ORIGINAL ARTICLE

International Trade Performance of Brazilian Soybean Exporting Municipalities

Desempeño del comercio internacional de los municipios brasileños exportadores de soya

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Abstract

This study developed the performance matrix of municipal soybean exports using the Revealed Comparative Advantage (RCA) and Relative Position (RP) indices. In a representative sample of the five Brazilian regions, it was reported that, on average, most of the municipalities being analyzed exhibit a revealed comparative advantage and are characterized as net soybean exporters. In terms of the performance matrix, 82% of the municipalities being considered are efficient in external soybean sales, with 62.2% showing stable efficiency. In this list, the Midwestern region holds most of this quantity, followed by the South. Therefore, the importance of soybeans for the export portfolio of Brazilian municipalities is confirmed, as the conditions favorable to the production of this commodity allows for the existence of advantages in its international trade. For municipalities with internal and/or external potential, strategies are needed to increase efficiency in external sales of this product.

Keywords: Performance matrix; agricultural and animal farming commodity; foreign trade; soybean farming.
JEL Classification: F10; Q13.

Resumen

Este estudio construyó la matriz de desempeño de las exportaciones municipales brasileñas de soja mediante los Índices de Ventaja Comparativa Revelada (IVCR) y de Posición Relativa (IPR). En una muestra representativa de las cinco regiones brasileñas, se verificó que, haciendo un promedio, la mayor parte de los municipios analizados presenta ventaja comparativa revelada y se caracteriza como exportadores líquidos de soja. En términos de la matriz de desempeño, 82% de los municipios considerados son eficientes en las ventas externas de soja, siendo 62.2% con eficiencia estable. En ese grupo, la región Centro-Oeste detiene la mayoría de ese cuantitativo, seguido por el Sur. Por tanto, se ratifica la importancia de la soja para la pauta exportadora de los municipios brasileños en la medida que las condiciones propicias a la producción de esta commodity posibilitan la existencia de ventajas en su comercio. Para los municipios con potencial interno y/o externo, son necesarias estrategias para ganar eficiencia en sus ventas externas.

Palabras clave: Matriz de desempeño; commodity agropecuaria; comercio exterior; cultivo de soja.
Clasificación JEL: F10; Q13.

1. Introduction

To understand the dynamics of foreign trade, one of the ways pointed out by Farias and Farias (2018) is to analyze whether a locality (country, region, state or municipality) has a comparative advantage in a commodity over another locality. This indicator has been widely used as a measure to capture the export performance of a commodity.

The growth of a country's exports is leveraged by an increase in world trade in a given good; by the country's insertion, which can be associated with trade agreements or product attributes, such as quality and lower prices in markets with a greater increase in imports and/or by the expansion of the country's participation in regional import markets and in the world import market (Figueira; Galache, 2023). Among agricultural commodities, soy stands out as

Among agricultural commodities, soy stands out as the main product on Brazil's export list. According to the Brazilian Association of Soybean Producers (AGROSOJA, 2024), in the last 40 years, soybean production has multiplied more than four times, from 26 million tons to 120 million tons, making the country the world's largest exporter of the grain. Motivated by the international demand for soybeans, according to the Ministry of Agriculture and Livestock (MAPA, 2024), the growth of the Brazilian soybean crop in the 21st century was mainly due to the strong expansion of the area and the growth in productivity. In this respect, Figueira and Galache (2023) pointed out that the expansion of the area occupied by soybeans can be attributed to soil and climate conditions, the availability of arable land and the development of more productive cultivars and more efficient production systems in Brazil.

Brazil has strong comparative advantages in soybeans for the medium and long term, and can expand its production by incorporating new areas, as well as sustainably increasing its productivity. However, simply having comparative advantages, especially natural ones, does not guarantee soybean production, let alone the progressive occupation of greater space in the international market. Therefore, in order to capture the opportunities favorable to Brazil in the international soybean market, it is necessary to pay attention to the various segments involved in the soybean production chain, both from the private sector and from government bodies, in order to offer a modern agricultural policy aimed at encouraging production and exports, with efficient mechanisms for incorporating technological advances, emphasizing the sustainable increase in productivity as a way of reducing production costs and limiting environmental impacts resulting from the expansion of the cultivation area; drawing up and maintaining strategic agribusiness planning, anticipating opportunities and threats, in order to act proactively to expand Brazil's participation in the international market for agricultural products, adjusting the actions of private initiative and the government; fostering, encouraging and supporting the transfer of technology to producers, accompanied by public policies that favor farmers who maintain constant increases in sustainable soybean productivity; a less complex tax structure that is fair and compatible with competitors in international trade, favoring the country's exports (Gazzoni; Dall'Agnol, 2018).

This study recognized the relevance of analyzing the export performance of soybeans, not only by measuring it using the revealed comparative advantage, widely used in the literature over the last ten years (Fries; Coronel, 2014; Conceição et al., 2016; Sossa; Duarte, 2019; Avelar; Tannus, 2022; Oliveira et al., 2022), but also the relative position indicator (Oliveira et al., 2022). As a way of verifying the efficiency of a locality (country, region, state or municipality) in the foreign trade of a given commodity, empirical evidence (Farias; Farias, 2018; Lucena et al., 2021; Oliveira et al., 2022; Schwertner et al., 2022; Favaretto et al., 2023; Lucena et al., 2023; Soares et al., 2024) has built a performance matrix, an analytical tool used in this study. The general aim of this study was to measure the competitiveness of soybean exporting municipalities using competitiveness indicators.

The article innovated by focusing on the main Brazilian municipalities exporting soybeans in foreign trade. To this end, a sample of Brazilian municipalities that exported soybeans in at least 50% of the established period was considered

According to Hedlund et al. (2021), soybeans became the market leader in exports from 2000 onwards and were; therefore, considered the starting year for this research, while the choice of 2024 as

the last year analyzed was due to the availability of data at the time of the research.

According to Oliveira et al. (2022), studies of this nature are fundamental for implementing public policies aimed at promoting the development of soybean cultivation in this region, helping to strengthen its competitiveness in foreign trade.

This article is structured in five sections, including these introductory remarks. The second section contains a literature review of studies carried out on the subject. This is followed by details of the methodological procedures used (analytical methods and data sources), accompanied by a discussion of the results in the fourth section. Finally, the main conclusions are summarized in the fifth section.

2.   Empirical Framework

The classical foundations of international trade are based on the theories of absolute and relative advantages, including the neoclassical Heckscher-Ohlin theory (Lucena et al., 2023). Other approaches consider the role of monopolistic competition and economies of scale in international trade. Added to this is Porter (1998) theory of competitive advantages.

On the other hand, authors such as Sánchez–Bayón et al. (2024) criticize the neoclassical synthesis, in which economic analyses follow a methodology derived from the natural sciences. In this context, Marxist theories stand out, such as the approaches proposed by Emmanuel (1972) to explain asymmetries in international trade; other approaches focus on questions of imperialism (Luxemburg 1968); and Wallerstein (1979) presents international trade as the "peripheralization" of regions.

More recent approaches include theories explaining international trade based on behavioral economics. In this sense, behavioral theory advances as a complement to the postulates of bounded rationality, positing that rational economic agents respond with optimized behavior and present no conceptual difficulty in dealing with international economic reality (Hosseini, 2013).

In this research, with a view to constructing the competitiveness matrix based on traditional international trade indicators, the literature review is based on empirical studies that consider classical and neoclassical currents.

Thus, the empirical framework is structured in two subsections. The first brings together empirical studies that have determined the export performance of soybeans using international trade indicators, such as revealed comparative advantage (IVCR) and relative position (IPR), considering the period from the 2000s onwards, with the exception of Oliveira et al. (2022), whose study began even though it began its study before 2000, was considered because it served as the basis for this article.

The second focuses on the performance matrix for different commodities, such as fish, coffee, soybeans, beef, yerba mate, fruit and cellulose, constructed as a trend in the historical series of the IVCR and relative position indices (Farias; Farias, 2018; Lucena et al., 2021; Schwertner et al, 2022; Favaretto et al., 2023; Soares et al., 2024) or as a trend in the historical series of Vollrath's Revealed Comparative Advantage (RCAV) and relative position indices (Oliveira et al, 2022; Lucena et al, 2023). The choice of the RCAV is justified by the fact that it removes the limitation of the IVCR, since the latter considers double counting when computing the sector in the country's total, as well as the country in the world's total.

2.1   *Indicators of revealed comparative advantage and relative position*

Fries and Coronel (2014) analyzed the competitiveness of Rio Grande do Sul's soybean exports from 2001 to 2012 using the Constant Market-Share (CMS) model and the Revealed Comparative Advantage Index (RCAI), Regional Orientation Index (ROI), Coverage Index (CI) and Frequency Index (FI). The results indicated that Rio Grande do Sul had Revealed Comparative Advantages for this commodity throughout the period analyzed, with the international trade effect and export destination contributing the most to exports.

Conceição et al. (2016) analyzed the degree of competitiveness of commodity exports in the states of Mato Grosso and Bahia, from 2008 to 2014. To this end, they used the indicators of Revealed, Symmetric and Vollrath Comparative Advantage, Coverage Rate, Contribution to the Trade Balance

and Intra-industry Trade. The results showed the presence of a revealed comparative advantage for soybeans in the state of Mato Grosso throughout the period considered, while in Bahia, soybeans proved to be competitive only in some of the years analyzed.

In addition to soybeans, Sossa and Duarte (2019) considered coffee, sugar and beef, in other words, they assessed whether Brazil had comparative advantage and competitiveness in international agribusiness trade between 2003 and 2013. They used the indices of Revealed Comparative Advantage (RCV), Revealed Comparative Symmetric Advantage (RCSV), Relative Export Advantage (REA) and Revealed Competitiveness (RC). Among the crops analyzed, none is comparable to soybeans, which stood out as the main crop with the highest RCV magnitudes, demonstrating that Brazil has an advantage in exporting this commodity during the entire period studied.

Avelar and Tannus (2022) investigated the export performance of soybeans between 2000 and 2019 to identify whether the country was competitive in terms of world trade. To achieve this goal, they used Market Share, the Revealed Comparative Advantage Index (RCAI) and the Balance Contribution Index (CCI). The RCVI results were considerably higher than unity in all the years analyzed, with an average value of 30, thus indicating that the country had an advantage 30 times higher than the index parameter, which legitimizes the competitiveness of soybeans.

Oliveira et al (2022) analyzed the performance of the main Brazilian soybean exporting states in international trade, with emphasis on the MATOPIBA region, made up of areas in Maranhão, Tocantins, Piauí and Bahia, from 1997 to 2020. The states of Goiás, Mato Grosso, Mato Grosso do Sul, Minas Gerais, Paraná, Rio Grande do Sul, Santa Catarina and São Paulo were also considered. They used Vollrath's Revealed Comparative Advantage (RCAV) and Relative Position (IPR) indices. The results indicated that, on average, Goiás, Maranhão, Mato Grosso, Mato Grosso do Sul, Paraná, Piauí, Rio Grande do Sul and Tocantins registered Vollrath's revealed comparative advantage. Among the states that make up the MATOPIBA region, only Bahia does not have Vollrath's revealed comparative advantage. As for the IPR, the results showed that, on average, all the states analyzed are net exporters of soybeans, with Mato Grosso, Paraná and Rio Grande do Sul standing out the most in the period considered.

2.2   *Performance matrix*

Farias and Farias (2018) analyzed the performance of fish exporting countries on the international market, with an emphasis on Brazil, from 2001 to 2016. The results showed that Brazil's export performance was inefficient and decreasing, as fish is not an important item in Brazilian exports.

Replicating the analytical procedure of Farias and Farias (2018), Lucena et al (2021) analyzed the performance of the main Brazilian coffee exporting states from 2000 to 2019, seeking to identify those that can be considered efficient in exporting this product. The states considered were Bahia, Ceará, Espírito Santo, Goiás, Mato Grosso do Sul, Minas Gerais, Pará, Paraná, Rio de Janeiro, Rio Grande do Sul, Roraima, Santa Catarina and São Paulo. The results indicated that only Minas Gerais and Espírito Santo are efficient, but the others have the internal potential to make coffee a significant part of their respective export agendas.

Oliveira et al (2022) used Vollrath's Revealed Comparative Advantage (RCAV) and Relative Position (IPR) indices, mentioned in the previous subsection, to construct the soybean export performance matrix. The results showed that all the states that make up the MATOPIBA region were classified as efficient, except for Bahia, which has the internal potential to make soybeans a significant part of its exports.

Schwertner et al. (2022) and Favaretto et al. (2023), inspired by the performance matrix measured by Farias and Farias (2018), analyzed, respectively, the performance of the main Brazilian beef and yerba mate exporting states for the period 2000 to 2020. Schwertner et al. (2022) considered Mato Grosso, São Paulo, Goiás, Minas Gerais, Mato Grosso do Sul, Rondônia, Pará, Tocantins and Rio Grande do Sul, while Favaretto et al. (2023) covered Paraná, Rio Grande do Sul, and Santa Catarina. The results showed that the efficient Brazilian beef exporting states were Rondônia, Mato Grosso,

Tocantins, Goiás, Mato Grosso do Sul and São Paulo and the three southern states were efficient in exporting yerba mate.

Like Oliveira et al (2022), Lucena et al (2023) also constructed the performance matrix of Brazilian fruit exports, with emphasis on the northeastern states, such as the trend in the historical series of Vollrath's Revealed Comparative Advantage (RCAV) and Relative Position (RPI) indices for the years 1997 to 2020. The study area covered the 17 states that exported fruit for the entire historical series (Acre, Alagoas, Amazonas, Bahia, Ceará, Espírito Santo, Minas Gerais, Pará, Paraíba, Paraná, Pernambuco, Piauí, Rio de Janeiro, Rio Grande do Norte, Rio Grande do Sul, Santa Catarina and São Paulo), plus the states of Maranhão and Sergipe (to include all the states in the Northeast region). Of these states, the results showed that Acre, Amazonas, Bahia, Ceará, Paraíba, Pernambuco, Piauí, Rio Grande do Norte and Sergipe were efficient, with seven of them belonging to the northeast.

Soares et al. (2024) analyzed the efficiency and potential of Brazilian pulp and its main competitors on the world market, from 1964 to 2022. The results indicated that Brazil was efficient and growing in the international pulp market.

Among the studies listed on the export performance of soybeans, none of them analyzed the main Brazilian municipalities that export soybeans in foreign trade. Therefore, this article seeks to fill this gap, helping to improve the literature on the subject.

3. Methodology

This section is dedicated to the methodology of this research. It is organized into two subsections. The first presents the analytical methods considered, while the second is used for the data sources, variables and sample delimitation.

3.1 Analytical methods

In terms of analytical methods, this study used the Revealed Comparative Advantage (RCVI) and Relative Position (RPI) indices, as well as simple linear regression to calculate the trend and construct the performance matrix.

The IVCR was proposed by Balassa (1965), based on David Ricardo's theory of comparative advantages. This indicator makes it possible to gauge which commodities a region has comparative advantages in producing and exporting (Fries; Coronel, 2014). In other words, the IVCR showed the performance of the region studied in international trade in ex-post terms, i.e. after the product has been sold. In mathematical terms, we have:

$$IVCR_i = \frac{\left(\frac{x_{ij}}{x_j}\right)}{\left(\frac{x_{iw}}{x_w}\right)} \tag{1}$$

where: the subscripts ,ij andw represent soy, the municipality (1,…,n municipalities) and Brazil, in that order, whileX_ij corresponds to the municipality's soy exports andX_j only to the municipality's total exports;X_iw are national soy exports andX_w only total Brazilian exports.

Thus, the IVCR can be classified according to its value into: a) the presence of a revealed comparative advantage, when it is greater than unity and b) a revealed comparative disadvantage when it is less than 1 (Lucena et al, 2021).

Proposed by Lafay et al. (1999), the IPR indicated the position of a country (state or municipality) in the international trade of a commodity. For Farias and Farias (2018), the IPR indicates whether the net exports or imports of a region (country, federation unit or municipality) are increasing at lower or higher rates than foreign trade. Algebraically, it can be written

$$IPR = \left[\frac{X_{ij} - M_{ij}}{w_i}\right] \tag{2}$$

Where: X_ij andM_ij are the soybean exports and imports, in that order, from municipality j;w_i is the value of Brazilian trade, i.e. soybean exports and imports. In terms of classification, according to Lucena et al (2023), if the IPR value is positive, the unit under analysis is a net exporter and if not, i.e. negative, it is a net importer.

In line with the literature, linear regression was used to obtain the trend from the IVCR and IPR historical series. Thus, taking the IVCR and IPR over time, equations (3) and (4) express the adjustment of these trends.

$$IVCR = \phi + \alpha t \tag{3}$$

$$IPR = \theta + \beta t \tag{4}$$

The coefficients α and β can be classified according to their sign (increasing or decreasing) and according to their statistical significance for each indicator. Coefficients that are different from zero, with significance equal to 5%, are considered statically significant. In this case, following the formulation of Farias and Farias (2018), the performance matrix for Brazilian municipal soybean exports comprises four categories, namely:

i) efficient, when the IVCR > 1 and IPR > 0, where the product is relevant to the state's exports and is sold efficiently on the foreign market;
ii) external potential, when the IVCR > 1 and IPR < 0, the product is important in the municipality's exports, but needs to gain efficiency in marketing;
iii) internal potential, when IVCR < 1 and IPR > 0, there is efficiency in marketing, but soy needs to improve its results in the export market, enabling comparative advantage to be achieved;
iv) inefficient, occurs when IVCR < 1 and IPR < 0, in which case soybeans are not relevant to the municipality's trade agenda.

It should be noted that, in this study, the indicator calculations, matrix construction, graphs and maps were carried out using the Python programming language in the Google Colab environment. Furthermore, the source of the data and the selection of the sample are described in the next subsection.

3.2   Data source, variables and sample

To calculate the municipal IVCR and IPR, we used data on soybean exports and imports from Brazilian municipalities, where the values are Free on Board (FOB) expressed in dollars. For this study, soybeans were considered, where the four–digit Mercosur Common Nomenclature (NCM) code is 1201.

To choose the sample of studies, the period from 2000 to 2024 was initially delimited, the latter being the most recent year with available data for soybean exports. Then, based on Lucena et al (2021), municipalities that exported soybeans in at least 50% of the established period were selected. With this filter, 188 Brazilian municipalities were selected. Table 1 shows the distribution by federation unit and major regions of the Brazilian municipalities selected in this study. It can be seen that 19 federative units are part of the sample, with Acre, Alagoas, Amapá, Ceará, Paraíba, Pernambuco, Rio Grande do Norte and Sergipe removed.

Among the participating states, Mato Grosso has the highest number of municipalities (43, or 22.9%), followed by Paraná (18.10%) and Rio Grande do Sul (10.11%). Conversely, only one municipality was considered in Amazonas (Itacoatiara), the Federal District (Brasília), Espírito Santo (Vitória), Rio de Janeiro (Rio de Janeiro) and Roraima (Boa Vista).

Table 1. Distribution, by federation unit and region, of the municipalities selected to analyze the performance of Brazilian municipal soybean exports between 2000 and 2024

UF/Region	n	% in the sample	Total % of municipalities
Amazonas	1	0.53	1.61
Bahia	6	3.19	1.44
Federal District	1	0.53	1.00
Espirito Santo	1	0.53	1.28
Goiás	13	6.91	5.28
Maranhão	10	5.32	4.61
Mato Grosso	43	22.87	30.5
Mato Grosso do Sul	10	5.32	12.66
Minas Gerais	11	5.85	1.29
Paraná	34	18.09	8.52
Pará	4	2.13	2.78
Piauí	4	2.13	1.79
Rio Grande do Sul	19	10.11	3.82
Rio de Janeiro	1	0.53	1.09
Rondônia	3	1.6	5.77
Roraima	1	0.53	6.67
Santa Catarina	7	3.72	2.37
São Paulo	13	6.91	2.02
Tocantins	6	3.19	4.32
Midwest	67	35.64	14.35
North East	20	10.64	1.11
North	15	7.98	3.33
South East	26	13.83	1.56
South	60	31.91	5.04

Source: Organized by the authors

In terms of regions, all were included, as shown at the bottom of Table 1. However, the Midwest had the largest share, with 67 municipalities, corresponding to 35.64% of the sample, followed by the South, with 31.91%.

Figure 1 shows the spatial distribution of the municipalities considered in Brazil. This illustration confirmed the pattern shown in Table 1, with a higher concentration of municipalities in the Midwest and South regions.

It is also worth highlighting the relevance of the region made up of Maranhão, Tocantins, Piauí and Bahia (acronym MATOPIBA) in soybean exports. However, as Oliveira et al (2022) pointed out, the evolution of exports from this area has increased progressively, with the largest volume in recent years. In this sense, given that the time frame of this study begins in 2000, it does not capture the volume of exports So, considering this area of study, as well as the methods presented, the next section deals with the presentation and discussion of the research results.

4.   Results and Discussion

Figure 2 shows the distribution of the number of municipalities per year, following the classification adopted for the IPR (a) and the IVCR (b). As far as the IPR is concerned, it can be seen that from 2004 onwards, in all years, most of the municipalities showed values higher than zero, i.e. they are net soy exporters.

Regarding the IVCR, 2004 also marked a change. In the first three years, most municipalities had a comparative disadvantage. The reversal of this situation, with a gain in advantages, signals a change in export patterns for this product, which is strongly related to the increase in soybean exports to China (Coronel et al., 2009).

Based on the overall average values, i.e. for the sample, of the IPR and IVCR, intervals were constructed with absolute and relative frequencies, as shown in Table 2. The analysis shows that 165

Figure 1. Spatial distribution of the Brazilian municipalities selected to analyze the performance of Brazilian municipal soybean exports from 2000 to 2024
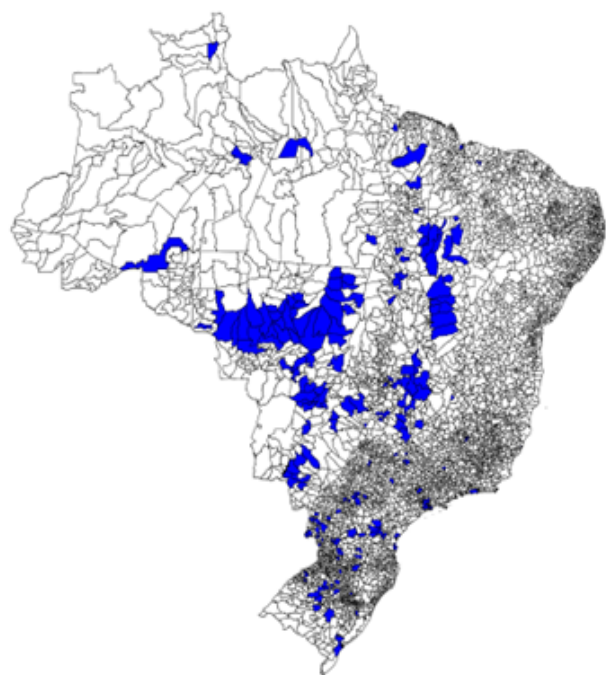
Source: Organized by the authors

(87.8%) of Brazil's soy exporting municipalities have an average IPR between 0 and 1, followed by 10.6% in the range between 1 and 5. In addition, only the municipality of Céu Azul, in Paraná, had an IPR lower than 0 and Paranaguá, also in Paraná, and São Paulo had values higher than 5.
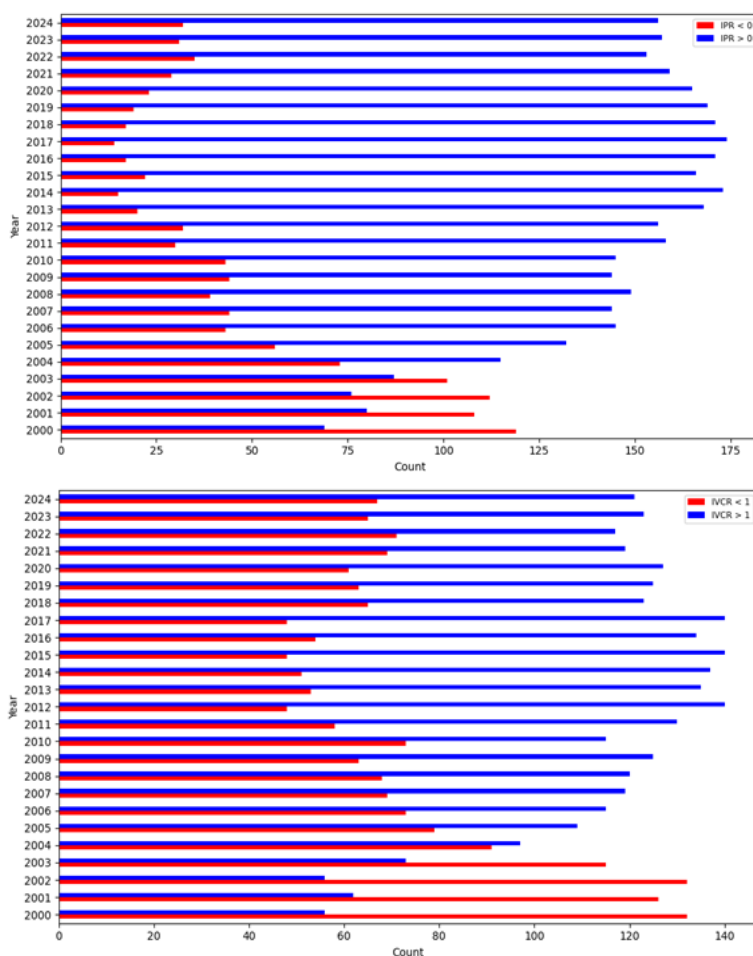
Source: Organized by the authors.

Classes	IPR	IPR (%)	Classes	IVCR	IVCR (%)
IPR$\leq$ 0	1	0.53	IVCR 1$\leq$	33	17.55
0 < IPR$\leq$ 1	165	87.77	1 < IVCR$\leq$ 4	49	26.06
1 < IPR$\leq$ 5	20	10.64	4 < IVCR$\leq$ 10	83	44.15
IPR > 5	2	1.06	IVCR >10	23	12.23

In the case of the average IVCR, the values are more evenly distributed between the intervals, without neglecting the fact that the classes are broader. To illustrate this, 26% of municipalities are between 1 and 4 and 44.15% are in the 4 to 10 range. Only 17.55% of the sample had a CIRV of less than one, i.e. no revealed comparative advantage in average terms (Oliveira; Lucena; Sousa, 2022).

Most of the municipalities analyzed are net exporters of soybeans, i.e., they have an IPR greater than zero, as well as having revealed comparative advantages in foreign sales of this commodity. These inferences are in line with studies for federal units and Brazil.

In this regard, Avelar and Tannus (2022) found comparative advantages for national soybean exports;

Figure 2. Distribution of Brazilian soy exporting municipalities, according to a) IPR in the period 2000 to 2024

Source: Organized by the authors

Oliveira, Lucena and Sousa (2022) showed that, among all the states in the MATOPIBA region, only Bahia did not have a comparative advantage, while all the federal units analyzed are net exporters, i.e. they have a positive IPR.

Following the methodological procedures, based on Lucena, Sousa and Coronel (2021) and Oliveira, Lucena and Sousa (2022), the performance matrix of Brazilian municipal soybean exports was drawn up, the result of which can be found in Table 1 in the Appendix. In order to summarize the results, tables and maps were drawn up, as follows.

Table 3, which shows the absolute and relative frequencies of Brazilian soy exporting municipalities, shows that 62.23% are efficient and stable. On the other hand, 21 (11.17%) have increasing efficiency in international soy exports.

Table 3. Absolute and relative frequency distribution of Brazilian soy exporting municipalities classified according to the behavior of the IVCR and IPR from 2000 to 2024

Classification	Number of municipalities	
	n	%
Efficient and growing	16	8.51
Efficient and stable	117	62.23
Efficient and decreasing	21	11.17
With external and stable potential	1	0.53
With internal and growing potential	6	3.19
With internal and stable potential	18	9.57
With internal and decreasing potential	9	4.79
Total	**188**	**100.00**

Source: Organized by the authors.

Figure 3 shows the distribution of municipalities according to the classification matrix. As can be seen, most efficient and stable municipalities are concentrated in the Midwest region of the country. In the efficient and decreasing case, there is a dispersion in terms of spatial distribution.

Figure 3. Distribution of Brazilian soy exporting municipalities, according to a) IPR in the period 2000 to 2024
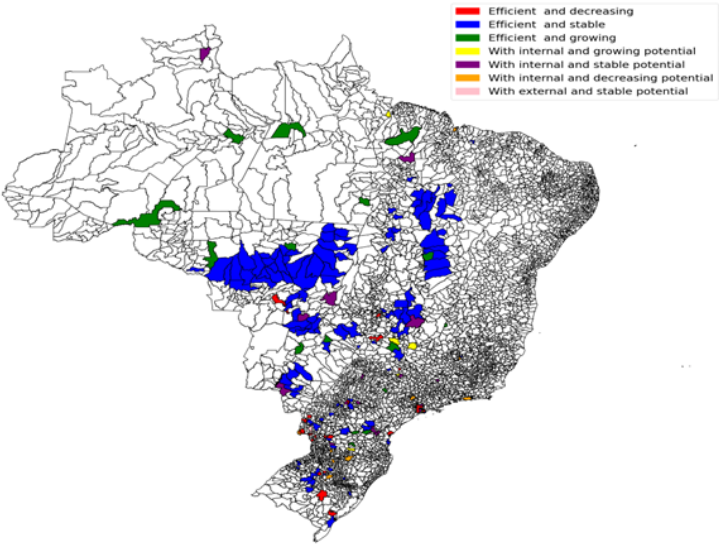
Source: Organized by the authors

Table 4 shows the distribution of municipalities according to their export performance, based on the major regions. Considering the efficient municipalities (in the increasing, stable and decreasing categories), the Midwest totals 64, followed by the South, with 47 municipalities.

Table 4. Absolute frequency distribution of soy exporting municipalities, by region, between 2000 and 2024, according to the performance matrix

Region	With external and stable potential	With internal and growing potential	With internal and decreasing potential	With internal and stable potential	Efficient and growing	Efficient and decreasing	Efficient and stable	Total
South	1	1	5	6	3	15	29	60
South East	0	4	3	7	3	3	6	26
North	0	1	0	1	6	0	7	15
Midwest	0	3	0	0	3	3	58	67
North East	0	0	1	1	1	0	17	20

Source: Organized by the authors.

In general, the Center–West and South regions concentrate most of the selected municipalities that simultaneously have comparative advantages and are net exporters of soy. Some municipalities have internal and/or external potential. In this case, they have the potential to make soy relevant in their respective export agendas.

5. ConclusionN

The aim of this study was to measure the competitiveness of soy exporting municipalities using competitiveness indicators. The results showed that from 2004 onwards, most of the municipalities analyzed had a Relative Position (RPI) higher than zero and a Revealed Comparative Advantage (RCVI) higher than unity, which is strongly related to the increase in exports to China.

Regarding the competitiveness matrix, more than 60% of the municipalities showed efficient and stable behavior and more than 10% showed efficient and decreasing behavior. As expected, the Midwest and South concentrate on many municipalities, which is related to their strong production, marketing and competitiveness.

Based on this research, it was possible to gain a clear understanding of which Brazilian municipalities have the potential to be more involved in the international soybean trade, which is fundamental for generating foreign currency and for sustainable economic growth. Despite this, this work has some limitations, which deserve to be highlighted, such as the almost inexistence of studies and research focusing on municipalities, which makes analysis and more robust discussions difficult, and the fact that these indicators, although widely used in trade literature, are statistical and do not allow for intertemporal analysis.

In this context, it is suggested that future research use Dynamic Computable General Equilibrium models to measure over time the impact of tariff and non-tariff barriers that the main importers use in relation to this commodity, as well as studies to measure the high costs of transportation and logistics, which hinder competitiveness and greater insertion in the international market.

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APPENDIX

Table 1. Performance matrix of Brazilian soy exporting municipalities from 2000 to 2024

Categories	Municipalities
Efficient and decreasing	Cachoeira do Sul - Cambé - Capanema - Chopinzinho - Cuiabá - Goiânia - Ibirubá - Itumbiara - Marechal Cândido Rondon - Não-Me-Toque - Orlândia - Palotina - Paranaguá - Pelotas - Santa Izabel do Oeste - Santa Terezinha de Itaipu - Santo Antônio do Sudoeste - Santos - São João - São Miguel do Iguaçu - São Paulo
Efficient and stable	Abelardo Luz - Alto Araguaia - Alto Garças - ... - Água Boa
Efficient and growing	Chapadão do Céu - Cláudia - Irati - Itacoatiara - Luís Eduardo Magalhães - Palmeira - Paragominas - Pederneiras - Pirapora - Porto União - Porto Velho - Redenção - Santarém - São Gabriel do Oeste - Uberlândia – Vilhena
With internal and growing potential	Araguari - Barcarena - Caçador - Cubatão - Patrocínio – Sertãozinho
With internal and stable potential	Araucária - Açailândia - Barra do Garças - Birigui - Boa Vista - Campo Largo - Clevelândia - Cornélio Procópio - Curitiba - Guarulhos - Paracatu - Pedra Preta - Ponta Porã - Ribeirão Preto - Rolândia - São Bernardo do Campo - Varginha - Vitória
With internal and decreasing potential	Belo Horizonte - Campinas - Campos Novos - Erechim - Foz do Iguaçu - Rio de Janeiro - Soledade - São Luís - Xanxerê
With external and stable potential	Céu Azul