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RAAE

Review of Agricultural and Applied Economics
The Successor of the Acta Oeconomica et Informatica
ISSN 1336-9261, XX (Number 1, 2017): 31–38
doi: 10.15414/raae/2017.20.01.31-38

REGULAR ARTICLE

TRADE COMPETITIVENESS IN GLOBAL TROPICAL FRUITS

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ABSTRACT

Trade in agricultural commodity has significantly played a vital role in world's economic growth and development. Drawing its strength from the agricultural industry, such important roles include contribution to quality food production, job creation, foreign exchange earnings, and industrial inputs. The objective of the article was to examine trade competitiveness and revealed comparative advantages of global tropical fruits and to measure the stability and duration of Balassa indices by applying Kaplan-Meier survival function and Markov transition probability matrices. Results reveal that Spain, Ecuador, and The United States were the main exporters of the examined tropical fruits in the periods evaluated, together giving 29% of all products exported. The top10 countries, therefore, consisted 60% of concentration, dominated by fresh or dried banana, including plantains, which constitutes more than 25% of trade, followed by fresh apples which represents more 18% of the total tropical fruits trade for all the periods. The Balassa indices, however, were the highest for Costa Rica and Ecuador. Typically, comparative advantages seem to diminish for most of the countries as manifested by the stability tests and mobility indices.

Keywords: Balassa, comparative advantage, growth, export, stability
JEL: R52, R58, H41

INTRODUCTION

Trade in agricultural commodity has significantly played a vital role in world's economic growth and poverty eradication. Thus, Food and Agriculture Organization assumptions "In order to meet the demand for food in 2050, annual world production of crops and livestock will need to be 60 percent higher than it was in 2006" (**FAO, 2016, p.1**). Drawing its strength from the agricultural industry, such important roles include contribution to quality food production, job creation, foreign exchange earnings, and industrial inputs (**Nwachukwu et, al., 2014**). **Boansi et, al. (2014)** assessed the revitalization of pineapple export industry of Ghana following its decline in both volumes and value since 2004. The findings of their study disclosed that there was competitive advantage in Ghana's fresh pineapple export industry which is more price-driven than volume driven. A positive correlation exists for both value and volume of exports with production, the index of competitiveness and trade liberalization. The policy implications of their findings was mainly centred on high productivity, openness to trade, and improved quality products for global competitiveness.

Adegbite et, al. (2014) analyse the comparative advantage and competitiveness of pineapple production in Osun State, Nigeria. The authors applied a technique of Multistage Sampling in choosing 120 respondents within the study area, using both primary and desk-research data. The data were then examined using descriptive statistics and Policy Analysis Matrix (PAM). Their concluding results revealed that both techniques assessed were more profitable at individual and social level, and the system of pineapple production applying 'sucker technique' was more competitive and had a higher comparative advantage than that of 'crown technique'. **Muhamad (2014)** investigates Malaysian pineapple comparative advantage and competitiveness in the global market by applying the Concentration Ratio, Herfindahl Index, and Porter's Diamond Theory. The research findings reveal a production instability and comparative disadvantage in the pineapple global market, unlike Costa Rica which was found to be the leading competitive country in exporting pineapple and many other tropical fruits.

Suresh & Mathur (2016) evaluated the export tendency of agricultural commodities from India during the past decade and found a significant improvement in the share in total export of agricultural commodities constituted by a shift in commodity composition. Their study identifies that the share in total export has diminished in some commodities; fish and marine products, fruits and nuts and coffee and tea, and a significant increase was realized in the case of cotton, spices, guargum, sugar, and cereals (basmati rice and maize). However, there was an improvement in comparative advantage in certain fruits and vegetables but a decline in some plantation crops, wheat, and rice.

El Hag (2014) analyses the comparative advantage and export competitiveness of Sudanese mango exports and found that there was comparative advantage in the mango export industry. Additionally, the results further revealed an instability in exports caused by the direct and indirect taxes imposed on the mango exports which resulted to a reduction in financial profitability. The theory of export competitiveness and comparative advantage have been long addressed in national and international studies (**Şahinli & Mehmet, 2013**). Some of which are: **Karakaya and Özgen (2002)**, **Yılmaz (2003)**, **Altay and Gacaner (2003)**, **Hillman (1980)**, **Bowen (1983)**, **Balassa (1965)**, **Balassa (1986)**, **Richardson & Zhang (2001)**, **Kojima (1970)**, **Yue (2001)**, and **Hinloopen & Marrewijket (2004)**, **Weiss, (2004)**, **Balassa (1977)**, **Bender and Li (2002)**.

The article assesses export competitiveness and revealed comparative advantages in global tropical fruits trade. It therefore, commits to the existing literature in the following ways: First, it applies the theory of revealed comparative advantages on a specific tropical product groups. Second, it evaluates products which are significant from a development economic prospect as tropical fruits are produced and exported by developing countries mainly from Africa. It is also important to note, as first elucidated in the early 1800s by David Ricardo, that a country can have an absolute advantage in the production of a good without having a comparative advantage. According to him, "Comparative advantage is what determines whether it pays to produce a good or import it....".

DATA AND METHODS

The research is based on the seminal work of **Balassa (1965)** in terms of scientific methods. Balassa's measurement of comparative trade advantage is calculated by different index numbers based on the concept of Ricardian trade theory. The original index of revealed comparative advantage is defined by Eq. 1 **(Balassa 1965).**

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

where:
X means export, i indicates a given country, j is a given product, t is a group of products and n is a group of countries. It follows that a revealed comparative advantage (or disadvantage) index of exports can be calculated by comparing a given country's export share of its total exports with the export share in total exports of a reference group of countries. If the value of B-index is higher than 1, a given country has a comparative advantage compared to the reference countries or, in contrast, a revealed comparative disadvantage if B-index is less than 1. The source of data is global tropical fruits exports at HS6 level for 1996-2015.

The Balassa-index (B-index) is widely criticised because it usually ignores the different effects of agricultural policies and exhibits asymmetric values. Trade structure is distorted by different state interventions and trade limitations while the asymmetric value of the B-index reveals that it extends from one to infinity if a country enjoys a comparative advantage, but in the case of comparative disadvantage, it varies between zero and one, which overestimates a sector's relative weight. However, there are many other specifications of the revealed comparative advantage (RCA) index available – see **Vollrath (1991)**; **Fertö & Hubbard (2003)**; **Utkulu & Seymen (2004)** for more details.

Furthermore, the paper also analyses the stability and duration of the RCA index in two steps by employing STATA software. First, Markov transition probability matrices are calculated and then summarized by using the mobility index, evaluating the mobility across countries and time. Second, following **Bojnec and Fertő (2008)**, a survival function $S(t)$ can be estimated for by the use of the non-parametric Kaplan–Meier product limit estimator, which pertains to the product level distribution analysis of the RSCA index. Following **Bojnec and Fertő (2008)**, a sample contains n independent observations denoted (t_i; c_i), where $i = 1, 2, \ldots, n$, and t_i is the survival time, while ci is the censoring indicator variable C (taking on a value of 1 if a failure occurred, and 0 otherwise) of observation i. Moreover, it is assumed that there are $m < n$ recorded times of failure. Then, we denote the rank-ordered survival times as $t(1) < t(2) < \ldots < t(m)$. Let n_j indicate the number of subjects at risk of failing at $t(j)$ and let d_j denote the number of observed failures. With the convention that $\hat{S}(t) = 1$ if $t < t(1)$,
the Kaplan–Meier estimator of the survival function is represented by Eq. 2.

$$\hat{S}(t) = \prod_{t_i<t} \frac{n_j - d_j}{n_j} \qquad (2)$$

The article employs global tropical fruits trade data of **World Bank (2016)** World Integrated Trade Solution (WITS) database at HS-6 level between 1996 and 2015 with the following product codes included: 080300, 080430, 080450, 080510, 080520, 080530,080540, 080710, 080720, and 080810. It focuses on the export side of the revealed comparative advantage index (B or RCA index) to exclude imports analysis, which is more likely to be influenced by agricultural policy interventions.

RESULTS AND DISCUSSION

It could be observed that Spain, Ecuador, and The United States were the major exporters of global tropical fruits in the periods assessed, accounting for 29% of all the exported products from 1996-2015 (Table 1). Consequently, the top 10 countries displayed a concentration of 60% from 1996–2015 (Table 1). Moreover, between the periods 1996-2000, 2001–2005, 2006–2010, and 2011–2015, Spain, Ecuador, The United States, Belgium, Netherlands, Costa Rica, France, Italy, China, and South Africa, constituted 60%, 63%, 60%, and 59% of global total exports of tropical fruits products respectively.

As for the global tropical imports, The United States, which was the 3rd main exporter of tropical fruits, is the leading importer of the same products (Table 2). France, Belgium, Netherlands, and Italy, four of the major exporters of tropical fruits, are the 5th, 6th, 7th, and 10th countries in global tropical fruits imports. These countries import in excess for consumption and re-export most of the products to earn them foreign exchange. The United Kingdom, Russian Federation, Japan, and Canada were also among the world major importers of tropical fruits, suggesting high levels of tropical fruits consumption. It is paramount to note that concentration of the 10 major importers of tropical fruits were 65%, 55%, 52% and 52% in the sub-periods estimated, respectively (Table 2). Meanwhile, The United States, Germany, and The United Kingdom were the main importers of the selected global tropical fruits in the analysed periods, accounting for 25% of all the products exported from 1996-2015 (Table 2).

However, shedding light on the tropical fruits by product, the most traded tropical fruits type is the fresh or dried banana, including plantains, (080300) which constitutes more than 25% of trade among the examined tropical products for the periods analysed, followed by fresh apples (080810) which represents more 18% of the total tropical fruits trade for all the periods (Figure 1).

Comparative Advantage– Patterns and Stability

With the composition of Balassa indices, the specialisation / concentration of countries in the global tropical fruits trade became evident. It is obvious that Costa Rica had the highest comparative advantage (CA) followed by Ecuador (Table 3), with unstable CA patterns for both exporting countries compared to China, which had the most stable comparative advantage as illustrated by (Figure 2), suggesting high potentials for competitiveness. Spain and South Africa also had relatively high comparative advantages in global tropical fruits exports, while similar numbers for other countries examined have varied significantly. It should be noted that China, France, Italy, and The United States, despite being four of the largest global tropical fruits exporters, have generally experienced a comparative advantage for all the periods analysed compared to Costa Rica, Ecuador, Spain, and South Africa.

The extent of mobility in the revealed comparative advantage (RCA) indices is constructed by applying the mobility index based on the Markov transition probability matrices (Figure 2). The findings demonstrate a relatively high mobility of the revealed comparative advantage (RCA) index in global tropical fruits trade for China, France, and Italy (Figure 2) putting forward stable competitive potentials, but a low mobility for Spain, Costa Rica, and South Africa. It is clear that more than 70% of the various vegetable product groups with a comparative advantage remained pertinacious for Belgium, The United States, and Netherlands.

As for the duration of revealed comparative advantages in the world tropical fruits exports, the non-parametric Kaplan–Meier product limit estimator was applied. As mentioned in the methodology, Eq. 2 was therefore applied on the panel dataset and results revealed that in general the survival times are sustainable over the period assessed (Table 4). Survival chances of 97% at the commencement of the period reduced to 7% by the end of the period, indicating that there exists high competition in global tropical fruits trade. Results differ by various product groups, proposing that the highest survival periods exist for fresh or dried grapefruits, giving the broad majority of world tropical fruits trade.

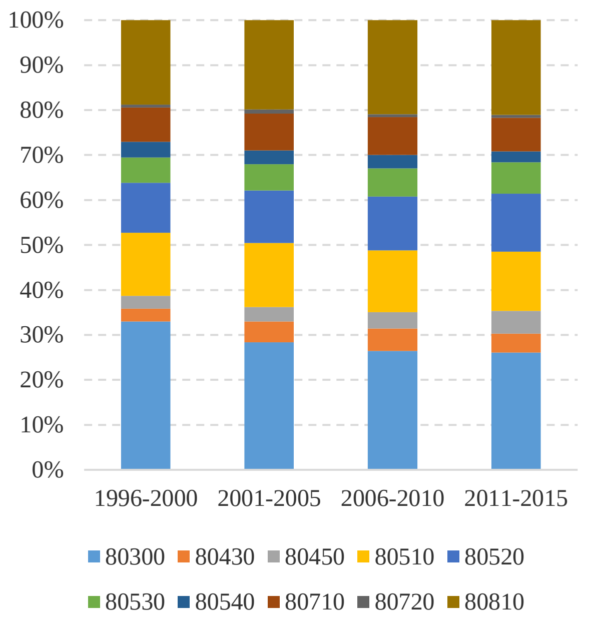

Figure 1. Global tropical fruits exports, 1996-2015, by product (in value terms, 1000 USD)

Note: 080300 -- Bananas, including plantains, fresh or dried; 080430 -- Pineapples, fresh or dried; 080450 -- Guavas, mangoes, and mangos teens, fresh or dried; 080510 -- Oranges, fresh or dried; 080520 -- Mandarins, clementines, wilkings, fresh or dried; 080530 – Lemons, limes, fresh or dried; 080540 -- Grapefruits, fresh or dried; 080710 -- Melons, watermelons, fresh; 080720 -- Papaws (papayas) fresh; 080810 – Apple, fresh.

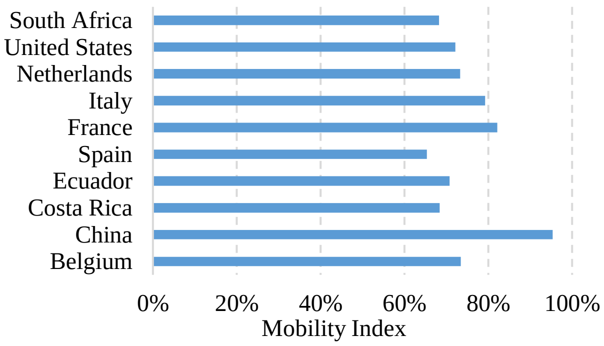

Figure 2. The mobility indices of RCA, 1996-2015, by country, percentage

Source: Own computation based on WITS (2016) data

Results of survival functions of the examined countries differed, proposing that the highest survival periods exist for Netherlands, giving the broad majority of global tropical fruits trade, while the lowest exist for France.

The equality of the survival functions across the top 10 countries can be measured using two non-parametric tests (Wilcoxon and log-rank tests). Results of the tests reveal that the hypothesis of equality across survivor functions can be rejected at the 1% level of significance, meaning that similarities in the duration of comparative advantage across major global tropical fruits exporters are absent (Table 5).

Table 1: TOP 10 tropical fruits exporters in the world, 2006-2015

Country	1996-2000 In 1000 USD	%	2001-2005 in 1000 USD	%	2006-2010 in 1000 USD	%	2011-2015 in 1000 USD	%	1996-2015 in 1000 USD	%
Spain	2390278	17%	2928747	18%	3997615	15%	4564796	13%	3470359	15%
Ecuador	1039341	8%	1041392	6%	1699539	6%	2484830	7%	1566275	7%
United States	1106720	8%	1154208	7%	1638201	6%	2245025	7%	1536038	7%
Belgium	465358	3%	1372109	8%	1935767	7%	1711977	5%	1371303	6%
Netherlands	613337	4%	751640	5%	1439288	5%	1825232	5%	1157374	5%
Costa Rica	803100	6%	813030	5%	1257586	5%	1315749	4%	1047366	5%
France	846867	6%	893684	5%	1055665	4%	1129727	3%	981486	4%
Italy	541714	4%	676860	4%	1135064	4%	1362108	4%	928936	4%
China	142660	1%	304323	2%	1071947	4%	2174298	6%	923307	4%
South Africa	317748	2%	473785	3%	900123	3%	1369086	4%	765185	3%
Top 10		60%		63%		60%		59%		60%

Note: Countries are listed in decreasing order based on their 1996-2015 averages.
Percentages are based on the value of tropical fruits total exports.
Source: Own composition based on WITS (2016) data

Table 2. Top 10 world importers of tropical fruits, 1996-2015, by country (% of value of tropical fruits total imports)

Country	1996-2000	2001-2005	2006-2010	2011-2015	1996-2015
United States	13%	11%	9%	10%	11%
Germany	12%	9%	8%	7%	8%
United Kingdom	9%	7%	6%	5%	6%
Russian Federation	3%	3%	5%	7%	5%
France	7%	5%	5%	5%	5%
Belgium	2%	6%	6%	5%	5%
Netherlands	5%	4%	5%	5%	5%
Japan	6%	4%	3%	3%	4%
Canada	4%	3%	3%	3%	3%
Italy	4%	3%	3%	2%	3%
Top 10 total	65%	55%	52%	52%	54%

Note: Countries are listed in decreasing order based on their 1996-2015 averages.
Source: Own calculations based on WITS (2016) data

Table 3. Balassa indices for top 10 global tropical fruits exporters, 1996-2015

Country	1996-2000	2001-2005	2006-2010	2011-2015	1996-2015
Belgium	1.43	1.45	1.41	1.07	1.32
China	0.17	0.15	0.25	0.37	0.24
Costa Rica	43.93	46.42	59.64	75.33	55.33
Ecuador	25.51	30.62	20.92	23.58	25.16
France	0.80	0.77	0.62	0.56	0.69
Italy	0.46	0.54	0.66	0.74	0.60
Netherlands	1.51	1.50	1.87	2.36	1.81
South Africa	4.45	5.47	5.65	6.35	5.48
Spain	6.53	6.60	6.39	6.22	6.43
United States	0.84	0.82	0.76	0.72	0.78

Source: Own calculations based on WITS (2016) data

Table 4: Kaplan-Meier survival rates for Balassa indices and tests for equality of survival functions in global tropical fruits trade, by product, 1996–2015

Years	Survivor Function	80300	80430	80450	80510	80520	80530	80540	80710	80720	80810
1996	0.9703	0.9694	0.9796	0.9745	0.9634	0.9592	0.9694	0.9702	0.9745	0.9692	0.9735
1997	0.9401	0.9331	0.9534	0.9484	0.9369	0.9233	0.9383	0.9399	0.938	0.938	0.9519
1998	0.9115	0.8964	0.932	0.9218	0.9046	0.8922	0.9067	0.909	0.9117	0.9115	0.9298
1999	0.8779	0.8593	0.9044	0.8891	0.8717	0.8499	0.8691	0.8774	0.8739	0.8789	0.9071
2000	0.8447	0.8214	0.8816	0.8611	0.8326	0.8072	0.8308	0.8514	0.8354	0.8457	0.8837
2001	0.8123	0.7829	0.8639	0.8264	0.7984	0.7638	0.7974	0.8244	0.7962	0.8117	0.8654
2002	0.7765	0.7434	0.839	0.7908	0.7576	0.7199	0.7572	0.8033	0.7561	0.7708	0.84
2003	0.7391	0.7031	0.8065	0.754	0.7218	0.6752	0.7161	0.7812	0.7151	0.729	0.8069
2004	0.7018	0.6617	0.7726	0.716	0.6909	0.6298	0.674	0.758	0.673	0.6861	0.7793
2005	0.6625	0.6192	0.7301	0.6831	0.6525	0.5836	0.6307	0.7335	0.6298	0.642	0.7504
2006	0.6203	0.5755	0.6859	0.6486	0.6059	0.5364	0.5925	0.6904	0.5852	0.5966	0.7198
2007	0.5792	0.5302	0.6396	0.6195	0.5577	0.4882	0.5526	0.6627	0.5392	0.5564	0.6871
2008	0.5336	0.4832	0.591	0.5724	0.5148	0.4388	0.5106	0.6232	0.4914	0.5071	0.6518
2009	0.4855	0.4342	0.5396	0.5392	0.4694	0.3879	0.4588	0.5695	0.4416	0.4557	0.6135
2010	0.4351	0.3827	0.4848	0.4935	0.4208	0.3353	0.4044	0.522	0.3967	0.4093	0.5606
2011	0.3787	0.328	0.4254	0.4331	0.3682	0.2806	0.3466	0.4698	0.3481	0.3509	0.5022
2012	0.3211	0.2691	0.36	0.3887	0.3101	0.2302	0.2844	0.4111	0.2945	0.2969	0.4361
2013	0.2553	0.2042	0.2855	0.3083	0.2436	0.1746	0.2157	0.3597	0.2336	0.2457	0.3583
2014	0.1794	0.129	0.2104	0.2109	0.176	0.1195	0.1476	0.2698	0.1598	0.181	0.2587
2015	0.0710	0.0387	0.0841	0.1055	0.0782	0.0358	0.0443	0.1686	0.0639	0.0543	0.115
log-rank test	0.0000										
Wilcoxon test	0.0000										

Source: own calculations based on WITS (2016) data

Table 5: Kaplan-Meier survival rates for Balassa indices and tests for equality of survival functions in global tropical fruits trade, by country, 1996–2015

Years	Survivor Function	Belgium	China	C/Rica	Ecuador	Spain	France	Italy	Netherlands	USA	S/ Africa
1996	0.9703	1.055	0.9497	0.9721	0.9708	0.975	0.96	0.955	0.98	0.96	0.985
1997	0.9401	1.0249	0.899	0.943	0.9468	0.944	0.919	0.909	0.9594	0.924	0.964
1998	0.9115	0.9948	0.849	0.913	0.9224	0.912	0.878	0.864	0.9487	0.888	0.953
1999	0.8779	0.9647	0.804	0.883	0.8973	0.880	0.837	0.818	0.932	0.846	0.936
2000	0.8447	0.9346	0.753	0.851	0.8652	0.853	0.795	0.772	0.9145	0.815	0.919
2001	0.8123	0.8972	0.703	0.818	0.852	0.830	0.753	0.726	0.8962	0.782	0.900
2002	0.7765	0.8587	0.653	0.790	0.8245	0.806	0.71	0.679	0.877	0.737	0.875
2003	0.7391	0.8191	0.603	0.762	0.789	0.775	0.666	0.632	0.8635	0.692	0.848
2004	0.7018	0.7781	0.552	0.731	0.7669	0.743	0.621	0.585	0.8491	0.646	0.819
2005	0.6625	0.7357	0.502	0.7	0.7285	0.709	0.576	0.537	0.8337	0.605	0.79
2006	0.6203	0.6916	0.452	0.657	0.6885	0.674	0.530	0.488	0.8087	0.562	0.758
2007	0.5792	0.6531	0.402	0.621	0.646	0.644	0.483	0.439	0.7907	0.519	0.724
2008	0.5336	0.6041	0.351	0.582	0.5922	0.603	0.429	0.395	0.7709	0.473	0.688
2009	0.4855	0.5524	0.306	0.529	0.5349	0.569	0.373	0.345	0.7489	0.426	0.649
2010	0.4351	0.4787	0.255	0.482	0.4834	0.531	0.317	0.299	0.7239	0.376	0.616
2011	0.3787	0.4021	0.204	0.429	0.4272	0.488	0.260	0.251	0.695	0.323	0.555
2012	0.3211	0.3317	0.158	0.365	0.3644	0.439	0.201	0.200	0.6602	0.267	0.513
2013	0.2553	0.2433	0.116	0.284	0.2915	0.395	0.141	0.147	0.6162	0.204	0.444
2014	0.1794	0.146	0.063	0.221	0.2004	0.356	0.077	0.088	0.5238	0.133	0.356
2015	0.0710	0.0292	0.012	0.158	0.1145	0.213	0.007	0.017	0.3666	0.039	0.213
log-rank test	0.0000										
Wilcoxon test	0.0000										

Source: own calculations based on WITS (2016) data

CONCLUSION

One of the major determinants and most important source of foreign exchange earnings in an economy is the performance of the agricultural export sector. Fruition in this sector has always attracted the policy makers' attention, diversified crops, and improved farm income. The article assesses the export competitiveness and revealed comparative advantage of tropical fruits in world trade, buttressing special attention to its duration and stability. It has concluded in several ways. first, by assessing the characteristics of global tropical fruits trade, it has been observed that Spain, Ecuador, and the United States were the major exporters of the selected tropical fruits in the periods examined, together constituting 29% of all products exported. The top10 countries, however, consisted 60% of concentration. On the other hand, the United States, Germany and the United Kingdom were the major importers, mainly for consumption and re-exporting purposes.

Second, the analysis has manifested that the most traded tropical fruits type is the fresh or dried banana, including plantains, (080300) which constitutes more than 25% of trade among the tropical products for the periods analysed, followed by fresh apples (080810) which represents more 18% of the total tropical fruits trade for all the periods. Third, the computation of the Balassa indices indicated that Costa Rica had the highest comparative advantage followed by Ecuador, with unstable ca patterns for both countries compared to china, which had the most stable comparative advantage, suggesting high potentials for specialisation and competitiveness. Spain and South Africa also had relatively high comparative advantages in global tropical fruits exports, revealing stable competitive possibilities. Lastly, according to survival tests, survival chances of 97% at the commencement of the period reduced to 7% by the end of the period, showing a high competition that exists among the global tropical fruits trade. The countries with comparative disadvantages over the periods analysed include: China, France, Italy and the United States. This finding corresponds with the studies of (**Muhamad, 2014**). Countries with higher comparative advantages over others like Costa Rica and Ecuador were the most efficient in the production of the selected tropical fruits.

Export competitiveness policies are usually illustrated as those that minimise cost of production, increase revenue, and improve efficiency of the exporting countries. As a result, policies that aim at increasing the value, efficiency, and growth rate of exports can be promoted and implemented. Also, foreign direct investment (FDI) should be attracted as this has been found to have a positive impact on export performance in different countries by bringing in foreign exchange, capital, technology and other important resources such as market knowledge.

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