sustainability

MDPI

Article

Competitiveness of Ecuador's Flower Industry in the Global Market in the Period 2016–2020

Inmaculada Guaita-Pradas [1,*], Luis Oswaldo Rodríguez-Mañay [2] and Inmaculada Marques-Perez [1]

[1] Faculty of Business Administration and Management, Economics and Social Science Department, Universitat Politècnica de València, 46022 Valencia, Spain
[2] Facultad de Ciencias Administrativas, Universidad Central del Ecuador, Quito 170129, Ecuador
* Correspondence: iguaita@upv.es

Abstract: More intense floriculture activity in Ecuador could mean huge improvements for the country's economic growth, while at the same time would be a sustainable exploitation of its natural resources. This study aims to help floriculture entrepreneurs in Ecuador with production planning, investment, and marketing strategies. With this in mind, two main objectives are addressed in the paper. The first one is to obtain an analytical overview of the world's flower industry and the chief exporting and importing countries, as well as of the types of flowers that are offered and demanded. The second is to determine the competitive position of Ecuador's flower industry and that of its direct competitors in the global cut flower marketplace. To accomplish the latter, we used Balassa's and Hinloopen and Van Marrewijk's measures and carried out statistical tests to validate the results. These indicated that both Ecuador and Colombia enjoy a strong comparative advantage among their direct competitors: the Netherlands, Kenya, and Ethiopia. Although the 2018 Logistics Performance Index and the 2017–2018 Global Competitiveness Index rankings put Ecuador in the 70th and 97th position worldwide, respectively, our findings show that Ecuador has the potential to achieve higher market shares in the flower trade globally. Consequently, strategic production policies should be implemented for Ecuadorian flower companies to adapt to the international flower trade requirements and for improving the production and supply chain technologies so that Ecuador can reach other foreign markets.

Keywords: exports; revealed comparative advantage; cut flowers; analysis of variance

Citation: Guaita-Pradas, I.; Rodríguez-Mañay, L.O.; Marques-Perez, I. Competitiveness of Ecuador's Flower Industry in the Global Market in the Period 2016–2020. *Sustainability* **2023**, *15*, 5821. https://doi.org/10.3390/su15075821

Academic Editor: Adela García-Aracil

Received: 15 February 2023
Revised: 13 March 2023
Accepted: 24 March 2023
Published: 27 March 2023

1. Introduction

World flower exports increased from USD 19.6 billion to USD 22.4 billion during the period from 2016–2020. In 2020, live plants accounted for USD 10.6 billion (47.70%), followed by cut flowers, which are the focus of this paper, which accounted for USD 8.7 billion (38.73%), and then by bulbs, tubers, and decorative cut leaves and branches of foliage plants, etc., which accounted for USD 3 billion (13.57%). The top five flower exporting countries are the Netherlands, Colombia, Ecuador, Kenya, and Ethiopia, with 80% of the world market, while the five largest importers are: the United States, Germany, the Netherlands, the United Kingdom, and Russia, with a market share of roughly 60% [1]. Europe is one of the biggest buyers of cut flowers, representing around 60% of the world's imports, and is the largest market, followed by the US and Japan. Globally speaking, the most popular cut flowers are roses, with 35% of the market share, followed by fresh flowers and buds (gypsophila, alstroemeria, aster, gerbera, and hydrangea), with 40%, chrysanthemums, 9%, carnations, 5%, and the rest of the flowers, 11% [1].

Flower producing countries can be grouped into four categories [2]:

1. The first group comprises countries such as India, Japan, and China whose national production meets domestic demand and that do not sell much abroad [3,4].
2. The second group of flower producers includes countries like Germany and the UK, that mainly cover their own demand for flowers through imports [5].

3. The third set of countries has a low domestic demand for flowers but export large quantities. This includes countries like Colombia, Ecuador, Kenya, and Ethiopia [2].
4. In the fourth group are countries that produce a large number of cut flowers and have a large internal market, although a significant part of their output is dedicated to export [2]. The benchmark country of this group is the Netherlands, which maintains its leadership in the global cut flower trade, thanks to the consolidation of Royal Flora Holland.

Ecuador belongs to the third group of countries, with low internal demand and a large volume of exports. Ecuador is a country that has had periods of political instability that have caused economic instability and a strangulation of economic growth with very high inflation rates.

After oil, Ecuador's three main export products are shrimp, bananas, and flowers. The flower industry is in fact one of the biggest in Ecuador, having a huge impact on the economy to which it contributes more than USD 1.2 billion [6]. The 2016–2020 period saw a diversification in the types of flowers exported, where roses with 73% (USD 609 million), fresh flowers and buds of gypsophila, alstroemeria, aster, gerbera, and hydrangea, with 22% (USD 181 million), were the most demanded. These two types of floral products accounted for 95% of Ecuador's flower exports.

Artificial intelligence techniques in Dutch greenhouses are an example to follow for floriculture in other countries, this technique allows for automatic harvesting of chrysanthemums. It is estimated that manual harvesting in the greenhouse produces approximately 100 stems every 4 min. If this task is automated, two thirds of the harvesting time could be saved [7,8].

Gerbera growers will be the first flower growers with a harvester robot that can drive around the greenhouse autonomously and perform all sorts of tasks. The gerbera harvesting robot carefully walks through a nursery. It does not work autonomously yet, but it can recognize a flower, follow the stem down, and harvest [9].

Our objective here is to examine the Ecuadorian flower industry and its position in the world flower market. To do so, we analyze the competitive [10–12] advantages of Ecuador's flower exports and those of the other current main flower exporters, i.e., the Netherlands, Colombia, Kenya, and Ethiopia. The latter three, being net exporters of cut flowers, are also direct competitors of Ecuador in the global marketplace. Moreover, the particular situation of Ecuador's competition with Colombia is highlighted since [13], for both countries, the US is the main destination for their flower exports.

This study provides Ecuadorian flower companies with an update on the floriculture sector at the global and national levels, which may be valuable for planning production, investments, and designing and implementing marketing strategies. Additionally, it can be useful as a tool for the Ecuadorian government to deliver a wide range of policies aimed at addressing its economic objectives, which would include measures related to the industry, transport, employment, agriculture, etc.

2. Methods

In the literature, comparative advantage is generally measured using Balassa's methodology [14,15]. For our analysis, we calculated a range of indices, proposed by Balassa, for Ecuador and the five major flower exporting countries (the Netherlands, Colombia, Ecuador, Kenya, and Ethiopia):

One of the indices measured is the relative export advantage (RXA), as shown in Equation (1):

$$RXA = \frac{\frac{X_{ij}}{X_{it}}}{\frac{X_{nj}}{X_{nt}}} \quad (1)$$

where X_{ij} are the exports of product j by country i; X_{it} are the total exports by country i; X_{nj} are the total exports worldwide of product j, and X_{nt} are the world's total exports.

An RXA value higher than 1 reveals that the country under study enjoys a comparative advantage in its exports of product *j*.

The comparative advantage for imports (RMA) is calculated in a similar way, as may be seen in Equation (2). RMA may be interpreted in a symmetric manner to the RXA equation: a country is relatively more vulnerable to the availability of imports of product *j* (compared to its entire economy) when the proportion of product *j* in the country's total imports $\left(\frac{M_{ij}}{M_{it}}\right)$ is larger than the proportion of world imports of product *j* in the world's total imports $\left(\frac{M_{nj}}{M_{nt}}\right)$.

$$RMA = \frac{\frac{M_{ij}}{M_{it}}}{\frac{M_{nj}}{M_{nt}}} \quad (2)$$

where M_{ij} are the imports of product *j* by country *i*; M_{it} are the total imports by country *i*; M_{nj} are the total imports worldwide of product *j*; and M_{nt} are the world's total imports.

The relative trade advantage (RTA) index is calculated from the difference between the import and export comparative advantage indices [16–18] (see Equations (2) and (3)).

$$RTA = RXA - RMA \quad (3)$$

In order to calculate comparative advantage more accurately, another index was developed using the natural logarithm (ln) of the relative advantages of exports and imports (ln RXA and ln RMA) [19]. In this way, the differences among the countries under study may be revealed. The revealed competitiveness (RC) index is obtained by subtracting the relative advantage of imports from that of exports (Equation (4)).

$$RC = lnRXA - lnRMA \quad (4)$$

The RC index expresses a country's business competitiveness and productive performance and provides insight into its degree of export specialization [20,21].

The revealed comparative advantage index (RCA) was developed from the RC index [22]. The RCA index measures a country's comparative advantage over its competitors with regard to the product analyzed. The higher the value of RCA, the greater the comparative advantage. The statistical significance of each value obtained is classified according to the scale proposed by Hinloopen and Van Marrewijk in 2001 [23] (see Table 1). We used Equation (5) which is defined in [11] to calculate the above. It should be noted that by applying the ln to the ratio between the exports of a given product and its imports, a lower value is obtained when it is multiplied with the ratio of exports to the country's total imports:

$$RCA = \ln\left[\frac{X_i}{M_i}\right] x \left[\frac{\sum_{i=1}^{n} X_i}{\sum_{i=1}^{n} M_i}\right] \quad (5)$$

where *Xi* is the exports value; *Mi*, the import value, and index *i* represents the sector.

Table 1. Main flower exporting countries ranking according to their comparative advantage level.

Category a: Comparative disadvantage	0 < RCA index ≤ 1	
Category b: Weak comparative advantage	1 < RCA index ≤ 2	The Netherlands and Ethiopia
Category c: Medium comparative advantage	2 < RCA index ≤ 4	Kenya
Category d: Strong comparative advantage	4 < RCA index	Ecuador and Colombia

Source: Authors' own construction based on publicly available data from [23].

The results of this equation are the RCAs, which shows the revealed comparative advantage (RCA) index scores for the main flower exporters in 2016–2020. They define

the competitiveness of the countries studied. These results are then classified into Table 1, which shows the main flower exporting countries rankings according to their comparative advantage level. This table is based on [23].

Finally, we performed an analysis of variance to find out whether the indices were statistically different. Moreover, the existence of correlations between the trade indices was studied here, as well as the scope of these correlations, which offers information on the degree or level of relationship between the indices. Furthermore, a *t*-test was used to verify whether any statistical differences existed among the five flower exporting countries in terms of the Balassa index [24].

3. Results and Discussion

3.1. Types of Flowers Exported from All the Countries of the World

The 2016–2020 period saw a diversification in the types of flowers exported, where fresh flowers and buds of gypsophila, alstroemeria, aster, gerbera, and hydrangea, accounting for 40% (USD 3.4 billion), roses accounting for 35% (USD 3 billion), and chrysanthemums accounting for 9% (USD 754 million) of the most demanded flowers. These three types of floral products reached 84% of world exports (Table 2).

Table 2. Types of flowers exported worldwide (thousands of USD).

Type of Flower	Value	%
Fresh flowers and buds of gypsophila, alstroemeria, aster, gerbera, and hydrangea	3,433,618	40%
Roses	3,017,702	35%
Chrysanthemums	754,216	9%
Dried, bleached, dyed, impregnated, or otherwise prepared cut flowers and buds	590,503	7%
Carnations	458,247	5%
Fresh cut lilies (*Lilium* spp.) and lily buds of a kind suitable for bouquets or ornamental purposes	215,962	2%
Orchids	199,319	2%
Fresh cut flowers and buds of a kind suitable for bouquets or other ornamental purposes	805	0%
Total exports	8,670,372	100%

Source: Authors' calculation from International Trade Centre (2022).

3.2. Flower Exports of the Main Exporting Countries

Table 3 provides information on the value of exports of the top five flower exporting countries classified by floral product. From the table, it can be seen that average exports of fresh flowers and buds were worth USD 3.4 billion over the period under study. The table also shows how these five countries alone constitute about 90% of world exports of the two main floral products: fresh flowers and buds of gypsophila, alstroemeria, asters, gerbera, hydrangea, and roses. Taking both products together, Dutch exports account for almost 50% of the market, the remainder being shared by the other four exporters, i.e., Colombia, Ecuador, Kenya, and Ethiopia.

Table 3. Main flower exporting countries ranking according to their comparative advantage level (thousands of USD).

Country	Value	Fresh Cut Flowers and Buds [1]	Country	Value	Roses
The Netherlands	1,967,057	57%	The Netherlands	1,209,837	40%
Colombia	702,016	20%	Ecuador	608,811	20%
Ecuador	181,195	5%	Kenya	458,460	15%
Kenya	85,645	2%	Colombia	319,909	11%
Ethiopia	24,116	1%	Ethiopia	170,981	6%
Total of the five exporting countries	2,960,028	86%	Total of the five exporting countries	2,767,997	92%

Source: Authors' calculation from International Trade Centre (2022). [1] Fresh flower and buds of gypsophila, alstroemeria, aster, gerbera, and hydrangea.

Thus, it is evident that the world's demand for flowers is basically oriented toward two types of products, namely fresh flowers and buds, as well as roses. Both the Netherlands and Colombia are present with these two products in the global flower market, while Ecuador, Kenya, and Ethiopia are specialized in only one of them, namely roses.

3.3. Types of Flowers Exported from Ecuador

In the 2016–2020 period, the flower export structure was as follows: roses 73% (USD 609 million), fresh flowers and buds of gypsophila, alstroemeria, aster, gerbera, and hydrangea, with 22% (USD 181 million), dried, bleached, dyed, impregnated, or otherwise prepared cut flowers and buds 2% (USD 19 million), carnations 2% (USD 17 million), chrysanthemums 1% (USD 6 million). Two types of floral products reached 95% of Ecuador's flower exports (Table 4).

Table 4. Types of flowers exported from Ecuador (thousands of USD).

Type of Flower	Value	%
Roses	608,811	73%
Fresh flowers and buds of gypsophila, alstroemeria, aster, gerbera, and hydrangea	181,195	22%
Dried, bleached, dyed, impregnated, or otherwise prepared cut flowers and buds	19,107	2%
Carnations	17,167	2%
Chrysanthemums	6207	1%
Fresh cut lilies (*Lilium* spp.) and lily buds of a kind suitable for bouquets or ornamental purposes	2121	0%
Orchids	344	0%
Fresh cut flowers and buds of a kind suitable for bouquets or other ornamental purposes	5	0%
Total exports	834,647	100%

Source: Authors' calculation from International Trade Centre (2022).

Rosas are the main export product of Ecuador, and it is for this reason that other types of flowers were not considered for the analysis (Table 4).

3.4. Comparative Advantage of Ecuador's Flower Exports

The index or Balassa index, also known as the revealed comparative advantage (RCA), is a measure used to study the comparative advantage of a country in producing certain goods and services in relation to other countries. It is calculated by comparing the share of a country's exports of a particular product to the share of the world's total exports of the same product.

The RCA helps to identify the products that a country has a comparative advantage in producing and exporting, as opposed to those products where it has a disadvantage. This information is useful for policymakers, businesses, and investors in making decisions about trade and investment.

There are several reasons why the RCA is a useful tool for studying comparative advantages. Firstly, it provides an objective and quantitative measure of a country's comparative advantage, which can be compared across countries and over time. Secondly, it can help to identify areas where a country has a potential for growth and development, as well as areas where it may be losing its competitive edge.

Thirdly, it can inform trade negotiations and policy decisions, as policymakers can use the information to promote exports of products where the country has a comparative advantage, and to negotiate for better market access for these products in other countries. Finally, it can also help to identify areas where a country may need to improve its competitiveness through investments in technology, infrastructure, and human capital.

Overall, the index or Balassa index (RCA) is a valuable tool for understanding the competitive position of a country in the global market and for making informed decisions about trade and investment.

In order to perform the analysis of the world flower market, we used production, export, and import data for the period from 2016 to 2020 from the United Nations Comtrade

and the International Trade Centre (ITC). Here, we focus on the relative market share and global distribution of floral products, their evolution and medium-term trends, as well as on the main exchange areas (exports and imports).

In the cases of Ecuador and Colombia, the value of the Balassa index (see Equation (5)) was higher than 4, and in both countries, the value of their flower exports can be considered significant compared to their value of imports, which was low. Ecuador and Colombia are net exporters of flowers, and the index results evidence their strong comparative advantage.

Table 5 shows the RCA indices for the studied countries: the Netherlands, Colombia, Ecuador, Kenya, and Ethiopia. The Dutch RCA index varies within a range from 1 to 2, placing the Netherlands at a weak comparative advantage. Colombia obtained an RCA index value greater than 4 in 60% of the years analyzed, which puts this country in the 'strong comparative advantage' category. Overall, Ecuador has an RCA index that is higher than 4. Ecuador's score of greater than 4 is similar to Colombia's. Therefore, both countries are net exporters of flowers, and their ratio of total exports to total imports is close to one. Regarding the two African countries studied and based on the data provided in Table 4, Kenya comes into the 'medium comparative advantage' category since the RCA index calculated for this country is within the range of 2–4, and the results for Ethiopia suggest it is at a weak comparative advantage because the RCA index value obtained lies within the 1–2 range.

Table 5. Revealed comparative advantage (RCA) index scores for the main flower exporters in 2016–2020.

	RCA				
Year	**The Netherlands**	**Colombia**	**Ecuador**	**Kenya**	**Ethiopia**
2016	1.60	3.63	12.09	4.30	1.37
2017	1.66	4.41	12.43	3.75	1.81
2018	1.66	4.48	8.65	3.59	1.88
2019	1.66	4.37	7.93	3.26	1.72
2020	1.61	3.81	10.79	3.87	1.61

Source: Authors' calculation from International Trade Centre (2022). Note: revealed comparative advantage (RCA) index.

Taking into account the scores provided in Table 5, and according to [23] Hinloopen and Van Marrewijk's scale (2001), Ecuador and Colombia, both having RCA index values higher than 4, are positioned in the countries' RCA rankings (Table 1) in the 'strong comparative advantage' category.

Kenya's Balassa index score falls into the 'medium comparative advantage' category, i.e., 2 < RCA Index $\leq$ 4 (Table 5). The difference with Ecuador lies in the fact that, in spite of both countries being net exporters of flowers, the ratio between total exports and imports varies in each case: the number of total exports and total imports of Ecuador are the same, while in the case of Kenya, its total imports far exceed its total exports.

As for the Netherlands and Ethiopia, these countries obtained an index value in the low interval (1 < RCA index $\leq$ 2), which indicates they have a weak comparative advantage. However, even if both countries are situated at the same level, their contexts are quite different. For instance, the Netherlands' volume of flower exports is the largest of the five flower exporting countries considered. The same is true of its level of flower imports, which is also among the highest (with regard to the other countries). This leads to the Dutch index obtaining a value of about 1.3. Additionally, its total exports exceed its total imports, and when multiplying both factors, an index value of 1.12 is obtained, meaning its Balassa index is between 1 and 2.

In the case of Ethiopia, its value of flower exports places it in the fifth position of the ranking, whereas its value of flower imports is almost zero. For this reason, if we use the first part of equation X, we obtain a value of about 8. However, when its total exports are divided by its total imports, the exports represent only 20% of the value of imports.

Consequently, when multiplying both terms, a Balassa index of less than 2 is obtained, which is why this country is classified in the 'weak comparative advantage' category.

3.5. Statistical Validation of the Results

The information in Table 6 shows the descriptive statistics of the estimates for Ecuador's relative export advantage, relative import advantage, relative trade advantage, revealed competitiveness, and Balassa indices. The highest average value was achieved with the relative export advantage index ($\overline{RXA}$ 86.01), which indicates a highly positive trade advantage.

Table 6. Descriptive statistics for Ecuador's flower export indices (RXA, RMA, RTA, RC, and RCA) from 2016–2020.

Indices	No.	Minimum	Maximum	Average	Standard Deviation	Coefficient of Variation
RXA	5	81.81	92.56	86.01	4.70	0.05
RMA	5	0.00	0.03	0.01	0.01	1.31
RTA	5	81.77	92.56	86.00	4.71	0.05
RC	5	7.89	12.91	10.18	2.02	0.20
RCA	5	7.93	12.43	10.38	2.02	0.19

Source: Authors' calculations from International Trade Centre (2022). Note: RXA: relative export advantage; RMA: relative import advantage; RTA: relative trade advantage; RC: revealed competitiveness; RCA: revealed comparative advantage.

The average value of the relative import advantage index ($\overline{RMA}$ = 0.01) was low, since Ecuador is not a flower-importing country. At the same time, we obtained a high average value in the relative trade advantage index ($\overline{RTA}$ = 86.00). This index essentially originates from RXA (Equation (1)), which is why the values of these two indices (RXA and RTA) are almost equal.

The average value of the revealed competitiveness index ($\overline{RC}$ = 10.18) indicates the strong comparative advantage Ecuador enjoys in the world floriculture industry, which is also confirmed by the average revealed comparative advantage value obtained ($\overline{RCA}$ = 10.38). The coefficient of variation, nevertheless, showed a larger relative dispersion (uncertainty) for the revealed competitiveness (CVRCA = 0.20) and Balassa indices (CVRCA = 0.19) with respect to the relative export advantage (CVRXA = 0.05) and the relative trade advantage (CVRTA = 0.05).

3.5.1. Analysis of Variance (ANOVA)

As the next step in our study, we carried out an analysis of variance (ANOVA) for Ecuador from 2016–2020. This analysis was performed in order to statistically validate the results obtained for all of the indices calculated. The F value obtained was 905.58, higher than its critical value, which was 2.87. Thus, the null hypothesis was rejected, and the indices' values are statistically different on account of Ecuador being a net flower exporter and because this country hardly imports any flowers.

3.5.2. Pearson's Correlation Analysis

Additionally, Pearson's correlation analysis [25] was conducted to measure the strength of the linear relationships between the pairs of the calculated indices. These correlations can either be negative or strong positive, moderate positive, or weak positive. On performing the analysis, two pairs of indices with a strong positive correlation were attained, as well as three pairs with a strong negative correlation (Table 7).

Table 7. Pearson's correlation test for Ecuador's indices.

		Pearson's Correlation Test				
		RXA ECU	**RMA ECU**	**RTA ECU**	**RC ECU**	**RCA ECU**
RXA ECU	Pearson's correlation	1.00	−0.79	1.00 **	0.87	0.82
	Sig. (two tailed)		0.11	0.00	0.06	0.09
	N	5	5	5	5	5
RMA ECU	Pearson's correlation	−0.79	1	−0.80	−0.88	−0.88 *
	Sig. (two tailed)	0.11		0.11	0.05	0.05
	N	5	5	5	5	5
RTA ECU	Pearson's correlation	1.00 **	−0.80	1.00	0.87	0.82
	Sig. (two tailed)	0.00	0.11		0.06	0.09
	N	5	5	5	5	5
RC ECU	Pearson's correlation	0.87	−0.88	0.87	1.00	0.913 *
	Sig. (two tailed)	0.06	0.05	0.06		0.03
	N	5	5	5	5	5
RCA ECU	Pearson's correlation	0.82	−0.88 *	0.82	0.913 *	1.00
	Sig. (two tailed)	0.09	0.05	0.09	0.03	
	N	5	5	5	5	5

Source: Authors' calculations from International Trade Centre (2022). Notes: * The correlation is significant at the 0.05 level (two-tailed). ** The correlation is significant at the 0.01 level (two-tailed).

3.5.3. Analysis of Variance (ANOVA)

We applied ANOVA to establish whether there were any statistical differences among the Balassa indices of the five countries analyzed. Given that the F value computed was 72.43, i.e., higher than the critical value of 2.87, we rejected the null hypothesis, which means that the Balassa indices are statistically different. The reason why they are not the same is because the values of the flower exports and imports and the values of total exports of each country are different, and therefore, do not have the same relationship.

3.5.4. *t*-Test

By means of a *t*-test (Table 8), statistically significant differences were also found between Ecuador's levels of comparative advantage of exports and those of the other four competing countries. Hence, Ecuador's Balassa index is not equal to that of the Netherlands ($\alpha = 0.00$), neither to Colombia's ($\alpha = 0.00$), Kenya's ($\alpha = 0.00$), nor Ethiopia's ($\alpha = 0.00$). When reviewing the country pairs, it is observed that in the case of the Netherlands versus Ethiopia ($\alpha = 0.63$) and of Kenya versus Colombia ($\alpha = 0.31$), their Balassa indices are statistically equal. This can be explained by the fact that the Netherlands and Ethiopia have an equal level of weak comparative advantage and that Kenya and Colombia have a similar ratio of flower exports to flower imports.

Table 8. Paired sample *t*-test for the RCA indices of Ecuador, the Netherlands, Colombia, Kenya, and Ethiopia from 2016–2020.

		Mean	**Standard Deviation**	**Mean Standard Error**	**Lower Limit**	**Upper Limit**	**t**	**df**	**Sig. (Two-Tailed)**
Pair 1	RCA ECU-RCA NL	8.74	2.03	0.91	6.22	11.26	9.61	4	0.00
Pair 2	RCA ECU-RCA COL	6.24	2.24	1.00	3.45	9.02	6.22	4	0.00
Pair 3	RCA ECU-RCA KE	6.62	1.73	0.77	4.48	8.77	8.57	4	0.00
Pair 4	RCA ECU- RCA ET	8.70	2.12	0.95	6.07	11.33	9.19	4	0.00
Pair 5	RCA NL-RCA COL	−2.50	0.36	0.16	−2.95	−2.05	−15.52	4	0.00
Pair 6	RCA NL-RCA KE	−2.12	0.41	0.18	−2.62	−1.61	−11.62	4	0.00
Pair 7	RCA NL-RCA ET	−0.04	0.17	0.08	−0.26	0.18	−0.51	4	0.63
Pair 8	RCA COL-RCA KE	0.39	0.74	0.33	−0.53	1.30	1.17	4	0.31
Pair 9	RCA COL-RCA ET	2.46	0.21	0.10	2.20	2.73	25.77	4	0.00
Pair 10	RCA KE-RCA ET	2.08	0.55	0.25	1.39	2.76	8.45	4	0.00

Source: Authors' calculations from International Trade Centre (2022). Note: RCA: revealed comparative advantage; t: test statistic; df: degrees of freedom; COL: Colombia; ECU: Ecuador; ET: Ethiopia; KE: Kenya; NL: The Netherlands.

Previous lines suggest that Ecuador primarily exports flowers and imports very few flowers. In comparison to other countries, Ecuador has a lower RCA index, with the highest RCA index being found in another country. Colombia and Kenya followed with lower RCA indices than the top-performing country (Figure 1).

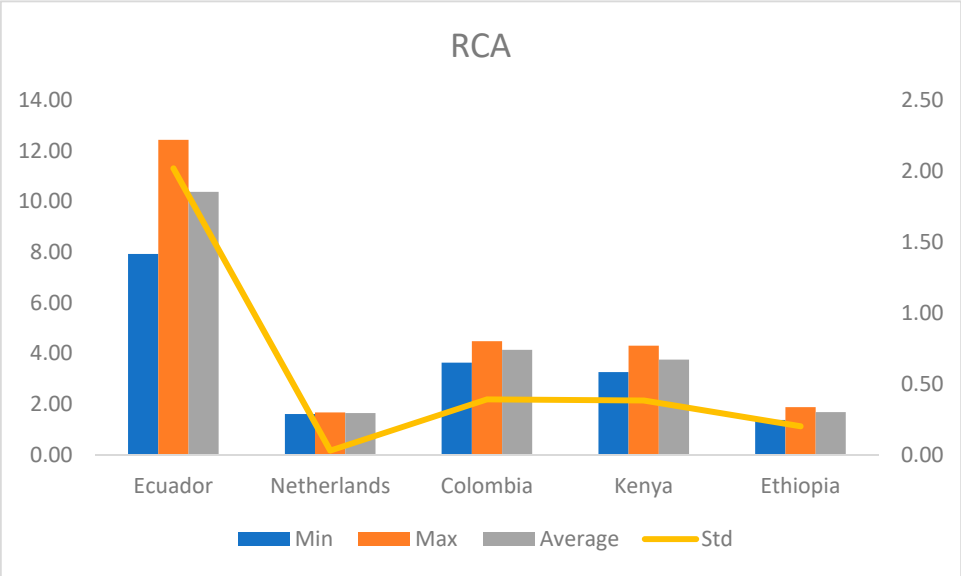

Figure 1. Main statistical characteristics (Min, Max, Average, Std) for the RCA indices of Ecuador, the Netherlands, Colombia, Kenya, and Ethiopia from 2016–2020. Source: Authors' calculations from International Trade Centre (2022).

3.6. Logistics Performance Index

Finally, to be able to frame the whole market situation for each of the countries under study and describe Ecuador's position, the logistics performance (LPI) and global competitiveness indices were considered. The LPI measures six dimensions: customs, infrastructure, international shipments, quality of logistics services, tracking and tracing, and timeliness of the delivery [26].

In 2018, Ecuador occupied the 70th position in the global LPI ranking and according to this index, it ranks third among the countries analyzed in this article. With a view to enhancing its logistics performance, Ecuador should improve in all these aspects, which would have a direct impact on its relative export advantage and Balassa index [26].

3.7. Global Competitiveness Index

Regarding the global competitiveness index, its parameters are grouped into 12 pillars: institutions, infrastructure, ICT adoption, macroeconomic stability, health, skills, product market, labor market, financial system, market size, business dynamism, and innovation capability.

The 2017–2018 global competitiveness index report ranks Ecuador 97th out of all countries worldwide and 4th with respect to the other main exporters of cut flowers. It also shows a decline in three components of the index as compared to the previous period from 2016–2017: in the basic requirements subindex, Ecuador drops from position 81 to position 87; in the efficiency enhancers subindex, it loses three positions, going from position 95 to 98, and in the innovation factors subindex, it falls from position 102 to 110 [27]. An overall improvement of this index would have a positive effect on Ecuador's results in the relative export advantage, relative trade advantage, revealed competitiveness, and Balassa indices.

4. Conclusions

Most cut flower exports from Ecuador are destined for three countries: the United States, Russia, and the Netherlands. In the period from 2016–2020, cut flower purchases

from these three countries accounted for 68% of Ecuador's flower exports. During that period, the Ecuadorian flower industry's dependence on exports to these three countries caused their value to drop, because in 2015 Ecuador's flower trade with Russia fell dramatically. Moreover, by 2020, it had still not been able to recover its previous levels of exports to Russia, nor those to the US or the Netherlands.

The largest market for cut flowers is the European Union, with a 60% share worldwide over the 2016–2020 period. However, Ecuador's presence in the EU flower market barely surpasses 4%. This forces Ecuador to rethink its marketing strategy for this market. Here, a complete overview of its production potential and the global flower demand is presented, providing Ecuadorian entrepreneurs and the government with a broader insight into the cut flower industry and its outlook, which can help develop policies that would encourage economic growth in the sector.

Therefore, Ecuador should currently adopt the following marketing strategies:

1. Market development. Ecuador should work on positioning its floral products in the EU marketplace, which is currently the major cut flower market in the world.
2. Related diversification. Ecuador should expand its production of cut flowers to other varieties such as chrysanthemums, carnations, lilies, orchids, and other fresh flowers and buds, which are currently demanded in the global market.

The Ecuadorian floriculture sector should seek to sign partnerships with universities currently training their faculty in different doctoral programs worldwide. University teachers can conduct ongoing studies and research, which would support and help the sector to maintain and increase its growth rate.

This study showed a correlation between the relative export advantage and the relative trade advantage, as well as between the revealed competitiveness and Balassa indices, which led us to conclude that any kind of growth in flower exports would have a positive effect on the comparative advantage of Ecuador's exports [28] resulting in its increase.

To optimize its comparative advantage in the exportation of cut flowers, Ecuador has to significantly improve its logistics performance and competitiveness in all of its product lines. Ecuador's direct competitors, Kenya and Ethiopia, are in a similar position as far as these two indices are concerned, and this is clearly an opportunity for Ecuador.

Ecuador's position in the logistics performance index ranking shows it is lagging behind in this respect. In fact, its score is far from being the best one. This points to the need for Ecuador to work jointly with control agencies and the productive sectors in order to climb the rankings since managing logistics effectively is key to selling any product abroad.

As reported by the global competitiveness index (GCI), Ecuador is among the last of the Latin American countries, which is especially worrying, given that Ecuador was ranked 91st in the 2016–2017 GCI report and only one year later, it had fallen to the 97th position. This is a clear indication of a setback in Ecuador's competitiveness. Indeed, Ecuador has lost ground in three components of the index: basic requirements, efficiency enhancers, and innovation factors, and these results call for the government and productive sectors to work together in order to improve each of the pillars that make up the competitiveness index.

Author Contributions: Conceptualization, I.M.-P. and I.G.-P.; methodology, I.G.-P.; software, L.O.R.-M.; validation, I.G.-P., formal analysis, L.O.R.-M.; investigation, L.O.R.-M.; resources, L.O.R.-M.; data curation, L.O.R.-M.; writing—original draft preparation, L.O.R.-M.; writing—review and editing, I.M.-P. and I.G.-P.; visualization, I.G.-P.; supervision, I.M.-P.; project administration, I.M.-P. All authors have read and agreed to the published version of the manuscript.

Funding: The translation has been funded by Facultad de Administración y Dirección de Empresas (Universitat Politècnica de València).

Institutional Review Board Statement: Not applicable.

Informed Consent Statement: Not applicable.

Data Availability Statement: ITC TRADE MAP Trade statistics for international business development (https://www.trademap.org/Country_SelProduct_TS.aspx?nvpm=1%7c%7c%7c%7c%7c%7c0603%7c%7c%7c4%7c1%7c1%7c2%7c2%7c1%7c2%7c1%7c%7c1/ accessed on 9 June 2022).

Conflicts of Interest: The authors declare no conflict of interest.

References

1. International Trade Centre. List of Exporters for the Selected Products (Flowers and Buds, Cut for Bouquets or Decorations, Fresh, Dried, Bleached, Dyed, Impregnated . . .). Available online: https://www.trademap.org/Index.aspx (accessed on 9 June 2022).
2. Ahmed, J.U.; Linda, I.J.; Majid, M.A. Royal FloraHolland: Strategic Supply Chain of Cut Flowers Business. In *Royal FloraHolland: Strategic Supply Chain of Cut Flowers Business*; SAGE Publications: Thousand Oaks, CA, USA, 2018; pp. 1–15. Available online: https://www.researchgate.net/publication/324433058_Royal_FloraHolland_Strategic_Supply_Chain_of_Cut_Flowers_Business (accessed on 18 August 2021). [CrossRef]
3. Jia, Q.; Wang, F.; Liu, Q. Growing of floricultural industry in China. *Acta Hortic.* **2016**, *1129*, 85–94. Available online: https://www.ishs.org/ishs-article/1129_12 (accessed on 27 August 2021). [CrossRef]
4. Bhagat, A.; Badgujar, C.; Bhosale, S.; Supe, V. An economics analysis for export of fresh cut rose flowers from India. *J. Pharmacogn. Phytochem.* **2019**, *8*, 291–298. Available online: www.phytojournal.com (accessed on 22 August 2021).
5. Van Liemt, G. *The World Cut Flower Industry: Trends and Prospects*; International Labour Office: Geneva, Switzerland, 1999; ISBN 92-2-111713-8.
6. Universidad San Francisco de Quito. Primer Panel Anual Sobre Desafíos Empresariales: Productividad 2018. Debate Sobre los Sectores Textil, Florícola y Software. Available online: https://www.flickr.com/photos/usfq1/albums/72157697364935470 (accessed on 21 February 2020).
7. Neefjes, H. Floribusiness. Edition 2. May 2022. Available online: https://digital.floribusiness.com/floribusiness-edition-2-2022/ (accessed on 2 March 2023).
8. Pater, S. Floribusines. Edition 3. July 2022. Available online: https://digital.floribusiness.com/floribusiness-edition-3-2022/ (accessed on 2 March 2023).
9. Sleegers, J. Floribusiness. Edition 1. February 2021. Available online: https://digital.floribusiness.com/floribusiness-edition-1-2021/ (accessed on 2 March 2023).
10. Alghamdi, S. A Review of Blood Delivery for Sustainable Supply Chain Management (BSCM). *Sustainability* **2023**, *15*, 2757. [CrossRef]
11. Idris, Z.; Ismail, N.; Ibrahim, S. Comparative Advantage and Competitiveness of COVID-19-Related Medical Products Exporters. *J. Compet.* **2022**, *14*, 61–79. [CrossRef]
12. Sergi, B.; D'Aleo, V.; Konecka, S.; Szopik-Depczynska, K.; Dembinska, I.; Ioppolo, G. Competitiveness and the Logistics Performance Index: The ANOVA method application for Africa, Asia, and the EU regions. *Sustain. Cities Soc.* **2021**, *69*, 102845. [CrossRef]
13. Rodriguez, L.; Guaita-Pradas, I.; Marques-Perez, I. Measuring the Supply Chain Performance of the Floricultural Sector Using the SCOR Model and a Multicriteria Decision-Making Method. *Horticulturae* **2022**, *8*, 168. [CrossRef]
14. Balassa, B. Trade liberalization and revealed comparative advantages. In *The Manchester School*; Wiley Online Library: Hoboken, NJ, USA, 1965; Volume 33, pp. 99–123. [CrossRef]
15. Fojtíková, L. China's trade competitiveness in the area of agricultural products after the implementation of the world trade organization commitments. *Agric. Econ.* **2018**, *64*, 379–388. [CrossRef]
16. Ignjatijevic, S.; Cavlin, M.; Dordevic, D. Measurement of comparative advantages of processed food sector of Serbia in the increasing the export. *Econ. Agric.* **2014**, *61*, 677–693. Available online: https://ageconsearch.umn.edu/record/186519/ (accessed on 27 August 2021). [CrossRef]
17. Pocol, C.; Ignjatijevic, S.; Cavicchioli, D. Production and Trade of Honey in Selected European Countries: Serbia, Romania and Italy. *Honey Anal.* **2017**, *1*, 3–26. Available online: https://www.intechopen.com/chapters/53417 (accessed on 2 September 2021). [CrossRef]
18. Algieri, B.; Aquino, A.; Succurro, M. International competitive advantages in tourism: An eclectic view. *Tour. Manag. Perspect.* **2018**, *25*, 41–52. Available online: https://www.sciencedirect.com/science/article/pii/S2211973617301162#:~:text=The%20presence%20of%20a%20competitive,competitors%20and%20realize%20stronger%20revenues (accessed on 21 August 2021). [CrossRef]
19. Vollrath, T. A theoretical evaluation of alternative trade intensity measures of revealed comparative advantage. *Weltwirtschaftliches Arch.* **1991**, *127*, 265–280. [CrossRef]
20. Bojnec, Š.; Ferto, I. Agri-food comparative advantages in the European Union Countries by value chains before and after enlargement towards the east. *Agraarteadus* **2019**, *30*, 69–77. Available online: https://www.researchgate.net/publication/338177646_AGRIFOOD_COMPARATIVE_ADVANTAGES_IN_THE_EUROPEAN_UNION_COUNTRIES_BY_VALUE_CHAINS_BEFORE_AND_AFTER_ENLARGEMENT_TOWARDS_THE_EAST (accessed on 23 August 2021). [CrossRef]

21. Liu, B.; Gao, J. Understanding the non-Gaussian distribution of revealed comparative advantage index and its alternatives. *Int. Econ.* **2019**, *158*, 1–11. Available online: https://www.sciencedirect.com/science/article/pii/S2110701718302130 (accessed on 28 August 2021). [CrossRef]
22. Gnangnon, S.K. Comparative Advantage Following (CAF) development strategy, Aid for Trade flows and structural change in production. *J. Econ. Struct.* **2020**, *9*, 1. Available online: https://journalofeconomicstructures.springeropen.com/articles/10.1186/s40008-020-0177-8 (accessed on 26 August 2021). [CrossRef]
23. Hinloopen, J.; Van Marrewijk, C. On the Empirical Distribution of the Balassa Index. *Weltwirtschaftliches Arch.* **2001**, *137*, 1–35. Available online: https://link.springer.com/article/10.1007/BF02707598 (accessed on 26 August 2021). [CrossRef]
24. Lind, D.; Marchal, W.; Wathen, S. *Statistical Techniques in Business & Economics*, 17th ed.; McGrawHill: Mexico City, Mexico, 2019; ISBN 978-1-4562-7215-9.
25. Calvi, M.; Urcola, H.; Cabrini, S.; Chávez, M. Structural and technological changes in cattle production in central-south Corrientes, Argentina, between 2005 and 2015. *Anim. Sci. Agro-Cienc.* **2019**, *35*, 115–125. [CrossRef]
26. Arvis, J.; Ojala, L.; Wiederer, C.; Shepherd, B.; Raj, A.; Dariabayeva, K.; Kiiski, T. The Logistics Performance Index and Its Indicators. 2018. In *Connecting to Compete 2018*; The International Bank for Reconstruction and Development, The World Bank: Washington, DC, USA, 2018.
27. Schwab, K. *The Global Competitiveness Report 2018*; World Economic Forum: Geneva, Switzerland, 2018; Volume 671, ISBN 978-92-95044-76-0.
28. Bartilol, M.; Keror, S.; Yego, H. Kenya's Export of Cut Flowers to the European Union: A Constant Market Share Analysis. *Int. J. Res. Innov. Soc. Sci.* **2019**, *III*, 2454–6186. Available online: https://www.researchgate.net/publication/332413595_Kenya\T1\textquoterights_Export_of_Cut_Flowers_to_the_European_Union_A_Constant_Market_Share_Analysis (accessed on 22 August 2021).