IFIP International Conference on Advances in Production Management Systems APMS 2021: Advances in Production Management Systems. Artificial Intelligence for Sustainable and Resilient Production Systems, September 2021, pp. 577-584
DOI: 10.1007/978-3-030-85902-2_61

Food Exports from Brazil to the United Kingdom: An Exploratory Analysis of COVID-19 Impact on Trade

João Gilberto Mendes dos Reis[1][0000-1111-2222-3333], **Sivanilza Teixeira Machado**[2][0000-0003-2746-7885] and **Emel Aktas**[3][0000-0003-3509-6703]

[1]RESUP – Supply Chain Research Group, Postgraduate Studies in Production Engineering/Postgraduate Studies in Business Administration, Universidade Paulista - UNIP, Dr. Bacelar. 1212, São Paulo SP 04026002, Brazil
joao.reis@docente.unip.br

[2]Instituto Federal de Educação Tecnológica – IFSP, Mogi das Cruzes. 1501. Suzano SP, 08673-010, Brazil
sivanilzamachado@ifsp.edu.br

Centre for Logistics and Supply Chain Management, Cranfield University, Cranfield MK430AL, United Kingdom.
emel.aktas@cranfield.ac.uk

Abstract. Brazil and the UK have been strategic partners throughout the years. While the former has traded minerals and food products – mainly agricultural commodities – the latter has been critical to infrastructure development in the South American country. However, the Crisis of COVID-19 Pandemic altered the scenario of international food production and distribution. This article aims to analyse Brazilian food exports to the UK in 2019 and 2020 to identify the impact of COVID-19 on the trade flows. To do so, we collected data from the Brazilian Ministry of Economy regarding the exports between the two nations and performed an exploratory investigation using graphical and quantitative analysis. The results suggest that the Pandemic crisis rose Brazilian exports of cereal and grains to the UK by around 50%, and the shortage of these items in the internal market has increased consumer prices by more than 60% during 2020.

Keywords: Food Supply Chains, International Trade, Market Fluctuations, Network Analysis.

1 Introduction

Brazil and the United Kingdom have been partners for centuries, first through Portugal that always had strong relations with the UK, where it commercialised agricultural items obtained from the colony in trade for textile products, and second directly with the country after the opening of Brazilian ports [1].

In the XIX century, during the Victorian years, the UK was the main actor responsible for the Brazilian development, building railways and infrastructure. The British reign sent materials and technicians and provided loans for the construction of Brazil. On the other hand, the country provided mineral – mainly gold – and agricultural products to attend to the necessities of the UK and its colonies [2].

Published by Springer. This is the Author Accepted Manuscript.
The final published version (version of record) is available online at DOI:10.1007/978-3-030-85902-2_61. Please refer to any applicable publisher terms of use.

Nowadays, the trade relations between these two countries are completely different. First, the bilateral relations were established by the European Union for some decades, and second, due to the Brexit process that is redefining agreements between nations. In a nutshell, Brazil is the primary source of food products coming from crops while the UK is responsible for trading more complex items. Brazil also plays a vital source of the UK's organic food imports [3]. This does not mean that in this trade the UK never sells food products to Brazil, but they are so specific and in small quantities.

In 2019, the world was stricken by the worst pandemic crisis since the Spanish flu one hundred years ago. The virus spread fast across the globe, destroying economies, collapsing healthcare systems, and killing approximately 2.9 million people [4]. Even though vaccines are developed and deployed, the world remains menaced, and differences among countries are exposed [5]. The fact is that right now, the crisis is still far from finishing since the virus keeps changing and spreading through the human hosts [6].

In this research, the question we seek to answer is whether Brazilian exports to the UK have been affected by the crisis brought by the COVID-19 Pandemic. Therefore, the purpose of this article is to investigate Brazilian exports to the UK in 2019 and 2020 (before and during the Pandemic), considering the volume of trade in kilograms and monetary value in USD to verify behaviour changes in this relation.

To do so, we collected data provided by the Brazilian Ministry of Economy about trade relations between countries and analysed these data using the well-known spreadsheet editing software Microsoft Excel® v.16, the social network analysis software UCINET® 6 for Windows, and Graphviz. Based on a quantitative and graphical analysis, the results indicate an increase in the volume of exports of cereal and grains as a consequence of the Pandemic crisis.

2 Methodology

To achieve our objective, we collected the volume of exports (quantity in kilograms and monetary value in the US dollars - USD) from Brazil to the United Kingdom using the international trade system of the Ministry of Economy of Brazil. The system is called ComexStat [7] and provided us with all items exported during 2019 and 2020 to the UK.

The data were organised using a spreadsheet in Microsoft Excel® v.2019. The food products were gathered in groups according to their characteristics: (1) Beverages; (2) Cereal and Grains; (3) Chocolate; (4) Coffee and Tea; (5) Cookies; (6) Dairy Products; (7) Edible Oils; (8) Fish; (9) Fruits; (10) Ice Cream; (11) Juice; (12) Meat (broiler, cow, and pig); (13) Sauce; (14) Soup; (15) Sugar; and (16) Vegetables. Note that the juice category is not included in beverages because we wanted to observe its influence in trade since it is a great Brazilian commodity, mainly characterised by orange juice [8].

We imported the data to a social network tool, the software UCINET 6 for Windows version 6.698, establishing the degree centrality [9] of the network for both in and out of the nodes (indegree and outdegree) in Tables 1 and 2.

Table 1. Outdegree values

ID	Outdeg (Kg)		nOutdeg		Outdeg (USD)		nOutdeg	
	2019	2020	2019	2020	2019	2020	2019	2020
Beverages	2433576	47309092	0.003	0.036	2151285	28470864	0.003	0.039
Cereal and Grains	540866816	791614592	0.599	0.595	168871792	253548288	0.274	0.348
Chocolate	13301	32356	0.000	0.000	63602	106339	0.000	0.000
Coffee and Tea	54745952	45442128	0.061	0.034	135768736	114640424	0.221	0.157
Cookies	53585	76947	0.000	0.000	168389	242960	0.000	0.000
Dairy Products	21038	27773	0.000	0.000	50251	53301	0.000	0.000
Edible Oil	127814	134087	0.000	0.000	546241	405334	0.001	0.001
Fish	64297	12761	0.000	0.000	391897	187584	0.001	0.000
Fruits	163770464	166545024	0.181	0.125	148558368	146575232	0.241	0.201
Ice_Cream	41881	55427	0.000	0.000	143664	187832	0.000	0.000
Juice	13911968	16220615	0.015	0.012	20076384	21610106	0.033	0.030
Meat (Broiler/Cow/Pig)	42851400	46794640	0.047	0.035	111590784	97820944	0.181	0.134
Sauce	930700	1396641	0.001	0.001	1237667	2406870	0.002	0.003
Soup	843	2509	0.000	0.000	5135	16349	0.000	0.000
Sugar	79215288	207667744	0.088	0.156	22934314	59026808	0.037	0.081
Vegetables	3506831	6818260	0.004	0.005	2765565	4104541	0.004	0.006

Table 2. Indegree values

ID	Indeg (Kg)		nIndeg		Indeg (USD)		nIndeg	

	2019	2020	2019	2020	2019	2020	2019	2020
Brazil/UK	902555712	1330150656	1.000	1.000	615324160	729403648	1.000	1.000

Afterwards, using the software Graphviz [10], we plotted four network graphics based on the trade data: (1/2) Exports in monetary value for 2019 and 2020; and (3/4) Exports in kilograms for 2019 and 2020. The groups were considered network nodes, and they were connected to a node of Brazil/UK exports based on the above-mentioned relations.

A graphical network approach was adopted to allow us to represent the differences among flows in a more comprehensive view. At the same time, it provided us with the opportunity to have access to some interesting representations of graph theory [10, 11]. The graphics are shown in the next section together findings discussion.

3 Results and Discussion

The networks comparing exports in 2019 and 2020 from Brazil to the UK in Free on Board (FOB) in USD currency is presented in Figures 1 and 2. The strength of lines indicates the degree of the trade.

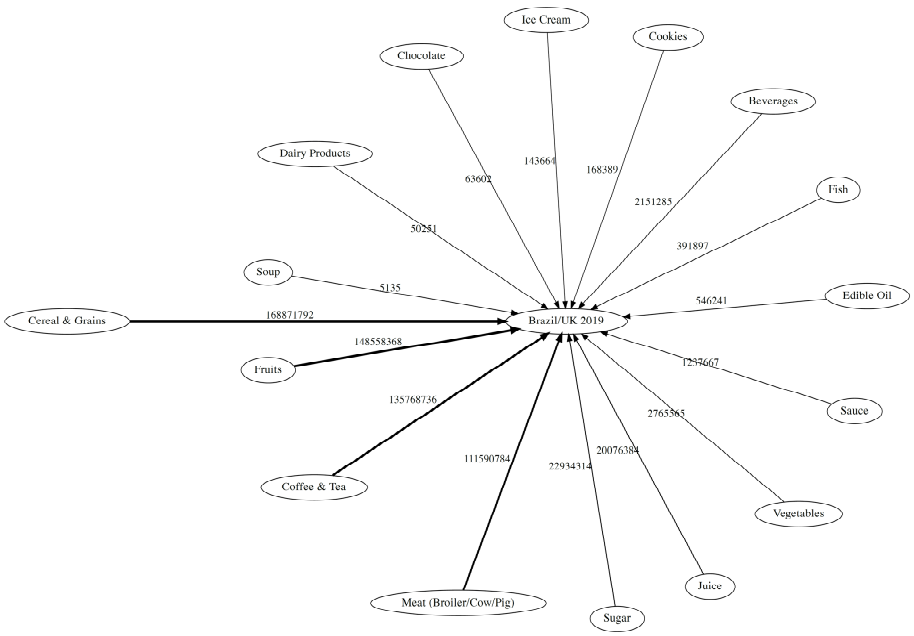


Fig. 1. Food product exports from Brazil to the United Kingdom in 2019 (USD).

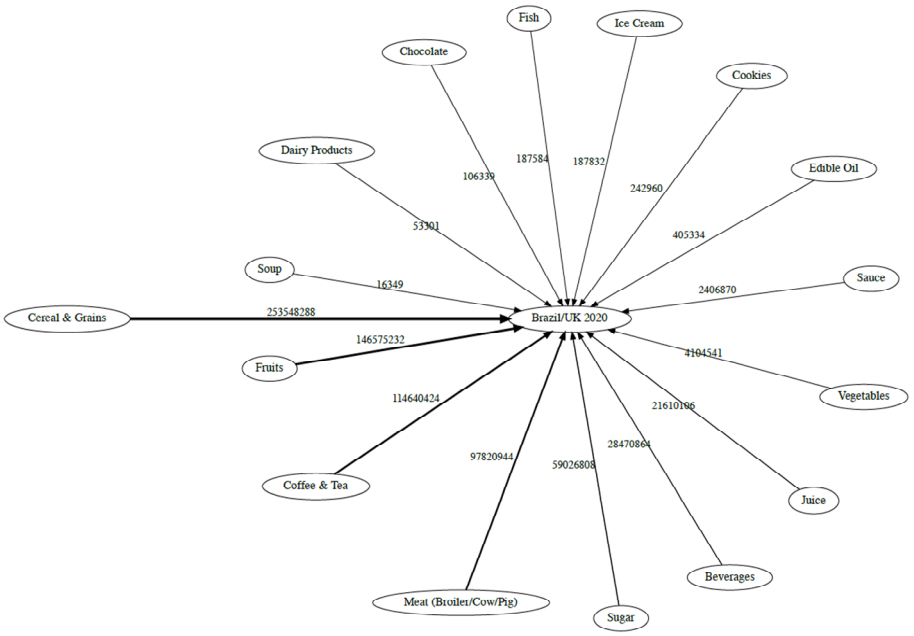


Fig. 2. Food product exports from Brazil to the United Kingdom in 2020 (USD).

The results did not show any difference among exports value position of food item groups between years for the five places; it was the same order: 1. Cereal and Grains, 2. Fruits, 3. Coffee and Tea, 4. Meat, and 5. Sugar. However, we identify that the exports in USD grew 15% from 2019 to 2020. The highlights were Beverages (1,223%), Soup (218%), Sugar (157%), Sauce (94%), Chocolate (67%) and Grains (50%). On the other hand, a reduction occurred in Fish (-52%), Edible oil (-26%), Coffee and Tea (-16%) and Meat (-12%).

After that, we performed the same analysis but now considering the weight of exports in kilograms. The results can be seen in Figures 3 and 4.

Considering the weight instead of monetary value, the order of importance for the five places was the same: 1. Cereal and Grains, 2. Fruits, 3. Sugar, 4. Coffee and Tea, and 5. Meat. The volume of beverages converted to kilograms increased by 1,884%, Soup 198%, Sugar 162%, Chocolate 143%, Vegetables 94%, Sauce 50%, and Cereal and Grains 46%. On the flipside, Fish decreased 80%, Coffee and Tea decreased 17%.

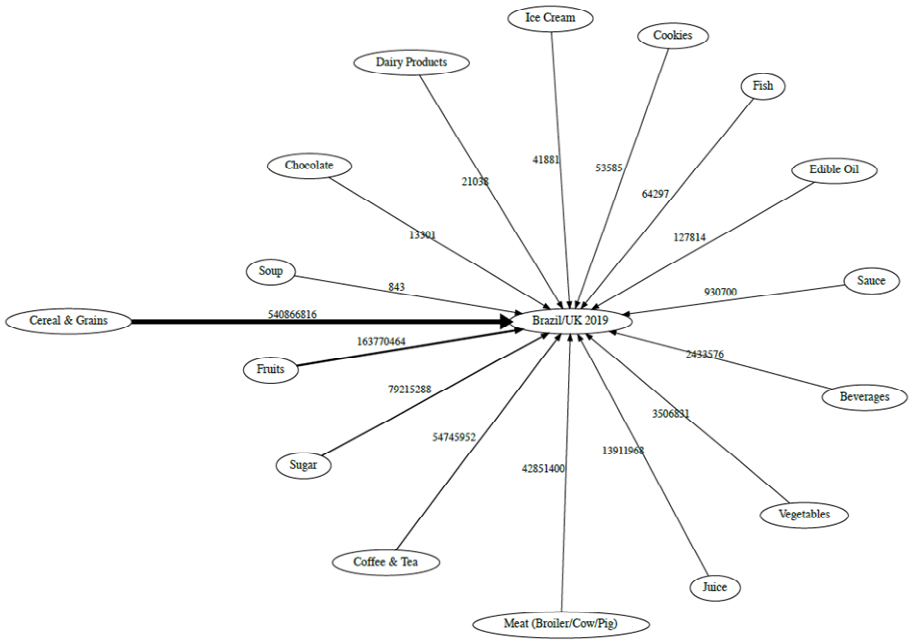


Fig. 3. Food product exports from Brazil to the United Kingdom in 2019 (kilograms).

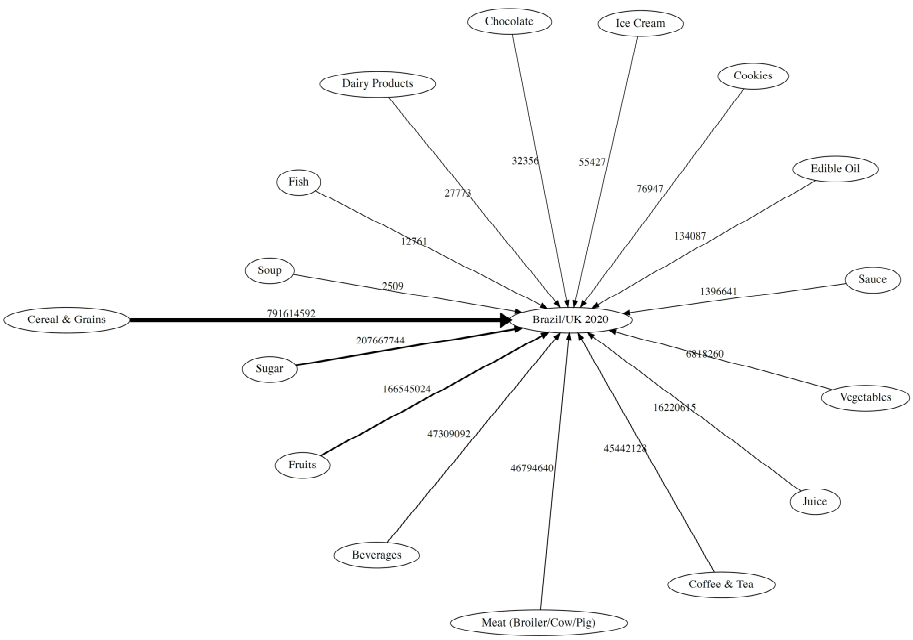


Fig. 4. Food product exports from Brazil to the United Kingdom in 2020 (kilograms).

Analysing the results, we note that beverages (by large composed of alcoholic drinks) performed a higher increase in quantity than in monetary value, indicating a better price per unit due to the volume. Considering the COVID-19 impact, the increase can represent a rise in alcoholic beverage consumption motivated perhaps by the anxiety and stress created by the Pandemic in the UK population. Garnett et al. [12] surveyed 30,375 adults in the UK from 21st March to 4th April 2020, demonstrating that 48.1% of respondents reported drinking about the same, and 26.2% reported drinking more than usual over the past week. Indeed, we cannot be conclusive about that on account of the shortness of the research, but it suggests a relation between the pandemic and the rise in alcohol consumption. The same phenomenon has been observed in Brazil, China, and Germany [13].

Moving for the most relevant items on trade between Brazil and the United Kingdom (beverages correspond to just 2% of trade by USD), cereal and grains correspond to 50% of the quantity and 29% of the monetary value. We observe an increase of 46% in cereal and grains trade to the UK. Developed countries have demonstrated remarkable robustness and resilience over their food supply chains during the COVID-19 crisis, maybe as a learning of the costly mistakes of the 2007-8 food price crisis [14]. The big issue is that the actions of rich nations to support their population are raising the internal prices in developing countries [15], where farms see this as an opportunity to attend international markets as one way to reduce their losses over the years [16]. There is a risk of food security in developing countries not from disruptions to supply chains but rather from the devastating effects of COVID-19 on jobs and livelihoods [14].

In Brazil, for instance, the economy collapsed due to the reduction of external investments, the aggravation of sanitary and the political crisis that resulted in a loss of 29% of the value of the Brazilian Real (BRL) against the US dollar in 2020 [17]. Therefore, the rise of international demand for food items aligned with competitive Brazilian prices caused by the devaluation of the currency created a shortage in the internal market. Moreover, the necessity of foreign agricultural inputs, such as fertilizer, and rebuying agricultural grains to the animal protein industry, make food prices in Brazil soar by 15% in 2020, and around 60% for cereal and grains [18].

Regarding fruits that are a valuable Brazilian commodity, they did not show significant differences between one year to another and remained a valuable Brazilian export item to the UK with 20% of the monetary value received in 2019 and 2020. However, the UK ranked as one of the most important partners and tends to increase its demand in the following years [19].

An unexpected result was the highest reduction of the coffee and tea market in Brazil. This market corresponds to 17% of the monetary value in the period but reduced by 16%, indicating that this result could be better. The same occurred with the meat market that declined 14% in value and 9% in volume. Indeed, these results may be influenced by the other partners trying to acquire the same commodities and not necessarily a reduction in the UK market. However, we can exclude the enormous impact of COVID-19 in these commodity markets.

4 Conclusions

The present article analysed the exports of food items between Brazil and the United Kingdom to identify possible effects of the COVID-19 Pandemic in the movement of these goods between the two countries. There is a long history between the two trading partners as a result of the influence of the UK in Portugal and afterwards in Brazil. The UK was critical in the process of Brazilian independence and development, mainly in the XIX century and the first half of the XX century. This process established a rich cultural exchange and economic trade.

Our results indicate an increase in exports of agricultural commodities (cereal and grains) and more complex food items such as beverages, soup, vegetables. The big issue for Brazil is that these items contribute little to the total trade. Besides that, the results allow us to suppose some impacts of the Pandemic in the behaviour of the UK consumer. Another significant result refers to an increase in food prices in Brazilian internal markets. It occurred as a consequence of the rise in international demand, as demonstrated by the Brazil/UK figures, and due to the devaluation of the Brazilian currency against the US dollar in 2020.

The limitations of the work include the sample size, the focus on two nations only, and the difficulty to capture in detail the COVID-19 impact. Moreover, two years is a small period to identify whether the behaviour will remain, or it is just a punctual situation. However, the study allows to create an exploratory analysis and establish a path to continue the research based on the assumptions here established.

5 References

1. Fausto, B., Fausto, S.: A Concise History of Brazil. Cambridge University Press (2014).
2. Graham, R.: Britain and the Onset of Modernization in Brazil 1850-1914. CUP Archive (1972).
3. Barrett, H.R., Browne, A.W., Harris, P.J.C., Cadoret, K.: Organic certification and the UK market: organic imports from developing countries. Food Policy. 27, 301–318 (2002). https://doi.org/10.1016/S0306-9192(02)00036-2.
4. Worldmeter: Coronavirus Update (Live): 132,815,247 Cases and 2,879,198 Deaths from COVID-19 Virus Pandemic - Worldometer, https://www.worldometers.info/coronavirus/, last accessed 2021/04/06.
5. BBC News: Covid vaccine tracker: How's my country and the rest of the world doing?, https://www.bbc.com/news/world-56025355, (2021).
6. WHO: COVID-19 vaccines, https://www.who.int/emergencies/diseases/novel-coronavirus-2019/covid-19-vaccines, last accessed 2021/03/27.
7. MInistry of Economy: Comexstat, http://comexstat.mdic.gov.br/pt/home, last accessed 2021/03/20.
8. Odilla, F.: O que o caminho do suco de laranja brasileiro até as prateleiras britânicas revela sobre os desafios do Brexit, https://www.bbc.com/portuguese/brasil-48146698.

9. Opsahl, T., Agneessens, F., Skvoretz, J.: Node centrality in weighted networks: Generalizing degree and shortest paths. Soc. Netw. 32, 245–251 (2010). https://doi.org/10.1016/j.socnet.2010.03.006.
10. Alejandro, V.A., Norman, A.G.: Manual Introdutório à Análise de Redes Sociais. Universidad Autonoma Del Estado de Mexico (2005).
11. Borgatti, S.P., Everett, M.G., Johnson, J.C.: Analyzing social networks. SAGE, Los Angeles (2013).
12. Garnett, C., Jackson, S., Oldham, M., Brown, J., Steptoe, A., Fancourt, D.: Factors associated with drinking behaviour during COVID-19 social distancing and lockdown among adults in the UK. Drug Alcohol Depend. 219, 108461 (2021). https://doi.org/10.1016/j.drugalcdep.2020.108461.
13. Garcia, L.P., Sanchez, Z.M., Garcia, L.P., Sanchez, Z.M.: Alcohol consumption during the COVID-19 pandemic: a necessary reflection for confronting the situation. Cad. Saúde Pública. 36, (2020). https://doi.org/10.1590/0102-311x00124520.
14. OCDE: Food Supply Chains and COVID-19: Impacts and Policy Lessons, http://www.oecd.org/coronavirus/policy-responses/food-supply-chains-and-covid-19-impacts-and-policy-lessons-71b57aea/, last accessed 2021/03/27.
15. Malpass, D.: COVID crisis is fueling food price rises for world's poorest, https://blogs.worldbank.org/voices/covid-crisis-fueling-food-price-rises-worlds-poorest, last accessed 2021/03/27.
16. Adami, A.: Exportações do agronegócio brasileiro em meio à pandemia do coronavírus -, https://www.cepea.esalq.usp.br/br/opiniao-cepea/exportacoes-do-agronegocio-brasileiro-em-meio-a-pandemia-do-coronavirus.aspx, (2020).
17. Reuters: How will the Brazilian real behave against the dollar in 2021?, https://labsnews.com/en/articles/economy/exchange-rate-imbalance-between-the-brazilian-real-and-the-dollar-will-persist-in-2021-say-analysts/, last accessed 2021/03/29.
18. IBGE: Tabela 7060: IPCA - Variação mensal, acumulada no ano, acumulada em 12 meses e peso mensal, para o índice geral, grupos, subgrupos, itens e subitens de produtos e serviços (a partir de janeiro/2020), https://sidra.ibge.gov.br/tabela/7060, last accessed 2021/03/29.
19. Macshane, G.: Brazil eyes opportunities to strengthen fresh-fruit ties with UK post-Brexit, https://www.producebusinessuk.com/brazil-eyes-opportunities-to-strengthen-fresh-fruit-ties-with-uk-post-brexit/, last accessed 2021/03/27.