COMPETITIVENESS OF ANIMAL PROTEIN EXPORTS FROM BRAZIL AND ITS RELATIONSHIP TO SUSTAINABILITY

COMPETITIVIDADE DAS EXPORTAÇÕES DE PROTEÍNA ANIMAL DO BRASIL E SUA RELAÇÃO COM A SUSTENTABILIDADE

Francieli Binotti
Mestre em Administração pela Universidade Estadual do Oeste do Paraná - UNIOESTE
Instituição: Universidade Estadual do Oeste do Paraná - UNIOESTE
Endereço: Rua Universitária, 1619 – Jd Universitário – Cascavel/PR CEP: 85819-110
E-mail: franbinotti05@hotmail.com

Geysler Rogis Flor Bertolini
Doutor em Engenharia de Produção pela Universidade Federal de Santa Catarina - UFSC
Docente do PPGAdm – Doutorado e Mestrado Profissional em Administração
Instituição: Universidade Estadual do Oeste do Paraná – UNIOESTE
Endereço: Rua Universitária, 1619 – Jd Universitário – Cascavel/PR CEP: 85819-110
E-mail: geysler_rogis@yahoo.com.br

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RESUMO

Este estudo objetiva analisar o impacto da sustentabilidade na competitividade das exportações do mercado brasileiro de proteína animal (carne de frango, carne bovina e carne suína), no período de 2000 a 2021. Foi utilizado o método Constant Market Share (CMS), dividindo a análise em subperíodos. A sustentabilidade do país foi avaliada pelo desempenho social, por meio do Índice de Desenvolvimento Humano (IDH), e pelo desempenho ambiental, avaliado a partir da Economia Líquida Genuína (PLE). Os resultados mostram que o Brasil é competitivo no mercado internacional de proteína animal e vem aumentando sua participação ao longo dos anos, destacando-se como um importante fornecedor de alimentos para o mundo. Com a chegada da pandemia em 2020, era esperada uma redução nas exportações brasileiras, devido ao aumento das restrições para combater o Coronavírus, mas as exportações de carne bovina e suína não foram afetadas, apenas a carne de frango teve uma redução, em 2020, no valor exportado e que foi superada no ano seguinte. As dimensões ambiental e social não apresentaram grande influência no desempenho competitivo; fatores como crescimento mundial, destinos das exportações e barreiras comerciais exerceram maior influência no desempenho exportador do país. Esta pesquisa contribui para ampliar o entendimento da relação entre o uso de estratégias de sustentabilidade para a competitividade do Brasil, e os subsídios teóricos permitirão ao país e às empresas exportadoras de carne adequar suas estratégias de sustentabilidade para um desempenho mais competitivo. Ao demonstrar a relação entre a variável sustentabilidade e as exportações de forma mais clara, é possível direcionar melhor as políticas públicas para a promoção do mercado brasileiro.

Palavras-chave: Mercado da Carne. Desempenho sustentável. Comércio exterior.

ABSTRACT

This study aims to analyze the impact of sustainability on the competitiveness of exports of the Brazilian animal protein market (chicken, beef, and pork), in the period from 2000 to 2021.The Constant Market Share (CMS) method was used, dividing the analysis into sub-periods. The country's sustainability was assessed by social performance, using the Human Development Index (HDI) and by Environmental Performance, assessed from the Genuine Net Savings (ANS). The results show that Brazil is competitive in the international animal protein market and has been increasing its share over the years, standing out as an important food supplier to the world. With the arrival of the pandemic in 2020, a reduction in Brazilian exports was expected, due to increased restrictions to combat the Coronavirus, but exports of beef and pork were not affected, only chicken meat had a reduction, in 2020, in the value exported and which was surpassed in the following year. The environmental and social dimensions did not show great influence on competitive performance; factors such as world growth, export destinations and trade barriers exerted greater influence on the country's export performance. This research contributes to broadening the understanding of the relationship between the use of sustainability strategies for Brazil's competitiveness, and the theoretical subsidies will allow the country and meat exporting companies to adapt their sustainability strategies for a more competitive performance. By demonstrating the relationship between the variable sustainability and exports more clearly, it is possible to better target public policies for the promotion of the Brazilian market.

Keywords: Meat Market. Sustainable Performance. Foreign trade.

1 INTRODUCTION

It was in the 1960s that Brazil stopped being a food importer and became an exporter. This fact occurred due to the combination of natural resources with knowledge and technology, with rural entrepreneurship and with the coordination of value chains ([ABPA, 2021). Therefore, in addition to adequately feeding the national population, the country is strengthening itself as an important supplier of food to the world.

The large meat production capacity that Brazil has is due to some particular advantages of the country; one of them is grain production, which is very rich and has a high growth indicator (FERREIRA; VIEIRA, 2019). But to maintain this advantage, investments that increase the quality of the exported product are needed, increasing competitiveness from the advance of the import market (RODRIGUES; MARTA-COSTA, 2021).

According to the *Ministério da Agricultura, Pecuária e Abastecimento* (MAPA), Brazilian agro exports grew from US$20.6 billion to US$120.5 billion between 2000 and 2021, especially soybeans, representing 40% of 2021 revenue and meats representing 16% (MAPA, 2022). The country's participation has been increasing significantly, as a result of efforts by national organizations in the development of behavioral models and investments in the market (STAL; SEREIA; SILVA, 2010).

Accompanied by this great growth in exports in recent years, there have been the imbalances caused by productive activities to the environment and society. According to the Food and Agriculture Organization of the United Nations (FAO) (2020), Agriculture is the sector responsible for consuming the largest amount of water in the world, using an average of 70% of all water consumed. Cattle ranching is the main reason for soil degradation and deforestation, due to the need for large areas of pasture, and emission of methane gas, which contributed to the greenhouse effect, as it is produced naturally by ruminants (OLIVEIRA, 2021).

On the other hand, the revenues generated with this increase in agro exports were relevant to the country's economy. In 2021, chicken meat exports generated a revenue of US$ 6.9 billion, beef, US$ 7.9 billion and pork US$ 2.6 billion (SECEX, 2022). These data show the importance of Brazil in the international market, as it is one of the three largest producers and exporters of these products (OECD,

2021). A factor that contributes to these results is the country's competitive cost structure (FERREIRA; VIEIRA, 2019) and also the strategies adopted to increase the productivity of the sectors, mitigate the impacts of barriers that harm exports and enable the integration of the productive sector with the industry (STAL et al., 2010).

With the arrival of the Covid-19 Pandemic, concern for animal health has increased, leaving even greater demands on surveillance systems. In view of this, Brazil gains a great opportunity to show the transparency of the production chain, which has reliable production processes in the field and industry (MALAFAIA; BISCOLA; DIAS, 2020). This pandemic and unexpected scenario has led some countries to impose even more restrictions on imports in order to protect their consumers (WORLD TRADE ORGANIZATION [WTO], 2020). Despite the impacts on the economy caused by the pandemic, Brazilian agribusiness exports were not negatively affected (MALAFAIA et al., 2020). But, even with the good performance, it is important to analyze how the country's competitiveness behaved in the face of the uncertainties of the lived environment, which generate tensions and imbalances in the market.

The sustainability of a market is one of the strategies used to make or maintain a competitive sector. Only with the balance between environmental, social, and economic aspects, at the same time, sustainability is achieved. Therefore, understanding the evolution of the country's competitiveness in the sector, combined with aspects of sustainability, may result in public policies that support and encourage its development, stimulating exports in the country in an even more sustainable way.

To fill the existing gap, it is necessary to verify the relationship between sustainability and competitiveness of exports from the Brazilian market of animal protein (chicken, beef and pork). Thus, the survey and understanding of these relationships can collaborate with the identification of strategies, potentials and challenges related to the internal and external market.

2 REFERENCIAL TEÓRICO

2.1 COMPETITIVENESS IN THE MEAT MARKET

Export competitiveness is an important indicator in the analysis of the flow of international trade. There are many methods available for analyzing a country's competitiveness; one of them is the Revealed Comparative Advantage Index (IVCR), which makes it possible to analyze competitiveness based on past information on trade flows (RAMOS, 2020).

Another method is the Constant Market Share (CMS), which analyzes the factors that contributed to the performance of exports in a market in relation to the others, in a given period. Richardson (1971) defines that the CMS has the purpose of examining the country's export growth, which basically attributes the favorable or unfavorable growth of exports to both the structure of exports and competitiveness. The basic assumption of the model is that the share of participation of a country or region in the world market of a given product does not change, according to Leamer and Stern (1970,) when 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.

Brazil's competitiveness in the meat market is due to internal factors, such as the country's large territorial extension, the large supply of raw materials for production, such as inputs for animal feed, and technological advances in this sector (GONÇALVES; PALMEIRA, 2006). The most recent study on the competitiveness of the pork market was by Gastardelo, Melz and Marion (2016), which highlighted the fragility of the sector related to animal health and cost of inputs. However, they also identified that Brazilian exports grew at higher rates than world rates.

Publications on the competitiveness of pork meat (GONÇALVES; PALMEIRA, 2006; MIELE; WAQUIL 2007; RUBIN; ILHA; LOPES, 2012; GASTARDELO et al., 2016) point to the opening of trade in 1990 as the fact that contributed to the increase of Brazilian competitiveness in international

trade. Production costs are also seen as an advantage for the country, as they have the lowest costs among the main producing and exporting countries. In addition, the performance reflects the incorporation of slaughter and processing technologies, livestock production with advances in genetics, grain availability, nutrition, organization, and coordination of the production chain.

Buhse et al. (2014) researched the behavior and competitiveness of beef in Mercosur countries, from 1991 to 2011. With the application of the Constant Market Share model, it was found that Argentina, Brazil, and Uruguay showed an increase in the share of world exports. Another positive result in relation to Brazil's competitiveness in the beef market was demonstrated in the study by Machado, Ilha and Rubin (2007), who used the Revealed Competitiveness Index (RCI). The authors emphasize that public policies aimed at agriculture are essential for the country's growth in the international market.

In publications on the competitiveness of beef (CARVALHO et al., 2006; MACHADO et al., 2007; SILVA; MARION; CAMPOS, 2008; SOUZA; CAMARA; SEREIA, 2011; BUHSE et al., 2014; STEFANUTTI, 2019; RODRIGUES; MARTA-COSTA, 2021), 50% used the Constant Market Share method (CMS); 29% applied the Revealed Competitiveness Index (RCI) and 21% used other methods and indicators. The results indicate that the country has become competitive in the sector; growth took place gradually, following the international market and, little by little, increasing its Market Share.

The publications on the competitiveness of chicken meat demonstrate the importance of the country in this market and its consolidation as one of the main suppliers of the product (SOUZA et al., 2011; SAGGIN, 2017; RIBEIRO; SANTOS; SILVA, 2021). The great representation of the poultry sector in the Brazilian economy is due to the natural conditions of the Brazilian territory and its competitiveness in two other important products for chicken meat: corn and soy (BENDER; SCHWERTNER; ARRUDA CORONEL, 2019).

Barcellos (2006) and Costa, Garcia and Brene (2015) state that, due to the high production of soybeans and derivatives, mainly bran, the country is able to further increase its exports of chicken meat and conquer new markets through quality and product differentiation. The state of Paraná is indicated by Souza et al., (2011) and Costa et al., (2015) as the state that has evolved the most, presenting exceptional performance in both production and export of broiler chicken.

Brazil is a major producer of animal protein and competes directly with other countries in the international market. The country's competitiveness is the result of the great availability of land, cheap labor, large supply of inputs, access to production technologies, among others (SAAB; NEVES; CLAUDIO, 2009).

2.2 SUSTAINABILITY IN THE MEAT MARKET

Global animal production is responsible for about 18% of greenhouse gas emissions and occupies 80% of the global agricultural area, being one of the main responsible for the loss of biodiversity (STEHFEST et al., 2013). But, due to this negative impact generated by the sector on the environment, companies in the sector have become susceptible to regulatory control by governments and international organizations through fines and cancellation of supply contracts (FLORES; GAVRONSKI, 2016; PORTOCARRERO; ARAÚJO, 2018; FEITOSA, 2019)

The social pressures and restrictions imposed on product exports mean that companies are forced to look for ways to reduce their environmental impact and improve their image in the face of their social responsibility. Adaptation to more sustainable processes facilitates exporters' access to markets with stricter environmental standards, enabling an increase in sales revenues. In this way, the search for compliance with internationally recognized standards is seen as a competitive advantage in the market (ARAÚJO; MENDONÇA, 2009; FLORES; GAVRONSKI, 2016).

Sustainability Indicators were created to assist in the assessment of established sustainability goals, providing stakeholders with adequate conditions for monitoring and supporting the decision-

making process (VEIGA, 2010). According to Guimarães and Feichas (2009), for indicators to be instruments of change towards the concept of sustainable development, they must measure different dimensions in order to apprehend the complexity of social phenomena; they should foster definitions in participatory models; communicate trends supporting the decision-making process and relate variables.

Economic growth through sustainable actions is still a challenge, but it can be achieved through the union of citizen practices and government policies (VEIGA, 2010). With the use of indicators that assess the social and environmental dimensions, it is possible to obtain a better perception of the country's sustainability, which, in turn, facilitates the comparison with economic development.

3 METHOD

This study aims to analyze the relationship between sustainability and competitiveness of exports from the Brazilian market of animal protein (chicken, beef, and pork) in the period from 2000 to 2021, its nature is quantitative with a fundamental purpose, as it translates, in numbers, opinions and information to classify and analyze them, seeking the meaning based on the perception of the phenomenon that has within its context. In addition, it aims to generate new knowledge that contributes to scientific advancement (KAUARK; MANHÃES; MEDEIROS, 2010).

When analyzing the meat export variable in association with sustainability indicators, quantitative research favors the interrelation of these data, which may reveal differences or similarities in their variations. Therefore, the descriptive approach was used to present and correlate the variables without manipulating them (KAUARK et al., 2010). In this case, the way in which the variables are related in view of the country's sustainability and competitiveness over the years contributes to the use of this level of research.

In accordance with its objectives, this study is also exploratory, which seeks to explore a problem in order to obtain its understanding. For Munaretto, Corrêa and Cunha (2013), exploratory research has as its main objective the improvement of ideas or the confirmation of intuitions, therefore, it seeks to understand the reasons, in addition to the motivations for certain attitudes and behaviors of people. The variables analyzed in the research were the HDI, ANS and the Market Share of exports, making it possible to understand the domestic and foreign market for animal protein and its relationship with sustainability.

The data to achieve objective were obtained through documents available in public institutions, such as the *Ministério do Desenvolvimento, Indústria e Comércio Exterior* (MDIC) and the *Secretaria de Comércio Exterior* (SECEX), based on the Foreign Trade Information Analysis System (AliceWeb), which has data on Brazilian exports by country of destination and the United Nations Commodity Trade Statistics Data base [UNCOMTRADE].

Other information used in the research, such as the country's HDI, was obtained through the United Nations Development Program (UNDP) database and the ANS, which is calculated by the World Bank, is available through its World dataBank database.

In order to analyze the competitiveness of Brazilian exports, it was necessary to divide the period studied into sub-periods, which will be carried out according to the events that generated the most impact on the export sector:

a) **First period: 2000 to 2004**. With its accession to the World Trade Organization (WTO), China has consolidated itself as an important provider of general manufactured goods on a global scale, being an economic power.
b) **Second period: 2005 to 2009**. Marked by the 2008 world crisis, which affected large economies, such as the United States and European Union countries. In this period, less developed countries, such as Brazil, did not feel the impacts of the crisis so much.

c) **Third period: 2010 to 2016**. In 2010, the process of global economic recovery began, and the Brazilian economy began to decline. Brazil went through a deep recession between 2014 and 2016, in which there was a worsening of the economic crisis, political crisis with the *impeachment* process of former president Dilma Rousseff.
d) **Fourth period: 2017 to 2021**. In 2017, the economy began to recover slowly and gradually. There were some negative shocks in these years, such as the truck drivers' strike in 2018; Argentina crisis; international uncertainty with the US-China trade war in 2019; and the health crisis with the arrival of the Coronavirus.

In the analysis of the competitiveness of Brazilian exports of animal protein, the Constant Market Share (CMS) was used, as it is one of the most used models in the related publications of this research. This methodology was popularized by Leamer and Stern (1970), with further development by Richardson (1971) and Fagerberg and Sollie (1987). In this study, the approach proposed by Leamer and Stern (1970) was used, which is defined as follows:

Equation 1 - CMS

$$\sum_{j}^{n} = \mathbf{1}\left(E'_J - E_J\right) = \sum_{i}^{n} = \mathbf{1}\left(rE_j\right) + \sum_{i}^{n} = \mathbf{1}\left(r_j - r\right)E_j + \sum_{i}^{n} = \mathbf{1}\left(E'_j - E_j - r_jE_j\right) \quad \textbf{(1)}$$

Wherein:
E_J = value of exports of the analyzed product for market j, in period 1.
E'_J = value of exports of the product developed for market j, in period 2.
$E'_J - E_J$ = effective growth in the value of exports of the analyzed product for market j.
r = percentage of growth in the values of world exports of the product analyzed from period 1 to period 2.
r_j = growth percentage in the values of world exports for market j from period 1 to period 2.
n = number of markets

For the development of the calculus, the General Algebraic Modeling System (GAMS) software was used, which creates a high-level programming language designed to build and solve mathematical models numerically (GILBERT, 2017). With the tool, it was possible to decompose the export growth rate into four effects, as shown in Table 1.

Table 1 - CMS template effects

Effect of World Growth	Indicates whether the analyzed country's exports grew at the same rate as world trade.
Commodity Effect	It presents changes in the structure of the agenda, focusing on products with more or less accelerated demand growth.
Regional Market Effect	It presents changes resulting from the concentration of exports to more or less dynamic markets.
Competitiveness Effect	Determined by the residual effect resulting from the difference between world proportional growth and the effective growth of a country's exports.

Source: adapted from Gilbert (2017).

With this, the behavior of exports of beef, pork and chicken was analyzed, and the determining factors of their growth were identified, through the application of the Constant Market Share model.

To identify the relationships between sustainable performance and export performance, statistical analysis of the data obtained in the study was performed, with a confidence level of 95%. The SPSS software was used to apply the Spearman correlation, in order to verify the intensity of HDI and ANS (sustainable performance) in relation to the Market Share (export performance) of each protein. According to Cohen (1992), results greater than 0.20 are considered a low correlation; there is median intensity above 0.50, and 0.80 or more is a strong correlation. Spearman's correlation was chosen, as the analyzed variables did not have a linear relationship.

Finally, special attention was given to the results obtained for the years 2020 and 2021, as it is an atypical year, due to the Covid-19 pandemic. The perspective of this analysis is to verify whether the competitiveness of exports was affected by the pandemic, as well as whether concerns about sustainability had any impact, since the country's focus was on meeting public health needs.

4 RESULTS AND DISCUSSION

4.1 Market share of brazilian animal protein exports

The Constant Market Share method evaluates the competitiveness of exports of a country or region, using the growth of world exports as a reference. That is, if the analyzed country's share of world exports does not change within a specific period the country is neither losing nor gaining competitiveness. In Table 2, an evaluation of the effect of competitiveness was made, considering the growth of each period studied and the Market Share of Brazil in the period, measured in millions of dollars for each protein.

Table 2 - Growth (in million US$) of animal protein exports and participation (%) of Brazil in world exports

BEEF	**PI 2000 a 2004**	**PII 2005 a 2009**	**PIII 2010 a 2016**	**PIV 2017 a 2021**
Growth of world exports	4,782,722.93	7,579,678.16	8,800,746.90	4,751,645.48
Growth of Brazilian Exports	1,450,890.44	605,807.27	493,558.95	2,897,512.93
% World growth	34,55%	35,71%	29,10%	10,59%
% Of growth Brazil	288,62%	25,12%	12,82%	57,15%
Market Share Brazil	7,06%	10,92%	11,93%	13,68%
PORK	**PI 2000 a 2004**	**PII 2005 a 2009**	**PIII 2010 a 2016**	**PIV 2017 a 2021**
Growth of world exports	6,249,093.59	5,345,778.4	-2,319,202.16	8,698,391.87
Growth of Brazilian Exports	580,479.40	-11,750.41	124,459.85	1,009,500.22
% World growth	65,59%	29,57%	-8,54%	29,01%
% Growth Brazil	357,23%	-1,05%	10,16%	68,91%
Market Share Brazil	3,21%	5,47%	4,97%	5,64%
CHICKEN	**PI 2000 a 2004**	**PII 2005 a 2009**	**PIII 2010 a 2016**	**PIV 2017 a 2021**
Growth of world exports	2,544,584.61	5,148,185.64	1,998,968.27	1,760,166.23
Growth of Brazilian Exports	1,685,926.63	1,490,333.44	162,137.08	421,740.52
% World growth	44,08%	51,17%	11,51%	8,06%
% Growth Brazil	209,35%	44,93%	2,80%	7,56%
Market Share Brazil	21,95%	32,28%	32,01%	29,24%

Source: made by the author with data from UnComtrade (2022).

Brazilian exports of beef, pork, and chicken, in the years 2000 to 2021, had significant differences between the analyzed periods, with the last period being the one with the highest growth in value of exports. Of the three proteins, beef was the one that presented assiduity in the growth of the Market Share and pork was the one that had the greatest uniformity in the percentage of the Market Share, in the four periods.

In the period from 2000 to 2004, Brazilian exports increased in value and had a growth rate even higher than the world average. Beef presented a Market Share of 7.06% and a growth of 288.62% in the period; this increase was possible due to the productivity gains of the Brazilian herd (MACHADO et al., 2007). Pork increased its exports by 357.23%, while world exports increased by 65.59%, with a Market Share of 3.21%; this growth was also pointed out in research by Rubin et al. (2012).

Chicken meat also had great evolution in the first period, with a market share of 21.95%. Barcellos (2006) pointed out the high competitiveness of the Brazilian product in the international market and Souza et al. (2011) and Costa et al., (2015) highlighted that the productivity of the state of Paraná contributed to this result for the country. Another highlight was the growth of world trade which provided the growth of animal protein exports (MIELE; WAQUIL, 2007; SAGGIN, 2017) that were still booming at the time driven by the growing demand from China, making the period favorable for the Brazilian economy, which largely depended on export.

The world crisis, faced between 2005 and 2009, did not generate impacts for Brazilian exports, as beef grew by 25.12%, an increase that is in line with the results of Rodrigues and Marta-Costa (2021). The good performance of chicken meat, with an increase of 44.93% in the exported value, was also reinforced by Saggin (2017), Bender et al., (2019) and Ribeiro et al., (2021). Pork, on the other hand, did not show growth, but managed to increase its market share by 5.47%.

However, period III had lower growth in exports; beef exports increased by 12.82%; pork, at 10.16%; and chicken, at 2.80%. Even though growth in the period did not reach high levels, as in previous years, the country's market share was not significantly affected; beef, for example, increased its percentage to 11.93%; chicken meat remained at 32%; and pork reduced to 4.97%. This low growth in exports was due to the Brazilian economic crisis of 2014, which ended the cycle of high commodity prices in the foreign market, affecting exports and reducing the inflow of foreign capital into the country.

Continuing the 2015/2016 recession, at the beginning of 2017, unemployment reached its peak with a rate of 13.7% of unemployed Brazilians (IBGE, 2021), but, throughout the year, new jobs were generated, and the rate had a small drop associated with the increase in GDP, which started the slow and gradual process of economic recovery (MINISTÉRIO DA ECONOMIA, 2018). However, with the arrival of the Covid-19 Pandemic in 2020, the economic recovery reform agenda had to be postponed (SILVA; SILVA, 2020).

In Period IV, a drop in Brazilian participation in chicken meat exports is seen. On the world stage, protein exports fell by 2.91% compared to the previous period; Brazil, on the other hand, had a growth of 4.76% in the export of chicken meat. Also, beef and pork had a significant growth in the period, being 57.15% and 68.91% respectively, surpassing the growth in value of Period I and increasing its Market Share. The increase in pork exports is explained by the effects of African Swine Fever, which, according to the OECD (2021), not only affected China but the entire Asian continent, increasing the demand for the Brazilian product.

The good performance of Brazil, in the export of animal protein, is seen based on the increase of the country's participation in the world market, demonstrating the productive potential and living up to the natural and acquired competitive advantages, which are highlighted in the studies by Silva et al., (2008); Machado et al., (2007); Stal et al. (2010); Souza et al., (2011); Costa et al., (2015); Bender et al., (2019); Ferreira and Vieira (2019); Malafaia et al., (2020); Ribeiro et al., (2021).

Over the four periods analyzed, beef showed growth and greater participation in the export market, indicating that the country-maintained investments and improvements in the sector. Rodrigues and Marta-Costa (2021) and Stefanutti (2019) had already pointed out that with continuous investments and adaptation of the sector to sanitary barriers, Brazil would become the main international supplier of the protein. Therefore, the Market Share of 13.68% was obtained, being the highest of all analyzed periods.

4.2 Growth decomposition of Brazilian exports from 2000 to 2021

The results obtained, with the application of the Constant Market Share model, made it possible to verify the sources responsible for the variation of the values of each analyzed period. In Table 3, the

country's performance in relation to world performance is seen according to the effect of world growth, commodity, regional market, and competitiveness.

Table 3 - Decomposition of the change in the value of Brazil's animal protein exports

BEEF	**Period I**	**Period II**	**Period III**	**Period IV**
World Growth Effect	173,667.87	861,077.85	1,026,046.38	538,232.44
Commodity Effect	38,239.16	- 58,426.12	395,75.,78	369,554.38
Regional market effect	131,709.96	636,911.04	-1,796,480.00	- 461,354.37
Competitiveness effect	1,107,273.40	- 833,755.47	868,237.61	1,007,854.40
Total Change	1,450,890.41	605,807.30	493,558.95	2,376,995.61
PORK	**Period I**	**Period II**	**Period III**	**Period IV**
World Growth Effect	106,586.82	331,708.49	114,372.12	354,710.25
Commodity Effect	8,345.41	- 177,073.20	98,402.21	419,654.56
Regional market effect	- 48,994.96	298,956.41	- 666,066.40	- 107,880.80
Competitiveness effect	514,542.12	- 465,342.12	577,751.93	959,150.09
Total Change	580,479.40	- 11,750.41	124,459.85	655,432.68
CHICKEN	**Period I**	**Period II**	**Period III**	**Period IV**
World Growth Effect	**354,945.49**	**1,697,050.40**	**665,833.58**	**- 55,300.58**
Commodity Effect	20,162.09	72,151.78	- 597,835.55	- 257,207.07
Regional market effect	- 93,503.37	- 138,834.48	126,936.77	920,193.56
Competitiveness effect	1,404,322.43	- 140,034.19	- 32,797.72	- 1,554,050.00
Total Change	1,685,926.63	1,490,333.51	162,137.08	946,368.01

Source: made by the authors with data from the Uncomtrade (2022)

In all analyzed periods, Brazilian exports of beef and chicken increased substantially. In period, most of the increase in export values of the three proteins corresponded to the impact of the country's competitiveness which boosted exports, followed by the general growth of world trade (CARVALHO et. al., 2006).

Pork and chicken showed negative values in the effect of the regional market, showing that export destinations were not concentrated in markets that had rapid growth. Beef, on the other hand, had a great contribution from the export destinations factor, confirming the results of Buhse et al. (2014) and Florindo et al. (2014). Other factors contributed to its overall growth, such as professionalization, the abundance of raw materials, inputs, industrialization, and the specialization of companies to work in the foreign market (GONÇALVES; PALMEIRA, 2006).

In period II, the three meats presented negative values in the competitiveness effect, indicating that this variable fell slightly in the period. But, even so, beef and chicken presented an increase in the total composition, as the world export growth favored this scenario; Furthermore, beef was favored by the regional effect (BUHSE et al., 2014; FLORINDO et al., 2014) and chicken meat, by the effect of the commodity. Pork had a drop in values, mainly in the competitiveness effect, which was also evidenced in the study by Gastardelo et al. (2016).

The destinations of exports of beef and pork, in period III, did not contribute to the positive value of the total change; chicken meat, on the other hand, benefited from the fact that its exports are directed to growing markets. In comparison with period II, beef showed an increase in the effect of world growth, commodity, and competitiveness, and, according to Florindo et al. (2014), it was possible with the end of the American crisis of 2008. The positive value of the effect of world growth indicated that pork

exports grew in the same proportion; associated with competitiveness, it was responsible for maintaining the country's exports, corroborating the research by Gastardelo et al. (2016).

In the last two analyzed periods, the destination effect of chicken meat exports corroborated for the growth of exports positively. This result was driven by China's rapid growth and the country's growing demand for Brazilian commodities. Also, competitiveness presented a negative value, indicating the need for flexibility agreements for markets with which Brazil already has a commercial relationship, as a way of improving policies to encourage product competitiveness (SAGGIN, 2017).

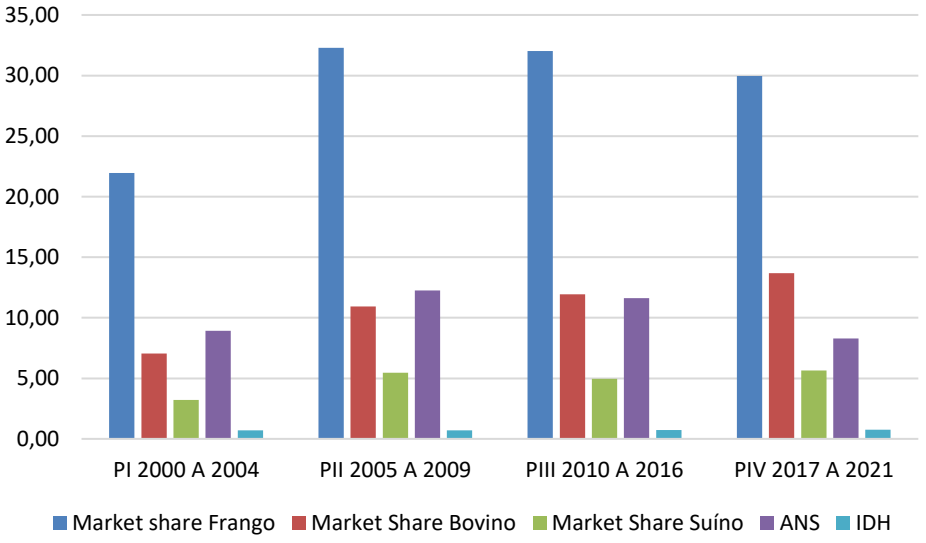
In period IV, which portrays the current situation, chicken meat had a positive value in the analysis of total change, as well as in period III, due to the destination markets for its exports, but also, according to Bender et al. (2019), because it was provided by the natural conditions of the Brazilian territory and its competitiveness in two other important products for chicken meat: corn and soybeans.

Also, in the last period, beef and pork increased their competitiveness, and this period had the highest value in total change. The effect of the destination of exports was not favorable for the two proteins, but, as it is a promising sector with a growing degree of international insertion and its ability to condition the development of the Brazilian economy, they arouse interest and increasingly direct attention to the expansion of the market.

4.3 Animal protein exports and sustainable performance

With the growth of Brazilian exports, the concern with the impact of productive activities on society and the environment is highlighted, as it is a sector that has a negative impact on biodiversity (STEHFEST et al., 2013). Therefore, to carry out the analysis of sustainable development, two indicators were used, the ANS and the HDI, relating them to the Market Share of each protein studied. It is seen in Figure 1 that the variation in the HDI is minimal from one period to another; ANS, on the other hand, presents a slightly more significant variation.

Figure 1 - Export market share and sustainable performance



Source: Made by the author with data from Uncomtrade (2022), World data bank (2022) and PNUD (2022).

In the period from 2000 to 2004, the HDI average was 0.693 and adjusted net savings had a percentage of 8.94%. In the period from 2005 to 2009, the HDI was 0.708 and the ANS 12.35%, showing a 2% growth in the HDI and 37% in the ANS in relation to the previous period. Making the same comparison with the Market Share of exports, growth is also seen, inferring that, as the country improved

its Sustainable performance, it also improved its Market Share. Over the years, it is seen that the adoption of more sustainable measures is a constant concern of the meatpacking industries, in order to incorporate the concept of sustainability as a competitive strategy (ARAÚJO; MENDONÇA, 2009; FEITOSA, 2019).

Comparing the PII with the PIII, there is an increase in the HDI and a decrease in the ANS, both by 5%. In this comparison, pork and chicken also suffered a drop in their Market Share; on the other hand, beef grew by 9%. The growth of Brazilian exports happened together with international trade and was fundamental for a more inclusive development, considering several factors, such as the social and sustainable aspect (PORTOCARRERO; ARAÚJO, 2018).

From period III to period IV, the HDI continued to show a growth of 2%, but the ANS had a decrease of 29% (from 11.62% in the PIII to 8.28% in the PIV). Beef and pork presented an increase, but chicken meat continued to suffer a decrease in its Market Share. Above all, the Brazilian production of chicken meat generates jobs and has an important social rule in the Brazilian economy; technological advances in the sector arise to mitigate problems related to sustainable production.

Although chicken meat has the highest Market Share among the three proteins analyzed, it is also the one that had the most variations between 2000 and 2021, as it had a standard deviation of 5.44 compared to 0.92 for pork and 2.81 for beef. In Table 4, the Spearman correlation was used, with a confidence level of 95%, in order to validate whether there is a relationship between HDI and ANS when compared to the Market Share.

Table 4 - Spearman's Correlation

	IDH	**ANS**
Chicken Market Share	0,091	0,821
Beef Market Share	0,198	0,368
Pork Market Share	0,552	0,368

Source: Made by the author with data from Uncomtrade (2022), World data bank (2022) and PNUD (2022).

Chicken meat was the one with the lowest correlation with the HDI, inferring that the variation in the HDI does not influence the variation in the Market Share of chicken protein; ANS, on the other hand, has a strong correlation with meat, that is, as the country's genuine net savings increase, the share of Brazilian chicken meat in the foreign market also increases. Beef showed a clear correlation with the two variables and pork had a medium correlation with the HDI and weak with the ANS, being the protein that was most influenced by the variation of the HDI. In this sense, the result of this analysis is in line with the research by Flores and Gavronski (2016), that pointing out that sustainability has little influence on Brazil's export performance.

However, it is seen that the concern for the environment is increasingly present in the production chain; the meatpacking industries seek to implement actions that reduce the environmental impact, which ranges from the creation process to the industrialization of the product (ARAÚJO; MENDONÇA, 2009; FLORES; GAVRONSKI, 2016; PORTOCARRERO; ARAÚJO, 2018; FEITOSA, 2019).

Genuine net savings exerted a greater influence than the HDI on exports. Therefore, it is important to adopt environmentally sustainable processes, which, in addition to reducing operating costs, allow access to market in countries with stricter environmental standards. Even if the HDI did not show a high correlation, the development of socially responsible practices in Brazil could generate advantages, such as productivity gains due to the greater concentration of skilled labor.

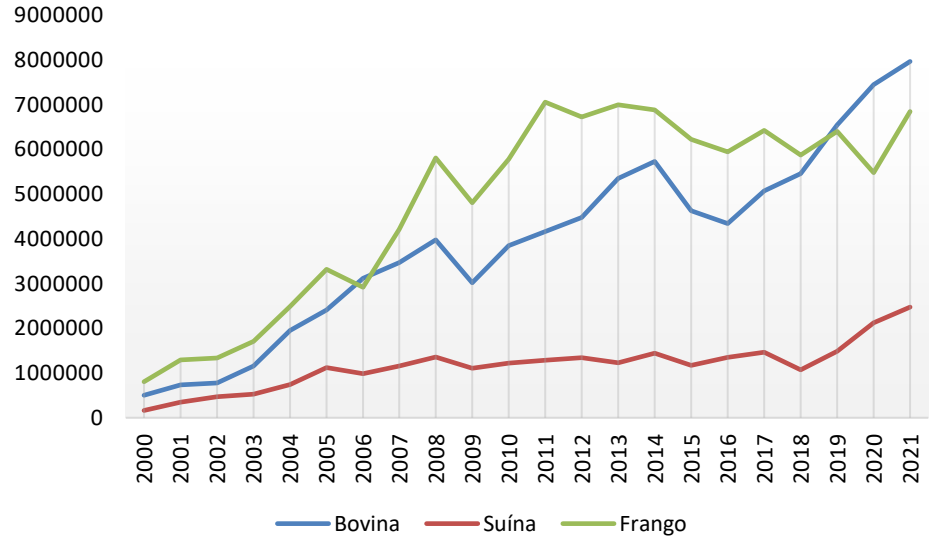
4.4 COVID 19 pandemic and Brazilian animal protein exports

Concerns about food safety became stronger in 2020 with the arrival of the pandemic, increasing restrictions on international trade in food, and especially animal protein, due to strict border controls and the preference for local production. Dweck, Rocha and Freitas (2020) pointed to a probable reduction in Brazilian exports, in addition to a change in their composition, with an increase in the importance of goods of agricultural origin. This reduction would have negative effects on the trade balance and increase the external vulnerability of the Brazilian economy.

With Covid-19, international trade was subject to great difficulties, due to the reduction in world demand for goods, due to restrictions on supply capacity in various sectors and countries (RIBEIRO; BAUMANN; OLIVEIRA et al., 2020). According to the OECD (2021); major economies had a drop in their gross domestic product in 2020, such as the United States, which had a retraction of 0.47%; Japan reduced by 0.09%; Germany at 0.04%; India at 0.17%; United Kingdom by 0.20%; France at 0.06%; and Italy at 0.12%. In 2021, this scenario changed, and the mentioned countries showed growth in GDP.

Analyzing all products and services exported by Brazil, in 2020, exports had a balance of US$ 209,180.2 million, 5.4% lower than in 2019, but in 2021, it totaled US$ 280,814.6 million, showing an increase of 27% compared to 2019 (SECEX, 2022). Figure 2 shows the behavior of meat exports studied in the period from 2000 to 2021.

Figure 2 - Value in Millions of Exports of animal protein over the period



Source: Made by the author with data from the Uncomtrade (2022).

Beef has been growing since 2016 and, even with the arrival of the pandemic, in 2020 it grew 14% compared to the previous year and ended 2021 with an increase of 7%. Pork exports jumped in 2019 and 2020 and, like beef, showed a significant 43% increase in exports. Chicken meat, on the other hand, had a sharp drop in exports of 14% compared to 2019, but in 2021, it recovered and had a 17% growth in value.

Based on the ascending analysis that the export value line presents in Figure 9 chicken meat was the product that was impacted by the arrival of the pandemic. But, when analyzing the exported volume of the product, in 2020, which was 4.231 million tons, an increase of 0.40% is seen compared to 2019. What happened was a reduction in the revenue obtained in the period in question. In 2021, product shipments reached a new record of 4,498 million tons, surpassing the mark of just over 4.3 million tons, which had remained unbeatable since 2016 (ABPA, 2021).

With the arrival of the pandemic, Brazilian exports were subjected to stricter security controls for their entry into importing countries. The adoption of protocols developed for the most varied fronts of action, cutting-edge technologies for monitoring, implementation of spacing in transport, and use of PPE were some examples considered by the meatpacking industries (ABPA, 2021).

The pandemic has brought numerous problems to the whole world, in addition to the high number of deaths and infected by the disease. There were also difficulties in trade, stoppages, increased unemployment, political conflicts, emergency measures, among many other situations that interfered with the experienced scenario. However, as seen, this pandemic scenario did not affect the animal protein market, but rather reinforced Brazil's responsibility as a major food provider to the world.

5 CONCLUSION

Brazil plays an important role in supplying food to the world, especially soy and meat. The country's animal protein exports grew gradually, following the international market, a fact provided by the competitive advantages of the sector. In this sense, the present research aimed to analyze the relationship between sustainability and competitiveness of exports of the Brazilian animal protein market (chicken, beef, and pork) in the period from 2000 to 2021.

The Constant Market Share model made it possible to identify the main sources of export growth. The results reveal that the effect of world growth was essential for the increase in exports of the three proteins. Beef showed growth in its share over the years and was the protein that most influenced the effect of competitiveness, with the availability of land and pastures, increase in the herd, genetic improvement, improved management, favorable weather conditions being the main competitive advantages of the product.

Pork has a smaller market share when compared to other meats, but even so, it increased its share in the market during the analyzed period. Factors such as grain availability, advances in genetics, slaughtering and processing technologies contributed to this result. The competitiveness effect was what most influenced the change in the value of exports, but there are still many barriers that impede the expansion of the sector. The large production capacity that the country has associated with the reduction of tariff and non-tariff barriers would be the ideal scenario for the expansion of pork exports, making Brazil even more competitive.

Chicken meat is the protein with the highest percentage of participation in the international market; the effect of world growth was essential for this to happen. Advantages, such as climate, technical innovations, logistical factors, availability of labor, natural and financial resources, contributed to the increase in productivity and, consequently, in exports.

When relating the competitive performance of beef, pork, and chicken with the HDI and the ANS, to verify the relationship that sustainable meat has on exports, a strong correlation is not seen. Thus, these indicators do not have a great influence on the competitive performance in the Brazilian animal protein market. Factors such as world growth, export destinations and trade barriers exert the greatest influence on the country's export performance. On the other hand, it is seen that sustainability is increasingly present in the sector and should be incorporated as a factor for the analysis of the country's competitiveness.

The Covid-19 pandemic caused many uncertainties to the market; a reduction in world demand for food was expected as a result of the imposition of restrictions related to food safety and, consequently, a reduction in Brazilian exports. Chicken meat suffered a 14% reduction in exported value in the first year of the pandemic, but in 2021 it recovered, reaching a new record in terms of quantity and value exported. On the other hand, beef and pork did not suffer a reduction, on the contrary; in 2020 and 2021, there was a significant growth in the value exported.

Finally, this research affirmed the relevance of Brazil in international trade, especially with regard to agribusiness and, in particular, the meat trade. In addition, the research added to the literature, considering that research on exports in the agribusiness sector, considering the variable of sustainability, still occupies a restricted space in the academic field.

For future research, it is suggested to use a greater number of sustainability indicators to verify the country's sustainable performance, allowing a more in-depth analysis of the relationship between sustainability and competitiveness. In addition, other models can be used together with the Constant Market Share, in order to verify the export performance from various angles and enable the projection of future scenarios for the sector.

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