gains, soybean meal and oil, being the second greatest producer worldwide for these commodities, besides presenting geographical conditions that allow increasing even more the production of this oleaginous. According to Coronel et al. (2008), the RSCA analysis indicated that Brazil presented during all the analyzed period (1995 – 2004) revealed comparative advantages both for grain, soybean meal and soy oil with values higher than to the unity and crescent in determined periods.

In the evaluation of the commercial behavior of the Brazilian agricultural products that we selected for the study by Waquilet al. (2004), what is about the revealed comparative disadvantage results, they observed that all the products had unfavorable results, highlighting mainly soy and derivatives, orange juice, chicken, sugar and coffee. In other study Diniz (2017) also affirms that Brazilian soy has a great advantage in international commerce.

However, a few more recent studies show that for every state the RCA is decreasing, result of a drop of the participation of soy in the Schedule as the exportation of the states and not of a drop in soy exportations, what did not occur (SOUZA et al., 2009). In the present study, the drop in the RCA, we observed mainly for the states of the Midwest region for the states of Mato Grosso, Goiás and Mato Grosso do Sul, to a reduction of 54,2%, 54,1% and 22,1% respectively. On the other hand the states of the South region, Paraná and Rio Grande do Sul, had a behavior a few differences in relation to the Midwestern states, because they presented a period of growth and then they passed through a period of RCA reduction through the years, staying evident the existing difference between the states of the Midwest region and the states of the South region (Figure 6).



Figure 6 - Revealed comparative advantage index (RCA) for the States of Mato Grosso, Paraná, Rio Grande do Sul, Goiás and Mato Grosso do Sul, for the period of 2006 to 2016.



Source: Research results.

This effect is similar to the RCA drop from the states of Mato Grosso and Goiás that also stays too evident when we made a correlation between this two states. The a correlation coefficient between the estimated RCA for the states of Mato Grosso and Goiás presented a great correlation, with  $r$  equal to 0,98 (Chart 8). Still in the same chart, it can be observed a correlation a few sorter between the States of Goiás and Mato Grosso do Sul, and between Mato Grosso and Mato Grosso do Sul, with a correlation coefficient of 0,69 and 0,61 respectively, showing that the Midwestern States of Brazil present an analog behavior to the RCA reduction.

Chart 8 - Correlation analysis of RCA between the Brazilian states that export soy.

States	MT	PR	RS	GO	MS
MT	1,00				
PR	-0,30	1,00			
RS	-0,20	0,03	1,00		
GO	0,98*	-0,30	-0,05	1,00	
MS	0,61*	-0,53	0,34	0,69*	1,00

\*: significantly to 5% level.

Source: Research the results.

Analyzing the other correlation results of Chart 8, beside not being statistically significant, it can be observed that the states of Paraná and Rio Grande do Sul have negative correlation to the states of Mato Grosso, Goiás and Mato Grosso do Sul, corroborating with the results already found in this study related to the RCA behaviour, revealing the existing difference between the states of the South Region and the Midwestern States about the RCA.

A factor that also may be related with the ICVR reduction along the years from the states that are the main producers of soy in Brazil, in special Mato Grosso and Goiás is because of the growth that has been occurring in domestic consume of soy in grains, which can get to 69,2 million of tons in 2026/27 (MAPA, 2017b). In the last years, an expressive growth also happened in the meat production in general through Brazil.

Therefore, although Brazilian agriculture will present the last years of the result expressed in terms of expansion, expansion of plant area and commercial insertion, we have problems in the analysis or logistic sector that affect the limits regarding the good performance of agribusiness. Inadequate infrastructure, combined with operational problems, requires better management of the national logistics system. (FERREIRA, 2016).

## **5 CONCLUSION**

The volume of soy produced in Brazil has been increasing each year and it is because of the great expansion in the agricultural area that has been occurring in Brazil in the last years, mainly in the Midwest and North regions of the country.

Starting from this scenario, the analysis of the Revealed Comparative Advantage Index (RCA) and the Symmetric Revealed Comparative Advantage (RSCA) indicated that the States of Mato Grosso, Paraná, Rio Grande do Sul, Goiás and Mato Grosso do Sul have an advantage in exporting soy in relation to Brazil. We observed in the present work that the states from the South region presented a period of growth and later decrease in the RCA, and the states from the Midwest region suffered only a reduction in RCA, possibly because the products from the soy complex is losing their representation in the exported total.

Lastly, even though government inputs destined in exportation of products like soy exist, such as the Kandir Law (1996) and the floating exchange regime, Brazil still faces problems with the flow of agricultural production, low storage capacity and port inefficiency.

This work as well as the others quoted in this research looked forward to contribute with information about the competition of the agribusiness, soy in specific. In the same way, other studies will be able to contribute with other important cultures on the Brazilian exportation list, or even the deepen of methodologies explaining other factors that influence positively or negation in the competition of Brazilian agribusiness.

## References

ALICEWEB, 2017. Exportação/importação de soja. Disponível em: <<http://aliceweb.mdic.gov.br/>>. Acesso em: 10 jun. 2017.

BALBINOT JUNIOR, Alvadi Antonio; HIRAKURI, Marcelo Hiroshi; FRANCHINI, Julio Cezar; DEBIASI, Henrique; RIBEIRO, Ricardo Henrique. Análise da área, produção e produtividade da soja no Brasil em duas décadas (1997-2016). Boletim de Pesquisa e Desenvolvimento / Embrapa Soja, n. 11, 2017.

BRANDAO, Antonio Salazar Pessoa; REZENDE, Gervásio Castro de; MARQUES, Roberta Wanderley da Costa. Crescimento agrícola no período 1999/2004: a explosão da soja e da pecuária bovina e seu impacto sobre o meio ambiente. Econ. Apl., Ribeirão Preto, v. 10, n. 2, p. 249-266, 2006.

CAMPOS, Lediany Freitas; LAGO, Sandra Mara Stocker. As ações coletivas sob a forma de cooperativas e a relevância na cadeia produtiva da soja no Paraná. Economia & Região, Londrina, v.4, n.2, 2016.

CASAROTTO, Eduardo Luis. Desempenho da pauta de exportações do agronegócio de Mato Grosso do Sul. Dissertação (Mestrado em Agronegócios), Universidade Federal da Grande Dourados. 94f.

CEPEA (Centro de Estudos Avançados em Economia Aplicada - ESALQ/USP), 2016. Índices exportação do agronegócio. Disponível em: <<https://www.cepea.esalq.usp.br/upload/kceditor/files/2016.pdf>>. Acesso em: 28 out. 2017.

COMEX VIS. Principais Produtos Exportados. Disponível em: <<http://www.mdic.gov.br/comercio-exterior/estatisticas-de-comercio-exterior/comex-vis/frame-ppe>>. Acesso em: 04 out. 2017.

CONAB (Companhia Nacional de Abastecimento), 2017a. Séries históricas. Disponível em: <<http://www.conab.gov.br>>. Acesso em: 25 abr. 2017.

\_\_\_\_\_. Acompanhamento da safra brasileira de grãos, v. 4 Safra 2016/17 - Décimo segundo levantamento, Brasília, setembro 2017b.

CORONEL, Daniel Arruda; DESSIMON, João Armando. Vantagens Comparativas Reveladas e Orientação Regional da Soja Brasileira em relação à China. Estudos do CEPE (UNISC), v. 26, 2007.

\_\_\_\_\_; CARVALHO, Fátima Marília Andrade; MACHADO, João Armando Dessimon.; WAQUIL, Paulo Dabdab.; SILVA ILHA, Adayr. Exportações do complexo brasileiro de soja - Vantagens comparativas reveladas e orientação regional. Revista de Política Agrícola, Ano XVII, n.4, 2008.

CORREA, Vivian Helena Capacle; RAMOS, Pedro. A precariedade do transporte rodoviário brasileiro para o escoamento da produção de soja do Centro-Oeste: situação e perspectivas. Rev. Econ. Sociol. Rural, Brasília, v. 48, n. 2, p. 447-472, jun. 2010

DALL'AGNOL, Amélio; LAZAROTTO, Joelsio José.; HIRAKURI, Marcelo Hiroshi. Desenvolvimento, Mercado e Rentabilidade da Soja Brasileira. Paraná: Embrapa Soja, 2010. 20 p. (Embrapa Soja. Comunicado Técnico, 74).

DINIZ, Adriana Fabrini. Vantagem comparativa revelada da agroindústria nacional no período 2003-2014. Revista Paranaense de Desenvolvimento, Curitiba, v. 38, n. 132, 2017.

DORNELES, Tathiane Marques; DALAZOANA, Francisca Maciel de Lima; SCHLINDWEIN, Madalena Maria. Análise do Índice de Vantagem Comparativa Revelada para o complexo da soja sul-mato-grossense. Revista de Economia Agrícola. São Paulo, v.60, 2013.

EMBRAPA (Empresa Brasileira de Pesquisa Agropecuária). Cultura da soja. Disponível em: <<http://www.embrapa.gov.br>>. Acesso em 10 jul. 2017a.

\_\_\_\_\_. Análise da área, produção e produtividade da soja no Brasil em duas décadas (1997-2016). Boletim de Pesquisa e Desenvolvimento 11, Embrapa Soja, 2017b.

FEIX; Rodrigo Daniel; ZANIN, Vanclei. Fontes de crescimento da agricultura no estado do Rio Grande do Sul entre 1990 e 2010. Ensaio FEE, Porto Alegre, v. 34, Número Especial, 2013.

FERREIRA, Jean Filipe Kortstee. Comportamento do frete rodoviário de soja: aplicação de um modelo de regressão linear múltipla. Dissertação (Mestrado em Pesquisa Operacional) - Universidade Estadual de Campinas, Faculdade de Ciências Aplicadas. Campinas, SP. 67f, 2016.

FIGUEIREDO, Adelson Martins; SANTOS, Maurinho Luiz dos. Evolução das vantagens comparativas do Brasil no comércio mundial. Revista de Política Agrícola, São Paulo, v. 1, 2005.

FRANCISCO, Eros Artur Boac; CÂMARA, Gil Miguel Sousa. Desafios atuais para o aumento da produtividade da soja. Instituto Nacional de Propriedade Rural-INPI. (Informações agronômicas n. 143), 2013.

FREITAS, Rogério Edivaldo; MENDONÇA, Marco Aurélio Alves de. Expansão Agrícola no Brasil e a Participação da Soja: 20 anos. Rev. Econ. Sociol. Rural, Brasília, v. 54, n. 3, p. 497-516, Sept. 2016.

GRETLM - GNU Regression, Econometrics and Timeseries Library, version 2017c, 2017.

HIDALGO, Álvaro Barrantes; MATA, Daniel Ferreira Pereira Gonçalves. A especialização do nordeste brasileiro e do estado de Pernambuco no comércio exterior. Recife: PIMES/Departamento de Economia, 2004.

HIRAKURI, Marcelo Hiroshi; LAZZAROTTO, Joelsio José. Evolução e Perspectivas de Desempenho Econômico Associadas com a Produção de Soja nos Contextos Mundial e Brasileiro. EMBRAPA, Documentos 319, 2011a.

\_\_\_\_\_. O agronegócio da soja nos contextos mundial e brasileiro. EMBRAPA, Documentos 349, 2014b.

IBGE (Instituto Brasileiro de Geografia e Estatística). Estatística da Produção Agrícola -2017. Disponível em: <<ftp://ftp.ibge.gov.br/>> Acesso em: 02 mai. 2017.

KRUGMAN, Paul Robin; OBSTFELD, Maurice. Economia Internacional - Teoria e Política, 5 ed., São Paulo: Makron Books, 2001.

LAURSEN, Keld. Revealed Comparative Advantage and the Alternatives as Measures of International Specialization. Working Paper, v. 30, n. 98, Conpenhagem: Danish Research Unit for Industrial Dynamics, 1998.

MAIA, Sinézio Fernandes. Impactos da abertura econômica sobre as exportações agrícolas Brasileiras: análise comparativa. In: CONGRESSO BRASILEIRO DE ECONOMIA E SOCIOLOGIA RURAL, 11., 2002, Passo Fundo. Anais... Brasília: SOBER, 2002. CD-ROM.

MAPA – 2017a. (Ministério da Agricultura, Pecuária e Abastecimento). Relatório de atividades 2016-Secretaria de Relações Internacionais do Agronegócio. Brasília – DF. Disponível em: <<http://www.agricultura.gov.br>>. Acesso em: 03 out. 2017.

\_\_\_\_\_. 2017b. Projeções do agronegócio - Brasil 2016/17 a 2026/27 - Projeções de Longo Prazo. Agosto de 2017 - Brasília – DF. Disponível em: <<http://www.agricultura.gov.br>> Acesso em: 02 nov., 2017.

MEREGE, Alessandra de Alencar; ASSUMPÇÃO, Maria Rita Pontes. Logística para exportação da soja paranaense. XXII Encontro Nacional de Engenharia de Produção - ENEGEP. Curitiba: Paraná, 2002.

MESQUITA, Carlos Wagner. Vantagem Comparativa Revelada: uma Análise do Perfil de Goiás. Conjuntura econômica goiana: boletim trimestral, n. 7, Goiânia. 2006 Disponível em: <<http://www.imb.go.gov.br/pub/conj/conj7/06.htm>>. Acesso em: 02 nov. 2017.

MOTA, Cláudia Cristal de Paiva; CERQUEIRA, Jéssica da Silva; REZENDE, Adriano Alves. Participação da produção da soja na balança comercial: uma análise comparativa a partir da produção do estado do Mato Grosso, no período de 2002 a 2012. Revista de Estudos Sociais, v. 15, n. 29, 2013.

OLIVEIRA, Marciele Freitas; SCHLINDWEIN, Madalena Maria. Índice de vantagem comparativa revelada para o complexo soja da Região Centro-Oeste brasileira. Revista de Estudos Sociais, v. 17, n. 33, 2015.

OMETTO, João Guilherme Sabino. Os gargalos da agroindústria. O Estado de São Paulo, 22 de maio 2006.

PEROBELLI, Fernando Sagueiro; VALE, Vinicius de Almeida; BELGO, Túlio Mesquita; LANZIOTTI, Felipe. Avaliação espacial das fontes de crescimento de um

conjunto de commodities agrícolas brasileiras exportáveis entre 2003-2013. Revista de Economia e Agronegócio, v. 14, 2016.

PEREIRA, Benedito Dias; SILVA, Paula Luciana; FARIA, Alexandre Magno de Melo; SILVA, Gerson Rodrigues; JOSEPH, Lázaro Camilo Recompensa. Especialização e vantagens competitivas do estado de Mato Grosso no mercado internacional: um estudo de indicadores de comércio exterior no período 1996-2007. Revista de Economia, v. 35, n. 3, 2009.

ROSA, Tatiana Diair Lourenzi Franco; ALVES, Alexandre Florindo. Comércio exterior de produtos agrícolas do estado do Paraná de 1989 a 2001: análise de vantagens comparativas e do padrão de comércio. Revista de Economia e Agronegócio, v. 2, 2004.

SANTOS, Patrick Leite; CAVALCANTE, Antonio Wisney Pedrosa; SILVA FILHO, Luís Abel. A competitividade do cacau baiano frente ao comércio internacional. Revista Economia & Tecnologia (RET), v.9, n.4, 2013.

SCHNEIDER, Mirian Beatriz; ARAÚJO, Rafael Henrique. Balança comercial agrícola paranaense: conjuntura pós-crise financeira de 2008. Revista Orbis Latina, v.4, n.1, 2014.

SILVA, Claiton Márcio da. Entre Fênix e Ceres: A grande aceleração e a fronteira agrícola no Cerrado. Varia hist., Belo Horizonte, v. 34, n. 65, p. 409-444, Aug. 2018

SILVA, Mygre Lopes Lopes; SILVA, Rodrigo Abbade; CONTE, Bruno Pereira; LERMEN, Nadine Gerhardt; CORONEL, Daniel Arruda; BENDER FILHO, Reisoli. Análise da competitividade dos principais complexos exportadores do agronegócio gaúcho. SINERGIA, Rio Grande, v. 20, n.1, 2016.

SIQUEIRA, Kennya Beatriz; PINHA, Lucas Campio; 2012. Vantagens comparativas reveladas e o contexto do Brasil no comércio internacional de lácteos. Boletim de Pesquisa e Desenvolvimento 34, Juiz de Fora: Embrapa Gado de Leite, 2011.

SOUZA, Rodrigo da Silva; WANDER, Alcido Elenor; CUNHA, Cleyzer Adrian. Análise da competitividade do Estado de Goiás em relação aos principais estados produtores de soja e ao mundo - vantagem comparativa revelada. In: CONGRESSO BRASILEIRO DE SOJA, 5., Goiânia. Anais... Londrina: Embrapa Soja, 2009.

\_\_\_\_\_. Análise da competitividade dos principais produtos agropecuários do estado de Goiás – vantagem comparativa revelada normalizada. 49º Congresso da Sociedade Brasileira de Economia, Belo Horizonte, 24 a 27 de julho de 2011.

WAQUIL, Paulo D.; ALVIM, Augusto M.; SILVA, Leonardo X.; TRAPP, Glaucilene P. Vantagens comparativas reveladas e orientação regional das exportações agrícolas brasileiras para a união europeia. Revista de Economia e Agronegócio, v.2, n.2, 2004.

*Submetido em 24/3/2020*

*Aprovado em 20/6/2020*

**Sobre o(s) Autor(es):**

**Daniele Sedorko Haliski**

Economista. Graduada em Ciências Econômicas da Universidade Estadual de Ponta Grossa (UEPG). Graduada em Ciências Contábeis da Universidade Estadual de Ponta Grossa (UEPG). Área de atuação: Economia, Administração e Contabilidade. Praça Santos Andrade, 01 - Centro, Ponta Grossa - PR, 84010-330.

Email: danii\_sh@yahoo.com.br

**Renato Alves de Oliveira**

Docente do Departamento de Economia da Universidade Estadual de Ponta Grossa (UEPG). Professor do Programa de Pós-Graduação em Economia da UEPG. Engenheiro Agrônomo (UFC). Mestre em Economia Rural (UFC). Doutor em Ciências-Economia Aplicada (ESALQ/USP). Área de atuação: Agronegócio, Desenvolvimento Regional e Organização Industrial. Praça Santos Andrade, 01 - Centro, Ponta Grossa - PR, 84010-330.

Email: natoliveiralves@hotmail.com

**Jerônimo Alves dos Santos**

Docente da Universidade Federal de São Carlos (UFSCAR). Graduado em Gestão do Agronegócio. Mestre e Doutor em Ciências-Economia Aplicada (ESALQ/USP). Área de atuação: Administração Rural, Economia e Agronegócio. Campus Araras. Rodovia Anhanguera, km 147. Araras, São Paulo, 13604-000.

Email: jeronimo2100@yahoo.com.br