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Revealed Comparative Advantage and Pakistan's Global Vegetable Potential in the Presence of Selected Exporters: New Evidence from Markov's Stability Matrices and Kaplan-Meier's Survival Function

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Abstract:

The main objective of this research study is to evaluate Pakistan's global agri-food product potential in the presence of the giant vegetable exporters of the world at HS-6 digit level of selected agri-food products during 1996-2020. Secondly, this study explores the stability and survival value of BRCA indices by employing Markov's transition probability matrices and Kaplan-Meier (K-M) survival function. Our findings reveal that Netherland, Spain, Mexico, and Belgium are the giant exporters of the selected agri-food products in the estimated-period, together giving 55% of all product exported. Normally, the results of mobility test and stability indices conclude that most of our selected countries (USA, China, Italy, Germany, Poland, Denmark, Canada and Turkey) have demonstrated, on average, a slow declining-trend in comparative advantage due to stiff competition in the global market while few exporters (Netherland, Spain, Mexico, France and Belgium) show a comparatively stable indices during the examined period. Therefore, these indices indicate a sharp decline in case of Pakistan, Russian Federation and Thailand. Furthermore, the agri-food products (070200) and (080590) comprise 25% and 20% of the selected commodities respectively. Finally, Pakistan being an agrarian economy and having BRCA index >1, should explore untapped global agri-food market by removing economic barriers, and improving agricultural production capabilities to enhance foreign exchange reserves.

Keywords:

Agri-food products, Giant exporters, Balassa RCA Index, Markov's Stability Matrices and Kaplan-Meier Survival Function, and Pakistan

1. INTRODUCTION

Foreign trade is one of the most dynamic factors to influence the process of economic development of any country. Exports and imports are equally important to boost up the economic development (Frankel, 1997; Tripathi and Leitao, 2013). Trade plays an important role in overall development and economic growth of an economy (Eaton and Kortum, 2002; Crawford and Fiorentino, 2005; Siddique et al. 2020). This may be considered, indeed, an important instrument for boosting industrialization process of the economy while, higher foreign exchange reserves are also crucial for sustained economic-development (Cernat, 2001; Anderson and Wincoop, 2003; Didier, and Hoarau, 2013; Mazumdar, 2015). Any country needs all kinds of raw material, semi-finished and capital goods to enhance its production and, to enlarge export growth if these goods are not produced domestically. The trade's share depends upon the persistent and growing trade surpluses (Cernat, 2001; Waheed, 2016).

On contrary, exports are also vital to increase the foreign exchange gap which may lead to increase not only the import capacity but also reduce dependence on foreign assistance (Oguledo and Macphee, 1994). The persistent economic growth and development in the economy reduce unemployment, control over inflation and poverty alleviation as well (Coulibaly and Fontagné, 2006). Due to reason, Pakistan has been recognized a large number of trade associations around the world (Abbas and Waheed, 2019; Hanif, 2018; Gul and Yaseen, 2011).

The process of globalization results in decrease in trade-barriers and trade integration among the different the economies. This may lead to boost trade share, and competition in the world market (Balassa, 1982; Edwards, 1993). The direct and positive effects of trade openness have been concluded on the basis of empirical evidences. In fact, the fast globalization process improves trade share and higher competition in the world trade activities through its exports of any particular economy. This process also provides the opportunities to acquire world's leading trade share through better quality of commodities and higher competition (Helpman et al., 1991; Sabonience, 2015).

Numerous trade studies and trade theories have been explained by the researchers and economists in the past to determine comparative advantage such as absolute and comparative advantages by Adam Smith and David Ricardo respectively. Therefore, according to Adam Smith (1776), absolute advantage is the key for the existence of trade between the countries. On the other hand, David Ricardo (1817) stresses that cost and technological differences are the important determinants of comparative advantage to boost up the trade activities among the various economies of the world. For H-O Model, endowment are responsible to influence the trade activities and trade patterns (Heckcher and Ohlin, 1919).

On contrary, Gottfried-Hebler (1930) and Samuelson (1950) consider that opportunity cost and factor prices are the important factors to affect the international trade and influence the comparative advantage. Similarly, according to product cycle model, innovations and technological

advancements are the vital determinants of comparative advantage (Posner, 1961). The concept of Balassa's (1965) revealed comparative advantage (BRCA) is different from traditional trade comparative advantage approaches. BRCA takes into account the impact of observable trader-patterns as well as the relative prices of un-observable trade characteristics.

This research study is novel in various ways. First, it takes into account the major export destinations of Pakistan which comprises more than 80 percent of the trade. Second, it employs the novel technique to find out the stability of the Balassa index in term of Pakistan's export among the giant competitors of Pakistan. Thirdly, a few previous research studies have been considered such a rigorous analysis to cope with the main issue of Pakistan's globally untapped trade potential among the selected giant exporters. Finally, this research will suggest the suitable policy implications to enhance the export revenues and reduce the deficit trade balance of Pakistan.

The organization of this research study consists as follow: section-2 represents the novel methodology and data source, section-3 provides the findings and discussion, while section-4 elucidates the conclusion and suggestions for effective policy implications.

1.2 Brief Overview of Pakistan's Trade Statistics

The comparative advantage is one of the key determinants to enhance international trade. The artificial barriers and restrictive policies created by the closed economies may hardly benefit to improve trade and commerce. Pakistan is an agrarian country with operative irrigation system while the contribution of agricultural sector is 19.5% of GDP. Trade deficit has been one of the major economic issues for Pakistan since many decades. Empirical study by Mohammad and Husain (2010) concludes that Pakistan's exports increased significantly during Korean-War in 1952-53. Secondly, when Z.A Bhutto's government devalued Pakistani Rupees by 131% to provide protection to domestic producer & exporters by imposing trade barriers on imports.

In the current era of trade and globalization, Pakistan's trading activities have been boosted up to 150 economies of the world. Pakistan's current GDP is USD 270.7 billion with 2.83% economic growth (SBP, 2020). Pakistan's exports & imports share in the world trade is 0.125% and 0.287% respectively. Per capita trade is 198 USD and current account deficit is 2.07% of GDP (WTO, 2020). Pakistan is the 5th most populated country with population growth rate is 2.1% (UNDP, 2020). The major contributing sectors are services, industry and agriculture with the share of GDP 58.60%, 20.77% and 19.03% respectively (PBS, 2020).

According to Atlas Economic Complexity Index, Pakistan is ranked 66th and 87th, the huge export and most complex economy in the world respectively (The Atlas of Economics Complexity Index, 2020). Major exports destinations of Pakistan are USA, China, UK, Afghanistan, Germany and UAE with the exports share of total exports 16.5%, 9.1%, 8%, 6.2%, 6% and 3.9% respectively at HS 6-digits level products (WDI, 2020).

Table-1 Pakistan and Top Selected Exporters of Vegetables Products, 1996 to 2020

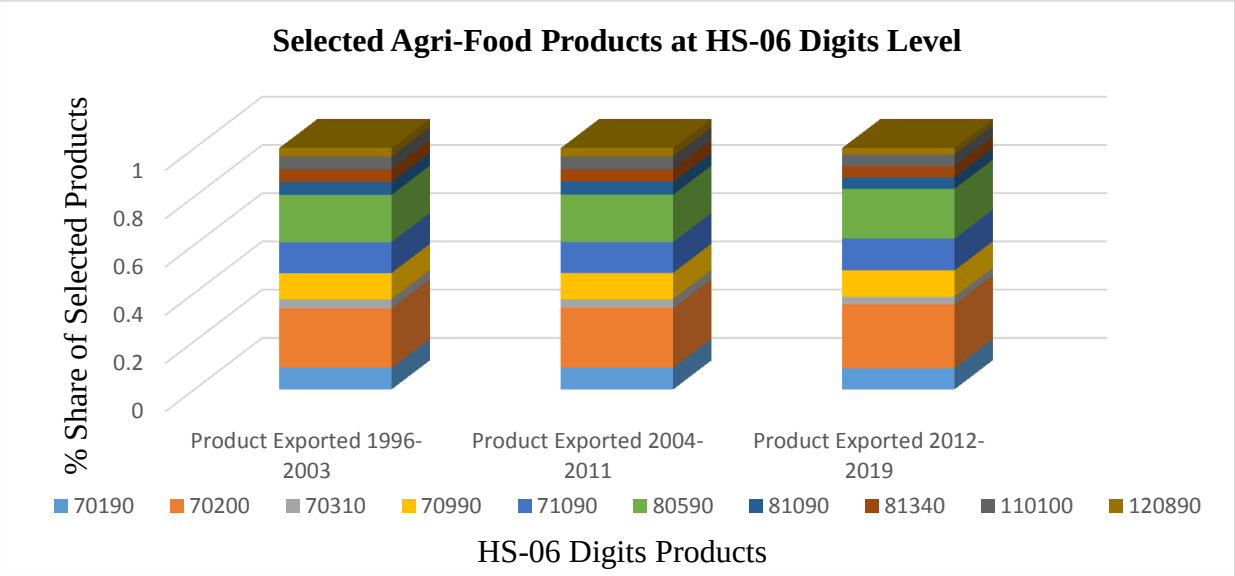
	Volume of Selected Agri-Food Products (in million US$)					% Share in Global Market 2020
Year/ Country	1996-2000	2001-2005	2006-2010	2011-2015	2016-2020	
Netherland	1540	1890	2177	2844	3022	17.23
Spain	1288	1723	2072	2354	2455	10.71
Mexico	897	1260	1340	1440	1702	07.52
China	152	544	678	911	1021	04.83
Thailand	340	277	344	398	456	01.80
United States	422	534	601	678	701	04.19
France	246	298	304	355	409	03.95
Canada	188	350	455	511	545	02.35
Belgium	633	711	990	1102	1234	06.25
Italy	260	301	359	441	490	01.35
Germany	390	425	440	410	438	01.66
Poland	689	702	710	765	776	06.04
Turkey	255	267	289	310	314	01.37
Denmark	422	392	414	450	385	410
Russian Fed.	354	387	399	401	435	02.39
Pakistan	3.45	5.66	7.89	11.7	10.5	0.89
Total	7157.45	9374.66	10765.89	12431.7	13408.5	76.06
Rest of the World	8945.30	11731.34	15556.55	16212.01	17761.23	23.94

Source: *Author's own compilation by taking 5-years average, based on WITS (2020) dataset*

Table-1 represents a five year average of dataset for selected vegetable exported agri-food product at HS-6 digits level of products for selected sample countries for the period 1996 to 2020. The major exporters of agri-food products are Netherland, Spain, Mexico, Belgium and Poland. Their share in the global vegetable market are 17.23, 10.71, 07.52, 6.25 and 6.04 respectively. Moreover, the major vegetable products exported and demanded globally were as fresh or chilled tomatoes (070200), fresh or chilled onions and shallots (071090) and citrus fruits, fresh or dried (080590) which contains share

of 35%, 23% and 17% respectively. Furthermore, more than 76% of these products were exported to the world from these selected countries.

Figure-1 Percentage Share of Global Selected Agri-Food Products at HS-06 digits level



Source: Author's own compilation by taking 05-years average, based on WITS (2020) dataset

Note: 070190–Potatoes, fresh or chilled nets; 070200-Tomatoes, fresh or chilled; 070310-Onions and shallots, fresh or chilled; 070990-Vegetables, fresh or chilled; 071090– Mixture of vegetables frozen, fresh or chilled;; 080590–Citrus fruits, fresh or dried; 081090-Fruits, fresh or dried; 081340-Fruits, dried; 110100–Wheat or meslin flour; 120890–Flours and meals of oil seeds or oleaginous fruits, except mustard.

Figure-1 represents the percentage share of our selected agri-food products at HS-06 digits level. The average of 08 years is taken for simplicity. It is obvious that more that 25% of vegetable product is 070200 which is exported in the world. The second most exported product is 080590 which comprises approximately 20% of the products.

Table-2 Average of Selected Economic Indicators of Pakistan and Selected Global Agri-Food Exporters, 1996 to 2020

Economic Indicator/ Country	Economic Growth (%)	Per Capita GDP (US$)	World's Exports Share (%)	Agri-Food Exports Share (%)	Per Capita Agri-Food Trade (US$)
Netherland	2.11	30128.48	07.55	26.87	151.55
Spain	3.57	17230.59	06.44	15.56	44.23
Mexico	4.94	6021.48	03.11	10.78	47.44
China	7.12	4650.55	01.67	08.34	33.27
Thailand	4.45	3456.56	01.20	24.76	67.87

United States	5.10	35465.76	05.45	11.45	22.85
France	2.83	26540.89	03.66	12.63	41.55
Canada	3.95	29876.79	04.23	10.55	49.86
Belgium	2.86	27877.65	02.77	11.62	159.43
Italy	3.34	22455.38	02.89	07.54	39.65
Germany	4.02	33345.23	01.84	06.21	51.54
Poland	5.46	11345.52	02.87	11.76	67.33
Turkey	7.85	6040.41	04.23	24.55	28.87
Denmark	4.32	32751.55	02.33	23.41	54.72
Russian Fed.	3.16	25433.34	02.87	34.85	45.58
Pakistan	3.23	990.11	00.08	18.12	05.66

Source: Author's own compilation by taking 25-years average, based on WDI (2020) and WITS (2020) dataset

Table-2 contains the selected economic-indicators of our sample countries to evaluate the growth and development pattern of each country over the time. An average of 25-years dataset has been calculated from 1996 to 2020. The highest and the lowest economic growth (%) are observed in case of China and Netherland respectively but surprisingly, Netherland also represents the highest agri-food trade share in its exports and world share.

This research study is novel and contributing to the existing literature in many ways. First, it employs the extensively used Balassa revealed comparative advantage (BRCA) index on selected vegetable products at aggregated (HS-2 digit level) and disaggregated levels (HS-6 digit level). Second, we summarized mobility index across the countries by calculating Markov transition probability matrices followed by Kaplan-Meier's survival function (K-M), a non-parametric estimator which is useful to pertain product-level distribution analysis of RSCA index. Third, it focuses on vegetable products from economic and development perspectives which are widely produced and exported by developing countries. Finally, it examines the determinants of Pakistan's global completeness and comparative advantage of vegetable products among top-selected exported countries of the world. Moreover, though Pakistan has very low share in the world exports which comprises less than 1% but still it has BRCA in that particular products at HS-2 digits level of aggregated products. For the purpose, data has been gathered from World Integrated Trade Solution and World Development Indicator, for the period 1996 to 2020. However, this article does not analyze the imports pattern of our sample countries and focuses on exports, BRCA index, Markov's transition probability matrices and Kaplan-Meier (K-M) Survival Function.

2. RESEARCH METHODOLOGY AND DATA SOURCE

2.1 Various Measurements of Revealed Comparative Advantage

RCA, suggested by Balassa (1965) focuses to estimate comparative advantage of any nation instead of focusing on, to determine its sources and, this approach is practicable and widely accepted in the modern world. However, there are many studies amended the definition of RCA after Balassa (1965) measurement of comparative advantage. For example, RCA was empirically studied first time by Liesner (1958) by following method:

$$RCA_1 = X_{pj} / X_{nj} \qquad (I)$$

Where, X_{pj} represents the exports of country P for commodity j and for X_{nj}; n is the set of countries for j commodities or sectors.

Bela Balassa (1965) introduced the following measure that is commonly and extensively accepted in the modern literature. It is considered as a more comprehensive and brief in nature. It has two dimensions i.e., greater than 1 and less than 1. If RCA is > 1, country has revealed comparative advantage in that commodity or industry. When RCA is less than 1, the result is reversed. However, $RCA_2 = 0$ explains no result. Balassa's (1965) RCA index is calculated as follow

$$BRCA_2 = RCA_{PL=} (X_{PL}/X_p) \div (X_{WL}/X_w) \qquad (II)$$

X_{PL}**:** exports of product L by country P, X_P: total exports from country P. X_{WL}**:** total exports of product L by rest of the world, X_W: total exports from world.

Another index to measure RCA is

$$RCA_3 = (X_{pj} \_ M_{pj}) / (X_{pj} + M_{pj}) \qquad (III)$$

$X_{pj} \_ M_{pj}$; the difference of exports and imports of country 'p' for 'j' sector or industry. This RCA ranges from -1 to +1. In case of $M_{pj}=0$, there will be comparative advantage. If $X_{pj} = 0$, that shows revealed comparative disadvantage.

Volrath (1991) explains the concept of revealed trade advantage (RTA) which estimates the change between relative exports and imports advantage, and can be calculated as:

$$RCA_4 = RTA = lnRX_A \_ lnRM_A \qquad (IV)$$

Where, RX_A represents relative exports advantage which can be calculated as (X_{pj} / X_{pt}) (X_{nj}/ X_{pn}) and RM_A shows relative imports advantage which is equal to $(M_{pj} / M_{pt}) / (M_{nj}/ M_{pn})$.This index represents the difference between the logarithmic revealed exports advantage and revealed imports advantage.

In this research study, number of trade specifications have been applied along with BRCA on the basis of previous studies (Sinanana and Hoseinbo, 2012; Brakman et al., 2013; Leromain and

Orefice, 2014; Laursen, 2015; Levchenko and Zhang, 2016). Furthermore, this article also evaluate the stability and duration of BRCA in two steps procedure. First step estimates, Markov's transition probability matrices to summarize the mobility index across the countries and time period. This index captures the degree of relative diagonal and off-diagonal terms in inverse of harmonic mean of the remaining expected duration in the given cell. Thus, Shorrocks (1978) introduced the following transitional probability matrix as:

$$\acute{M}t = \frac{\check{C} - t\acute{r}(\mathcal{P})}{\check{C} - 1} \qquad (1)$$

Where, $\check{C}$ is the total number of cells, and $t\acute{r}(\mathcal{P})$ represents the transition probability matrix. Moreover, a higher value say closer to '1' shows a greater mobility while, '0' represents perfect immobility. This mobility index is useful to rank the agri-food sectors.

Second step captures the nonparametric Kaplan-Meier (K-M) product limit estimator. Bojnec and Ferto, (2016) the survival function $\acute{\boldsymbol{S}}_{(t)}$ pertains to product distribution analysis of RSCA index. Thus, K-M estimator of survival function with the condition $\acute{\boldsymbol{S}}_{(t)}=1$, if $t < t_{(1)}$, is as follow:

$$\acute{\boldsymbol{S}}_{(t)} = \prod_{t(i) < t} \frac{nj - dj}{nj} \qquad (2)$$

Where, i=1, 2, …, n and t_i: is the survival time. We introduce the censoring indicator c_i for observations i (considering 1 if failure occurred and 0 otherwise). Furthermore, $m < n$ recorded times of failure are assumed to rank order survival time as $t_1 < t_2 <,….,, < t_m$. The n_j and d_j denote the number of subjects risk of failing and number of observed failure at t_j respectively.

3. RESULTS AND DISCUSSIONS

Table-3 demonstrates the results of BRCA as mentioned in methodology section. Moreover, the index value of each country is measured from 1996 to 2020 by utilizing equation (II). The average of five year results have been demonstrated of each country's BRCA to comprehend. The findings show an increasing trend in Balassa's revealed comparative advantage (BRCA) index value in case of Netherland, Spain and Pakistan at HS-02 digits level of aggregated agri-food products while, most of the economies demonstrated slightly decreasing BRCA index values such as Mexico, China, Germany, United States, Belgium and Italy. Furthermore, a static value of BRCA has also been observed in case of Thailand, France, Canada, Poland, Denmark, Russian Federation and Turkey.

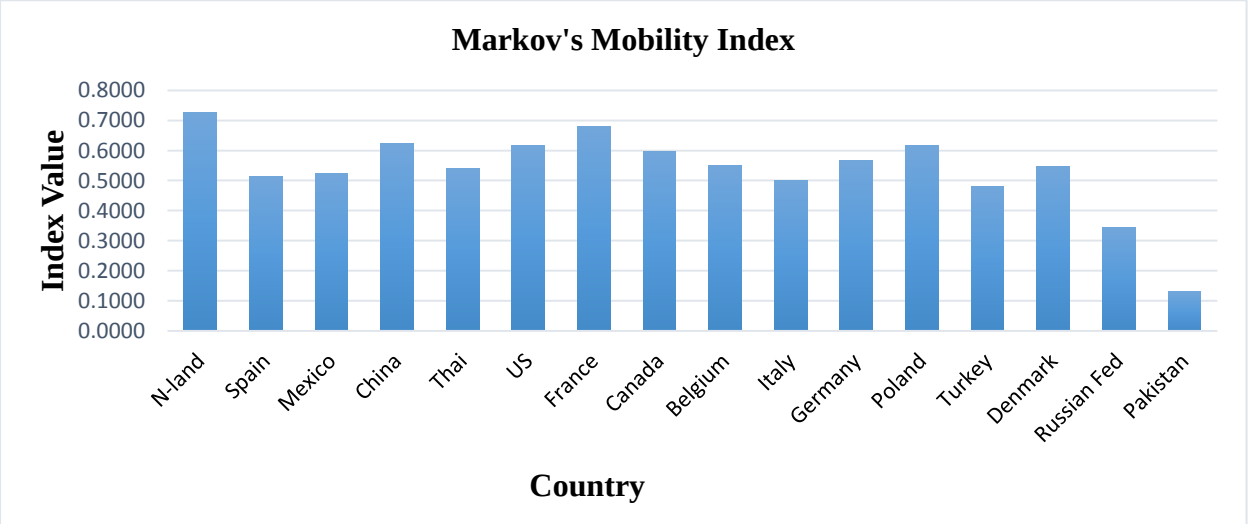
Table-3 Balassa Revealed Comparative Advantage Index at HS-2 Digits Level of Agri-Food Products, 1996 to 2020

$BRCA\ Index = (X_{PL}/X_p) \div (X_{WL}/X_w)$					
Country	**1996-2000**	**2001-2005**	**2006-2010**	**2011-2015**	**2016-2020**
Netherland	01.56	01.44	01.89	02.34	02.12

Spain	02.45	02.76	0.3.01	03.22	03.15
Mexico	01.44	01.12	01.34	01.01	01.15
China	01.02	01.04	01.01	0.96	0.89
Thailand	02.11	02.01	01.75	01.45	01.56
United States	01.88	01.44	01.64	01.32	01.45
France	01.15	0.104	01.22	01.03	01.14
Canada	01.41	01.04	01.66	0.96	01.12
Belgium	01.12	01.03	0.98	0.95	0.97
Italy	01.01	01.05	0.94	0.90	0.87
Germany	01.88	01.01	0.87	0.55	0.67
Poland	01.11	01.20	0.94	0.97	0.98
Turkey	02.11	02.01	01.75	01.45	01.56
Russian Fed.	01.01	01.03	0.96	01.02	0.95
Pakistan	0.98	1.67	2.01	01.65	2.16

Source: Author's own compilation by taking 05-years average, based on WITS (2020) dataset

Fugure-2 Markov's Transitional Probability Matrices; Mobility Index for Selected Panel Countries



Source: Author's own compilation by taking 05-years average, based on WITS (2020) dataset

The degree of Mobility of BRCA indices has been measure by employing Markov's transition probability matrices. The summarizing results of mobility index are represented in figure-2. The

findings represent the lowest and the highest mobility index in case of Pakistan and Netherland for selected global agri-food products at HS-06 digits level. It is also evidenced that the most of our sample countries i.e., Mexico, Spain, China, Thailand, France, US, Germany, and Denmark demonstrate mobility index values between 50% and 70%. However, in case of Turkey, Italy and Russian Federation the mobility index range is 35% to 49%. Similar results were found by Geweke et al., (1986); Bekucs et al., (2010) and Kelley et al., (2012).

Table-4 Kaplan- Meier (K-M) Survival Function; BRCA Pakistan and Selected Exporters for Selected Agri-Food Products at HS-6 Digits Level, 1996 to 2020

Survival Function (HS-06 digits Coded Commodities)										
Year	**070190**	**070200**	**070310**	**070990**	**071090**	**080590**	**081090**	**081340**	**110100**	**120890**
1996	0.7842	0.7707	0.7822	0.7822	0.7880	0.7864	0.8529	0.7683	0.7833	0.7966
1997	0.7467	0.7335	0.7467	0.7416	0.7471	0.7507	0.8253	0.7284	0.7822	0.7599
1998	0.7091	0.6900	0.7153	0.7001	0.7001	0.7139	0.8021	0.6877	0.7467	0.7276
1999	0.6699	0.6455	0.6828	0.6577	0.6523	0.6760	0.7778	0.6460	0.7153	0.6885
2000	0.6307	0.6055	0.6490	0.6142	0.6038	0.6369	0.7522	0.6033	0.6828	0.6594
2001	0.5896	0.5644	0.6136	0.5695	0.5544	0.5964	0.7316	0.5649	0.6490	0.6232
2002	0.5480	0.5219	0.5702	0.5235	0.5040	0.5603	0.7094	0.5250	0.6136	0.5855
2003	0.5034	0.4716	0.5248	0.4759	0.4525	0.5220	0.6852	0.4832	0.5702	0.5455
2004	0.4546	0.4199	0.4771	0.4264	0.3995	0.4746	0.6496	0.4392	0.5248	0.5030
2005	0.4059	0.4657	0.4409	0.3748	0.3451	0.4386	0.6102	0.3927	0.4771	0.4573
2006	0.3537	0.4083	0.3929	0.3203	0.2886	0.3988	0.5770	0.3427	0.4409	0.3991
2007	0.2991	0.4544	0.3482	0.2621	0.2296	0.3535	0.5376	0.2882	0.3535	0.3447
2008	0.2349	0.4950	0.2849	0.1985	0.1670	0.2999	0.4725	0.2271	0.2999	0.2819
2009	0.1613	0.4268	0.2201	0.1263	0.0987	0.2318	0.4081	0.1548	0.2318	0.1923
2010	0.0592	0.4380	0.1201	0.0345	0.0179	0.1264	0.4597	0.0563	0.1264	0.0874
2011	0.7685	0.7553	0.7666	0.7666	0.7723	0.7706	0.4358	0.7530	0.7706	0.7807
2012	0.7317	0.7189	0.7317	0.7267	0.7321	0.7357	0.4088	0.7139	0.7357	0.7447
2013	0.6949	0.6762	0.7010	0.6861	0.6861	0.6997	0.4861	0.6739	0.6997	0.7130
2014	0.6565	0.6326	0.6691	0.6445	0.6392	0.6625	0.4623	0.6331	0.6625	0.6747
2015	0.6181	0.5934	0.6360	0.6019	0.5917	0.6242	0.4371	0.5912	0.2991	0.6463
2016	0.5778	0.5531	0.6013	0.5581	0.5433	0.5845	0.5169	0.5536	0.2349	0.6107
2017	0.5371	0.5114	0.5588	0.5130	0.4939	0.5491	0.4952	0.5145	0.1613	0.5737
2018	0.4934	0.5621	0.5143	0.4664	0.4434	0.5116	0.4715	0.4736	0.0592	0.5346
2020	0.4455	0.5115	0.4675	0.4179	0.3916	0.4651	0.4366	0.4305	0.7685	0.4930
Average	0.5811	0.6145	0.5423	0.4651	0.4467	0.5156	0.4878	0.4654	0.5012	0.4467

Source: Author's own compilation based on WITS (2020) dataset, *Long-rank-test; 0.0001 and Wilcoxon-test; 0.0000*

able-5 Kaplan- Meier (K-M) Survival Function for BRCA Pakistan and Selected Exporters of Agri-Food Products, 1996 to 2020, Survival Function (By Country)

Year	N-land	Spain	Mexico	China	Thailand	US	France	Canada
1996	0.7842	0.7707	0.7822	0.7822	0.6880	0.7864	0.8529	0.7683
1997	0.7467	0.7335	0.7467	0.7416	0.6471	0.7507	0.8253	0.7284
1998	0.7091	0.6900	0.7153	0.7001	0.6001	0.7139	0.8021	0.6877
1999	0.6699	0.6455	0.6828	0.6577	0.6523	0.6760	0.7778	0.6460
2000	0.6307	0.6055	0.6490	0.6142	0.6038	0.6369	0.7522	0.6033
2001	0.5896	0.5644	0.6136	0.5695	0.5544	0.5964	0.7316	0.5649
2002	0.5480	0.5219	0.5702	0.5235	0.5040	0.5603	0.7094	0.5250
2003	0.7034	0.4716	0.5248	0.4759	0.4525	0.5220	0.6852	0.4832
2004	0.7546	0.4199	0.4771	0.4264	0.3995	0.4746	0.6496	0.4392
2005	0.7059	0.3657	0.4409	0.3748	0.3451	0.4386	0.6102	0.3927
2006	0.7537	0.3083	0.3929	0.3203	0.3886	0.3988	0.5770	0.3427
2007	0.7991	0.2544	0.3482	0.3621	0.3296	0.3535	0.5376	0.3882
2008	0.7349	0.1950	0.2849	0.3985	0.3670	0.2999	0.4725	0.3271
2009	0.7613	0.1268	0.2201	0.3263	0.3987	0.2318	0.4081	0.3548
2010	0.7592	0.0380	0.1201	0.4345	0.4179	0.1264	0.2597	0.3563
2011	0.7685	0.7553	0.7666	0.5666	0.5723	0.7706	0.8358	0.5530
2012	0.7317	0.7189	0.7317	0.5267	0.5321	0.7357	0.8088	0.5139
2013	0.6949	0.6762	0.7010	0.6861	0.6861	0.6997	0.7861	0.5739
2014	0.6565	0.6326	0.6691	0.6445	0.6392	0.6625	0.7623	0.5331
2015	0.6181	0.5934	0.6360	0.6019	0.5917	0.6242	0.7371	0.5912
2016	0.6778	0.5531	0.6013	0.5581	0.5433	0.5845	0.7169	0.5536
2017	0.6371	0.5114	0.5588	0.5130	0.4939	0.5491	0.6952	0.5145
2018	0.6934	0.4621	0.5143	0.4664	0.4434	0.5116	0.6715	0.4736
2020	0.6455	0.4115	0.4675	0.4179	0.3916	0.4651	0.6366	0.4305
Average	0.7123	0.6933	0.6193	0.5945	0.5274	0.5412	0.6743	0.5654

Continue	Survival Function (By Country)							
Year	**Belgium**	**Italy**	**Germany**	**Poland**	**Turkey**	**Denmark**	**Russian Fed**	**Pakistan**
1996	0.7833	0.7707	0.7822	0.7822	0.6680	0.7864	0.5529	0.1683
1996	0.7822	0.7335	0.7467	0.7416	0.6471	0.7507	0.5253	0.1284
1997	0.7467	0.6900	0.7153	0.7001	0.6001	0.7139	0.5021	0.1877
1998	0.7153	0.6455	0.6828	0.6577	0.6523	0.6760	0.5778	0.1460
1999	0.6828	0.6055	0.6490	0.6142	0.6038	0.6369	0.5522	0.1033
2000	0.6490	0.5644	0.6136	0.5695	0.5544	0.5964	0.5316	0.1649
2001	0.6136	0.6219	0.5702	0.5235	0.5040	0.5603	0.5094	0.1250
2002	0.5702	0.6716	0.5248	0.4759	0.4525	0.5220	0.5852	0.1332
2003	0.5248	0.6199	0.5771	0.4264	0.3995	0.4746	0.5496	0.1292
2004	0.4771	0.6657	0.5409	0.5748	0.3451	0.4386	0.5102	0.1227
2005	0.4409	0.6083	0.5929	0.5203	0.3886	0.3988	0.4770	0.1427
2006	0.3535	0.6544	0.5482	0.5621	0.3296	0.3535	0.4376	0.1182
2007	0.2999	0.6950	0.5849	0.5985	0.3670	0.3999	0.3725	0.1171
2008	0.3318	0.6268	0.5201	0.5263	0.3987	0.3318	0.3081	0.1548
2009	0.3264	0.6380	0.1201	0.5345	0.3179	0.3264	0.2597	0.0563
2010	0.3706	0.7553	0.5666	0.7666	0.3723	0.3706	0.3358	0.1530
2011	0.4357	0.7189	0.7317	0.7267	0.4321	0.4357	0.3088	0.1139
2012	0.5997	0.6762	0.7010	0.6861	0.3861	0.4997	0.3861	0.1039
2013	0.6625	0.6326	0.6691	0.6445	0.3392	0.4625	0.3623	0.1031
2014	0.5991	0.5934	0.6360	0.6019	0.3917	0.4242	0.3371	0.1012
2015	0.5349	0.5531	0.6013	0.5581	0.3433	0.4845	0.3169	0.1036
2016	0.5613	0.5114	0.6588	0.5130	0.3939	0.4491	0.3952	0.1145
2017	0.5592	0.6621	0.6143	0.5664	0.3434	0.4116	0.3715	0.0736
2018	0.7685	0.6115	0.6675	0.5179	0.3916	0.4651	0.3366	0.0305
2020	0.6706	0.6553	0.6636	0.5666	0.3723	0.4706	03358	0.0530
Average	0.6912	0.6845	0.6787	0.5845	0.4156	0.5365	0.3888	0.1073

Source: Author's own compilation by taking 05-years average, based on WITS (2020) dataset

Table-4 demonstrates the findings of the non-parametric K-M survival function (from equation 2) index of each selected agri-food exports products after calculating BRCA indices (equation II). The K-M product limit was employed on the panel dataset and evaluated that survival times have not been continued over the period from 1996 to 2020 for each product. The value of survival function indicates an average decline by 55%, 44%, 41% and 38% in product code 070190, 081090, 070990 and 110100 respectively over the period due to high competition in the global

market. Moreover, an average of 35% to 30% decrease has been in product code 070200, 070310, 070090, and 080590 respectively. However, on average random behavior of product survival value is observed for the product (081040) and (120890) over the period. Similar results have been evaluated by many researcher in their studies such as Sinanana and Hoseinbo, 2012; Brakman et al., 2013; Levchenko and Zhang, 2016.

In table-5, K-M survival function has been calculated for selected exporters of agri-food products after calculating BRCA (from equation II) over the period of 25-years. An average of survival index constructed on the basis of the panel dataset shows a varying trend in our study. For instance, a comparative low decline in case of Netherland, Spain, Mexico, Belgium, Germany and Poland due to continuous penetration while a sharp decrease has been observed for Pakistan, Thailand, and Russian Federation for the period 1996 to 2020 due to stiff competition and loosing shares in the global market. Therefore, a comparative high-low trend has been observed in case of US, France, Canada. Moreover, China, Italy and Turkey represent a comparative random patterns during their survival period from 1996 to 2020. Similar evidences have been estimated in many studies like Zhu et al., 2010; Leromain and Orefice, 2014; Laursen, 2015; Bejenek and Ferto, 2016.

Patterns and Stability of Comparative Advantage

The degree and stability of trade specialization has been measured by BRCA index. From the results of table-4, it is evidenced that Spain has high comparative advantage, and Thailand represents the most stable comparative advantage during the examined period from 1996 to 2020. Among the major exporters of the vegetable products, Netherland, Spain, Mexico, Belgium, France and Italy have relatively high competitiveness in the global vegetable agri-food products at HS-6 digit level while, other countries like US, China, Denmark, Poland and Canada have varied significantly. It is also observed that Netherland, Spain, despite of largest exporters, have slightly decreasing and low comparative advantage as compare to Poland, Denmark, US, China and Turkey. The summarizing results of Markov's transition probability matrices by employing mobility index, followed by BRCA estimation have been shown in figure-2. The findings exhibit a relatively low mobility of BRCA in case of Thailand, Russian Federation and Pakistan. It is clear that more than 55% RCA of the agri-food products persistent with Belgium, Spain, Mexico, Netherland, although the lowest mobility measures to Pakistan, Russian Federation and Thailand. The results of panel K-M non parametric product limit estimator reveal that survival times are gradually decreasing in case of Pakistan, Russian Federation, Turkey and Thailand while the value of K-M show a relative medium-stable for Netherland, Spain, Mexico, Belgium and Germany. The quality of survival function across the major exporters of agri-food have been estimated by employing Wilcoxon and Long-rank of non-parametric tests. The findings of each result reject the null hypothesis i.e., H_0; there exists similarities across the survival function among selected agri-food products and we conclude that duration of comparative advantage during the time period is absent at 1% level of significance. Finally, according to survival function, it is cleared that the highest survival period exists for Netherland, Spain, Mexico, Belgium

while the lowest for Pakistan and Russian Federation followed by medium time survival for rest of the examined countries.

CONCLUSION AND POLICY IMPLICATION

The purpose of this study is to estimate Pakistan's global vegetable competitiveness using Balassa revealed comparative advantage index by taking into account the Markov's stability duration and Kaplan-Meier transitional probability function. First, by considering the characteristics of global agri-food products, it has been assessed that Netherland, Spain, Mexico, Belgium, were the major exporters of the selected vegetables at HS-06 digits level during the period. These countries, together providing 55% of exported vegetables as well as consisting 70% concentration agri-food products from our sample selected countries. On the other hand, rest of the countries provide the remaining exports to the world. Second, our estimation revealed that the fresh or chilled tomatoes (070200) and fresh or chilled onions and shallots (070310) which account for more than 35% and 25% of trade among our examined products respectively for the period. Third, the estimation of BRCA indices evaluate that Netherland and Spain have the largest value of comparative advantage over the period. However, there has been observed a comparatively decreasing trend in BRCA index for China, Italy, Germany, Turkey, Poland and Russian Federation while, a stable BRCA index value has been observed in case of US, Thailand, France, Canada, but Pakistan's BRCA index value is surprisingly increased over the period though its global share has been very low over the period. Moreover, the results of Markov's mobility index reveals that Pakistan has the lowest mobility of BRCA in the global vegetable products. Netherland and Belgium have the highest survival, while Turkey, and Poland have comparatively low-stable competitive potential. Finally, the results of Kaplan-Meier survival function predict that the survival chance of Russian Federation was reduced to 50% by the end of the period, indicating a stiff competition exists in the global agri-food products among the countries. As Pakistan is an agrarian country and having world's best irrigation system, so, Pakistan should get advantage of revealed comparative advantage as its BRCA index is greater than 1. Though Pakistan's agri-food export share in the world market is very low but it has still some potential to enhance its global penetration by exploring untapped trade dimensions. In short, Pakistan should adopt farm mechanization, the latest agricultural tools, and better high yield seeds to boost its agri-food production, and by reducing the cost of production to compete in the international market in the presence of global giant exporters.

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