
Factors That Determine International Competitiveness of Agricultural Products in Latin America 1990-2020

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Abstract: Agriculture has played a crucial role in the economy and the development of many countries. Moreover, the basic needs for human survival are; food, shelter and cloth are link on agricultural production. Most developed countries see that agriculture provides them with food and raw materials for different goods such as (shelter, medicine, fuel and clothing) which has led to increase in incomes, livelihoods and standard of living. This study aimed at analysing the relationship between International competitiveness of agricultural products, with area, fertilizer, labour force, economic growth, foreign direct investment, exchange rate and inflation rate in Latin America during the period of 1991-2019. In this study, panel data econometric method was used, as well as cross-section dependence (Pesaran test), unit root (cross-section Augmented Dickey Fuller and Cross-sectional Im, Pesaran, and Shin tests), cointegration (Pedroni and Fisher-Johansen tests), and heterogeneous causality (Pedroni and Fisher-Johansen tests) (Hurlin and Dumitrescu test). The results reveal that the model has cross-sectional dependency and that they are integrated at one I (1). The "fully modified OLS and dynamic OLS estimators" were used to examine the existence of a long-term relationship and it was found that a long-term relationship existed between the selected variables. The study revealed a positive significant relationship between International Competitiveness of the agricultural raw material and area, fertilizer, labour force, economic growth, foreign direct investment, while international competitiveness has negative relationship with exchange rate, and inflation. The economy policy recommendations deduced from this investigation is that Foreign Direct Investment and labour force have a positive contribution to the increase of International Competitiveness of agricultural products.

Keywords: Revealed Comparative Advantage, Agricultural Products, Area, Fertilizer, Economic Growth, Granger Causality, Panel Unit Root

1. Introduction

Several investigations have shown that international competitiveness is a vital process for a country to improve its economy. How the industrial organization in a country manages, its competitiveness can affect the growth and development of a country's economy. A country needs to achieve international competitiveness because the economic environment is changing rapidly, and this change is characterized by phenomena such as globalization. For a country to compete successfully in this era, it must improve its international competitiveness and assess the determinants/sources of its international competitiveness [29].

Competitiveness is an indicator that helps with the supply of goods and services to buyers at an affordable price and good quality than other suppliers. These two factors have the most impact on sales volume; however, additional activities like as market research, advertising, customer interactions, sales networks, and customer service also contribute to competitiveness [18].

Competitiveness can be either international or national. It can be on domestic products or products going into the international market. For a country or industry to gain/maintain market shares and compete favourably in the market, its needs to employed the production of goods that have the least opportunity cost. The competitiveness of a

product can also be evaluated at market (industry) level. A further differentiation of competitiveness takes place with regard to the spatial dimension of the analysis [18]. Because it is a relative measure, the competitiveness of companies or regions can be compared within a country or between countries. Competitive analyzes can differ in terms of the depth of investigation [19]. This investigation intended to find out the determinant of international competitiveness of agricultural products.

Agriculture is a vital sector in the economy of Latin America. Some of these countries have used agricultural products to enter into the international market, which has boosted their GDP. According to Organic World (2019), the level of agriculture in Latin America will continue to increase due to their large agricultural land area. For example, the Dominican Republic has 159, 000 hectares of land, which is considered a large area for farming and production, Peru has nearly 25, 600 hectares, and Ecuador has more than 15'000 hectares [28].

According to OECD/FAO (2019), Latin American are the major exporters and also major importers of most agricultural products. Latin America has different farm sizes and structures operating with different levels of technology, making it easy for them to involve more in the production system. This achievement has contributed greatly to their income, employment, and trade. Among their biggest exports are soybeans, pork, maize, chicken, animal feed, sugar, coffee, and fruits and vegetables, also Latin America is the leading importer of maize, wheat, soybeans, dairy, pork, and a variety of poultry products [26].

In 2017, Brazil was the largest agricultural and food exporter in Latin America, with over USD 79.3 billion in exportation, followed by Argentina with USD 35.0 billion, Mexico with USD 32.5 billion in agricultural exportation, Chile with over USD 17 billion in exportation, Ecuador with USD 10.4 billion, and Peru with USD 8.8 billion in exportation [26].

However, it can be seen that the largest importer of wheat is also a country in Latin America, Brazil. In order to alleviate poverty in Latin America, several countries increased their work force by 14.1 percent in 2018. The agricultural industry employed the bulk of the labour force in Bolivia, Guatemala, Peru, Ecuador, Honduras, Nicaragua, and Haiti [26]. Argentina, Brazil, and Venezuela are among

the Latin American countries having large areas of land and suitable climates with temperate grassland vegetation for animal grazing [41]. The agricultural industry is said to generate 10% of these nations' GDP (Belize, Bolivia, Dominica, Ecuador, Haiti, and Paraguay) (World Bank, 2019). With increased agricultural activity, the degree of rural poverty in various Latin American nations has been decreased to a minimal advantage of 20% [41; 26].

Most research has not addressed the international competitiveness of agricultural goods and their determining elements in Latin America, despite the fact that Latin America contains numerous nations that are among the world's greatest producers of agricultural products. It can also be seen that the majority of their products are perishable products that spoil quickly if not properly stored, and most of these Latin American countries lack the basic technology to preserve their agricultural products, lack adequate fertilizer, and they have high level of inflation, among other issues. It is surprising that the majority of these agricultural goods cannot make their way to the international market or find it difficult to compete in the international market. Latin America is blessed with various agricultural goods that can solve hunger both within and externally, yet the majority of these nations still suffer from a lack of resources and a low standard of living. The purpose of this research is to identify the factors that influence the international competitiveness of agricultural goods in Latin America.

This study is an effort to further understanding the relationship between revealed comparative advantages of agricultural products, and area, fertilizer, labour force, economic growth, foreign direct investment, and exchange rate and Inflation rate (Figure 1). The GNP categorization index was employed in this study to categorize Latin American nations according to income level criteria, which are divided into three major groups: high income (developed countries), newly rising economies (emerging), and low-income countries (developing). High-income countries have a GNP per capita of \$12,536 or more, whereas lower-middle-income countries have a GNP per capita ranging from \$1,036 to \$4,045. Upper Middle-income economies have GNP per capita ranging from \$4,046 to \$12,535, whereas low-income countries have GNP per capita of \$1,035 or less [41]. In this study, inequality is also characterized as very low, low, medium, high, and very high.

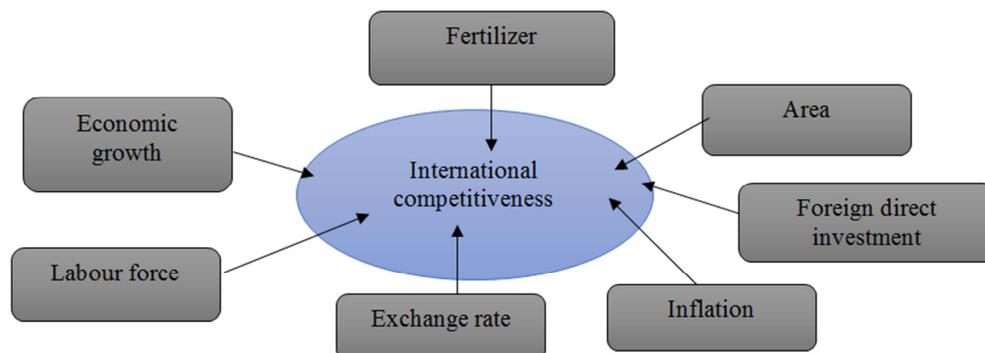


Figure 1. Determinants of Revealed comparative advantages.

This study utilized an updated panel dataset of twenty-one (21) Latin American countries selected from different regions from 1991 to 2019. These countries were selected based on their agricultural exportation level, economic growth rate, agricultural land area, and agricultural production level. It also uses comparative advantages, area, fertilizer, labour force, economic growth, foreign direct investment, exchange rate, and inflation rate in Argentina, Bolivia, Brazil, Cuba, Colombia, Costa Rica, Chile, Dominican Republic, Ecuador, El Salvador, Guatemala, Haiti, Honduras, Mexico, Nicaragua, Panama, Paraguay, Peru, Puerto Rico, Uruguay and Venezuela.

2. Theoretical Literature

According to the OECD (2016), competitiveness is the level of production of goods and services of a country entering international competition, while international competition is a process in which a higher level of competitiveness is achieved at different levels, corporate, regional and national [25]. A country's competitiveness contributes to its capacity to maintain a high level of national income, a favourable position in the global economy, and the ability of a country to establish a business climate in which local enterprises and businesses can compete internationally [36]. Competitiveness is described as a collection of institutions, regulations, and circumstances that influence a country's profitability. Identification of present and potential national economic advantages, as well as understanding the global product market, aids in the creation of comprehensive programs to boost market and product competitiveness and also to create competitive capability in the agriculture sector [42]. As a result, recognizing the importance of agricultural product exports in nations' economies, the relevance of sales and marketing in the various phases of exporting products, and researching the notion of competitive advantage and factors effective in this sector have been discussed [32; 33]. Countries must pay closer attention to market demands and needs in order to obtain a competitive edge and success (consumers). Some economists, such as Adams Smith (Absolute Advantages), David Ricardo (comparative advantage), and Porter (competitive advantage), have studied the benefits of international commerce (comparative

advantage) Economists such as Balassa, Valrass, Heckscher, and Ohlin have made their positions on absolute advantage, natural advantage, and relative advantage [33].

2.1. Comparative Advantages Theory

The Ricardian Model

Comparative advantage refers to an economy's ability to produce a certain item or service at a lower opportunity cost than its trade competitors. The notion of comparative advantage presents opportunity cost as a consideration to look out for when deciding between several production possibilities [35]. Comparative advantage is an economic theory proposed by British economist David Ricardo in 1817. David Ricardo (1817), stated that land, labour, capital, and entrepreneurship are the key sources of a country's comparative advantage [34]. Ireland and China can be used as examples. Ireland has a comparative advantage in cheese and butter due to its climate and wide agricultural land area appropriate for cow raising, whereas China has a comparative advantage in electronics due to its labour availability [19]. A country will export the commodities or services in which it has the greatest comparative advantage and import those in which it has the least comparative advantage, according to the notion of comparative advantage [31].

The phrase "comparative" refers to something that is relative rather than absolute. According to Widodo (2010), the Ricardian model is based on a number of assumptions, including the following [38]:

1. There should be a fixed endowment of (identical) resources,
2. In this model, factors of production are totally movable between different uses inside a country,
3. In this model, factors of production are stationary outside,
4. A labour theory of value 1 is used in this model,
5. The degree of technology is likewise set for both nations.
6. Constant unit costs of manufacturing,
7. Full employment and perfect competition,
8. There are no government-imposed economic constraints,
9. There are no internal or external transportation fees.

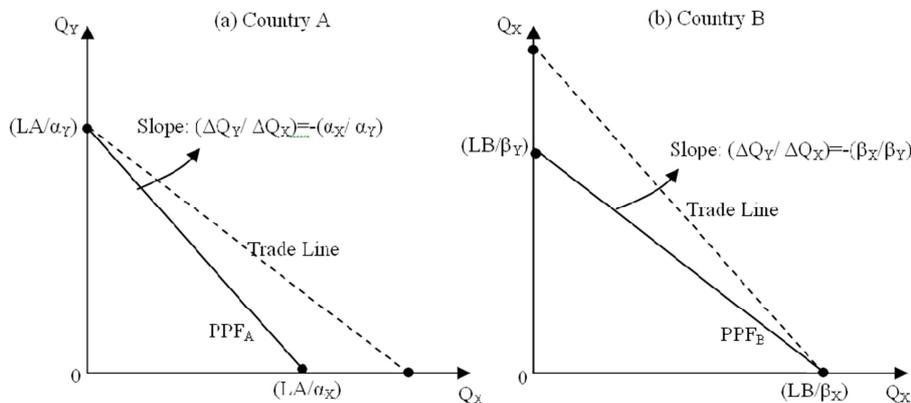


Figure 2. The Ricardian Model (elaboration of Widodo, (2010)) [38].

relative trade results. This model posits that the commodity trade pattern reflects both inter-country disparities in relative costs and non-price variables [17].

$$RCA_{ij} = \frac{\left(\frac{x_{ij}}{\sum x_j} \right)}{\left(\frac{x_j}{\sum x_j} \right)}$$

Where:

RCA = revealed comparative advantage for commodities i

X_{ij} = goods export i by country j

∑X_j = total exports by country j

X_{i World} = world goods export i

∑X_{World} = world total exports

RCA indices suggested by Vollrath (1991).

$$RCA^4_{ij} = \frac{X_{ij}/X_{ik}}{X_{nj}/X_{nk}} - \frac{M_{ij}/M_{nk}}{M_{nj}/M_{nk}}$$

$$RCA^5_{ij} = \ln \left(\frac{X_{ij}/X_{ik}}{X_{nj}/X_{nk}} \right)$$

$$RCA^6_{ij} = \ln \left(\frac{M_{ij}/M_{ik}}{M_{nj}/M_{nk}} \right)$$

Where:

X_{ij} = exports of goods i by country j

X_{ik} = total exports by country j

X_{nj} = world exports of goods i

X_{nk} = total world exports

M_{ij} = imports of goods i by country j

M_{ik} = total imports by country j

M_{nj} = world imports of good i

M_{nk} = total world imports

According to Vollrath (1991), a positive value of RCA_{4ij}, RCA_{5ij} or RCA_{6ij} indicates a comparative advantage, whereas a negative value suggests a comparative disadvantage [37].

$$RCA = (X_{ij}/X_{it}/X_{nj}/X_{nt}) \tag{1}$$

where n is a collection of nations and their respective relative import advantages.

$$RMA = (M_{ij}/M_{it}/M_{nj}/M_{nt}) \tag{2}$$

where m represents imports, then

$$RMA = RXA - RMA \tag{3}$$

Vollrath's second measure is the logarithm of the relative export advantage (lnVER). The third measure revealed competitiveness (CR) is:

$$CR = \ln RXA - \ln RMA \tag{4}$$

The advantage of these last two indices is that they are symmetric at the origin. Positive values of RTA, lnRXA and RC reveal a comparative or competitive advantage. According to Vollrath (1989), one issue with this and other comparable indices is that observable trading patterns are likely to be influenced by government policies and may misrepresent the underlying comparative advantage.

Indices of Revealed Comparative Advantages of Raw Agricultural Material Latin America

ARG is for Argentina; BOL is for Bolivia; BRA is for Brazil; COR stands for Costa Rica; DOM is for the Dominican Republic; CHI is for Chile; ECU is for Ecuador; SAL stands for El Salvador; GUA is for Guatemala; HON stands for Honduras; MEX is for Mexico; NIC is for Nicaragua; PAN stands for Panama; PAR is for Paraguay; PER stands for Peru; URU stands for Uruguay; VEN stands for Venezuela.

Table 1. Indices of Revealed Comparative Advantages Raw Agricultural Material Latin America.

year	ARG	BOL	BRA	CHI	COL	COR	DOM	ECU	SAL	GUAT	HON	MEX	NICA	PAN	PAR	PERU	URU	VEN
1991	0	0	1.38	3.58	2.36			0.43				0.44	0	0	15.73	0	0	0
1992		3.22	1.35	3.86	2.7			0.52			0	0.43	0	0	14.14	1.31	0	0
1993	0.89	4.11	1.35	4.54	2.61		0	0.74	0	1.32	0	0.41	0.75	0	11.91	0	0	0.1
1994	1.21	4.12	1.52	4.52	2.23		0	0.77	0.17	1.33	0.98	0.36	0.72	0	8.79	0.95	1.96	0.06
1995	1.59	4.11	2.05	4.89	1.97	1.48	0	1.11	0.24	1.18	0.65	0.39	0.8	0.12	10.31	1	2.36	0.08
1996	1.7	4.42	1.85	4.31	2.35	1.56	0	1.7	0.18	1.55	0.61	0.38	1.43	0.14	9.4	1.07	2.33	0.1
1997	1.22	5.04	1.9	4.38	2.21	1.69	0	1.85	0.18	1.33	0.61	0.35	0.95	0.17	5.31	1.15	2.36	0.17
1998	1.05	4.18	2.17	4.61	2.39	1.58	0	2.4	0.15	1.22	0.6	0.29	0.73	0.29	5.96	1.08	2.13	0.14
1999	1.16	3.05	2.66	5.7	2.3	1.4	0	2.54	0.14	1.29	0.78	0.26	0.72	0.14	7.12	1.43	2.39	0.15
2000	0.84	2.33	2.89	5.49	1.97	1.19	0	2.19	0.14	0	0.81	0.23	0.61	0.18	7.66	1.47	2.57	0.16
2001	0.81	1.68	2.65	5.66	2.06	1.23	0	2.43	0.17	1.4	0.82	0.23	1.17	0.24	6.75	1.33	2.97	0.15
2002	0.75	1.3	2.77	5.68	2.38	1.46	0.23	2.45	0.19	1.49	0.89	0.24	1.01	0.2	5.29	1.38	3.3	0.14
2003	0.76	1.22	2.82	5.35	2.5	1.34	0.27	2.39	0.19	1.6	0.91	0.22	0.85	0.31	5.02	1.37	3.79	0.11
2004	0.81	1.21	2.83	4.89	2.37	1.04	0.21	2.59	0.23	1.87	1.01	0.24	0.72	0.35	7.32	1.11	4.26	0.07
2005	0.75	1.34	2.81	4.54	2.18	1.08	0.19	2.28	0.24	2.14	1.2	0.26	0.85	0.29	6.15	1.04	4.46	0.07
2006	0.75	1.44	3	3.67	2.37	1.15	0.22	2.38	0.29	2.48	1.19	0.21	0.48	0.33	5.62	0.92	5.9	
2007	0.71	1.58	2.87	4.05	2.42	1.17	0.25	2.86	0.29	2.71	1.1	0.22	0.42	0.28	3.97	0.8	5.7	0.07
2008	0.62	1.13	2.79	4.62	2.07	1.14	0.32	2.55	0.37	3.33	0	0.26	0.39	0.3	2.62	0.89	9.62	0.08
2009	0.73	1.32	2.94	4.97	2.17	1.19	0.51	3.13	0.37	2.59	0.99	0.25	0.41	0.25	2.97	0.89	8.32	0.06

year	ARG	BOL	BRA	CHI	COL	COR	DOM	ECU	SAL	GUAT	HON	MEX	NICA	PAN	PAR	PERU	URU	VEN
2010	0.69	0.97	2.85	3.93	1.82	0.93	0.42	2.64	0.48	2.82	0.82	0.21	0.5	0.35	2.15	0.74	8.54	0.04
2011	0.71	0.68	2.31	3.71	1.26	0.63	0.46	2.25	0.56	3.01	0.78	0.23	0.5	0.56	1.5	0.63	7.27	0.04
2012	0.59	0.46	2.72	4.06	1.28	0.58	0.47	2.28	0.67	3.11	0.87	0.24	1.7	0.58	1.9	0.63	6.21	0.04
2013	0.56	0.34	2.63	4.36	1.38	0.54	0.45	2.21	0.73	3.1		0.22	1.15	0.56	1.31	0.72	7.21	0
2014	0.72	0.36	2.93	4.56	1.67	0.56	0.43	2.49	0.68	2.29	1.01	0.21	0.6	1.53	1.25	0.95	8.1	
2015	0.68	0.49	3.48	4.89	2.18	0.67	0.4	3.21	0.65	2.07	0.96	0.19	0.58	0.9	1.55	0.99	11.99	
2016	0.65	0.53	3.63	5.02	2.57	1.64	0.45	3.83	0.57	1.98	0.96	0.18	0.44	0.94	1.31	0.88	12.9	
2017	0.69	0.5	3.64	5.15	2.53	1.47	0.35	3.8	0.67	2.62	0.96	0.13	0.54	0	1.33	0.8	15.25	

Source: WITS, 2022.

3. Empirical Literature

Cruz-López *et al.* (2022) analyzed the competitiveness of Mexico's avocado from 1995 to 2020 in the world market [29]. The materials and methods used are based on the figures of production, exports and imports of avocado consulted in official sources, and through the calculation of trade competitiveness indicators, specifically the indicators of relative trade balance, tradability indicator, trade dependence coefficient and the degree of export openness. The results obtained reflect that avocado production in Mexico is competitive at the international level.

González Catalán (2021) examined regional competitiveness using a set of comparable regional indicators for Chile, Colombia, and Mexico over the period of 2008-2017 and through a model that separates input competitiveness [12]. The measurement makes it possible to compare regional competitiveness between countries. The results show that the high regions with higher input competitiveness for the period studied make greater progress in competitiveness outcomes and that competitiveness plays an important role in population well-being.

Montaño Méndez, *et al.* (2021) determined the competitiveness of the Mexican red tomato in the international market through the Relative Export Advantage (RXA) and Constant Market Share (CMS) [23]. The Mexican product was determined to be competitive in the US market and to have a high market concentration, with 98 percent of Mexican red tomato exports going to the US.

Kharlamova, and Vertelieva (2013) reviewed the existing theoretical approaches to this phenomenon and the definition of "national competitiveness" as an economic category; they analyzed the factors influencing the level of national competitiveness; they also defined clusters of countries according to their level of relative national competitiveness of Ukraine and 29 other countries from 2004 to 2012. They found that there is a high correlation between competitiveness level and list of factors that can potentially increase/decrease a state's competitive advantages [18].

Ostadi, Hortman, and Mojoudi (2013) investigated the Determination of Competitive Advantage in the Iranian Agricultural Sector Using the TM Index [22]. The purpose of this research was to determine Iran's prospective export capacity based on the competitive advantage of the trade map (TM) in the agriculture sector. Using competitive advantage indicators, the prospective export capabilities of selected

agricultural goods (wheat, lentil, potato, onion, soya, cotton, peas, and maize) were evaluated in this study. According to the conclusions of this study, most of its agricultural goods have a competitive edge.

Latruffe, (2010) reviewed the literature on competitiveness, productivity and efficiency in the agri-food sector [19]. It clarified the concepts and terminology used in this area and provides a critical assessment of the approaches and indicators used in the literature to measure competitiveness, productivity and efficiency at sectoral and farm level. It also reviewed recent evidence on productivity growth, changes in relative competitiveness across subsectors and countries, and the determinants of competitiveness, and identifies key knowledge gaps. This report proposes paying more attention to the food sector, factors of competitiveness other than prices and the impact of government intervention on competitiveness.

Yu-Jie Feng (2008) investigated the problem of evaluating agricultural goods' competitiveness in international trade, which is a critical point in agricultural modernization and international trade [42]. First, an index system for evaluating the competitiveness of agricultural goods in international commerce is defined, consisting of eight indices. He creates an experiment scheme based on the effectiveness of the suggested fuzzy AHP technique and 10 different types of agricultural products. When compared to standard AHP, the suggested technique outperforms it, with the average competitiveness evaluation error rate of our proposed Fuzzy AHP and AHP being 8.3 percent and 5.58 percent, respectively.

Serin and Civan (2008) employed the Revealed Comparative Advantage (RCA) and Comparative Export Performance (CEP) indices to determine the extent to which Turkey has a comparative advantage in the production of tomatoes, olive oil, and fruit juices for the EU market [33].

Lindberg and Surry (2005) investigated the Mediterranean nations' fruit and vegetable trading performance [21]. They used the approaches of Revealed Comparative Advantage and Constant Market Share Analysis. The countries with the greatest Revealed comparative advantage for fruit are claimed to be Morocco, Tunisia, Turkey, and Spain. Spain, Turkey, and Greece are the countries that contribute the most to global exports.

Muaz *et al.* (2004) examined the impact of the Euro-Mediterranean partnership on the agricultural sectors of five southern Mediterranean countries: Jordan, Palestine, Syria, Lebanon and Egypt [24]. In this study, two quantitative techniques were used. Market Analysis and Policy Analysis

Matrix The research revealed that the five nations had a competitive advantage in producing and exporting practically all of the selected products (green beans, tomato, strawberry, sweet melon, sweet pepper, thyme, roses, carnation, grapes).

Kutlu (2004) investigated Turkey's competitiveness versus European countries. The following indices were used: Export Share Index, Revealed Comparative Index, and Net Export Index [35]. Turkey is said to have a competitive advantage in the industries of fruits and vegetables processing, starches and cereals, and confectionery. However, it does not have for the sector of live animals and fodder.

Çakmak (2004) used the inter-industry index on Turkey's agro-food trade [5]. According to the findings, agricultural trade between Turkey and the EU is characterized by a high

and rising level of product overlap, particularly for those categories of commodities exposed to processing before reaching the ultimate consumer.

The study by Fertő and Hubbard (2003) revealed comparative advantages and competitiveness in the Hungarian agri-food sector [11]. They used the four indices to show that Hungary comparative advantage for 11 out of 22 aggregated products, namely live animals, meat, cereals, vegetables.

Gorton et al. (2000) used the revealed comparative advantage (RCA) and domestic resource cost to assess the competitiveness of agricultural output in Bulgaria and the Czech Republic in comparison to foreign markets and the EU (DRC) [13].

Table 2. Empirical review of the Revealed comparative advantages part of the World.

Lebdouli (2019)	A quantitative policy evaluation using the in-difference method	Chile (1960-2017)	It finds that public institutions are essential in overcoming market failures inhibiting the emergence of new industries. and quality control role.
Jayadi and Aziz (2017)	Products mapping using Revealed Symmetric Comparative Advantage (RSCA) and Trade Balance Index (TBI)	Indonesia, Malaysia, Philippines, Singapore, Thailand and Vietnam (1997-2014)	This study's findings were as follows: First, the comparative advantage of six nations increases on average. Second, Thailand and Vietnam appear to have more dynamic comparative advantages and trade balance shifts than the other four nations. Third, six countries compete and complement each other.
Hong, Tran and Bin (2017)	NEI, RCA, RTA, LFI and NRCA to measure comparative advantage. OLS regression and transition matrices to analysis the dynamics of the indicator. To verify the consistency, statistical approaches based on cardinal, ordinal, and dichotomous measurements were used.	Vietnam (1997-2014)	According to the findings, Vietnam is highly competitive in the agriculture and fisheries sectors, but not in the livestock and processed food sectors.
Bonelli and Pinheiro (2015)	Comparative productive advantage, accumulated learning in the domestic market, technology and brand name control	Brazil (1995-2004)	It demonstrates the importance of efficiency gains and sunk costs in export expansion, leading to the following conclusions: both economic policy and comparative advantage were significant in the formation of new export operations; economies of scale were a major factor of competitiveness.
Sachhithra et al. (2014)	Revealed Symmetric Comparative Advantage (RSCA), Trade Balance Index (TBI)	Sri Lanka (2000, 2005 and 2010)	Although Sri Lanka has a comparative advantage in leading exports, it does not contribute significantly to overcoming the negative impact of comparative disadvantage and net import items.
Erkan and Saricoban (2014)	Revealed comparative advantage (RCA) indices for each country concerned are calculated according to the SITC Technology Classification	Turkey and EU+13 countries (1993-2012)	The results show that science-based products have no significant impact on increasing the share of exports from Turkey and EU+13 countries in world trade in general. However, the EU+13 countries' export competitiveness has been increasing after accession to the EU and Turkey's competitiveness is weaker than the EU+13 countries.
Widodo (2010)	Revealed comparative advantage (RCA) and Products mapping	ASEAN countries (1976-2005)	This finding strongly supports the theory of comparative advantage. The revealed comparative advantage (RCA) is a popular metric for measuring a company's competitiveness and advancement.
Mehmood et al., (2012)	Revealed Comparative Advantage (RCA) Balassa (1965) Index	India, Pakistan, Bangladesh and Sri Lanka (2001-2010)	According to the RCA indices, most SAARC countries have a strong RCA in a few areas but a great potential for bilateral or multilateral trade.
Thamiam et al., (2011)	Relative Trade Advantage (RTA), Revealed Comparative Export Advantage (RXA), and Revealed Comparative Advantage (RCA) indices	580 agroforestry items were identified using data from the commerce map at the HS level 6. Based on agricultural origin, the 580 goods were divided into 82 groups. (2001-2008)	Fruit crops (avocado, papaya, citrus, pineapple, cashew, lemon and lime, guava, mango, mangosteen, and durian), tubers (cassava and arrowroot), medicinal plants (ginger and turmeric), cardamom, coffee, mushrooms, Bamboo, Vanilla, Cocoa, and Beans were among the non-traditional exports that proved competitive in the global market, according to the Relative Trade Advantage Index. Cinnamon had the most RXA, RTA, and RCA levels, followed by tea, cloves, coconut, and nutmeg. The major export destinations for the highly competitive items proved to be the United Arab Emirates, France, and Germany.

Hausman and Klinger (2008)	Real Exchange Rate	Peru (1960-2005)	Peru's actual exchange rate is not exceptionally poor for a nation of its income level. The real exchange rate and the labour market rules affect activities across the board. According to a Revealed Competitive Analysis of Mexican Agricultural Exports, Mexico does not have a clear competitive advantage in agricultural and food product production and exports in general. When the RCA analysis is performed at the commodity subgroup level, however, the results show that Mexico may have a clear competitive advantage in vegetables and fruits but not in other key export categories such as animals and animal products or processed food. While Mexico's comparative advantage in animal products appears to be growing, it has been losing its comparative advantage in vegetables during the last decade. Fruit exports from Mexico appear to be maintaining their competitive advantage.
Williams and Malaga (2010)	The Revealed Comparative Advantage methodology	Mexico (1989-2004)	
Mika Widgrén (2004)	The Balassa index of revealed comparative	Asian, American and European	

4. Methodology

4.1. Data

This study uses annual data from 1991 to 2019 for Argentina, Bolivia, Brazil, Colombia, Costa Rica, Chile, Dominican Republic, Ecuador, El Salvador, Guatemala, Honduras, Mexico, Nicaragua, Panama, Paraguay, Peru,

Puerto Rico, Uruguay, and Venezuela on international competitiveness, area, fertilizer, labour force, economic growth, foreign direct investment, and exchange rate and inflation rate. Latin American countries are divided into the following regions:

North America: Mexico; Central America: Guatemala, Honduras, El Salvador, Nicaragua, Costa Rica, and Panamá; South America: Colombia, Ecuador, Peru, and Venezuela.

Table 3. Source of Data.

Variables	Description	Data source
RCA: International competitiveness	Agricultural raw material revealed comparative	WITS
Area	Agricultural land (% of land area)	WDI
FERT: Fertilizer	Fertilizer consumption (Kilogram per hectare of arable land)	FAO
LABF: Labour force	Total labour force	WDI
EGRT: Economic growth	GDP constant dollars of 2010	WDI
FDI: Foreign direct investment	measured by net inflow, % of GDP	WDI
EXCH: Exchange rate	Real effective exchange rate index (2010=100)	WDI
INFLA: Inflation	Inflation, GDP deflator (annual %)	WITS

4.2. Econometric Models

This study considers the use of econometric models to explain the relationship between the selected variables. From the review of different works of literature, this research considers the use of International competitiveness

(RCA) as the dependent variable on Area (ARE), Fertilizer (FERT), Labour force (LABF), Economic growth (EGRT), Foreign Direct Investment (FDI), Exchange rate (EXCH) and Inflation rate (INFLA). The equation is expressed as follows:

$$RCA=f(RCA, ARE, FERT, LABF, EGRT, FDI, EXCH, INFLA)$$

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 + \beta_7 X_7 + \beta_8 X_8 + \mu$$

Where i represent the cross-section (twenty-one countries), t is the data period, u represents the error term. The $\beta_1, \beta_2, \beta_3, \beta_4, \beta_5, \beta_6, \beta_7,$ and β_8 represent coefficients,

It is necessary to acknowledge the use of a cross-sectional dependency test to show the relevance of the panel data. This study uses a cross-sectional dependency test devised by Pesaran (2007) to test the cross-sectional dependency between variables. Panel root test has been discussed among the econometric model gurus as having a higher advantage against the time series unit test. There are different unit root tests commonly use in research; among them is the test of Levin, Lin, and CHU (2002), Im, Pearan, and Shin (2003),

Augmented Dickey-Fuller unit root test (1999). This research uses Cross-sectional Augmented Dickey-Fuller (PESCADF), Pesaran (2007), and Cross-sectional Im-Pesaran-Shin (CIPS) (2002), panel unit root test to test the variables' stationarity.

The most widely used unit roots test with panel data is I (0), I (1) (all one (1), or one (1), and zero (0) or two (2)). A cointegration test is required, and if the variables are cointegrated, another coefficient estimator is required. For this study, all the variables were integrated at I (1), The Pedroni and the Fisher-Johansen cointegration were applied to test for cointegration among the variables. It shows that the variables have at most three variables cointegrated. According to the

econometrics literature, when the variables cointegrate, the OLS model used to estimate the coefficients of panel data models is biased and generates contradictory estimates. The new methods developed to estimate cointegration relationship using data re the FMOL and DOLS estimators. These approximations produce estimators' coefficients that are asymptotically unbiased and normally distributed.

The FMOLS estimator behaves relatively well, generating consistent estimates even in small samples and allowing control of the endogeneity of its regressors and serial correlation. For this reason, this investigation will have both FMOLS and DOLS estimators for cointegrated heterogeneous panels. To generate cross-sectional dependent errors in heterogeneous panels, and the Dmirescu and Hurlin

(2012) test was used in this study.

5. Results and Discussion

5.1. Cross-Section Dependence

Table 4, estimate variables for cross-section dependence. It can be seen that the null hypothesis of non-dependence was rejected for all variables at a significant level of 1% and 5% respectively. The table shows that there is transversal dependency and the variables of each of the countries are correlated with each other. It is important to apply the panel unit root test to test for stationarity among the variables. For this study two test were selected.

Table 4. Pesaran test for cross-sectional dependence.

Variable	RCA	ARE	FERT	LABF	EGRT	FDI	EXCH	INFLA
CD statistic	2.01**	-2.28**	24.8***	59.30***	54.89***	10.26***	3.60***	24.14***
p value	0.044	0.023	0.000	0.000	0.000	0.000	0.000	0.000
Corr.	0.032	-0.035	0.379	0.906	0.839	0.157	0.107	0.369

Notes *** & ** denotes the rejection of the null hypothesis at 1% and 5%
*** & ** $p < 0.000$ & 0.05 .

5.2. Panel Unit Root Test

Table 5, shows the result of the CADF and the CIPS panel unit root test which confirm that the variables are integrated at one I (1). Some of the variables were not stationary at level but became stationary at first difference at 1% significance level.

Table 5. Cross-sectional Augmented Dickey Fuller (CADF) and Cross-sectional Im, Pesaran, and Shin (CIPS) panel unit root test.

Variable	Deterministic Parameters	CADF	CIPS
At level			
RCA	CT	-4.785***	-0.379
ARE	CT	-1.830	-1.802
FERT	CT	-1.916	-3.008***
LABF	CT	-2.059	-2.383
EGRT	CT	-1.192	-1.163
FDI	CT	-2.109	-3.773***
EXCH	CT	-3.053***	1.400
INFLA	CT	-3.232***	
First difference			
RCA	C	-6.860***	-7.709***
ARE	C	-3.328***	-3.442***
FERT	C	-3.456***	-4.585***
LABF	C	-2.842***	-3.672***
EGRT	C	-2.300***	-3.341***
FDI	C	-3.856***	-5.077***
EXCH	C	-5.308***	-5.169***
INFLA	C	-5.228***	-5.888***

Notes *** denotes the rejection of the null hypothesis at 1%
*** $p < 0.000$.

5.3. Panel Cointegration Test

Table 6, demonstrated the findings of the Kao cointegration test. The null hypothesis of non-cointegration at 1% and 5% level of significant are rejected. It shows that there is

cointegration among the regressand and regressors across the different countries selected for the research, and cointegration exist among the selected variables. This indicate that there is long-run relationship among the variables.

Table 6. Results of Kao and Pedroni cointegration test.

Test	t-statistic	p-value
Kao cointegration test		
ADF	-2.455***	0.007
Pedroni cointegration test		
Phillips-Perron	-1.909**	0.028
Argumented Dickey-Fuller	-2.762***	0.002

Notes *** & ** denotes the rejection of the null hypothesis at 1% and 5%
*** & ** $p < 0.000$ & 0.05 .

Table 7. Results of Fisher-Johansen cointegration test.

Null Hypothesis	Trace test	Max-Eigen Test
R=0	250.4***	125.1***
R≤1	485.8***	266.9***
R≤2	377.2***	211.7***
R≤3	236.6***	139.2***
R≤4	162.6***	93.3***
R≤5	96.85***	62.22

Notes *** & ** denotes the rejection of the null hypothesis at 1% and 5%
*** & ** $p < 0.000$ & 0.05 .

Table 8, demonstrated the findings of the estimation of the long run coefficients with FMOLS and DOLS. It can be seen that in the long the run of FMOLS, an increase in area, fertilizer, labour force, economic growth and foreign direct investment at 3.49%, 2%, 3.21%, 5.02%, and 14% respectively will bring about increase in the international competitiveness of agricultural products in Latin America, while an increase in inflation and exchange rate at 8%, and 41% respectively, will lead to decrease of the international competitiveness of agricultural products in Latin America.

It can be seen that in the long run of FMOLS, an increase in area, fertilizer, labour force, Economic growth and foreign direct investment at 33%, 3%, 2.31%, 3.04%, and 7% respectively will bring about increase in the international competitiveness of agricultural products in Latin America, while an increase in inflation and exchange rate at 2%, and 7% respectively, will lead to decrease of the international competitiveness of agricultural products in Latin America.

5.4. Estimation of the Long-Term Coefficient

Table 8. Results of FMOLS and DOLS coefficients.

Variable	FMOLS coefficients	DOLS coefficients
ARE	3.498***	0.334***
FERT	0.023***	0.003***
LABF	3.210***	2.300***
EGRT	5.020***	3.040***
FDI	0.148***	0.079***
EXCH	-0.084***	-0.029**
INFLA	-0.419***	-0.386***

Notes *** denotes the rejection of the null hypothesis at 1%
*** $p < 0.000$.

6. Conclusions and Policy Recommendation

This study aimed at analysing the relationship between international competitiveness of agricultural products, area, fertilizer, labour force, economic growth, foreign direct investment, exchange rate and inflation rate in Latin America during the period of 1991-2019. This research used the "fully modified OLS and dynamic OLS estimators" to examine the existence of a long-term relationship and it found that a long-term relationship existed between the selected variables. It can be seen that in the long the run an increase in area, fertilizer, labour force, economic growth and foreign direct investment at 3.4%, 2%, 3.2%, 5.0%, and 14% respectively will bring about increase in the international competitiveness of agricultural products in Latin America, while an increase in inflation and exchange rate at 8%, and 41% respectively, will lead to decrease of the competitiveness of agricultural products in Latin America.

Policy Recommendation

1. Recommendations for strengthening and increasing the productivity of the agricultural area.
 - 1) Implementation of agricultural reforms: To improve production, agriculture reforms are the first and predominant point. The government must work on agricultural land policies, from land distribution to protecting property rights through land governance reforms.
 - 2) The government should make it easier for farmers to access land to start and expand their farms with financial assistance in order to produce large quantities of agricultural products. Also people and organizations that have unused land necessarily partner with farmers who would cultivate their land.

- 3) The use of machines and tractors must be implemented and monitored. These machines have the qualities that make rough growing areas smooth for efficient field work. Working in the field is easy, that means an improvement in productivity is easy.

2. Recommendations on the rate of inflation.

In an effort to reduce the rising rate of inflation, the government implemented measures to ensure effective monetary policy, fiscal prudence, and exchange rate stabilization.

For the agricultural products to perform better in the international market, the Latin America government need to work on its exchange rate, trade, and monetary and fiscal factors by:

- 1) Take measures on the circulation of money because it directly affects the general level of prices of goods in the country.
- 2) Increase the level of local manufacturing.
- 3) Economic diversification: the country should not depend on a single source of income, but other natural resources should also be explored and converted into a source of income for the country. Agriculture should be the top priority of any administration in Nigeria if the country is to regain lost glory.
- 4) Increase the level of security in the countries.

Limitations

This study has potential limitations because some data from the countries were not up to date, and some years were missing.

Future research direction

This study can be improved by including more indicators like wages/salaries, Government spending, R&D, technology, productivity, and taxes to measure international competitiveness of agricultural products. Therefore, future research should incorporate a parametric nonlinear model and longitudinal analysis to review the relationship between competitiveness of agricultural products area, fertilizer, labour force, Economic growth foreign direct investment, exchange rate, and inflation.

References

- [1] Balassa, B. (1965). Trade liberalization and 'revealed comparative advantage'. *The Manchester School*, Vol. 33, Pp. 99-123.
- [2] Balassa, B. (1965). Trade Liberalization and Revealed Comparative Advantage. *The Manchester School of Economic and Social Studies*.
- [3] Balassa, B. (1977). Revealed' Comparative Advantage Revisited: An Analysis of Relative Export Shares of the Industrial Countries, 1953-1971. *The Manchester School of Economic & Social Studies*, Vol. 45 (Issue 4), Pp 327-44.
- [4] Bonelli, B., & Pinheiro, A. C. (2015). New Export Activites in Brazil: Comparative Advantage, Policy or Self Discovery? Originally published by Ipea, Discussion Paper.

- [5] Cakmak, E. (2004). Structural Change and Market Opening in Turkish Agriculture, EU-Turkey Forum. *Working Papers, No: 10*. Obtenido de www.ceps.be
- [6] Cruz-López, D. F., Caamal-Cauich, I., Pat-Fernández, V. G., & Salgado, J. R. (2022). Competitiveness of Mexico's Hass avocado exports in the world market. *Revista Mexicana Ciencias Agrícolas, Vol. 13* (num. 2).
- [7] Dumitrescu, E., & Hurlin, C. (2012). Testing for Granger non-causality in heterogenous panels. *Journal of Econometrics, Vol. 29*, Pp. 1450-1460.
- [8] Echeverría, J. (2008). Apropiación social de las tecnologías de la información y la comunicación. *Revista Iberoamericana de Ciencia, Tecnología y Sociedad - CTS., Vol. 4*, (núm. 10.), pp. 171-182. Obtenido de <https://www.redalyc.org/pdf/924/92441011.pdf>
- [9] Erkan, B., & Saricoban, K. (2014). Comparative Analysis of the Competitiveness in the Export of Science-Based goods regarding Turkey and the Eu+13 Countries. *Istanbul University 2nd World Conference On Technology, Innovation And Entrepreneurship*.
- [10] Ferman, M., S., A., & Yüksel, A. (2004). Export Competitive Power and Sustainability of Turkey: Competitor Countries in EU Market and Comparison for Turkey, SPO, Turkish Economics Congress, Development. *Strategies and Macroeconomic Policies, Proceedings II, Ankara (in Turkish)*.
- [11] Fertő, I., & Hubbard, L. (2003). Revealed Comparative Advantage and Competitiveness in Hungarian Agri- Food Sectors., *The Journal of World Economy, Vol. 26*, (No. 2).
- [12] González Catalán, S. (2021). Regional Competitiveness in Latin America: A Comparative Study of the Key Elements for Regional Performance. *Journal of Regional Research / Investigaciones Regionales, Vol. 2* (num. 50), pp. 125-146, 2021.
- [13] Gorton, M., Davidova, S., & Ratinger, T. (2000). The Competitiveness of Agriculture in Bulgaria and the Czech Republic Vis- à- vis the European Union (CEEC and EU Agricultural Competitiveness),. *Comparative Economic Studies, XLII*, (No. 1), Pp. 59- 86.
- [14] Hausmann, R., & Klinger, B. (2007). The Structure of the Product Space and the Evolution of Comparative Advantage. *CID Working Papers 146, Center for International Development at Harvard University*.
- [15] Hausmann, R., & Klinger, B. (s.f.). Growth Diagnostics in Peru. *CID Working Paper No. 181, Centre for International Development Harvard University*.
- [16] Im, K., Pesaran, M., & Shin, Y. (2003). Testing for unit root tests in heterogenous panels. *J. Econom., Vol. 115*, Pp. 53-74.
- [17] Jayadi, A., & Aziz, H. (2017). Comparative Advantage Analysis and Products Mapping of Indonesia, Malaysia, Philippines, Singapore, Thailand, and Vietnam Export Products. *Journal of Developing Economies*. doi: 10.20473/jde.v2i1.5119.
- [18] Kharlamova, G., & Vertelieva, O. (2013). The International Competitiveness of Countries: Economic-Mathematical Approach. *Economics & Sociology, Vol. 6*, (No 2), pp. 39-52. doi: 10.14254/2071-789X.2013/6-2/4.
- [19] Latruffe, L. (2010). Competitiveness, Productivity and Efficiency in the Agricultural and Agri-Food Sectors. *OECD Food, Agriculture and Fisheries, No. 30*. doi: <http://dx.doi.org/10.1787/5km91nkdt6d6-en>
- [20] Levin, A., Lin, C. F., & Chu, C. S. (2002). Unit root tests in panel data: Asymptotic and finite-sample properties. *Journal of Econometrics, Vol. 104*, Pp. 1–24.
- [21] Lindberg, E., & Surry, Y. (2005). An Analysis of Trade Performance and TradeFlows for Fruits and Vegetables in Mediterranean Countries,. *EAAE, XI. Congress. Poster Presentation Copenhagen*.
- [22] Mehmood, S., Ahmad, M., Ahmad, Z., & Bokhari, I. (2012). Patterns of comparative advantage in chemicals sectors: a study on trade potential among major saarc countries,. *Interdisciplinary Journal of Contemporary Research Business, Vol. 4* (2), Pp. 91-101.
- [23] Montaña Méndez, L. E., Valenzuela Patrón, I. N., & Villavicencio López, K. V. (2021). Competitiveness of the Mexican red tomato in the international market: analysis 2003-2017. *Revista Mexicana Ciencias Agrícolas, Vol. 12* (num. 7). Obtenido de <http://www.scielo.org.mx/pdf/remexca/v12n7/2007-0934-remexca-12-07-1185-en.pdf>
- [24] Muaz, S., Jabarin, A., Assaf, L., Sahawneh, M., El- Roudan, O., Al- Saeed, A.,... Saleh, A. (2004). The Impact of EuroMediterranean Partnership on the Agricultural Sectors of Jordan, Palestine, Syria, Lebanon and Egypt (The Case of Horticultural Exports to EU Markets). *Forum Euro-Mediterranean Des Instituts Economiqes (FEMISE)*.
- [25] OECD. (2016). Agricultural trade. Retrieved from The changing landscape of agricultural markets and trade:. Obtenido de <https://www.oecd.org/agriculture/topics/agricultural-trade/>
- [26] OECD/FAO. (2019). Latin American Agriculture: Prospects And Challenges. *OECD-FAO Agricultural Outlook 2019-2028*.
- [27] Organic World. (2019). Organic Agriculture in Latin America.
- [28] Organic World. (2019). *The World of Organic Agriculture. Statistics and Emerging Trends 2019*. Research Institute of Organic Agriculture FiBL and IFOAM Organics International, Frick and Bonn. 20 edition. Obtenido de <https://shop.fibl.org/chde/2020-organic-world-2019.html>
- [29] Osamor, I. P., Akinlabi, H., & Osamor, V. C. (2013). An Empirical Analysis of the Impact of Globalisation on Performance of Nigerian Commercial Banks in Post-Consolidation Period. *European Journal of Business and Management, Vol 5* (5), pp. 37 – 45.
- [30] Pesaran, M. H. (2007). A simple panel unit root test in the presence of cross-section dependence. *J. Appl. Econom, Vol. 22*, Pp. 265-312.
- [31] Ricardo, D. (1817). *On the Principles of Political Economy and Taxation*. London: John Murray.
- [32] Sachhithra, K., & Sajeev, G. (. (2014). Comparative advantage in international trade: A study Based on leading Exports in Sri Lanka. doi: DOI: 10.4038/KJM.V112.6453 Corpus ID: 59025062.
- [33] Serin, V., & Civan, A. (2008). “Revealed Comparative Advantage and Competitiveness: A Case Study for Turkey towards the EU. *Journal of Economic and Social Research, Vol. 10* (2), pp 25-41.

- [34] Thamiem, S., Weerahewa, J., Pushpakumara, D., & Singh, V. (2011). Trade Competitiveness of Agro forestry Crop Sector in Sri Lanka. *Tropical Agricultural Research*, Vol. 22 (4), Pp. 338 – 347.
- [35] Utkulu, U., & Seymen, D. (2004). Revealed comparative advantage and competitiveness: Evidence for Turkey vis-a` - vis the EU 15. paper presented at the European Study Group 6th Annual Conference, Nottingham.
- [36] Valenzo, M., Galeana, E., & Martínez, J. (2015). Competitividad y Supply Chain Management en la Industria Exportadora de Aguacates en Mexico. *Revista Internacional Administracion & Finanzas*, Vol. 8 (2), pp. 1-19.
- [37] Vollrath, T. (1991). A theoretical evaluation of alternative trade intensity measures of revealed comparative advantage. *Review of World Economics (Weltwirtschaftliches Archiv)*, Vol. 127 (2), Pp. 265-280. doi: 10.1007/BF02707986.
- [38] Widodo, T. (2010). Comparative advantage: Theory, Empirical Measures and Case Studies. *Reviews of Economics and Business studies*. doi: Corpus ID; 22740470.
- [39] William, W. G., & Malaga, J. (2010). La Competitividad de México en la Exportación de Productos Agrícolas. *Revisita Mexicana de agronegocios, VL-XIV*.
- [40] WITS. (2022). *The World Integrated Trade Solution*. World Bank. Obtenido de <https://wits.worldbank.org/>
- [41] World Bank. (2019). Ending Poverty, Investing in Opportunity. *World Bank Annual Report*. Obtenido de file:///C:/Users/user/Downloads/9781464814709.pdf
- [42] Yu-Jie, F. (2008). Evaluating the Competitiveness of Agricultural Products in International Trade based on Fuzzy Analytic Hierarchy Processes. doi: 1473-8031 print DOI 10.5013/IJSSST.a.17.16.08.

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