Estimation of competitiveness indicators in avocado importing markets

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ABSTRACT
Objective: The main objective of the work was to analyze the competitiveness of avocados produced in Mexico during the study period from 1995 to 2019 in the world market, derived from the production surplus.
Design/Methodology/Approach: The methodological design contemplated the use of trade competitiveness indicators at the level of importing world markets, the Revealed Comparative Advantage Index and the Normalized Revealed Comparative Advantage Index were calculated, data on avocado exports were analyzed as well as total agricultural exports made by Mexico to the world, and specifically to countries such as the United States, Canada and Japan.
Results: The results obtained suggest that avocado production in Mexico is highly competitive at the international level.
Study Limitations/Implications: The importance of making an analysis of the main avocado production variables was to locate the situation of products coming from Mexico with respect to the world situation.
Findings/Conclusions: Internationally, Mexican avocado production stood out in first place, with 2.4 million tons and 1.3 million tons of avocado were destined for export in 2019, contributing more than 45% of the world export market. These exports represented a very significant percentage of avocado imports in countries such as the United States of America, Canada, Japan, Europe and Central America. Currently, 100% of the national requirements are satisfied with domestic production; likewise, world imports have increased 171.97% in the last decade.

Keywords: Avocado, Competitiveness, Comparative advantage, Balassa, Normalized.

INTRODUCTION

Avocado tree (*Persea americana* Mill.) (Lauraceae), known as palta in Central America, is a large perennial fruit tree that can grow up to 24 m. It grows mainly in sub-humid temperate climates. It can withstand temperatures up to 10 °C, although the optimum temperature for the tree development is 20 °C. Its fruit has a green skin with a large seed inside. Its edible pulp is yellow, it has a buttery texture when it is ripe, it can have a nutlike flavor (akin to hazelnut or walnut), pleasant to the palate.

Avocados are used as a complement to a wide variety of foods, due to their high proteins, vitamins, and minerals content. Oils can be extracted from their high fatty matter which, once processed, are used in the cosmetic and pharmaceutical industry.

Mexico is one of the largest producing and consuming countries. Avocado is grown in 177,000 hectares, 85% of which are in the State of Michoacán (Consejo Nacional Agropecuario, 2019). In fact, especially in Mexico, dynamics of world avocado production respond to exports. Hass is the most consumed avocado variety in Mexico.

In Mexico, the annual *per capita* consumption of this variety was 3.5 kg in 2019 (USDA, 2019). Mexico is the main avocado producer worldwide: in 2019, it concentrated 30.19% of the world production, followed by Indonesia (6.75%) and Dominican Republic (6.65%) (FAOSTAT, 2019). Mexico has a major role in avocado production and as a price setter country. With a record production of 1,997,629 tons in 2019, Mexico strengthened its position as the main global avocado supplier, with presence in markets of Europe, Asia, Australia, North, Central, and South America.

Mexican avocado is a successful export product. México is the main avocado supplier in the international market with a 45.95% share of the world exports value. Exports place Mexico as the main avocado marketer in the world. Currently, the United States of America is the main buyer of Mexican avocado: approximately 75% of its imports come from Mexico, while these represent about 85% of total exports. Avocado demand has increased in 26 countries, including the United States of America, Canada, Japan, Guatemala, and El Salvador (Fundación Produce Michoacán, 2018).

The Mexican avocado also arrives to China and member countries of the European Union and the Trans-Pacific Partnership (TPP), as well as nations without free trade agreements with Mexico (Fundación Produce Michoacán, 2018).

From 2016 to 2019, the average sales of Mexican avocados to the world were 1,740 million dollars, with a 15.2% Average Annual Growth Rate (AAGR). The main export destinations for this product are the United States of America, Japan, Canada, Spain, France, the Netherlands, El Salvador, China, Honduras, and Guatemala, which together account for approximately 98% of total exports. USA accounts for approximately 76.8% of the Mexican fruit purchases, followed by Japan (7.0%), Canada (6.7%), Spain (1.7%), France (1.7%), and the Netherlands (1.6%) (TRADEMAP, 2019).

At the end of 2019, agrifood exports amounted to 29 billion dollars, 34.4% of which was concentrated in products such as beer, tomato, avocado, bovine cattle, beef, and tequila (Consejo Nacional Agropecuario, 2019). The importance of Mexican avocado is growing: out of every ten avocados marketed worldwide, approximately three are sold by Mexican producers (FAOSTAT, 2019).

There are two approaches to measure competitiveness: one of them uses direct indicators through production cost comparisons in competing countries or regions, adjusted by logistics costs (transport costs) and marketing support services costs (contributions, fees, and profit margins) (Cafiero, 2006). This comparison is useful, but it has limitations, such as the different transportation costs or the lack of information (Sharples, 1990).

Another option is to measure competitiveness through indirect indicators, such as market share or any revealed comparative advantage index. This approach also has

limitations —such as the information searching complexity or the calculation method—, but it has the advantage that it can be calculated with current trade statistics (Fundación Produce Michoacán, 2018).

Comparative advantage is a necessary theoretical element to explain the international trade origins. The basis of this theory can be found in Adam Smith and his *Inquiry into the Nature and Causes of the Wealth of Nations*, in which he discusses the trade logic between people and between countries. This logic is based on the suitability of specializing in the production of what a country can produce at a lower cost and trade it for what other countries do best, for the benefit of both parts; this is the classic division of labor, which depends on the differences of capital, workers, and natural resources, as well as other elements (Ríos, 2006).

Subsequently, David Ricardo extended this Division of Labor Theory to the comparative advantage. Heckscher and Ohlin predict that, if a country has a relative abundance of a factor (labor or capital), it will have a comparative and competitive advantage regarding those goods that need a greater number of the said factor: *i.e.*, countries tend to export goods that are intensive in the factors which they have in abundance (Krugman, 2001). The aforementioned model is also known as the factor proportions theory. However, the comparative advantage can be empirically measured by the Revealed Comparative Advantage (RCA) Indexes, which are calculated from observable trade patterns that allow such advantage to be distinguished. This research contributes to the discussion about the vegetable-fruit product competitiveness issue and its close relationship with outstanding performance as an exporter. Specifically, it aims to analyze the aspects related to the competitiveness of avocado produced in Mexico from 1995 to 2019, characterizing the economic variables of the worldwide avocado production and trade.

MATERIALS AND METHODS
Information and variables

The information about the variables was obtained from the United Nations Statistics Division of the Food and Agriculture Organization (FAOSTAT), United States Department of Agriculture-Foreign Agricultural Service (FAS-USDA), and Hass Avocado Market Information (INFOHASS). The information on the production variables was obtained from these sources, as well as the statistics corresponding to worldwide avocado imports and exports to the United States of America, Canada and Japan. As a result of the said surplus, the period from 1995 to 2019 was analyzed to calculate RCA and NRCA. The information obtained is shown in Table 1.

Indicators of revealed comparative advantage

Specifically, the information analysis was performed to calculate the revealed comparative advantage (RCA) index and the normalized revealed comparative advantage (NRCA) index which are described below:

a) Revealed Comparative Advantage (RCA) Index. Competitiveness can be measured at various levels: country, sector, company. In this study the revealed comparative

Table 1. World avocado (*Persea americana* Mill.) exports from Mexico to the main importing countries (1995-2019).

Year	Avocado from Mexico to USA	Totals Mexico to USA	Avocado from Mexico to Canada	Totals Mexico to Canada	Avocado from Mexico to Japan	Totals Mexico to Japan	Avocado Mexico to the world	Totals Mexico to the world
	Xk_{ij}	Xt_{ij}	Xk_{ij}	Xt_{ij}	Xk_{ij}	Xt_{ij}	X_{kiw}	XT_{iw}
1995	18,418	66,273,641	8,581	1,987,400	10,620	1,002,146	178,936	79,541,554
1996	28,891	80,570,022	8,956	2,172,000	14,318	1,146,128	181,079	95,999,740
1997	34,278	94,376,864	9,971	2,157,000	13,545	2,943,211	183,103	110,431,498
1998	78,622	103,001,767	9,924	1,519,300	17,454	1,670,137	185,195	117,539,294
1999	85,697	120,262,033	11,347	2,311,200	18,768	2,723,126	188,286	136,361,816
2000	126,721	147,399,940	12,305	3,340,000	28,117	2,008,982	189,234	166,120,737
2001	99,301	140,564,406	15,121	3,082,600	24,937	2,015,706	190,512	158,779,733
2002	134,732	141,897,649	15,322	2,991,300	25,347	1,785,467	193,034	161,045,980
2003	186,129	144,293,352	19,741	3,041,800	49,953	1,770,137	195,063	164,766,436
2004	188,838	164,521,981	24,430	3,291,500	57,878	2,169,540	212,036	187,998,555
2005	385,755	183,562,833	30,434	4,234,500	60,273	2,551,534	378,825	214,232,956
2006	279,772	211,799,370	37,542	5,176,200	63,127	2,823,211	338,470	249,925,144
2007	613,317	223,133,251	49,388	6,491,000	65,317	3,152,927	604,758	271,875,312
2008	623,271	233,522,728	63,535	7,102,300	73,711	3,783,075	706,696	291,342,595
2009	774,186	185,101,145	65,396	8,244,200	82,287	2,798,855	776,481	229,703,550
2010	616,536	238,684,422	80,158	10,685,600	120,574	3,472,852	680,803	298,473,146
2011	962,923	274,426,516	109,376	10,694,600	131,766	3,961,463	962,233	349,433,386
2012	860,126	287,842,151	122,849	10,937,600	161,880	4,414,570	1,016,079	370,769,890
2013	1,141,751	299,439,147	145,811	10,452,700	162,143	4,251,479	1,264,162	380,015,051
2014	1,526,345	318,365,502	160,935	10,714,200	168,569	4,311,841	1,599,141	396,911,688
2015	1,703,479	308,864,381	155,597	10,821,200	153,516	4,759,820	1,871,224	380,549,593
2016	1,992,886	302,575,327	174,406	10,007,274	211,145	5,759,576	2,314,213	409,401,075
2017	2,727,914	306,532,317	224,033	10,834,600	205,145	5,771,384	2,983,267	414,201,022
2018	2,448,439	314,762,532	223,266	10,995,120	217,866	6,335,130	2,735,420	433,164,209
2019	2,588,635	314,146,176	225,000	10,992,002	181,000	5,997,934	2,901,444	411,287,003

Source: Developed by the authors based on FAOSTAT y FAS-USDA data, 2019.

advantage (RCA) index and the normalized revealed comparative advantage (NRCA) index were calculated to measure the avocado competitiveness at the global importing market level. Data on avocado exports, as well as on total agricultural exports from Mexico to the world —particularly to the United States of America, Canada and Japan— was analyzed.

This index may take negative or positive values. A negative index is indicative of a trade deficit; therefore, it represents a disadvantage in the trade of this product. On the contrary, a positive index is indicative of a surplus and, therefore, it is an advantage in trade flows (Durán & Álvarez, 2008).

The Balassa index is included in the Revealed Comparative Advantage indicators and measures the relative importance of a product within exports from one market to

another market versus the importance of exports of the same product in worldwide exportation. It was calculated as follows:

$$(1) \qquad RCA_{kij} = (X_{kij} / XT_{ij}) / (X_{kiw} / XT_{iw})$$

Where: RCA_{kij}: Revealed Comparative Advantage Index of product k from country i to country j; X_{kij}: Exports of product k from country i to country j; X_{tij}: Total exports from country i to country j; X_{kiw}: Worldwide exports of product k from country i; XT_{iw}: Total worldwide exports from country i.

b) Normalized Revealed Comparative Advantage (NRCA) Index is another variable which is calculated with the coefficient of world imports of the product as the denominator coefficient of exports at the product level, in order to obtain a specialization index.

The calculated index can take values between 1 and -1, where values between $+0.33$ and $+1$ reflect a comparative advantage for the country and, consequently, mean that trade with the analyzed country is favorable. Meanwhile, values between -0.33 and -1 reflect a comparative disadvantage for the country. Finally, values between -0.33 and $+0.33$ show a tendency towards intra-product trade, meaning that products of the same technological group are exchanged (Durán and Álvarez, 2008).

To improve the RCA analysis (Durán and Álvarez (2008)), the index is normalized to a maximum of 1 and a minimum of -1, as follows:

$$(2) \qquad NRCA = (RCA - 1) / (RCA + 1)$$

Where: $NRCA$: Normalized Revealed Comparative Advantage Index; RCA: Revealed Comparative Advantage Index.

In most cases, the positive Balassa and Normalized RCA obtained in the main importing countries for the 1995-2019 period reflect the comparative advantage existence and the competitiveness of avocado exports to the USA, Canada, and Japan (Table 2).

RESULTS AND DISCUSSION
Exports destinations
The main destinations of Mexican avocado exports in 2019 were the USA with 914,530 tons, Canada with 89,048 tons, and Japan with 74,358 tons. (Table 2 and Figure 2). The focus of avocado exports on the USA is explained by the insufficient American production which fails to meet the domestic demand, as a consequence of its geographical disadvantage and the enormous size of its market, to which 85% of Mexican avocado exports is sent (Figure 1).

Figure 2 highlights the value (millions of dollars) of Mexican avocado exports to the main destinations in 2019.

Table 2. RCA and NRCA indicators of avocado (*P. americana*) from Mexico in the main export destinations (1995-2019).

Year	RCA Mexico-USA	RCA Mexico-Canada	RCA Mexico-Japan	NRCA Mexico-USA	NRCA Mexico-Canada	NRCA Mexico-Japan
1995	9.82	76.30	343.14	0.82	0.97	0.99
1996	14.11	68.97	311.71	0.87	0.97	0.99
1997	17.87	83.26	263.56	0.89	0.98	0.99
1998	29.11	61.63	269.02	0.93	0.97	0.99
1999	33.30	78.27	833.15	0.94	0.97	1.00
2000	50.93	78.12	453.25	0.96	0.97	1.00
2001	35.98	81.58	381.56	0.95	0.98	0.99
2002	33.94	53.96	335.61	0.94	0.96	0.99
2003	23.59	30.38	260.51	0.92	0.94	0.99
2004	22.04	36.30	610.71	0.91	0.95	1.00
2005	25.24	23.80	164.14	0.92	0.92	0.99
2006	22.32	31.58	192.42	0.91	0.94	0.99
2007	46.50	35.31	231.72	0.96	0.94	0.99
2008	51.09	47.94	249.50	0.96	0.96	0.99
2009	43.85	32.70	246.57	0.96	0.94	0.99
2010	40.80	43.70	433.73	0.95	0.96	1.00
2011	44.06	41.90	312.99	0.96	0.95	0.99
2012	41.66	49.13	407.39	0.95	0.96	1.00
2013	41.83	42.53	318.59	0.95	0.95	0.99
2014	39.80	36.29	262.76	0.95	0.95	0.99
2015	33.75	28.89	184.87	0.94	0.93	0.99
2016	26.59	21.78	147.21	0.93	0.91	0.99
2017	27.02	20.05	100.72	0.93	0.90	0.98
2018	31.01	26.06	160.86	0.94	0.93	0.99
2019	26.50	20.13	106.03	0.93	0.91	0.98

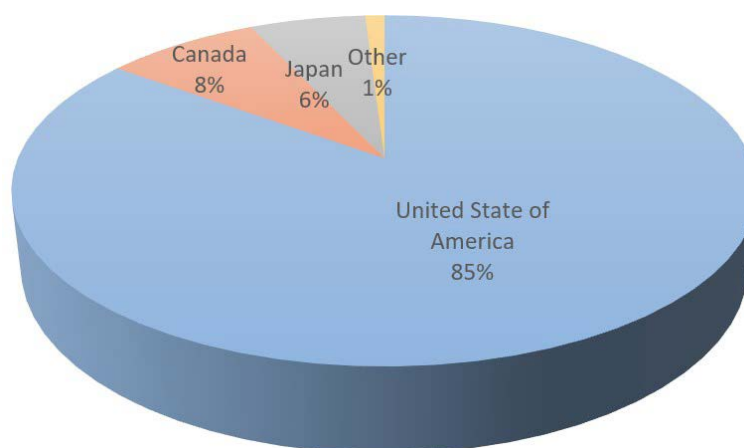Source: Developed by the authors based on FAOSTAT and FAS-USDA data, 2019.

Figure 1. Main destinations of Mexican avocado exports in percentages (2019).
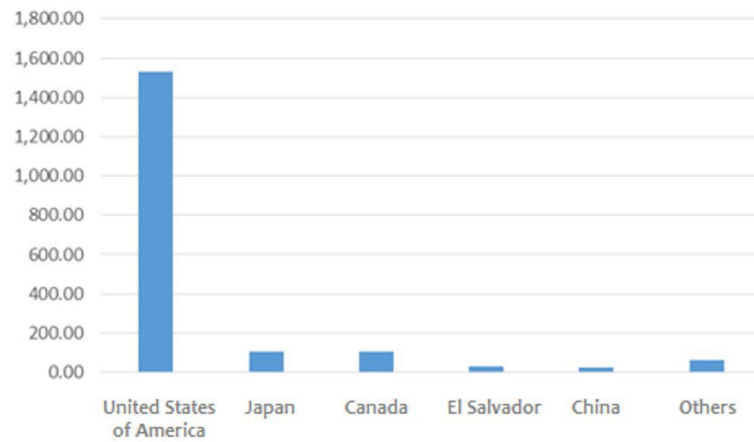Source: Developed by the authors based on FAOSTAT data.

Figure 2. Main destinations of Mexican avocado exports in 2019 (Millions of dollars).
Source: Ministry of Economy, Mexico (2019).

RCA of avocado exported to the United States of America

The USA market is the main destination of Mexican avocado exports. There were increasing periods from 1995 to 2019. In general, the RCA trend in that period was positive and increasing, with an average 32.51 RCA, which indicates that Mexico had a wide comparative export advantage in the USA market, with an exports value of 2,588,635 thousand dollars in 2019 (FAOSTAT, 2019). Meanwhile, the average NRCA of avocado exports to the US market was 0.93 (range: 0.33 to 1) for the 1995-2019 period with a rising trend that reflects the existence of a comparative advantage (Table 2 and Figures 3 and 4).

RCA of avocado exported to Canada

The Canadian market is the second destination of Mexican avocado exports. Avocado imports by Canada constantly increased during the 1995-2019 period. An increase in the RCA trend was observed during the 1995-2019 period; the 46.02 average indicates
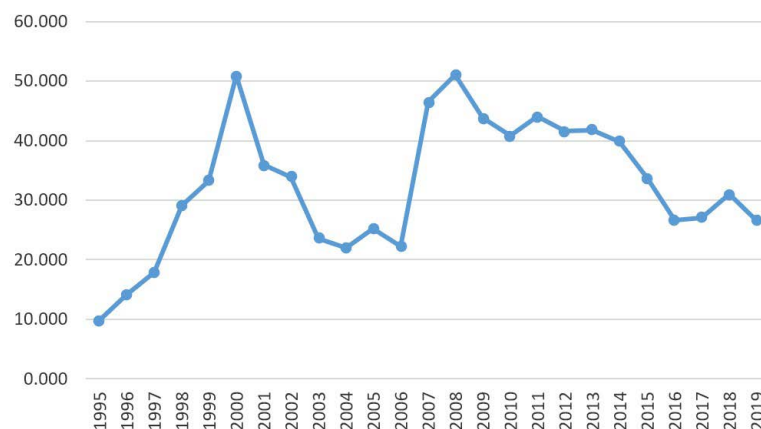

Figure 3. RCA of avocado (*P. americana*) exports to the USA.
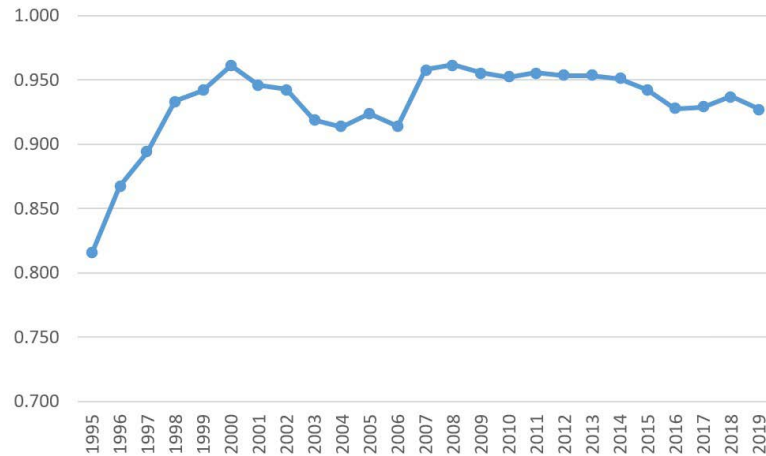Source: Developed by the authors based on FAOSTAT and FAS-USDA data, 2019.

Figure 4. NRCA of avocado (*P. americana*) exports to the USA.
Source: Developed by the authors based on FAOSTAT and FAS-USDA data, 2019.

prominent levels of comparative advantage and an export value of 225,000 thousand dollars was reached in 2019 (FAOSTAT, 2019). Meanwhile, during the course of the same period, the NRCA average of the avocado exports to the Canadian market was 0.95 (range: 0.33 to 1), reflecting the existence of a comparative advantage (Table 2 and Figures 5 and 6).

RCA of avocado exported to Japan

The Japanese market is the third destination of Mexican avocado exports. From 1995 to 2019, there were increasing periods. During those years, the RCA had an increasing trend (average: 303.27), indicating extremely high levels of comparative advantage; an export value of $181,000 thousand dollars was reached in 2019 (FAOSTAT, 2019). Meanwhile, during the course of the same period, the average NRCA of avocado exports to the Japanese market was 0.99 (range: 0.33 to 1) with an increasing trend, reflecting the existence of a great comparative advantage (Table 2 and Figures 7 and 8).
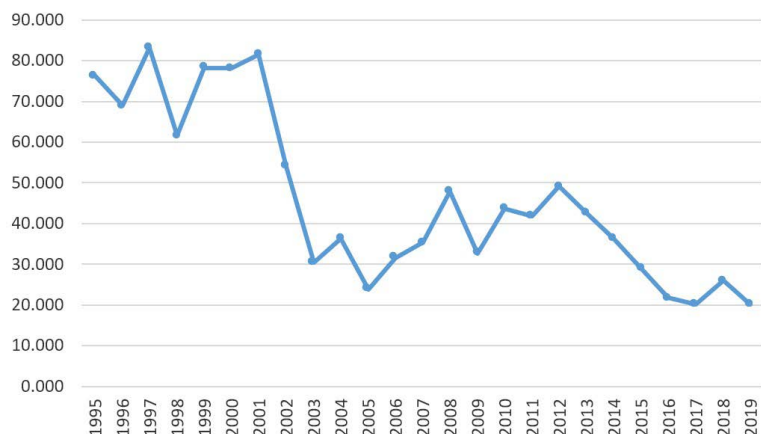

Figure 5. RCA of avocado (*P. americana*) exports to Canada.
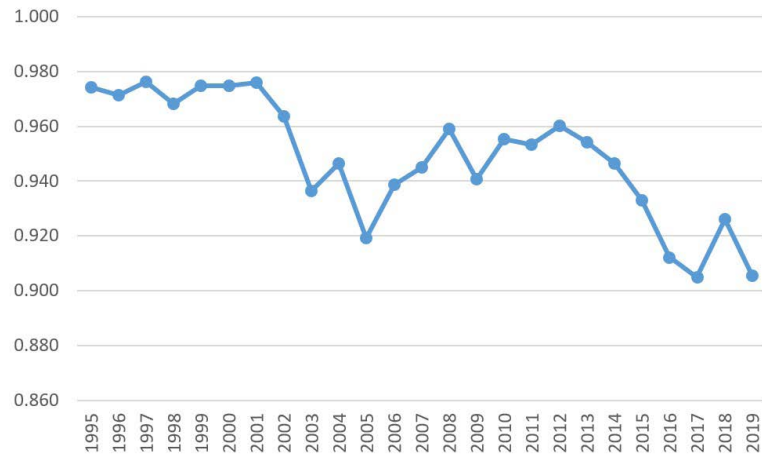Source: Developed by the authors based on FAOSTAT and FAS-USDA data, 2019.

Figure 6. NRCA of avocado (*P. americana*) exports to Canada.
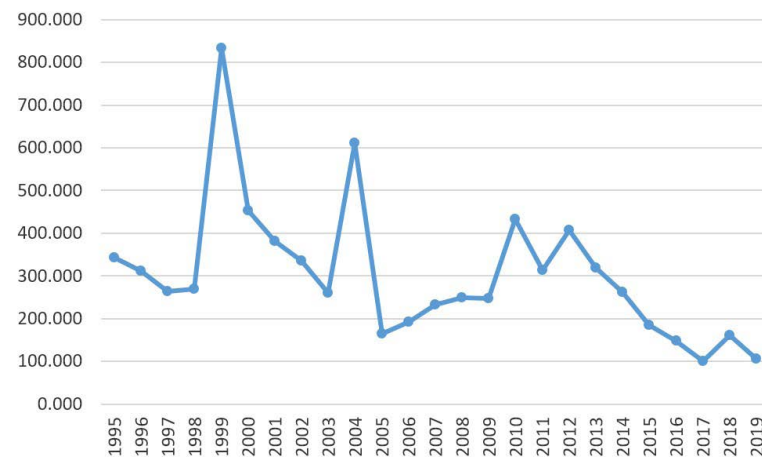Source: Developed by the authors based on FAOSTAT and FAS-USDA data, 2019.

Figure 7. RCA of avocado (*P. americana*) exports to Japan.
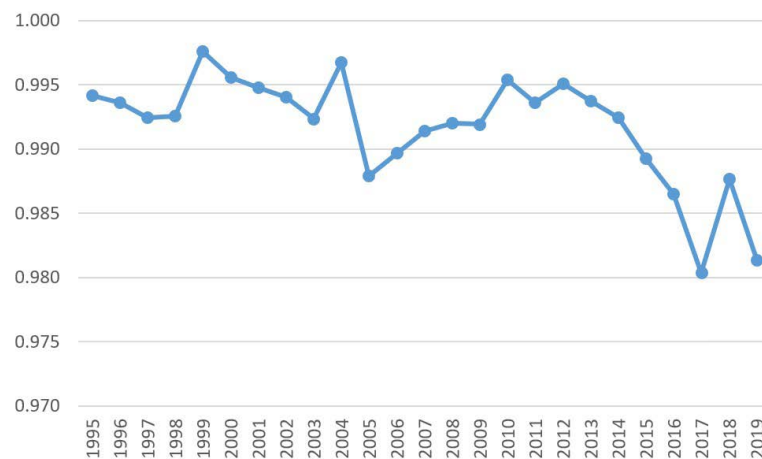Source: Developed by the authors based on FAOSTAT and FAS-USDA data, 2019.

Figure 8. NRCA of avocado (*P. americana*) exports to Japan.
Source: Developed by the authors based on FAOSTAT and FAS-USDA data, 2019.

CONCLUSIONS

Mexico holds the first place as producer and the third one as exporter, making it a major worldwide avocado producer and exporter. Its main trade partners are the United States of America, Canada, and Japan. Most of the avocado produced in Mexico is mainly destined to the United States of America. The calculated RCA and NRCA reflects that Mexican avocado is highly competitive in the United States of America, Canada, and Japan.

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