Competitio 2022. XXI. évfolyam
doi: 10.21845/comp/2022/1–2/2.

Analysis of Competitiveness in the Agri-food sector: The case of Latin America and the Caribbean Region

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Latin America and the Caribbean (LAC) countries are among the global leaders in the production and exports of agricultural and fisheries commodities, accounting for 15% of the world's average agri-food export from 1995 to 2019. With rising global market competitiveness, considering the agri-food sector, it is important to assess if the region can compete against other global rivals, and in what products. Accounting for regional potential economic power, remarkable agricultural food export and market expansion, this paper explored the LAC agricultural trade patterns and export competitiveness through the analysis of the Revealed Comparative Advantage (RCA) index, and its modifications – SRCA (Symmetric Revealed Comparative Advantage), RTA (Relative Trade Advantage, and RC (Revealed Competitiveness) – in the agricultural sector for the period of 1995-2019. This paper contributes to the literature by presenting the export characteristics in Latin American developing countries, which can be an important instrument for decision-makers in the agricultural trade policy. Throughout the research period, the results indicated that Brazil, Argentina, and Mexico were the TOP agri-food exporters in LAC. The highest RCA, SRCA, and RTA were found in Guatemala, whereas the greatest RC was found in Argentina. At the product level analysis, oil seeds and oleaginous fruits, miscellaneous grains, seeds and fruit, industrial or medicinal plants, and straw and fodder (HS12) were the most exported items at the 2-digit level. Fruit and nuts, edible; peel of citrus fruit or melons (HS08) had the most competitiveness in the worldwide market, with the highest SRCA and RC

The present publication is the outcome of the project „From Talent to Young Researcher project aimed at activities supporting the research career model in higher education", identifier EFOP-3.6.3-VEKOP-16-2017-00007 co-supported by the European Union, Hungary and the European Social Fund.

indices, whereas coffee, tea, mate, and spices (HS9) had the highest BRCA and RTA values. The evidence suggests that among the TOP 10 exporters in LAC, all indices in the global agri-food trade are said to be relatively stable, whereas survival rates do not persist over time.

Keywords: International trade, Agri-food sector, Revealed Comparative Advantages, Revealed Competitiveness, Kaplan-Meier survivor function, Latin America and the Caribbean.

JEL Codes: Q13, Q17

1. Introduction

Agricultural trade has long been used by countries to supplement their domestic production. Land, labour, and capital supply, as well as climatic conditions, are determinants that might affect production capacities and, as a result, trade flows. Following the liberalization of economic nations, the world witnessed an outstanding growth in the volume of international trade (Jambor and Babu, 2016).

Nonetheless, dramatic changes in global agri-food commerce occurred in the second half of the twentieth century, including a significant decline in its trade (in contrast to a rise in manufactured products) that also coincided with the expansion of high-value-added products in agricultural and food trade worldwide. This change in trade structure generated unequal consequences on regional performance, with high-income developed countries benefiting the most from the new scenario, and also affecting agri-food competitiveness of nations.

The modern global trade structure has also impacted the competitiveness of nations involved in the production and export of agri-food goods, with Latin America and the Caribbean region being one of the most prominent players in this regard. The region accounted for 14.28 percent of all agricultural goods exported in the world (average for the 1995-2019 period), making it the third largest food exporter, at the regional level.

LAC's agricultural trade surplus has continuously risen, serving as a shield against major economic declines during recessions and times of economic crisis (Arias et al., 2017). As a result, many governments in the region began to perceive competitiveness in the agri-food sectors as a crucial topic, realizing that the sector can contribute to overall economic growth and sustainable development. Furthermore, the prospects for the future is that LAC's abundance of natural resources is likely to continue to play an important role in global agricultural production and trade. Because of that, the importance of studying the agri-food competitiveness of Latin America and the Caribbean becomes evident.

This article aims to expand the existing literature by providing an analysis of the agri-food competitiveness of Latin America and the Caribbean region on global

markets. Furthermore, it identifies where competitiveness lies in the region, in the interest of encourage the development of appropriate policies aimed at the growth and development of the sector.

To accomplish this, the revealed comparative advantages are investigated by nation and product level, over the years 1995-2019, for the top 10 exporting countries in the LAC region, resulting in a thorough study of the region's long-term agri-food competitiveness.

Following the introduction, section two provides an overview of the agri-food sector in Latin America and the Caribbean. The third section displays the methodology and data that were employed. The results and discussion are presented in section four, containing descriptive data on LAC trade tendencies, identifying significant players and products, analysis of the comparative advantage patterns of the TOP exporters, as well as stability tests to determine the duration of their advantages. Finally, part five concludes this work.

2. Review of literature

2.1. Agricultural development of Latin America and the Caribbean region

One of the biggest global development challenges humanity faces in the 21st century is still related to agri-food sectors. In 2018, the Food and Agriculture Organization (FAO) estimated that about 820 million people were undernourished all over the world and around 2 billion suffered from micronutrient deficiencies, being low productivity and competitiveness in the agricultural sector is one of the main reasons for food insecurity. Assuming current global trends in food consumption and population, the demand for agricultural products will grow by 15% over the coming decade and approximately 70% more food will be needed by 2050 (FAO, 2009; OECD/FAO, 2019).

Latin America and the Caribbean (LAC), which covers more than 2 billion hectares and encompasses 34 countries, is one of the key regions affected by these challenges. The region has become the world's leading net food exporting region, playing a key role in providing enough food for the increasing global population, as well as in environmental sustainability, which, to be fulfilled, will need long term strong investments and good related policies.

Over the last decades, LAC countries have shown positive trends in the development of the agricultural sector, which has occurred particularly in the growth of agricultural trade. The region has an abundance in land and water. From its available area, 38% are used for agriculture and 46% are covered with forests, thus accounting for 14% of global production and 23% of the world's exports of agricultural and fisheries commodities. Although it is presumed that production will

slow down over the years, the expectation is that by 2028, LAC will account for more than 25% of global exports in agricultural and fisheries products, emphasising to the region the positive impact of trade openness at the global level (OECD/FAO, 2019).

Moreover, the LAC region is one of the few parts of the world with significant resources of unexploited agricultural land, suggesting that it will continue to play a pivotal role in global food production and exports in the future (Duff & Padilla, 2015). Many of the region´s countries have risen to 'middle-income' status and achieved high agricultural productivity growth in recent years, resulting in increased export competitiveness.

Latin America, in general, had an excellent economic performance between the years 2003 and 2010, thanks to the international commodity boom. The period became known as the Golden Era, a time of economic growth and reduction of poverty and inequality in the region. The commodity boom, predominantly due to the sharp increase in demand from emerging markets, especially from China, combined with low-interest rates in developed countries, brought prosperity to the region, with clear observed changes such as social inclusion, macroeconomic stability, and growth (Maghin & Renon, 2018).

The financial vigour gave governments throughout all Latin America region unusual levels of features and the usage of the resources was translated into a serious engagement to equity that, however, has not corresponded with compelling investments in the future. By 2010, as pointed out by Maghin and Renon (2018), a gradual inevitable and announced decline began to take place, and the normal pattern of falling commodity prices relative to manufactured products was recovered, reflecting crisis expectations for most economies dependent on commodity exports, due to a possible vulnerability to rising macroeconomic challenges. The authors claim that, by the end of 2012, it was revealed that decisions made during the boom were not sustainable, "the gains of golden era had been temporary, and at worst illusory" (Maghin & Renon, 2018, p 138).

Following the period of fast economic growth associated with high commodity prices (Golden Era), LAC entered a phase of an almost lethargic performance, from 2010 to 2016. Despite some differences within the region, many countries have faced some recession, macroeconomic turbulence and/or a slowdown in growth, meantime a sharp drop in commodity prices took place. Finally, in 2017, the prices started to stabilize and, together with a depreciation in the exchange rate, which in its turn made their exports more competitive, a modest recovery begin to happen in the region's countries. Yet, with the exception of Mexico, which in 2019 reached the position of the largest exporter to the US, "despite the somewhat better terms of trade and the greater competitiveness from real exchange depreciation, exports from the region have stagnated, or even declined".(World

Bank, 2019, p.16) The region is still growing slower than other emerging markets and even richer advanced economies.

According to the World Bank report, LAC's financial situation is especially affected by domestic conditions, as international conditions have recently become more favourable, and the inward-looking strategy played a crucial role in the region's small growth. Despite the fact that LAC signed a high number of trade agreements, they have proven to be superficial and primarily intra-regional alliances with small market partners of little economic complexity (World Bank, 2019).

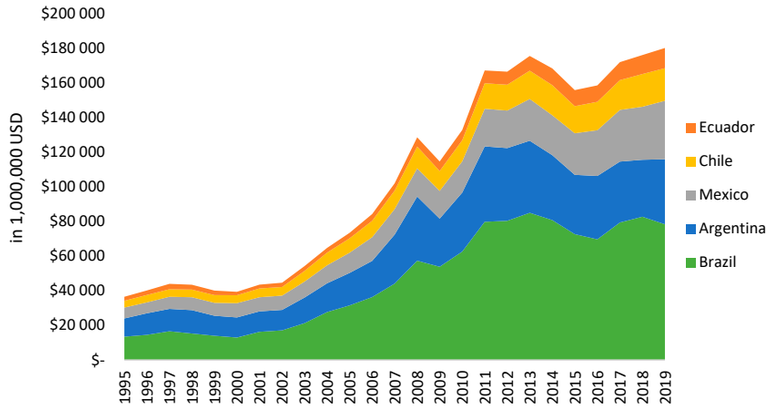
Rodríguez (2004) argues in his studies that due to various political, social and economic conflicts, Latin America was unable to achieve higher levels of economic growth, which caused the region to experience a prolonged macroeconomic crisis. For the author, it is necessary to first understand Latin American distinctive politics, so that it becomes possible to comprehend the real reason for the poor institutions in the region.

Therefore, competitiveness in the agri-food sectors started to be considered a key issue for many governments in the region as they realised that the sector can contribute to general economic growth and sustainable development. Nevertheless, according to OECD-FAO (2019), the support provided to the farmers is low when compared to the OECD countries and the global average, which indicates that decisions related to aspects of production are mainly determined by market indicators.

Despite the fact that agriculture has a lower level of participation today than in 1996-98, currently, the sector represents an average of 4.7% of the region's total GDP. This change shows that it is extremely important for the economy across much of LAC (OECD/FAO, 2019). Although the performance has been distinct across the region, in general, over the past two decades, agriculture and fisheries have grown at a faster pace when compared with OECD countries. The region has become a major exporter of soybeans, maize, sugar, coffee, pork meat, animal feed, and fruits and vegetables, with Brazil being indicated as the largest exporter, followed by Argentina, Mexico, Chile and Ecuador (Figure 1). Overall, LAC's agricultural trade surplus has steadily increased and has served as a kind of "buffer" against large economic contractions during periods of recession and times of economic crisis (Arias et al., 2017).

As shown above, the region has a great influence on the global agricultural sector, and the prospects for the future is that its abundance of natural resources is likely to continue to play an important role in global agricultural production and trade. Whereas the region has an abundancy in land, labour and other resources, the economic growth in LAC in the last decade has been quite disappointing and the region is lagging behind in terms of global competitiveness. This contrast makes evident the importance of studying the competitiveness of LAC in agri-food as a whole.

Figure 1: Leading exporters of agricultural products of Latin America and Caribbean in million USD, 1995-2019



Source: Own composition based on World Bank WITS database (2021)

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2.2. Agri-food competitiveness

Measuring agricultural competitiveness is difficult due to the term's complexity and subjectivity, as well as the inherent unpredictability of the agriculture sector and the entanglement of its surroundings. According to Maranhão and Vieira Filho (2017), the international markets for agricultural products are highly complex, with the competitiveness of these goods determined by production process efficiency, logistics and transportation, macroeconomic and marketing variables, and sector support policies.

Jambor and Babu (2016) calculated the Revealed Comparative Advantage (RCA) for all countries and agricultural products for the period of 1991-2014. The authors took an average of all years analysed and concluded that the most competitive nations are Netherlands, Spain and Denmark, while Montserrat, Brunei and the Cook Islands were the least competitive, presenting comparative disadvantage.

By analysing the Normalised Revealed Comparative Advantage (NRCA) index and its trends for the EU-27 member states from 2000 to 2011, S. Bojnec and Ferto (2018) intended to explore the length of comparative advantage of the European Union's agri-food export. Results indicated that, although the NRCA index was higher than zero for the majority of agri-food items, a substantial percentage of them are of a shorter duration, lasting just a reduced number of years.

Jambor et al. (2018) analysed spice trade competitiveness worldwide by examining the Balassa Index (RCA) from 1991 to 2015. They observed that the market was concentrated in Guatemala, Sri Lanka, and India, which had the highest indices over the period, while Germany and the Netherlands, despite being the largest exporters, had a comparative disadvantage in global spices trade.

In order to investigate if Brazilian chicken exports are competitive globally, Galle et al. (2020) calculated the Revealed Comparative Advantage (RCA) and the Symmetric Revealed Comparative Advantage (SRCA) indices for 2009-2016 period. Although declining, the indices results indicated comparative advantage during the whole period, revealing that the sector is competitive.

Similarly, Lobzhanidze (2021) calculated the Revealed Comparative Advantage (RCA) and the Relative Export Advantage (RXA) to assess the competitiveness of the Georgian mineral water sector. The research concluded that the sector is competitive and that the rate of growth of mineral water exports is positively associated with the measured competitiveness.

Although extremely important due to the fact the sector can contribute to overall economic growth and sustainable development, when compared to the industry sector, studies of competitiveness in the agri-food sector are very modest, and works that analyse underdeveloped nations are much more sparse (Jambor et al., 2018). In addition, prior research has indicated a constantly changing scenario for global agri-food competitiveness, in terms of market positions (products and countries) (Mizik, et al., 2020). It is inferred that RCA stability and duration are limited, suggesting a constant need to adapt and assess updated data to bring novelty to the literature.

On the whole, based on the context above, the purpose of this article is to contribute to the existing literature by calculating revealed comparative advantage indices of Latin America and the Caribbean agri-food trade for a relatively long period of time (1995-2019). The paper will be identified where competitiveness lies in the region, in which products, and will also check the stability and duration of the RCA indices.

3. Material and Methods

Modern economies are built on the foundation of competition. Despite its extensive use, the term competitiveness lacks a standard definition and is measured in a variety of methods. The different understandings of its definition and its value for policy were never harmonized, the reason why the results from competitiveness analysis can often be open to different interpretations (Sanfey & Zeh, 2012).

At the macroeconomic level, competitiveness is far too loosely defined. According to Atkinson (2013), competitiveness is defined as a region's capacity to export more in value-added terms than it imports, a measurement that should include all "terms of trade" in order to incorporate all government "discounts" (Atkinson, 2013, p. 2). The World Economic Forum provides one of the most frequently recognized definitions today, which defines national competitiveness as a "system of institutions, laws, and conditions that determine a country's level of production" (WEF, 2016, p. 4). We consider competitiveness to be intrinsically linked to international trade performance when evaluated at a macro level, and, in accordance with Jámbor and Babu (2016), its definition to be closely associated to the notion of comparative advantage, which refers to a region's capacity to create products and services at a lower opportunity cost than its competitors.

In addition to the defining issue, competitiveness involves a wide range of methodologies and measurement techniques. To interpret and measure the competitiveness of TOP 10 LAC nations exporters, this research will use the Balassa Index (1965) of Revealed Comparative Advantage (RCA), which measures the proportion of a country's exports for a single commodity to the exports of all commodities, and the similar share for a set of selected countries, as it follows:

$$RCA_{ij} = \frac{\left(X_{ij} / X_{it}\right)}{\left(X_{nj} / X_{nt}\right)} \quad (1)$$

Where X represents exports, i indicates a country, j is a commodity, t is a group of commodities, and n a set of selected countries. On that account, if RCA > 1, the comparative advantage of a country is revealed, compared with the reference selected countries.

The RCA, however, is far from flawless. It has been subjected to several critics, particularly for disregarding the impacts of agricultural policy and other economic interventions, which can lead to an overestimation of comparative advantage values. That is why the RCA computation is based on export statistics, where the impact is less than that of imports. Furthermore, the indicator is questioned for providing asymmetric values, which can vary from 1 to infinite, in the case of comparative advantage, and only from 0 to 1 if a country has a comparative disadvantage, overestimating the relative weight of a sector (De Benedictis et al., 2004; Jambor & Babu, 2016; Bojnec & Ferto, 2019; Mizik et al., 2020).

Vollrath (1991) proposed three distinct revealed comparative advantage specifications to overcome the shortcomings of the Balassa index,. First, the Relative Import Advantage index, which is analogous to the RCA but incorporates imports rather than exports in Equation 1. In opposition to the RCA, when the RMA index is lower than 1, there is a comparative advantage, suggesting more competitiveness.

The second approach is to calculate the difference between RCA and RMA, thus determining the Relative Trade Advantage (RTA), which a positive value indicates revealed competitiveness:

$$RTA_{ij} = RCA_{ij} - RMA_{ij} \quad (2)$$

Vollrath's (1991) third approach calculates the natural logarithm of the RCA and RMA, and measures its difference, resulting in the index of revealed competitiveness (RC), which shows revealed competitiveness when incorporating a positive value:

$$RC_{ij} = [ln\ RCA_{ij}] - [\ln RMA_{ij}] \quad (3)$$

Dalum et al. (1998) developed an innovative method for dealing with the RCA index's asymmetric value problem. By changing the original index as follows, he constructed the Symmetric Revealed Comparative Advantage (SRCA) index:

$$SRCA_{ij} = \frac{[RCA_{ij} - 1]}{[RMA_{ij} + 1]} \quad (4)$$

SRCA numbers between 0 and 1 indicate a comparative export advantage, whereas values between -1 and 0 suggest a comparative export disadvantage. Because the SRCA distribution is symmetric around zero, possible bias is eliminated using this index (Dalum et al., 1998).

It should be mentioned that the methodology described above has several shortcomings. First, one of the most significant complications is the complexity of the world food trading system. Trade takes place at all levels (individuals, companies, multinationals, and countries) and because agricultural commodities are essential for humanity's survival, their trading is very intense, making it extremely difficult to summarize and consolidate the exact quantity of agricultural trade. As a result, trade values may not always add up to the total trade value for a particular country set of data. A further challenge arises when there are no observations, such as when two nations do not trade with each other for a while or when the amount of commerce is so little that the value is recorded as null. This

can lead to under or overestimated indices. Additionally, each index has its own set of constraints, such as asymmetry, government-induced distortions, and market interference, to name a few.

However, despite their limitations, the indices may provide further insight into a nation's agri-food competitiveness. This research will concentrate on the original Balassa (1965) index, as well as the adjustments elaborated by Vollrath (1991) and Dalum et al. (1998).

Estimates of the Kaplan–Meier survival functions, an empirical, nonparametric technique to survival and hazard function estimation, was also used to examine the duration of revealed competitive advantages. The function, according to Greene (2012) is given as follows: consider that the time observations are sorted in ascending order, with t_1 being smaller than t_2 and so on, and that no observations are suppressed for the time being. Assume that the data contains K distinct survival times, abbreviated T_k; K will equal n unless there are ties. The number of individuals whose observed time is at least T_k is denoted by n_k. At this time, the risk set is defined as the group of individuals whose duration is at least T_k. As a result, n_k represents the size of the risk set at time Tk. The number of observed spells finished at time Tk is denoted by h_k. A survival function estimate based only on empirical evidence would be:

$$\widehat{S}(T_k) = \prod_{i=1}^{k} \frac{n_i - h_i}{n_i} \tag{5}$$

In a manner similar to that of Bojnec and Fertő (2008), given that many observations are censored, the Kaplan–Meier estimator of the survival function is then:

$$\widehat{S}(t) = \prod_{i(i)<t} \frac{n_i - h_i}{n_i} \tag{6}$$

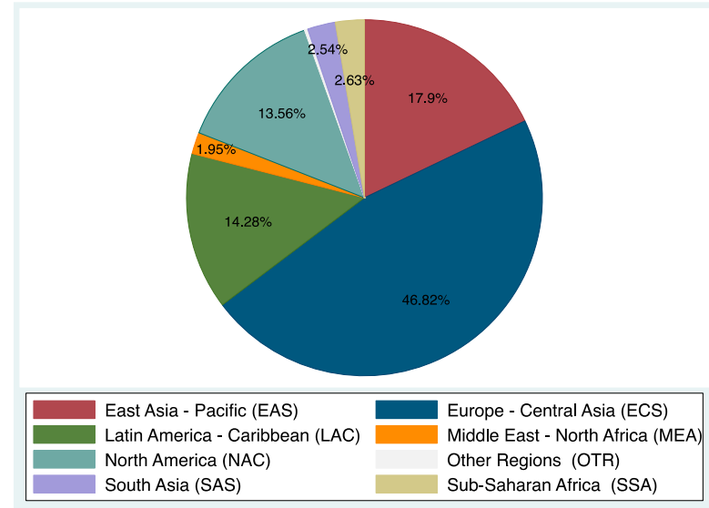
Assuming $\widehat{S}(T_k) = 1$, if $t < t(1)$, it is noted that the Kaplan–Meier estimator is robust to censoring and uses information from both censored and non-censored observations.

This article made use of the World Integrated Trade Solutions (WITS) software, which is based on the United Nations Statistical Division's Commodity Trade Statistics Database (COMTRADE) (UNSD). The data was selected by using the Harmonized System at the two-digit level, catalogue of agricultural goods, which encompasses HS chapters 1 to 24, as listed in Appendix 1.

4. Results and Discussion

Taking into consideration World Bank global regions and analysing total exports from 1995 to 2019, Europe – Central Asia (ESC) is the one that exported the most to the world, followed by East Asia – Pacific (EAS) and North America (NAC). However, if we consider only the exports of agricultural products, Latin America and the Caribbean (LAC) is the third largest food exporter at the regional level in the same period (Figure 1).

Figure 2: Global agri-food exporters in percentage of total average exports from 1995 to 2019



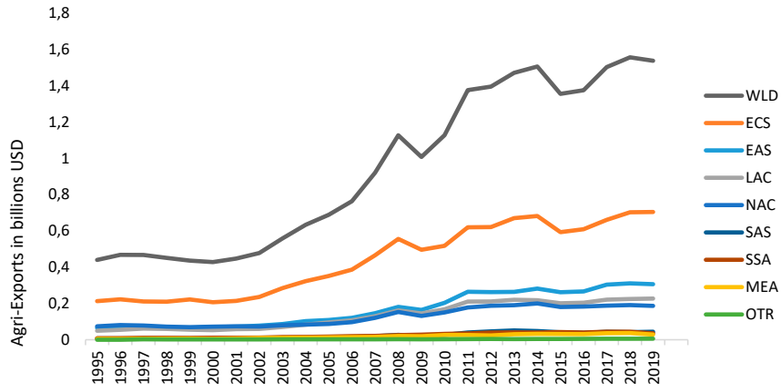
Source: Own composition based on World Bank WITS database (2021)

Latin America and the Caribbean region, as Figure 2 suggests, accounted for 14.85% of all products from agriculture traded in the world from 1995 to 2019. In this period the biggest exporting countries were Brazil, Argentina, Mexico, Chile, Ecuador and Colombia. These countries together accounted for 82% of LAC exports, showing that the sector is highly concentrated in the region.

Following production improvements, worldwide exports have been gradually growing during the last 20-25 years. In this period, total exports of the world increased by 294% in current prices (export in 1995 was 4 trillion US dollars, whereas in 2019 this value increased to 17 trillion dollars) while global agri-food export increased by 250% – from 439 billion to 1 trillion and five hundred thirty-six billion dollars (although some decrease was observable in the meantime). Mean-

while, Latin America and the Caribbean agri-food export have risen by 350% in the same period - from 49 to 226 billion US dollars. Consequently, from 1995 to 2019, LAC agri-food export has increased to a greater extent than agricultural or even total export growth (Figure 3).

Figure 3: The evolution of agricultural products export at the regional level, from 1995 to 2019, in billions USD.



Note: All countries - World (WLD), East Asia - Pacific (EAS), Europe - Central Asia (ECS), Latin America - Caribbean (LAC), Middle East - North Africa (MEA), North America (NAC), Other Regions (OTR), South Asia (SAS), and Sub-Saharan Africa (SSA).
Source: Own composition based on World Bank WITS database (2021)

The breakdown of LAC agricultural exports by country sheds more light on the trends discussed above. During the time studied, ten nations with different locations provided the majority of the region's agricultural export, with varying concentration ratios (Table 1). The concentration of the TOP 10 agri-food exporters has been remarkably consistent — these nations accounted for more than 90% of all agri-exports in all periods. Brazil, Argentina, Mexico and Chile held the first fourth place, respectively, throughout all the periods.

Table 1: TOP 10 agri-food exporters in Latin America and the Caribbean in percentage of region's agri-food total export for the period of 1995 to 2019.

1995-1999		2000-2004		2005-2009	
Brazil	26%	Brazil	29%	Brazil	35%
Argentina	22%	Argentina	21%	Argentina	21%
Mexico	12%	Mexico	14%	Mexico	11%
Chile	8%	Chile	9%	Chile	8%
Colombia	7%	Colombia	5%	Colombia	4%
Ecuador	5%	Ecuador	4%	Ecuador	3%
Costa Rica	4%	Costa Rica	3%	Peru	3%
Peru	3%	Peru	3%	Uruguay	2%
Guatemala	3%	Uruguay	2%	Costa Rica	2%
Uruguay	2%	Guatemala	2%	Guatemala	2%
LAC TOP 10	91%	LAC TOP 10	90%	LAC TOP 10	92%
2010-2014		**2015-2019**		**1995-2019**	
Brazil	38%	Brazil	36%	Brazil	35%
Argentina	19%	Argentina	16%	Argentina	19%
Mexico	11%	Mexico	13%	Mexico	12%
Chile	7%	Chile	8%	Chile	8%
Ecuador	4%	Ecuador	5%	Ecuador	4%
Peru	4%	Peru	4%	Colombia	4%
Colombia	3%	Colombia	3%	Peru	4%
Uruguay	3%	Paraguay	3%	Uruguay	2%
Paraguay	2%	Guatemala	2%	Costa Rica	2%
Guatemala	2%	Uruguay	2%	Guatemala	2%
LAC TOP 10	93%	LAC TOP 10	93%	LAC TOP 10	92%

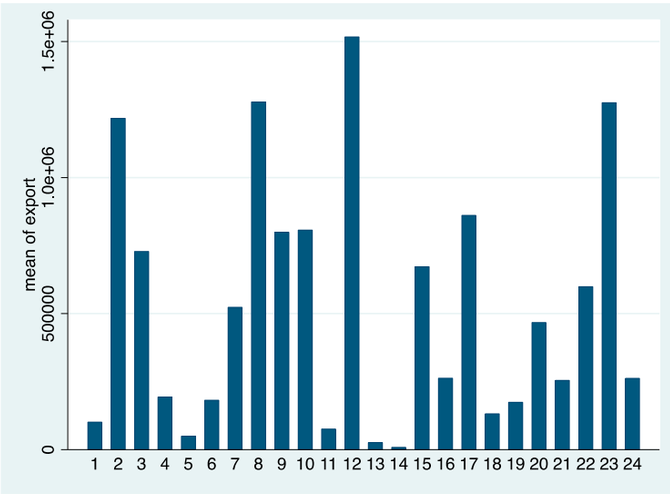
Source: Own composition based on World Bank WITS database (2021)

To highlight the position of Brazil in the agri-food sector of Latin America and the Caribbean region is important. Brazil has long been heavily active in international trade; the country's agricultural food export rates and market development have been exceptional, with the country ranking as the LAC's major and, since 2011, the world fifth-largest agricultural and food exporter (World Bank, 2021).

The product structure of LAC agri-exports is also worth being investigated (Figure 4). When analysing the agricultural export at the HS 2-digit product level, we can conclude that the most traded chapter category was HS-12 (oil seeds and

oleaginous fruits; miscellaneous grains, seeds and fruit, industrial or medicinal plants; straw and fodder), followed by 08 (fruit and nuts, edible; peel of citrus fruit or melons), 23 (food industries, residues and wastes thereof; prepared animal fodder), 2 (meat and edible meat offal) and 17 (sugars and sugar confectionery).

Figure 4: Agricultural products at 2-digit level, exported by Latin America and the Caribbean to the world market, 1995-2019



Note: 1 - Live animal; 2 - Meat and offal; 3 - Fish other aquatic invertebrates; 4 -Dairy produce; 5 - Animal originated products; 6 - Trees and other plants, live; 7 – Vegetables and certain roots and tubers; 8 - Fruit and nuts; 9 - Coffee, tea, mate and spices; 10 – Cereals; 11 - Products of the milling industry; 12 - oleaginous and miscellaneous grains, seeds and fruit, industrial or medicinal plants; 13 - Lac; gums, resins and other vegetable saps and extracts; 14 - Vegetable products plaiting materials; 15 - Animal or vegetable fats, oils and waxes; 16 – Meat, fish or crustaceans, and other aquatic invertebrates; 17 - Sugars and sugar confectionery; 18 - Cocoa and cocoa preparations; 19 - Preparations of cereals, flour, starch or milk; pastry cooks' products; 20 - Preparations of vegetables, fruit, nuts or other parts of plants; 21 - Miscellaneous edible preparations; 22 - Beverages, spirits and vinegar; 23 - Food industries, residues and wastes thereof; and 24 - Tobacco and manufactured tobacco substitutes

Source: Own composition based on World Bank WITS database (2021)

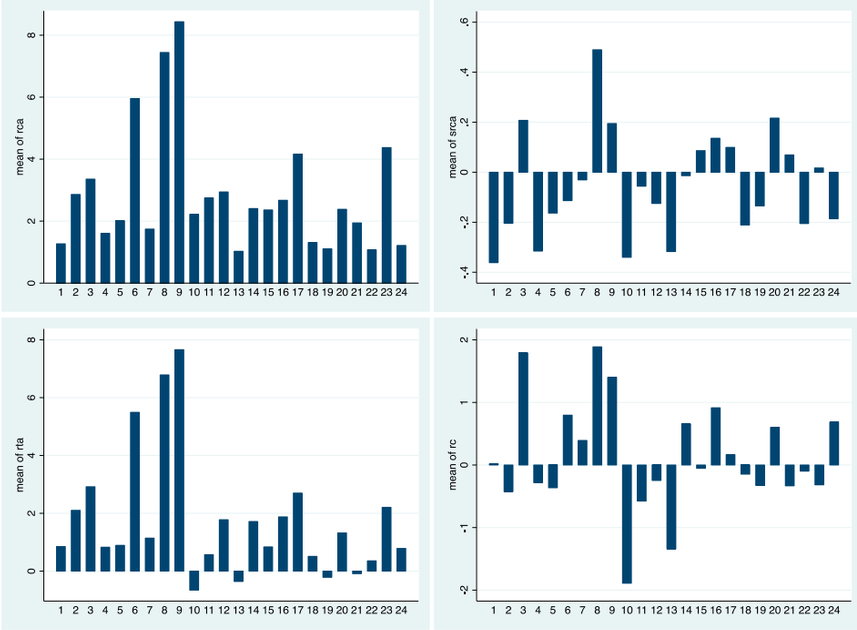
The product structure of LAC's agricultural export has altered very slightly over time. In addition, the product concentration was relatively high, to the point that the TOP 5 most exported categories at the 2-digit level - product codes 12, 8, 23, 2 and 17 above mentioned - accounted for 50% of total agricultural products exported in the whole region.

5. Patterns of the LAC agri-food competitiveness

The trade competitiveness was calculated by using Revealed Comparative Advantage Indices for LAC agri-food sector. The RCA defined by Balassa (1965), and its derivatives RMA and RC, proposed by Vollrath (1991), and SRCA, suggested by Dalum et al. (1998), were investigated further in this work (Figure 5). It is worth noting that the time span under consideration is 25 years, in order to properly examine long-term trends and construct a dataset of econometrically acceptable size. As a result, the findings were expressed as an arithmetic mean to offer a better understanding of the indices through time, in line with previous important studies such as Jambor and Gibba (2017), Jambor et al. (2018), Matkovski et al. (2019), and Mizik et al. (2020).

At the product level, from 1995 to 2019, the highest RCA values were found in product codes 09 (coffee, tea, mate, and spices), followed by 08 (fruit and nuts, edible; peel of citrus fruit or melons) and 06 (trees and other plants, live; bulbs, roots, and the like; cut flowers and ornamental foliage). All other products have demonstrated to be competitive in the worldwide market in all of the years analysed, with RCA values higher than 1. Considering Symmetric Revealed Comparative Advantage, product codes 03 (fish and crustaceans, molluscs and other aquatic invertebrates), 08 (fruit and nuts, edible; peel of citrus fruit or melons), 09 (coffee, tea, mate and spices), 15 (animal or vegetable fats and oils and their cleavage products; prepared animal fats; animal or vegetable waxes), 16 (meat, fish or crustaceans, molluscs or other aquatic invertebrates; preparations thereof), 17 (sugars and sugar confectionery), 20 (preparations of vegetables, fruit, nuts or other parts of plants), 21 (miscellaneous edible preparations) and 23 (food industries, residues and wastes thereof; prepared animal fodder) demonstrated a comparative export advantage, with values ranging from zero to one.

Figure 5: Revealed Comparative Advantage Indices by product code at HS 2 digit-level, 1995-2019



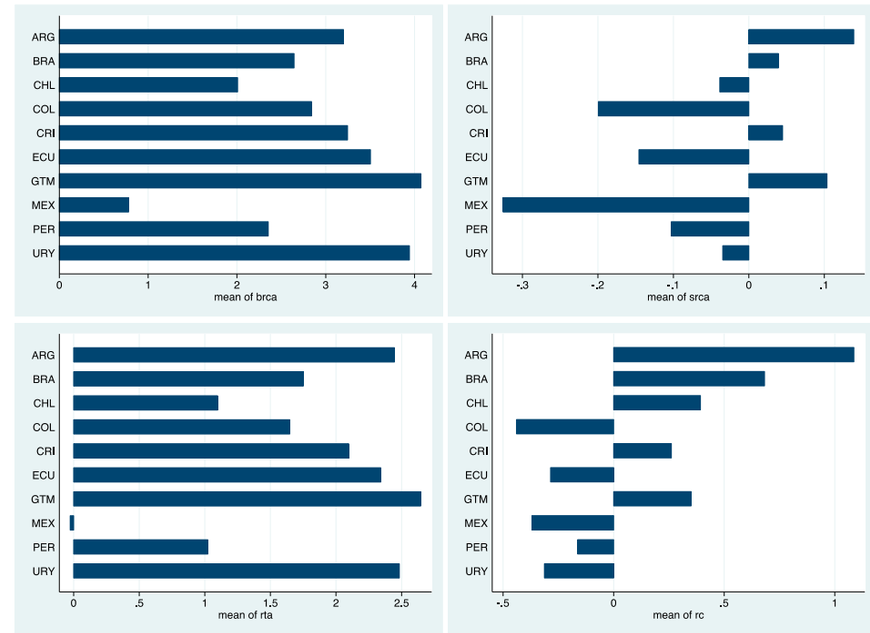
Note: 1 - Live animal; 2 - Meat and offal; 3 - Fish other aquatic invertebrates; 4 -Dairy produce; 5 - Animal originated products; 6 - Trees and other plants, live; 7 – Vegetables and certain roots and tubers; 8 - Fruit and nuts; 9 - Coffee, tea, mate and spices; 10 – Cereals; 11 - Products of the milling industry; 12 - oleaginous and miscellaneous grains, seeds and fruit, industrial or medicinal plants; 13 - Lac; gums, resins and other vegetable saps and extracts; 14 - Vegetable products plaiting materials; 15 - Animal or vegetable fats, oils and waxes; 16 – Meat, fish or crustaceans, and other aquatic invertebrates; 17 - Sugars and sugar confectionery; 18 - Cocoa and cocoa preparations; 19 - Preparations of cereals, flour, starch or milk; pastry cooks' products; 20 - Preparations of vegetables, fruit, nuts or other parts of plants; 21 - Miscellaneous edible preparations; 22 - Beverages, spirits and vinegar; 23 - Food industries, residues and wastes thereof; and 24 - Tobacco and manufactured tobacco substitutes
Source: Own composition based on World Bank WITS database (2021)

Following Vollrath's methodology, the revealed import advantage values were computed by generating the Relative Trade Advantage index, which produced similar results to the RCA index, with product codes 09 (coffee, tea, mate and spices), 08 (fruit and nuts, edible; peel of citrus fruit or melons), and 06 (trees and other plants, live; bulbs, roots and the like; cut flowers and ornamental foliage) proved to be the most competitive. However, with RTA less than zero, product

codes 10 (cereals), 11 (products of the milling industry; malt, starches, inulin, wheat gluten), 19 (preparations of cereals, flour, starch or milk; pastry cooks' products), and 20 (preparations of vegetables, fruit, nuts or other parts of plants) were not competitive throughout the study period. The RC index was also examined, and less than half of the items had Revealed Competitiveness (values greater than one) with product codes 08 (fruit and nuts, edible; peel of citrus fruit or melons), 03 (fish and crustaceans, molluscs and other aquatic invertebrates), and 09 (coffee, tea, mate and spices) having the highest rates.

At the country level (Figure 6), Guatemala, Uruguay, and Ecuador are the most competitive countries among the LAC TOP 10 agricultural and food exporters from 1995 to 2017 (based on an average of the RCA for all years investigated), while Peru, Chile, and Mexico are the least competitive. Argentina is the most competitive country shown by SRCA, followed by Guatemala, Costa Rica, and Brazil, with all other nations having a comparative export disadvantage.

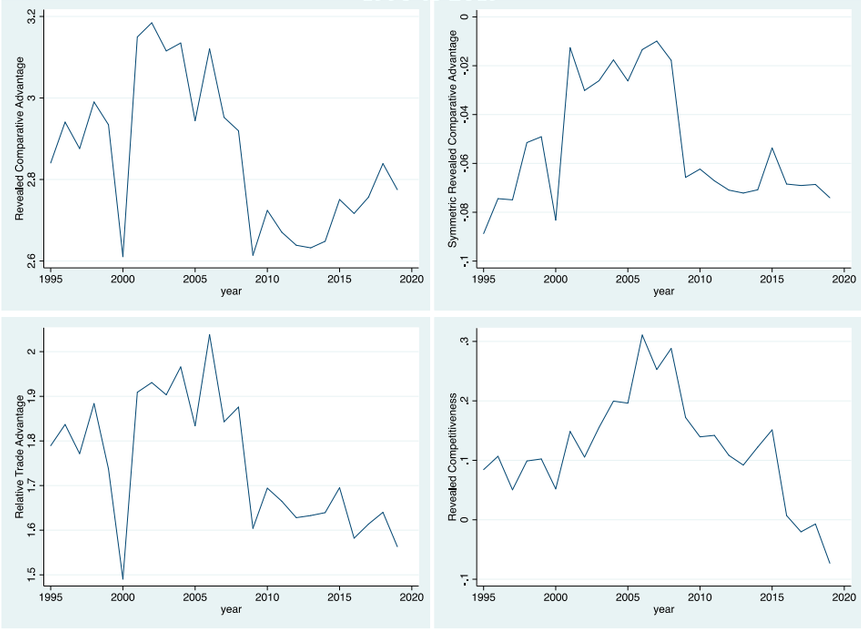
Figure 6: Revealed Comparative Advantage Indices by country, from 1995-2019



Source: Own composition based on World Bank WITS database (2021)

Except for Mexico, the RTA index evaluation showed a relative trade advantage for every country, with Guatemala, Uruguay, and Argentina ranking the highest. Argentina, Brazil, Chile, Costa Rica, and Guatemala had the highest revealed competitiveness results when considering the RC index, whereas the other five countries were not competitive.

Figure 7: Revealed Comparative Advantage indices over time 1995 to 2019



Source: Own composition based on World Bank WITS database (2021)

Figure 7 presents the competitiveness interpretation throughout time from 1995 to 2019. For all of the years investigated, there was a clear comparative advantage, with the greatest BRCA values occurring between 2001 and 2006. When looking at the SRCA, the scenario is radically different, with all values being negative, resulting in a long-term export comparative disadvantage. The Relative Trade Advantage index also disclosed competitiveness over time, whereas the Revealed Competitiveness index only indicated a lack of competitiveness in the years 2017, 2018, and 2019.

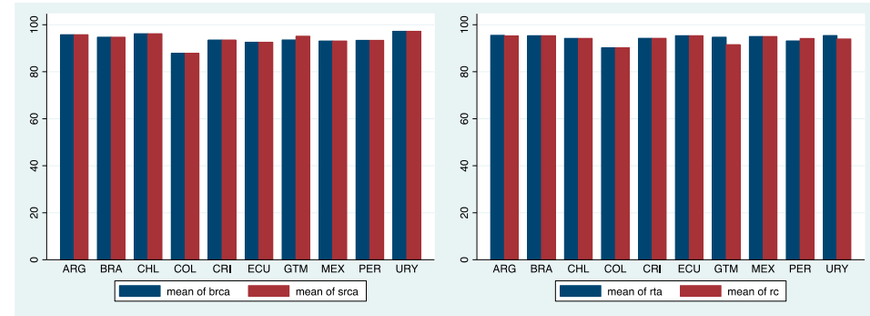
6. Markov transition probability and the Kaplan–Meier survival rate of RCA indices in LAC

In this part, the duration and the stability of RCA indices were examined. Firstly, the Markov transition probability index is investigated, which assesses changes of RCA indices across nations and over time than is the Kaplan–Meier survival function was estimated.

The Markov process is a stochastic model that describes a series of potential occurrences where the probability of each event is solely determined by the state obtained in the preceding event (Gagniuc, 2017). In this study, Markov transition probability matrices were calculated and then summarized through using mobility test, allowing to assess mobility across nations and time periods.

The degree of transition mobility of all indices is depicted in Figure 8 using the Markov transition probabilities. The higher the index value, the less dynamism there is, implying that the index indicators are more likely to remain persistent. Results indicated low mobility of RCA, SRCA, RTA, and RC indices in LAC agri-food trade for the studied period, suggesting stable competitive potentials. For all TOP 10 economies analysed, more than 90% of product groups' comparative advantages remained stable.

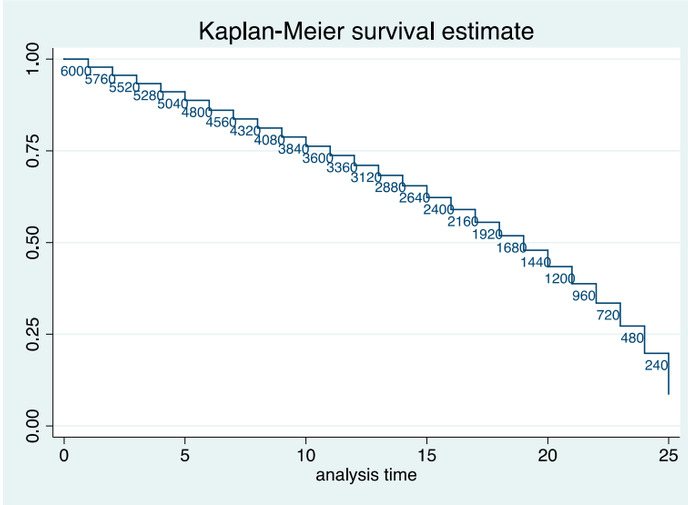
Figure 8: The mobility of BRCA, SRCA, RTA and RC indices, by country, in percentage, 1995-2019



Source: Own composition based on World Bank WITS database [2021]

The non-parametric Kaplan–Meier product limit estimator was used to calculate the length that the product groups have maintained a revealed comparative advantage, during the 25-years (Figure 9).

Figure 9: Kaplan-Meir survival rates of RCA indices in LAC for the period of 1995-2019



Source: Own composition based on World Bank WITS database (2021)

In general, the findings show that survival times of RCA indices in LAC do not endure over time. Survival prospects decreased from 98 percent at the beginning of the period to 9 percent at the end, implying that the worldwide market is continually changing and that there is fierce competition in the global agri-food trade, accordingly to Jámbor et al. (2017) and Bojnec & Ferto (2018). The findings varied by item category, revealing that HS-04 (Dairy produce; birds' eggs; natural honey; edible products of animal origin, not elsewhere specified or included) had the shortest survival duration, while HS-08 (Fruit and nuts, edible; peel of citrus fruit or melons) had the highest survival times, giving the vast majority of LAC agri-trade (Appendix 2).

While these findings are reliable and consistent with the empirical literature and previous forecasts, its analysis can provide some policy lessons. If a product has a comparative advantage and is therefore competitive in the global market for a certain nation, it should be an indication for its government to concentrate and emphasize on exporting such items.

As previously indicated, international agriculture trade is incredibly fierce and there is not a specific component or a single combination of elements that can boost a country's agricultural competitiveness. Likewise, there is not a single activity or collection of actions that will ensure future success in international agricultural commerce. Nevertheless, Jámbor and Babu (2016) analysed the WEF

competitiveness 12 pillar framework, which associates competitiveness to productivity signalling that a more competitive economy would develop more quickly over time, and adjusted it to the agriculture sector. According to the authors, creating efficient institutions, a favourable environment, and well-functioning land markets, while also investing in physical infrastructure, health and education, along with improving market access, agricultural risk management, innovation and technology adoption, as well as ensuring food security, are all prerequisites for improving agricultural competitiveness.

7. Conclusion

The competitiveness of Latin America and the Caribbean's top ten agri-food exporting nations, over the period of 25 years (1995-2019), was investigated in this article through using Revealed Comparative Advantage (RCA) index and its variations SRCA (Symmetric Revealed Comparative Advantage), RTA (Relative Trade Advantage), and RC (Revealed Competitiveness), which, despite their limitations (such as dataset complexity, asymmetry, and forced or uninduced market distortions), may provide valuable perspectives into a nation's agri-food competitiveness.

Multiple findings are explored in the study. First, by examining the characteristics of LAC's agri-food trade, it was revealed that Brazil, Argentina, and Mexico were the leading exporters throughout the study period, accounting for 67 percent of all agri-food products exported, whereas the TOP 10 nations accounted for 92 percent of the total agricultural products.

Second, our study revealed that oil seeds and oleaginous fruits, miscellaneous grains, seeds and fruit, industrial or medicinal plants, and straw and fodder (HS12) were the most exported items by LAC at the 2-digit level from 1995 to 2019, accounting for more than 12% of total agri-food exports. By analysing competitiveness at the product level, BRCA and RTA indices results showed that coffee, tea, mate and spices (HS9) were the most competitive crops, while the SRCA and RC calculations endorsed that fruit and nuts, edible; peel of citrus fruit or melons (HS08) had the highest competitiveness in the global market.

Third, the calculation of Balassa indices revealed that among the major agricultural exporters in LAC, Guatemala, Uruguay, and Ecuador had the highest comparative advantages in all periods analysed, while Guatemala, Argentina, and Brazil had the largest comparative export advantages. The countries with the highest relative trade advantage indices were Guatemala, Uruguay, and Argentina, whereas Argentina, Brazil, and Chile had the highest revealed competitiveness indices.

Furthermore, the results demonstrate that all indices in global agri-food trade are persistent for the TOP 10 countries in LAC, implying stable competitive potentials. In a like manner, according to Kaplan-Meier survival rates, survival prospects of 98 percent at the start of the time plummeted to 9 percent at the end of the term, implying that global agricultural commerce is particularly competitive.

The results of this study are consistent and trustworthy enough to have policy implications. If it is clear which products and markets a certain nation is competitive in, the country should aim to focus on exporting those commodities in order to increase the value of its export earnings.

In terms of study implications, this paper dataset could be exploited for more in-depth analyses of agricultural trade and competitiveness trends by country (if LAC countries are specifically chosen), providing then better understanding of national issues) and by product (if the data is collected at the HS-6 dig level, which is the highest level of data disaggregation), allowing a more detailed analysis of specific commodities. Further development of relevant policies addressing the most competitive product categories provided by this work also has a lot of potential (keeping in mind that, as previously mentioned, several actions and recommendations must be implemented simultaneously, with the goal of promoting agricultural sector growth and development in the LAC area.

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Appendix 1

Appendix 1. Agricultural product codes and descriptions at the HS-2 level.

Product Code	Description
01	Animals; live
02	Meat and edible meat offal
03	Fish and crustaceans, molluscs and other aquatic invertebrates
04	Dairy produce; birds' eggs; natural honey; edible products of animal origin, not elsewhere specified or included
05	Animal originated products; not elsewhere specified or included
06	Trees and other plants, live; bulbs, roots and the like; cut flowers and ornamental foliage
07	Vegetables and certain roots and tubers; edible
08	Fruit and nuts, edible; peel of citrus fruit or melons
09	Coffee, tea, mate and spices
10	Cereals
11	Products of the milling industry; malt, starches, inulin, wheat gluten
12	Oil seeds and oleaginous fruits; miscellaneous grains, seeds and fruit, industrial or medicinal plants; straw and fodder
13	Lac; gums, resins and other vegetable saps and extracts
14	Vegetable plaiting materials; vegetable products not elsewhere specified or included
15	Animal or vegetable fats and oils and their cleavage products; prepared animal fats; animal or vegetable waxes
16	Meat, fish or crustaceans, molluscs or other aquatic invertebrates; preparations thereof
17	Sugars and sugar confectionery
18	Cocoa and cocoa preparations
19	Preparations of cereals, flour, starch or milk; pastry cooks' products
20	Preparations of vegetables, fruit, nuts or other parts of plants
21	Miscellaneous edible preparations
22	Beverages, spirits and vinegar
23	Food industries, residues and wastes thereof; prepared animal fodder
24	Tobacco and manufactured tobacco substitutes

Source: Own composition based on World Bank WITS database (2021)

Appendix 2

Appendix 2. Kaplan-Meier survival rates for Balassa indices in agri-food trade by LAC, 1995-2019

Years	Survivor Function	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
1995	0.98	0.97	0.98	0.99	0.97	0.98	0.98	0.98	0.99	0.99	0.97	0.98	0.98	0.97	0.98	0.98	0.99	0.99	0.98	0.97	0.98	0.98	0.96	0.98	0.97
1996	0.96	0.94	0.95	0.98	0.94	0.95	0.95	0.97	0.98	0.98	0.94	0.95	0.96	0.94	0.96	0.96	0.98	0.98	0.95	0.95	0.97	0.97	0.93	0.96	0.94
1997	0.93	0.90	0.92	0.97	0.90	0.93	0.93	0.95	0.97	0.96	0.91	0.93	0.94	0.90	0.93	0.93	0.97	0.96	0.92	0.92	0.95	0.96	0.90	0.93	0.92
1998	0.91	0.87	0.89	0.96	0.87	0.90	0.90	0.93	0.96	0.95	0.87	0.90	0.92	0.87	0.92	0.91	0.96	0.95	0.89	0.90	0.93	0.94	0.86	0.91	0.89
1999	0.89	0.84	0.86	0.95	0.84	0.87	0.88	0.92	0.95	0.94	0.84	0.88	0.90	0.84	0.89	0.90	0.95	0.93	0.87	0.87	0.92	0.93	0.83	0.88	0.86
2000	0.86	0.81	0.83	0.93	0.80	0.84	0.85	0.89	0.93	0.91	0.81	0.85	0.86	0.81	0.86	0.88	0.93	0.91	0.84	0.83	0.90	0.91	0.80	0.85	0.83
2001	0.84	0.77	0.80	0.91	0.77	0.81	0.82	0.87	0.92	0.89	0.78	0.83	0.84	0.78	0.84	0.86	0.92	0.89	0.82	0.80	0.89	0.89	0.77	0.83	0.80
2002	0.81	0.73	0.77	0.90	0.74	0.77	0.79	0.85	0.91	0.87	0.75	0.81	0.81	0.76	0.81	0.85	0.90	0.87	0.78	0.78	0.87	0.87	0.74	0.80	0.78
2003	0.79	0.70	0.74	0.88	0.70	0.74	0.76	0.83	0.91	0.84	0.71	0.79	0.79	0.73	0.79	0.84	0.89	0.85	0.74	0.75	0.86	0.85	0.71	0.78	0.76
2004	0.76	0.67	0.72	0.87	0.67	0.71	0.73	0.81	0.91	0.82	0.68	0.77	0.76	0.70	0.76	0.82	0.87	0.83	0.71	0.73	0.84	0.83	0.68	0.75	0.74
2005	0.74	0.64	0.69	0.85	0.63	0.67	0.71	0.79	0.90	0.79	0.64	0.75	0.73	0.67	0.74	0.81	0.86	0.81	0.68	0.71	0.82	0.80	0.66	0.72	0.71
2006	0.71	0.61	0.66	0.83	0.60	0.64	0.68	0.76	0.90	0.76	0.61	0.72	0.70	0.64	0.72	0.80	0.84	0.79	0.65	0.67	0.81	0.77	0.63	0.69	0.68
2007	0.68	0.58	0.63	0.81	0.57	0.61	0.64	0.74	0.89	0.73	0.57	0.69	0.67	0.60	0.70	0.79	0.83	0.77	0.60	0.64	0.79	0.75	0.61	0.66	0.64
2008	0.65	0.54	0.61	0.79	0.53	0.58	0.61	0.72	0.88	0.70	0.54	0.66	0.63	0.57	0.67	0.77	0.81	0.75	0.56	0.61	0.77	0.73	0.59	0.63	0.61
2009	0.62	0.51	0.58	0.76	0.49	0.55	0.58	0.69	0.87	0.67	0.51	0.63	0.59	0.52	0.64	0.75	0.79	0.71	0.52	0.57	0.75	0.70	0.56	0.60	0.58
2010	0.59	0.47	0.54	0.73	0.45	0.51	0.54	0.66	0.86	0.64	0.47	0.60	0.55	0.49	0.61	0.73	0.77	0.68	0.47	0.54	0.73	0.67	0.53	0.57	0.54
2011	0.56	0.43	0.51	0.70	0.42	0.47	0.51	0.63	0.86	0.61	0.43	0.57	0.50	0.44	0.59	0.70	0.74	0.64	0.42	0.50	0.70	0.64	0.49	0.54	0.51
2012	0.52	0.40	0.47	0.67	0.38	0.43	0.47	0.60	0.84	0.58	0.40	0.52	0.46	0.39	0.56	0.67	0.72	0.60	0.38	0.46	0.67	0.61	0.46	0.50	0.47
2013	0.48	0.37	0.43	0.63	0.34	0.39	0.43	0.56	0.83	0.53	0.36	0.47	0.41	0.34	0.53	0.64	0.68	0.56	0.33	0.42	0.65	0.57	0.44	0.46	0.43
2014	0.43	0.32	0.39	0.59	0.30	0.34	0.39	0.51	0.82	0.49	0.32	0.43	0.37	0.29	0.49	0.61	0.65	0.51	0.29	0.38	0.61	0.54	0.39	0.41	0.39
2015	0.39	0.27	0.34	0.54	0.26	0.30	0.34	0.47	0.80	0.44	0.27	0.38	0.31	0.25	0.44	0.58	0.61	0.46	0.25	0.32	0.58	0.49	0.35	0.37	0.34
2016	0.33	0.22	0.29	0.47	0.22	0.24	0.29	0.42	0.78	0.39	0.22	0.32	0.26	0.20	0.37	0.54	0.57	0.41	0.20	0.27	0.53	0.44	0.29	0.31	0.29
2017	0.27	0.17	0.23	0.39	0.17	0.19	0.23	0.37	0.73	0.32	0.17	0.25	0.20	0.14	0.32	0.49	0.51	0.35	0.15	0.20	0.50	0.34	0.23	0.25	0.24
2018	0.20	0.11	0.16	0.31	0.11	0.13	0.16	0.29	0.66	0.24	0.11	0.18	0.13	0.09	0.23	0.41	0.43	0.26	0.09	0.13	0.45	0.22	0.16	0.19	0.18
2019	0.09	0.04	0.06	0.16	0.03	0.05	0.06	0.18	0.53	0.12	0.03	0.07	0.04	0.02	0.09	0.29	0.30	0.13	0.02	0.04	0.31	0.07	0.07	0.07	0.07
Log-rank test	0.00																								
Wilcoxon test	0.00																								

Source: Own composition based on World Bank WITS database (2021)