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APPLYING THE VOLLRATH AND LAFAY INDICATORS TO MEASURE THE COMPETITIVENESS OF MEXICAN AVOCADO

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ABSTRACT

In 2022, global avocado production reached approximately 7.3 million tons, 2.7 times higher than in 2000, when it was 2.8 million tons. The main exporting countries are Mexico, the Netherlands, Chile, Indonesia, Peru, and the United States of America; together contributing more than 60% of world production. Mexican avocado production ranked first, with 2.4 million tons, of which 1.3 million tons were destined for export in 2022, representing 55% of production and more than 32% of global exports. The total value of Mexican avocado exports in 2022 reached 2.098 billion dollars. The most important markets in the same year were the United States (2.039 billion), Canada (208 million), Japan (142 million), Spain (83 million), and Honduras (36 million). Our principal aim was to analyze the competitiveness of Mexican avocados in the global market from 2000 to 2022, for which some indicators that measure the competitiveness of agricultural products were calculated, such as the Relative Export Advantage Index proposed by Vollrath (+21.08), the Normalized Revealed Comparative Advantage Indicator (+0.91), the Lafay Indicator (1.82), the Export Coefficient (+43.0), the Export Specialization Coefficient (+4.57), and the Trade Dependence Indicator (0). Results demonstrate the existence of a comparative advantage, which reveals Mexico's position as a net exporter, showing zero trade dependence on this product.

Key words: exports, imports, production, trade balance.

INTRODUCTION

The origins of avocado date back to 1500 B.C., when it was cultivated in the highlands of southern Mexico; in pre-Columbian times in Peru, it was introduced by the Inca Tupac Yupanqui after conquering the Palta tribe in the Northern area of Ecuador. Thus in South America, the avocado is known as "palta". This fruit comes from the *Persea americana* Mills tree, pertaining to the Lauraceae family; a family characterized by its great morphological variability, which includes 92 genera and more than 2,840 species distributed in tropical and subtropical regions throughout the world (Renner, 2004; Chanderbali *et al*., 2008).
This is a subtropical fruit that grows on a tree, whose production and consumption have expanded worldwide, mainly in areas with tropical temperatures or Mediterranean climates. Although Mexico is currently the largest producer and exporter of avocados in the world, this was not always the case. The expansion of this species extended from Mexico to northern California. With the arrival of the Spanish, fruit quality manifested the selection and propagation process by seed that the inhabitants of Central America had developed. The Spanish brought the avocado to Spain in 1600, and subsequently, worldwide distribution initiated. Five centuries later, in the 1900s, some specimens with

better attributes began to be selected. The "Fuerte" variety was introduced to California in 1911, which came from Atlixco, Puebla, Mexico. In California, Rudolph Hass patented a new variety called Hass Avocado in 1935, which he identified among the trees in his orchard. This variety was smaller in size and had specific flavor and ripening qualities, which significantly increased commerce, especially in 1993 with the North American Free Trade Agreement.

Among the characteristics of the avocado, its normal weight varies between 200 and 400 g; with a thick green skin that variesin shade according to the variety. The pulp is oily, cream to yellowish-green, with a flavor similar to that of a nut. It contains a single light brown rounded seed, measuring 2 to 4 cm. It is an evergreen tree; which begins to fruit at 4 to 7 years of age. Most avocados can be grouped as members of a single species: *Persea americana* Mill, which has a relatively shallow root system, lacks visible root hairs but grows secondary branches. Leaves are alternate and multiform. Tree growth commonly varies between an erect shape and low spreading forms.

In 2022, in Mexico, the area planted for avocado production constituted 259,769 ha, 164,865 ha (270%) more than in the year 2000 (94,904 ha). The state of Michoacán constitutes the largest area (183,385 ha), representing 70.6% of the national total; followed by Jalisco with 27,395 ha (10.5%) and the State of Mexico with 13,124 ha (5.1%). The harvested area reached 204,496 ha, representing an increase of 14,252 ha (7.5%) compared to the year 2000 (94,104 ha). Michoacán contributed 84.8% (173,487 ha) of the national total, and Jalisco 12.3% (25,247 ha); these two states together represent 97.1% of the area (Servicio de Información Agroalimentaria y Pesquera-SIAP, 2023).

Avocado production in Mexico has significantly increased in recent years, due to favorable growing conditions; most production takes place in the state of Michoacán, where the climate is warm and humid with abundant rainfall, and in response to growing consumer demand. It represents 4.39% of the national agricultural Gross Domestic Product (GDP) and 8.8% of fruit production (Corporate statistical data from the Food and Agriculture Organization-FAOSTAT, 2023). The production volume of avocados in Mexico reached 2.44 million tons, representing an increase of 55% compared to the amount reported in 2000, which was 1.1 million tons.

Avocado is one of the most prominent products in national agri-food exports. Mexico is the main supplier to the international market, contributing 46% of the value of exports and of great importance, as it is estimated that out of every 10 avocados sold worldwide, four are sold by Mexican producers. Agri-food exports in 2022 totaled 45.250 billion dollars, compared to 2000 with 7.230 billion dollars, with a surplus balance of 6.737 billion dollars. Among these exports, beer ranks as the top exported product at 5.600 billion dollars, followed by tequila with 4.000 billion dollars, whereas avocado ranks third with 3.200 billion dollars (Secretaría de Agricultura y Desarrollo Rural-SADER, 2023). Mexico is the world's leading exporter of avocados (75%), followed by the Netherlands (20%) and Spain (5%) in 2022. In descending order, this is followed by Chile, the United

States, Kenya, and New Zealand. In terms of value, Mexico exported 2.975 billion, the Netherlands 1.166 billion, followed by Spain with 462 million dollars.

On average, in 2022, the annual per capita consumption of this variety in Mexico was 8.1 kg (Consejo Nacional Agropecuario, 2023). Consumption of this fruit has increased in 26 countries, including the United States, the Netherlands, France, the United Kingdom, Spain, and Japan. From 2000 to 2022, the average sales of Mexican avocados worldwide were worth 2.900 billion dollars; the main export destinations for this product are the United States (78%), Japan (5%), Canada (4%), Spain (3%), France (3%), the Netherlands (2%), El Salvador (2%), and China (1%), which together accounted for about 98% of the total exports. Currently, the United States is the main buyer of Mexican avocados, with about 95% of its imports of this fruit coming from Mexico, meaning 9 out of 10 avocados are from Mexico.

The research intended to analyze competitiveness of avocados, produced in Mexico in the international market and factors such as price, quality, and availability that determine exports to the main importing markets, taking into account the (comparative and revealed) advantages of the product.

The hypothesis is that avocados produced in Mexico are competitive in the international market because national production meets the domestic market demand and provides an exportable supply for the main international importing markets, placing Mexico as the world's number one exporter. Specifically, Mexico is internationally competitive in avocado exports, as explained by the trade index values that exceed the critical point, aligning with its current position as one of the leading producers and the top exporter of avocados in the international market.

THEORETICAL FRAMEWORK

The term competitiveness evolves and incorporates new elements such as technological, productive, and organizational changes. According to Avendaño *et al*. (2006), the competitiveness of exports can be measured through indirect indicators such as market share or some revealed comparative advantage index. One of the most commonly applied indices is the one developed by Vollrath (1991), which measures revealed comparative advantages and competitive advantage for specific agricultural products, using information related to the trade variable. This index has thus allowed the quantification of a product's or industry's competitiveness, based on a global comparison. However empirically, comparative advantage can be measured through the Revealed Comparative Advantage (RCA), indices which are calculated based on observable trade patterns that make it possible to discern this advantage.

Neoclassical theory holds that international trade can be interpreted in terms of comparative advantage, where each nation will focus on producing products and services that show advantage, thus taking advantage of differences with other countries. Economists like Leontief (1956) opened the discussion on the predictive power of the neoclassical theory of international trade, more specifically, complying with the Heckscher-Ohlin model.

According to this model, economic openness consists of a zero-sum game, where progress or development of some countries is at the expense or lagging behind of others. It adds that a country cannot concentrate its production on high productivity goods because their demand is limited, and they are oversupplied.

Other theories, such as the factor price equalization theorem, refer to the fact that in a free trade scenario, if two countries do not fully specialize, the relative and absolute prices of production factors and goods converge to reach a common value. This implies that free trade in goods partially eliminates incentives for the adjustment of production factors at an international level. In similar manner, the Stolper-Samuelson theorem explains that an increase in the relative price of a good will lead to an increase in the real price and the relative price of the production factor used intensively in the production of that good, will result in a reduction of the real price and the relative price of other production factors. Similarly, the Rybczynski theorem (1955) implies that given the relative price of goods and production factors, an increase in the value of a production factor will proportionally increase the production of a good that is intensive in terms of that factor, while reducing production of the other good.

Comparative advantage is the central concept in international trade theory, which holds that a country or region should specialize in producing and exporting those goods and services it can produce relatively more efficiently than others, and import goods and services for which it has a comparative disadvantage. This theory was first proposed by David Ricardo in 1817, as a basis for increasing the economic well-being of the population through international trade. The theory of comparative advantage usually recommends specialized production in a country, based on the intensive use of those production factors with which the country is well-endowed (such as raw materials, fertile lands, or skilled labor); and perhaps the accumulation of physical capital along with speedy research. Chudnovsky and Porta (1990) point out that Revealed Comparative Advantage measures the relative performance of a country's or sector's exports and is defined as a country's share in world exports of a good compared to its share of the world export total. In other words, the index facilitates identification of a country's export specializations.

In the case of agricultural products, competitiveness refers to the ability to create benefits and deliver value through cost efficiency or product differentiation. Sumaya *et al.* (2014) argue that to increase the competitiveness and diversification of the agricultural sector's marketing, it is necessary to differentiate foods and incorporate them into value chains that consider consumer needs and demands.

Some studies that address this topic through quantitative techniques include Contreras (1999), who analyzed the competitiveness and evolution of the revealed comparative advantage of Mexican avocados in the French market from 1986 to 1997 and used the Vollrath index to measure the level and evolution of the country's revealed comparative advantage in this product. In this study, an adapted version of the Constant Market Share Analysis method was applied to break down the growth of exports to the French market and quantify the part attributable to the competitiveness factor. It concluded that Mexico

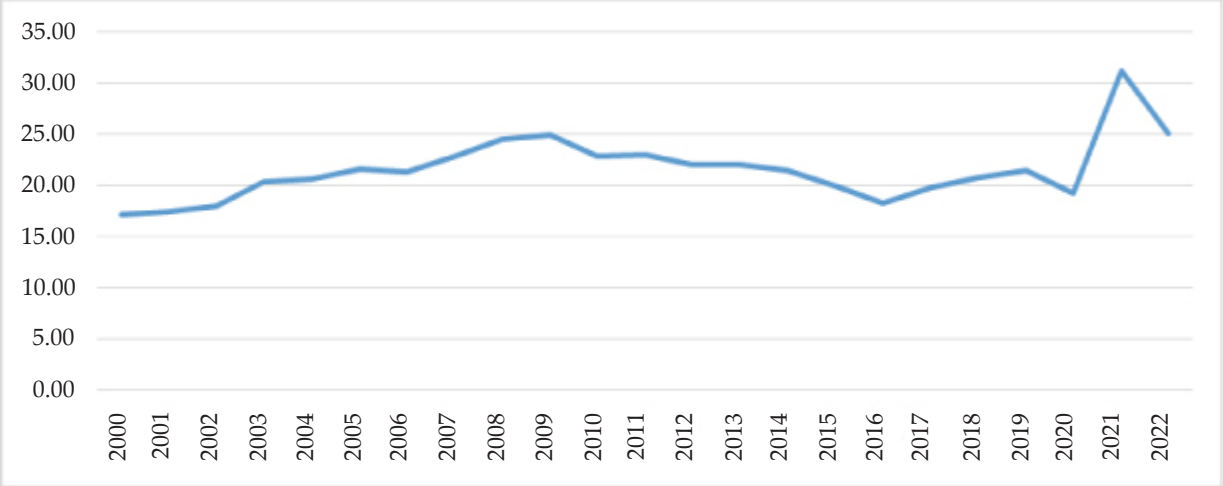
shows increasing revealed comparative advantages in avocados. Contrarily, Avendaño (2008), in the case of vegetables and fruits, highlighted the negative effect for Mexico, as it is one of the main suppliers of fruits to the US market, but the participation of fruits and vegetables decreased, affecting the export industry. For this analysis, the additive revealed comparative advantage index was applied to Mexico.

Durán and Álvarez (2011) classified comparative advantage indicators into three categories: a) basic trade position indicators, which include components of the current account such as the trade balance, the services balance, the income balance, and the direct transfer balance, which define the level of internationalization of a certain economy; b) indicators related to trade dynamism, which analyze the comparative advantages or disadvantages of a country's trade exchanges with its trading partners or with various groups of countries that constitute a trade bloc or market; these include trade openness indices, trade exchange indices, concentration-diversification index (Herfindahl-Hirshman Index, HHI) , Grubel-Lloyd index; and c) relative trade dynamics indicators, which measure the importance of the proportion represented by trade among members of a certain regional grouping, highlighting the intra-regional, extra-regional trade index and trade intensity.

The importance of competitiveness studies lies in their ability to help countries determine their policies for competitiveness (Török, 2008), to promote and focus resources on sectors or products where they can boost growth and development in international trade (Talikadze, 2020) and to secure a segment that benefits companies in that sector (Marlenovna, 2019). Similarly, Nava *et al*. (2017) indicated that competitiveness is closely related to the ability to create an environment that fosters sustained growth in productivity and is reflected in improvement in the population's living standards. They also noted that factors enabling increased competitiveness, such as work ethic, specialization, quality, managerial and financial capacity, occur in both micro and macro environments.

Other assessment tools include the Export Relative Advantage Index proposed by Vollrath (1991), which measures the existence of competitiveness in a country's exports, compared to the rest of the world; the Lafay indicator (1992), which measures trade performance and specialization in certain sectors; the export coefficient, which indicates the proportion of national production that is exported; the export specialization coefficient, which provides information on products revealing specialization in a country's export sector; and the trade dependency indicator, expressing the percentage of international competition as opposed to domestic demand.

The Normalized Revealed Comparative Advantage Index is another variable calculated using the coefficient of world imports of the product as the denominator and the coefficient of exports at the product level as the numerator, to obtain a specialization index, as shown in Figure 1. According to Benedictis *et al.* (2002), the difficulty of interpreting or comparing the Balassa (1965) RCA index between countries and time periods, combined with its asymmetric nature and variable measurement value, has led some authors to propose other versions of the original index. According to Malca *et al.* (2016), the best option for determining the aspect of comparative advantage that a



Source: self-elaborated with data from SIAP (2023).
Figure 1. Revealed comparative advantage index for Mexican avocado.

country has with respect to a product, in a more precise and consistent way, is by applying the Normalized RCA (NRCA) index. The NRCA enables comparisons between products and countries over time, using.

METHODOLOGY

We analyzed information from the 2000 to 2022 period, describing the economic variables of avocado production worldwide, as well as the statistics corresponding to avocado imports and exports globally. The following indicators were calculated: the Export Relative Advantage Index proposed by Vollrath, the Normalized Relative Comparative Advantage Index, the Lafay Indicator, the Export Coefficient, the Export Specialization Coefficient, and the Trade Dependency Indicator.

This research was conducted based on production and trade information to measure the competitiveness of avocados for the period 2000 to 2022 from the Agricultural and Fisheries Information Service (SIAP) and the Food and Agriculture Organization's statistical database (FAOSTAT). Indicators were as follows:

a) The Export Relative Advantage Index proposed by Vollrath (1991), also known as the Export Relative Advantage Index (ERA), is essentially a reworking of the index proposed by Balassa, called the Revealed Comparative Advantage (RCA) (Laursen, 1998). This formula is based on a set of indicators adapted from the methodology proposed by the Economic Commission for Latin America and the Caribbean (ECLAC, 2008), and its measurement is expressed as follows:

$$IVCR_{ik} = \frac{\left(X_{ki} / X_{ti}\right)}{\left(X_{kw} / X_{tw}\right)}$$

where $IVCR_{kij}$: revealed comparative advantage index of product k of country i; X_{ki}: exports of product k made by country i; X_{ti}: total exports of country i; X_{kw}: exports of product k undertaken around the world; X_{tw}: total world exports.

Vollrath (1991) examined trends in international competitiveness in agriculture through alternative measurements of revealed comparative advantages, using export and import data, thus incorporating both the effects of relative supply and relative demand for goods. The possible values of this indicator are that if it is positive and high, it means that there is a comparative advantage for this product, indicating the proportion of the product's exports compared to the total exports of the country and to world exports. Conversely, a negative value reveals a comparative disadvantage for the country for which it was calculated. b) The Normalized Revealed Comparative Advantage: This is another indicator calculated, using the coefficient of world imports of the product as the denominator and the coefficient of exports at the product level as the numerator to obtain a specialization index. The calculation formula is as follows:

$$IVCRN = \frac{(IVCR - 1)}{(IVCR + 1)}$$

where *IVCRN*: the normalized revealed comparative advantage index; *IVCR*: the revealed comparative advantage index.

To enhance the analysis of the IVCR, the index is normalized to a maximum of 1 and a minimum of -1. The calculated indices can take values between 1 and -1, where values between +0.33 and +1 indicate that there is a comparative advantage for the country; therefore, trade with the analyzed country is favorable. In contrast, values between -0.33 and -1 indicate a comparative disadvantage for the country, and values between -0.33 and +0.33 show a tendency towards intra-product trade, that is, the exchange of similar products belonging to the same industry. This term is generally applied to international trade when there is import and export of the same type of goods or services. Although this phenomenon is difficult to explain through classical trade theories, it can be perfectly understood today, if analyzed in terms of specialization and performance (Durán and Álvarez, 2011).

c) The Lafay Specialization Indicator (1992) nominates an indicator to measure trade performance and specialization in certain sectors. Lafay (1992) introduced this concept to measure the degree to which a country has a comparative advantage, promoting it as an exporter of that product. It is obtained by dividing the domestic production of the product in question by apparent national consumption, comprising domestic production plus imports, minus exports of this product. The Lafay index for product *i* with respect to country *j* can be expressed as follows:

$$IL = \frac{Q_{ij}}{Q_{ij} + M_{ij} - X_{ij}}$$

where *IL*: Lafay index; Q_{ij}: domestic production of product *i* of country *j*; M_{ij}: imports of product *i* of country *j*; X_{ij}: exports of product *i* from country *j*.

This indicator has the advantage that it relates production to perceived national consumption. In addition to relating the impact that the product has on the domestic market; if a value greater than 1 is obtained, the country is a net exporter, which makes it more competitive internationally for that product.

d) The Export Coefficient (EC): this measures the percentage of a country's total exports in terms of the world's total exports. This relationship can be used to evaluate the change in a country's share of the global market over time. It indicates the proportion of national product that is exported, and the calculation procedure is as follows:

$$CE = \left(\frac{X_{tx}}{Q_{tx}} \right) * 100$$

where *CE*: is the export coefficient; X_{tx}: is the total exports of product *x*; Q_{tx}: is the total production of product *x*.

The higher the coefficient value obtained, the greater the product's competitiveness in trade.

e) The Export Specialization Coefficient (ES): this is a modified RCA index, where the denominator is measured in relation to specific markets or partners. It provides information on products revealing specialization in a country's export sector and is calculated as the ratio between the proportion of a product as a share of a country's total exports and the proportion of this product among world imports:

$$ES = \frac{\left(x_{ij} \,/\, X_{ti} \right)}{\left(m_{jk} \,/\, M_{tk} \right)}$$

where x_{ji}: is the value of exports of product *j* in country *i*; X_{ti}: is the value of total exports in country *i*; m_{ik}: is the value of imports of product *j* in market *k*; M_{tk}: is the value of total imports in market *k*.

This indicator is similar to the Revealed Comparative Advantage in that a value below 1 indicates a comparative disadvantage and a value that exceeds 1 represents specialization in that market.

f) The commercial dependency coefficient (GI) is the proportion of a country's product-specific imports in relation to apparent national consumption. It expresses the percentage indicating the impact of international competition against internal demand. This is calculated as follows:

$$GI = \frac{M_{ij}}{Q_{ij} + M_{ij} - X_{ij}}$$

where GI_{ij}: is the level of import penetration of product *i* coming into country *j*; M_{ij}: is the imports of product *i* in country *j*; X_{ij}: is the exports of product *i* by country *j*; Q_{ij}: is the domestic production of product *i* in country *j*.

If the indicator ranges between 0 and 1, as the indicator approaches zero, the competitiveness of the sector or production chain grows, and imports may become negligible; even if part of national production is dedicated to exports.

RESULTS

In order to determine the competitiveness level of this Mexican agricultural subsector, the Revealed Comparative Advantage Index was used, in order to determine whether there is competitiveness in terms of exports from this Mexican agricultural subsector compared to the principal countries trading these types of goods in the North American market. Likewise, it determines whether this competitiveness is diminished due to Mexico's imports in this subsector exceeding the proportion exported to the U.S. market. Table 1 presents the data for economic variables of commercial activity and the calculation of the Revealed Comparative Advantage Indicator (Table 1).

DISCUSSION

Competitive behavior is revealed by analysis of trade indicators. Revealed competitiveness is a number that measures the relative performance of a country's or sector's exports, which is defined as a country's share in world exports of a good, as opposed to its share in total world exports (Vollrath, 1991). According to Table 1, the IVCR analyzed from 2000 to 2022 manifested high and positive values, averaging 21.58, with a minimum value of 17.16 in 2000 and a maximum of 31.29 in 2021. This means a comparative advantage for this product exists, as these values highlight the impact of the product's exports, in terms of the country's total exports and exports worldwide.

From 2000 to 2009, the IVCR of Mexican avocados showed an increasing trend, strengthened up by an increase in exports to the U.S., which rose from 180 thousand to 776 thousand tons. However, it is noteworthy that from 2010 to 2016, there was another significant decrease explained by a greater increase in total exports from this country to the U.S. From that year, the IVCR again shows that Mexican avocado production and export represent a comparative advantage for the country. Furthermore, its production

Table 1. Economic indicators of commercial activity (in dollars) for Mexican avocado.

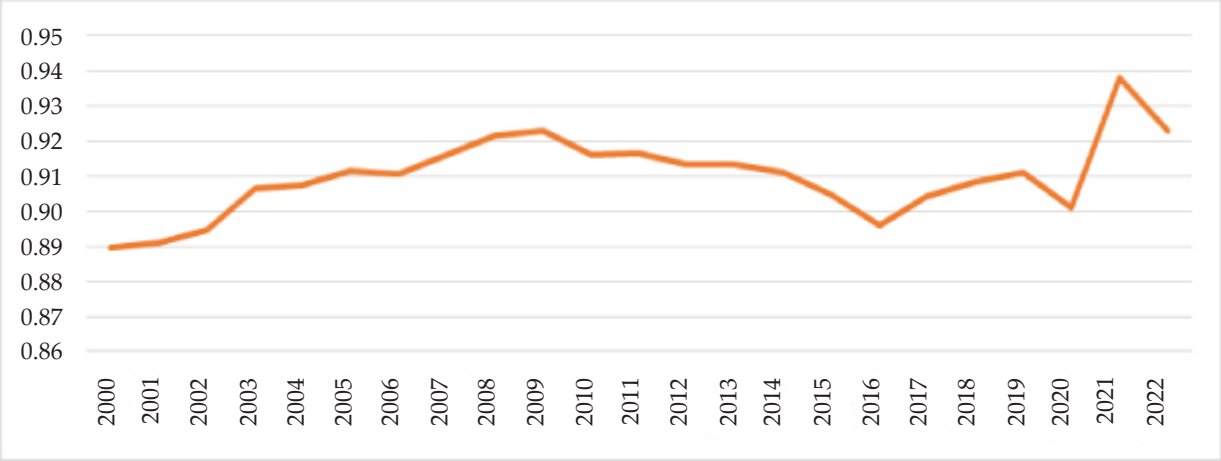
Year	$IVCR_{ik}$	IVCRN	IL	CE	ES	GI
2000	17.16	0.89	2.19	54.27	6.28	0
2001	17.39	0.89	1.53	34.80	6.36	0
2002	18.01	0.89	1.47	31.86	6.25	0
2003	20.38	0.91	1.50	33.20	6.32	0
2004	20.58	0.91	1.41	29.05	7.10	0
2005	21.64	0.91	1.72	41.77	5.66	0
2006	21.38	0.91	1.68	40.43	9.15	0
2007	22.86	0.92	1.64	39.09	4.47	0
2008	24.49	0.92	1.71	41.40	4.98	0
2009	24.94	0.92	1.43	29.98	4.15	0
2010	22.91	0.92	1.47	32.11	4.62	0
2011	23.00	0.92	1.41	29.16	2.96	0
2012	22.08	0.91	1.54	35.26	4.03	0
2013	22.09	0.91	1.78	43.81	4.11	0
2014	21.51	0.91	1.65	39.46	2.86	0
2015	19.97	0.90	1.89	47.11	3.33	0
2016	18.21	0.90	2.17	53.99	3.75	0
2017	19.85	0.90	2.03	50.74	2.69	0
2018	20.79	0.91	2.15	53.56	3.32	0
2019	21.47	0.91	2.30	56.50	3.07	0
2020	19.23	0.90	2.11	52.55	3.20	0
2021	31.29	0.94	2.33	57.07	3.05	0
2022	25.04	0.92	2.65	62.30	3.50	0

Source: self-elaborated with data from SIAP and FATOSTAT (2023).

is of great importance in terms of Mexico's overall exports to the U.S., and compared to the world's exports of this good. These results are consistent with Villegas (2021), who assessed the Revealed Comparative Advantage Index by Vollrath (1991) and stated that Mexico, Canada, and Spain obtained a revealed comparative advantage from 2001 to 2019 in avocado production.

To enhance the competitiveness analysis, the IVCR normalization process was assessed in terms of total exports (Figure 2). This process is very precise and consistent for empirical analysis, as it contains optimal properties concerning a theoretical point of view that are very useful for research; it enables comparisons, measures the underlying comparative advantage (or disadvantage) precisely and consistently, and more accurately reflects the relative competitiveness of a country in terms of specific products compare to other countries and over time (Yu *et al.*, 2009). The index is normalized to a maximum of 1 and a minimum of -1. According to Table 1, the average value obtained is 0.91, which reflects that there is a comparative advantage for the country; meaning that trade with the analyzed country is favorable for Mexico.

In this regard, Figure 3 shows the IL obtained for the subsector and reveals that throughout all years, the country presented values above 1, averaging 1.82. This indicates the existence



Source: self-elaborated with data from Table 1.
Figure 2. Normalized Revealed Comparative Advantage Index for Mexican avocado.

of comparative advantages in Mexican avocado production, allowing it to position itself as a net avocado exporter during that period. This demonstrates a surplus in the trade of avocado produced in Mexico, and therefore, it has an advantage in the trade exchanges that Mexico carries out with the rest of the world, specifically concerning this crop.

Likewise, this index presented a notable upward trend during the analyzed period, which, according to Durán and Álvarez (2011), is explained by an increase in exports as a destination for the product, as well as an increase in avocado production in Mexico.

Source: self-elaborated with data from Table 1.
Figure 3. Lafay Index for Mexican avocado.

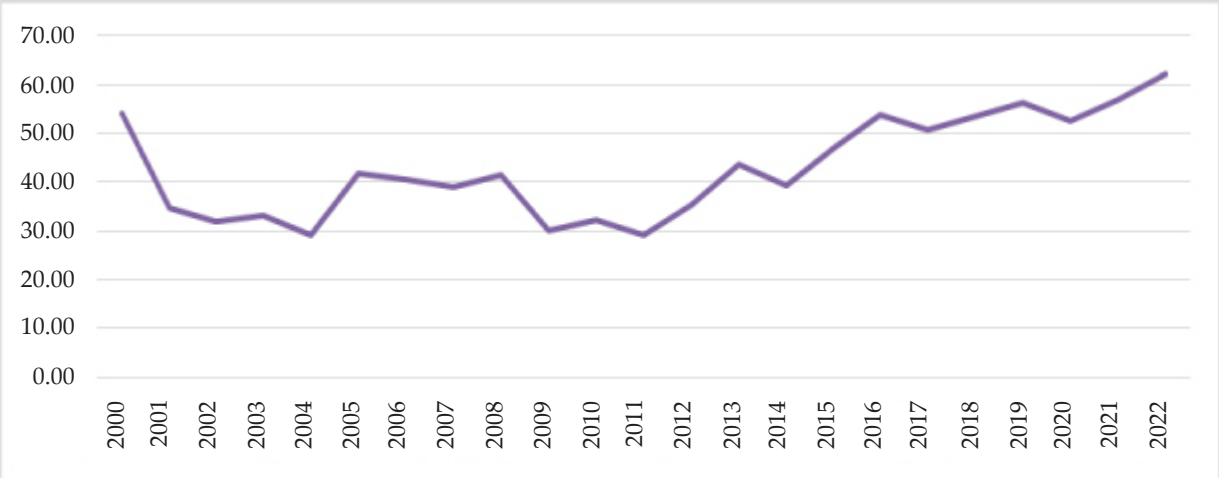
Similarly, the IL presented a minimum value of 1.41 in 2004 but has shown an upward trend since 2014, reaching its maximum of 2.65 in 2022. Thus, no year manifested behavior contrary to that of a net exporter.

Figure 4 represents the export coefficient, indicating the proportion of national production that is exported. The higher the coefficient, the greater the product's commercial competitiveness. During the study period, the average value was 43.0, which is very high, indicating greater commercial competitiveness of the product. Minimum value was 29.04 in 2004, and from 2011 onward, there was sustained growth, reaching its highest value of 62.30 in 2022. This reflects a high export coefficient and greater volume exported, as a significant share of production is destined to the international market.

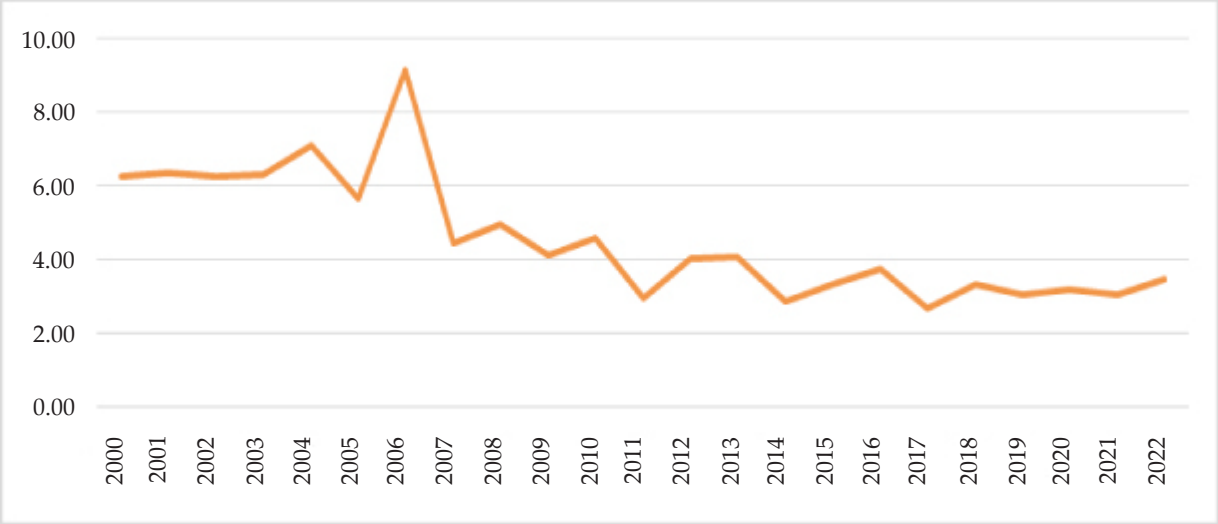
The export specialization coefficient index (Figure 5) is similar to the Revealed Comparative Advantage index. A value below 1 indicates a comparative disadvantage, while a value above 1 represents market specialization. During the study period, the average was 4.57, indicating a high degree of specialization. This suggests that Mexico is highly competitive in avocado production and export, with a significant share of production destined to the external market. The minimum value was 2.86 in 2014, and the maximum was 9.15 in 2006. Despite high values, the overall trend is downward.

The calculated trade dependency index had values of 0 during the period from 2000 to 2022, indicating high sectorial competitiveness and minimal imports; complying with Mexico's status as a net exporter and self-supplier.

The openness of the U.S. market to Mexican avocados represents an opportunity to stimulate regional development and agricultural producers. It benefits states like Michoacán, with extensive experience and productive resources, and also opens opportunities for other states with suitable conditions to enter the U.S. avocado export market.



Source: self-elaborated with data from Table 1.
Figura 4. Mexican avocado export coefficient index.



Source: self-elaborated with data from Table 1.
Figura 5. Mexican avocado export specialization coefficient index.

CONCLUSIONS

Greater competitiveness of a product in the international market is reflected in increased exports and market share. Analysis indicates that the Mexican avocado subsector had manifested competitiveness during the study period. This is linked to the country's commercial specialization, resulting in a favorable trade balance.

Mexico's exports showed a growing trend, while imports remained at zero, leading to a positive trade balance. Vollrath's Revealed comparative advantage index showed positive values, indicating a comparative advantage, with a high proportion of avocado exports in terms of total exports.

The normalized revealed comparative advantage index confirmed the existence of a comparative advantage, with values close to 1. In trade indices analysis, Mexico showed a Lafay index above one, highlighting its role as a net exporter and self-supplier, with no imports during the same period. Mexico is self-sufficient in avocado production, meets its domestic demand, and is a strong competitor in the external market.

Regarding the Export Specialization Coefficient, values much higher than one were obtained, consistent with Mexico's export and commercial activity. Finally, the Trade Dependency Indicator showed values of zero throughout the study period, concluding that Mexican avocado is competitive in the country's agricultural sector, with significant growth in avocado activity nationwide, in recent decades.

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