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Impact of Economic Globalization on Agricultural Competitiveness in Developing and Developed Countries

Doctoral (Ph.D.) dissertation

by

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TABLE OF CONTENTS

I. INTRODUCTION

1.1. Background

Economic globalization (EG) can be defined as a process in which governments rapidly liberalize trade, investment, finance and long-distance movements, as well as the information and perceptions that accompany market exchanges (Dreher, 2006). In several developed countries, EG grew by 77% in East Asia, 55% in Europe and Central Asia, and the lowest in North America at 41%. Developing countries also do not want to be left behind to improve their role in the global economy. Countries in the Latin America & Caribbean region experienced a 56% rise in EG, while the Middle East and South Asia saw 50% and 60% increases, respectively, and finally in Sub-Saharan Africa by 52% (KOF Swiss Economic Institute, 2021).

Many economists investigated EG, resulting in the debate regarding its impact in different places. EG can increase trade volumes, foreign direct investment (FDI) inflow, economic growth, infrastructure development, technology, foreign tourists, and international events; and reduce inflation, income disparity, poverty, malnutrition, unemployment, and illegal economic in developing countries (Hoang, 2020; Munir & Bukhari, 2020). On the other hand, EG makes developing countries vulnerable to even slight external shocks or crises. EG is also to blame for rising worker exploitation, income inequality and resource distribution, large-scale urbanization, and many sother issues (Fatihudin, 2019).

Scholte (2005) revealed that globalization is dominated by a single global-Western conglomerate, failing developing countries' economic, social, technical, political, and cultural mobilization. Western countries also apply double standards, pushing for trade liberalization for their exports while protecting industries vulnerable to competition with developing countries, such as agriculture (Ghosh, 2009). Hence, many countries have violated the agreement on agriculture (AoA) under the WTO (Losch, 2004). Even though the AoA promised to reduce protectionist trade practices and eradicate a variety of trade distortions and barriers (Ghosh, 2009). Meanwhile, consumers in developed countries have a dynamic demand for agricultural products and focused on healthy, quality and environmentally friendly food (Polimeni et al., 2018).

Nowadays, the global economy has also suffered because of the Covid-19 pandemic. This pandemic also has effects on agriculture, such as changes in planting area and crop productivity, decreases in total agricultural production and GDP, lowered farm-gate product prices, increases production costs, causes farmers lose a lot of profits, increases emphasis on local products, difficulties of moving agricultural products within the supply chains, worker shortages, and heightened food insecurity (Gupta et al., 2021; Jha et al., 2021; McBurney et al., 2021). An update of the international political situation creates new conditions for further development because the increasing conflicts between Russia and Western countries (mainly but not exclusively member states of NATO) lead to fragmentation of the global supply system (Nasir et al., 2022).

There have been many studies on EG with different findings, even contradictory ones. However, these studies have only been conducted in a few countries. This results in a partial equilibrium, there will undoubtedly be controversy regarding the study's findings. As a result, I conducted a wider study with a larger sample of nations to achieve a general equilibrium.

1.2. Research Question and Objective

Based on the introduction, this research has 3 research questions:

a. Do agricultural products in developing countries have competitiveness?
b. Do agricultural products in developed countries have competitiveness?

c. Does economic globalization have an impact on agricultural competitiveness in developing and developed countries?

After formulating the research question, this study aims to:

a. identify the competitiveness of agriculture in developing countries.
b. identify the competitiveness of agriculture in developed countries.
c. know the direction and how big the influence of economic globalization on agricultural competitiveness in developing and developed countries.

1.3. Hypothesis

There are 3 hypotheses for this study:

Hypothesis 1: agricultural products in developing countries have competitiveness.
Hypothesis 2: agricultural products in developed countries have competitiveness.
Hypothesis 3: economic globalization has a positive impact on agricultural competitiveness in developing and developed countries.

II. THEORETICAL FRAMEWORK AND LITERATURE REVIEW

2.1. Theoretical Framework

Adam Smith was the first economist to propose EG through free trade and a strong advocate of little government intervention in the economy (laissez-faire). Free trade will promote global wellbeing by allowing the most efficient use of the world's resources. The idea is for one country to specialize in producing its absolute advantage commodity while trading a portion of its output with the other country for its absolute disadvantage commodity (Salvatore, 2013). The next economist to endorse EG is David Ricardo, who emphasizes the importance of labor productivity (Krugman & Obstfeld, 2003). Ricardo proposed the law of comparative advantage in his Principles of Political Economy and Taxation, which was published in 1817. This is one of economics' most significant and unchallenged laws, with several practical applications (Salvatore, 2013). This law assumes that trade between countries would be liberalized and made free suddenly. The initial differences in relative prices of products across countries will encourage trade between them. Since the differences in prices are a direct result of technological differences across countries, it is the differences in technology that drive trade in the model (Suranovic, 2012).

One of the most influential theories in international economics is that international trade is mostly driven by differences in countries' resources. The Heckscher-Ohlin (H-O) highlights the interaction between the proportions in which different sources of production are accessible in different countries and the proportions in which they are used to produce different commodities (Krugman & Obstfeld, 2003). The H-O theory is expressed in terms of factor intensity and factor abundance. Factor intensity is the amount of capital per unit of labor used in the production of two commodities. Factor abundance can be defined in two ways. (Salvatore, 2013). The H-O also claims that special protection is needed for sectors that rely heavily on factors that the country is poorly endowed (Kwon, 2011).

Lastly, Michael Porter invented the "Diamond Theory." Porter's "focus on rivalry or competition" is a diversion from traditional economic thinking. Because of shifting patterns in world trade, globalization of the world economy, rapid distribution of technology and information, and the growth of transnational organizations, countries' rivalry has evolved during the previous decade (Smit, 2010). Porter also revealed the importance of government policies that increase the productivity of generated assets, allowing people and businesses to innovate new products or provide existing products at cheaper real costs (Dunning, 1993). This theory is the basis for this research.

The "Diamond Theory" shows how a country's competitiveness is determined by its industry's ability to innovate and upgrade. Because of the pressure and challenge, companies acquire an advantage over the world's greatest rivals. Strong domestic competitors, aggressive home-based suppliers, and demanding local customers help them succeed. Nations have grown more essential, not less, in a more globalized world. The nation's role has expanded as the foundation of competitiveness has turned more and more to the generation and assimilation of information. A highly localized process is used to establish and maintain a competitive advantage (Porter, 1990).

2.2. Literature Review

EG has many effects, both positive and negative, especially in the agricultural sector. EG has been able to boost agricultural production (Kamran et al., 2021). This is due to several reasons, such as agricultural production factors being used more often (Jorgenson & Carolina, 2008), the farmers' motivation to fulfil the rising domestic and international markets demand, government

efforts and policies to increase food production and expansion the international food organization's role (Díaz-Bonilla, 2010).

Furthermore, EG makes a country more open and reliant on food imports, reducing self-sufficiency capacity. Hence, when there is a global food crisis, these countries will be affected. For example, food prices rose throughout the first half of the 1970s, raising worries about social and political stability in food-importing developing countries (Díaz-Bonilla, 2010). Another example is that the global financial crisis caused the economic recession and reduced consumer purchasing power in developed and developing countries. Consequently, the farmers had to contend with dynamic market conditions for their products (Swaffield & Primdahl, 2010).

Apart from production, food quality has increased along with the implementation of EG. These quality requirements often serve as non-tariff barriers, too. Today's growing consumer demand has encouraged producers to be more concerned about food quality. Various food certifications and regulations have emerged to achieve it (Josling, 2012; Qiang et al., 2020). Food certification also makes tracing the origins of food more accessible in the event of a problem (Opara & Mazaud, 2001). On the other hand, this certification is considered a trade barrier since many agricultural products from developing countries are unable to meet it and are refused entry to developed countries (Diao et al., 2002).

Finally, EG can help to improve food diversification and the supply chain (Renard, 1999). Agricultural production factors and food are becoming more readily available and traceable (Opara & Mazaud, 2001). Many new food processing businesses have sprung up in developing countries and increased food diversification (Camargo & Wang, 2015). Furthermore, many multinational agricultural corporations invest in developing countries and link upstream and downstream (vertical integration). They act not only as providers of agricultural production factors but also as producers, processors and retailers (Biles et al., 2007). Likewise, in developed countries, EG can increase the availability of raw materials for industry and ensure the continuity of the food supply chain (Renard, 1999). This makes food more accessible to customers (Nelson et al., 2016).

This point of view is still hotly debated. According to Meher (2009), EG failed to provide small farmers with a better and more sustainable livelihood. They can't compete with farmers or businesses that employ cutting-edge technologies. They lack the technical ability and financial resources to employ sophisticated technologies (Nugroho, 2021). EG also causes farmers to lose agricultural land because it was bought by a foreigner and reduces access to public agricultural services (Todirica et al., 2018). They eventually went bankrupt, lost their jobs, were frustrated and even suicide (Pirkle et al., 2015).

Another problem is that many countries raise trade barriers. Whereas countries with competitive production sectors and great export potential have pushed for more open markets, those that are less competitive and scared of negative effects for their farmers have been hesitant to push for more liberalization. Likewise, many governments intervene with subsidized programs (Diao et al., 2002; Bullion, 2003). As a result, trade is no longer fair, resulting in significant losses for agricultural businesses and decreased exports (Atici, 2005).

EG has a significant economic impact on agriculture. EG increase economic growth, the share of agriculture to GDP, and employment in agriculture; develop the rural and urban area and reduce poverty (Ding et al., 2016; Kamran et al., 2021). However, economic growth is unequal, resulting in agricultural inequity. Only a few parties get a large share of profits from agricultural trade. This disparity also exists between developing and developed countries. EG also cannot increase productivity in terms of workforce development and instead harms the use of child labour for

agricultural activities. Instead of attending school, these children choose to work on the farm (Lin, 2021). This shows that EG also impacts social and political change (Ghosh, 2009).

For the environment, EG has both beneficial and harmful impacts. EG increases pesticide and fertilizer use while improving resource efficiency (Schwarz et al.,2019). The efficient use of land and other resources is achieved by applying technology, improved plant types, and mechanization. Meanwhile, EG continues to have a detrimental influence on resource sustainability (Li et al., 2017). For example, groundwater use increases for irrigated commercial crops (Schwarz et al., 2019). In developing countries, environmental degradation and deforestation are caused using chemicals and resource overexploitation. It appears that agricultural business players have become less concerned about environmental sustainability due to the commercialization of agriculture (Hopewell, 2013).

EG has a beneficial influence on infrastructure and R&D procurement, with no negative consequences. First, EG helps construct agricultural infrastructure (Mykhailov et al., 2021). Furthermore, the mechanization of agricultural cultivation occurs rapidly, resulting in increased yield. This also affects agro-industry upgrading, resulting in a rise in the added value of agricultural products (Neilson et al., 2020). Second, EG helps to accelerate the transfer of technology and know-how from developed to developing countries. This is achieved through several international research collaborations, FDI inflows and trade cooperation (Camargo & Wang, 2015; Song & Zhang, 2016).

III. MATERIAL AND METHODS

3.1 Data source

This study employed panel data, which combines time-series and cross-sectional data. The time-series data in this study are from 1990 until 2020 and the cross-section data are from 71 developing countries and 24 developed countries (Table 1). I used IMF indicators to classify countries including developing countries and developed countries. This study will also use several other explanatory variables and data sources, as shown in Table 2.

Table 1. List of Developing and Developed Countries

Developing Countries			Developed Countries
1. Albania	25. Fiji	49. Nigeria	1. Australia
2. Bangladesh	26. Gabon	50. Pakistan	2. Austria
3. Benin	27. Guatemala	51. Panama	3. Belgium
4. Bolivia	28. Guyana	52. Paraguay	4. Canada
5. Botswana	29. Haiti	53. Peru	5. Cyprus
6. Brazil	30. Honduras	54. Philippines	6. Czechia
7. Brunei Darussalam	31. Hungary	55. Poland	7. Denmark
8. Bulgaria	32. India	56. Romania	8. Finland
9. Burkina Faso	33. Indonesia	57. Russia	9. France
10. Burundi	34. Iran	58. Rwanda	10. Germany
11. Cambodia	35. Iraq	59. Saudi Arabia	11. Greece
12. Cameroon	36. Jamaica	60. Senegal	12. Iceland
13. Chile	37. Jordan	61. South Africa	13. Israel
14. China	38. Kenya	62. Sri Lanka	14. Italy
15. Colombia	39. Lesotho	63. Sudan	15. Netherlands
16. Congo	40. Madagascar	64. Togo	16. New Zealand
17. Costa Rica	41. Malawi	65. Trinidad and Tobago	17. Norway
18. Democratic Republic of the Congo	42. Malaysia	66. Turkiye	18. Portugal
19. Dominican Republic	43. Mali	67. Uganda	19. Republic of Korea
20. Ecuador	44. Mauritania	68. United Republic of Tanzania	20. Spain
21. Egypt	45. Mauritius	69. Uruguay	21. Sweden
22. El Salvador	46. Mexico	70. Yemen	22. Switzerland
23. Eswatini	47. Mongolia	71. Zambia	23. United Kingdom of Great Britain and Northern Ireland
24. Ethiopia	48. Nepal		24. United States of America

Table 2. Data variable

Variable	Symbol	Source
Agricultural Comparative Advantage	ACA	Index, calculated by the author
Temperature change (^{0}C)	TEMP	FAO
Industry (including construction), value added (annual % growth)	IND	World Bank
Population (000 people)	POP	World Bank
Consumption of renewable energy (% of total final energy consumption)	RENEW	World Bank
Total natural resources rents (% of GDP)	RENT	World Bank
Net Forest conversion (000ha)	CONV	FAO
Consumer price index (%)	CPI	IMF
Official exchange rate (LCU per US$)	EXC	Federal Reserve Economic Data
Economic globalization index	EGI	KoF
Land area equipped for irrigation (%)	IRRI	FAO
Mobile cellular subscriptions (per 100 people)	MOB	World Bank
Employment in agriculture, forestry, and fishing (000 people)	EMPL	ILO
Human capital index	HCI	Penn World Table

3.2. Data analysis

3.2.1. Agricultural competitiveness of a country (ACA)

ACA can be measured using Revealed Comparative Advantage (RCA). RCA measures the agricultural export performance of developing and developed countries can be written (Balassa, 1965):

$$RCA_{ij} = \left(\frac{X_{ij}}{X_{it}}\right) / \left(\frac{X_{ej}}{X_{et}}\right) \quad (1)$$

where: X_{ij} = the current year's total value of agricultural exports of a country (US Dollars), X_{it} = the current year's total value exports of a country (US Dollars), X_{ej} = the current year's total value of agricultural exports of all countries (US Dollars), and X_{et} = the current year's total value exports of all countries (US Dollars). The formula produces the following results: 1) a country has a comparative advantage if the index generated by the RCA calculation is greater than 1, and 2) a country has a comparative disadvantage if the RCA value is less than 1.

3.2.2. Determinant of ACA

The empirical analysis begins with a unit root test before the estimation. The stationarity test was performed to eliminate spurious regression. One type of test is used to evaluate the stationarity of the variables, including Levin Lin Chu (Levin et al., 2002):

Following that, I performed the three-stage least squares (3SLS). The 3SLS model was chosen because the study model, particularly the TEMP, has an endogeneity problem. Endogeneity occurs when the TEMP is supposed to influence ACA; while other variables, including ACA, have an effect on the TEMP at the same time (Batmunkh et al., 2022).

Equation 1:

$$TEMP = \beta_0 + \beta_1 ACA + \beta_2 IND + \beta_3 POP + \beta_4 RENEW + \beta_5 RENT + \beta_6 CONV + \mu \quad (2)$$

Equation 2:

$$ACA = \gamma_0 + \gamma_1 TEMP + \gamma_2 CPI + \gamma_3 EXC + \gamma_4 EGI + \gamma_5 IRRI + \gamma_6 MOB + \gamma_7 EMPL + \gamma_8 HCI + d_{it} + \sigma \quad (3)$$

d_{it} = cross-country heterogeneity. This variable represents the differences in conditions and policies between countries that are not included in the study's explanatory variables.

The 3SLS model must pass several post-estimation tests to be valid. Post-estimation tests for the 3SLS model include (Greene, 2003): 1) an endogeneity test using the Hausman method, 2) a weak instrument test using the Stock & Yogo method, and 3) an identification restriction test using the Sargan method. The 3SLS model is valid when it satisfies these three assumptions. First, the model must have an endogeneity problem, meaning that the dependent variables in 2 or more equations mutually influence each other simultaneously (J. Li et al., 2021). If this happens, the multiple linear regression will be inefficient and can produce a biased estimation (Hill et al., 2021). Second, the use of the 3SLS model must fulfill the assumption that the model's instrument variables are strongly correlated with endogenous regressors (Choi et al., 2018). Third, the 3SLS model must meet the identification restriction test criteria, where the 3SLS model is valid when the compiled model is a just-identified or over-identified (Mariano, 2007).

IV. AGRICULTURAL COMPETITIVENESS IN DEVELOPING AND DEVELOPED COUNTRIES

4.1. Agricultural competitiveness in developing countries

Tables 3a-3f depict agricultural competitiveness in developing countries. Developing countries that are categorized as having agricultural competitiveness (ACA > 1) include Benin, Bolivia, Brazil, Bulgaria, Burkina Faso, Burundi, Cambodia, Cameroon, Chile, Colombia, Costa Rica, Dominican Republic, Ecuador, Egypt, El Salvador, Eswatini, Ethiopia PDR, Fiji, Guatemala, Guyana, Honduras, India, Indonesia, Jamaica, Jordan, Kenya, Lesotho, Madagascar, Malawi, Malaysia, Mali, Mauritius, Nepal, Pakistan, Paraguay, Peru, Philippines, Poland, Romania, Rwanda, Senegal, South Africa, Sri Lanka, Sudan (former), Togo, Turkiye, United Republic of Tanzania, Uganda Uruguay, and Yemen. Meanwhile, countries that have lost their agricultural competitiveness (ACA < 1) include Albania, Bangladesh, Botswana, Brunei Darussalam, China, Congo, Democratic Republic of the Congo, Gabon, Haiti, Hungary, Iran, Iraq, Mauritania, Mexico, Mongolia, Nigeria, Panama, Russian Federation, Saudi Arabia, Trinidad and Tobago, and Zambia. Therefore, hypothesis 1 of this study is unproven because there are developing countries that do not have agricultural competitiveness.

Romania is a developing country that has increased its agricultural competitiveness seven times in the last three decades. Several other countries have seen significant increases in agricultural competitiveness over the last three decades, including Brazil (58.94%), Egypt (29.38%), Indonesia (122.69%), Iran (195.45%), Jamaica (44.12%), Malawi (11,18%), Nepal (336.06%), Russian Federation (245.83%), South Africa (72.15%), Uruguay (60.80%), Yemen (61.54%), and Zambia (427.78%).

However, countries such as Botswana (-50.00%), Brunei Darussalam (-75.00%), China (-65.67%), Dominican Republic (-55.06%), El Salvador (-55.51%), Eswatini (-44.96%), Ethiopia (-36.16%), Guyana (-63.53%), Honduras (-53.55%), Hungary (-63.26%), Lesotho (-54.55%), Madagascar (-22.19%), Mali (-73.42%), Mauritania (1262.5%), Mauritius (-108.88%), Mongolia (-77.82%), Paraguay (-13.62%), Philippines (-38.04%), Rwanda (-73.88%), Senegal (-29.06%), Sudan (-45.66%), Togo (-26.84%), Türkiye (-47.10%), the United Republic of Tanzania (-53.44%), and Uganda (-54.44%) have lost their competitiveness. The country with the most drastic decline in agricultural competitiveness in the last 3 decades is Panama.

Table 3a

Agricultural competitiveness in developing countries based on RCA values

Year	Albania	Bangladesh	Benin	Bolivia	Botswana	Brazil	Brunei Darussalam	Bulgaria	Burkina Faso	Burundi	Cambodia	Cameroon
1990	2.60	1.17	3.20	2.09	0.48	3.02	0.04	1.48	7.99	9.58	4.80	3.00
1991	2.56	0.93	2.82	1.82	0.51	2.70	0.04	2.28	6.24	10.04	1.79	1.96
1992	2.41	0.77	2.77	1.59	0.55	2.68	0.03	2.43	5.64	9.37	0.64	2.07
1993	2.26	0.61	2.70	1.82	0.62	2.81	0.03	2.17	6.76	9.50	0.55	1.43
1994	1.63	0.47	3.54	2.43	0.57	3.21	0.03	2.42	3.98	10.47	1.11	2.69
1995	0.84	0.44	5.77	2.35	0.71	3.36	0.04	2.55	1.42	10.63	1.31	3.97
1996	1.89	0.37	5.34	2.85	0.58	3.48	0.10	2.14	1.25	10.90	0.74	4.07
1997	2.31	0.45	6.45	3.60	0.50	3.71	0.01	1.76	1.18	8.24	0.69	3.08
1998	1.13	0.37	6.79	3.89	0.85	3.76	0.01	2.08	8.40	11.44	0.37	3.24
1999	0.57	0.34	7.03	4.71	0.51	3.95	0.01	2.08	6.47	11.16	0.63	3.90
2000	1.36	0.33	14.89	4.96	0.69	3.65	0.00	1.53	7.40	13.46	0.23	3.11
2001	1.06	0.23	13.83	4.51	0.86	4.13	0.01	1.68	10.34	11.28	0.37	3.37
2002	1.04	0.29	8.98	4.84	0.35	4.09	0.01	1.86	9.14	10.70	0.30	3.87
2003	0.88	0.26	13.53	4.36	0.30	4.15	0.01	1.52	13.81	11.66	0.29	3.73
2004	0.93	0.24	14.15	4.24	0.22	4.29	0.00	1.61	10.69	6.89	0.33	3.91
2005	0.98	0.39	14.54	3.21	0.18	4.18	0.00	1.71	12.82	15.38	0.21	3.26
2006	0.96	0.42	15.77	2.56	0.17	4.23	0.00	1.65	11.39	12.94	0.27	2.82
2007	0.90	0.43	12.70	2.56	0.47	4.32	0.00	1.41	10.59	15.44	0.27	2.95
2008	0.70	0.23	5.46	2.22	0.46	4.46	0.00	1.91	5.74	15.02	0.24	2.37
2009	0.63	0.23	5.74	2.72	0.68	4.62	0.00	2.20	5.41	11.52	0.23	3.65
2010	0.52	0.27	6.61	2.20	0.74	4.54	0.00	2.40	4.04	12.51	0.52	4.08
2011	0.59	0.27	5.14	2.07	0.33	4.48	0.00	2.17	2.86	9.27	0.76	3.42
2012	0.64	0.23	2.92	1.92	0.31	4.63	0.00	2.17	3.11	9.53	0.70	3.19
2013	0.63	0.21	3.62	2.31	0.34	4.77	0.02	2.42	4.79	7.71	0.86	3.43
2014	0.37	0.23	2.28	2.02	0.27	4.80	0.05	2.18	4.18	8.13	0.98	2.99
2015	0.70	0.24	3.12	2.19	0.31	4.93	0.01	2.05	3.79	7.88	0.89	4.10
2016	0.87	0.18	2.02	2.56	0.22	4.68	0.01	2.02	3.59	7.82	0.78	4.38
2017	0.58	0.17	3.46	1.71	0.23	4.59	0.01	1.77	3.23	6.07	1.11	3.69
2018	0.50	0.17	4.13	2.09	0.24	4.62	0.01	1.93	3.25	6.56	0.91	3.54

2019	0.73	0.21	2.67	2.06	0.24	4.62	0.01	2.00	2.62	5.88	0.83	3.26
2020	0.74	0.22	3.31	2.39	0.24	4.80	0.01	1.93	1.52	5.89	1.10	4.04

Table 3b

Agricultural competitiveness in developing countries based on RCA values

Year	Chile	China	Colombia	Congo	Costa Rica	Democratic Republic of the Congo	Dominican Republic	Ecuador	Egypt	El Salvador	Eswatini	Ethiopia PDR
1990	1.51	0.67	3.86	0.16	5.91	1.53	5.63	3.18	1.77	5.35	6.85	8.85
1991	1.61	0.66	3.75	0.14	6.10	1.09	6.14	3.88	1.12	5.63	6.13	8.65
1992	1.68	0.60	3.83	0.15	3.91	2.16	5.82	3.13	1.37	4.82	5.06	8.24
1993	1.82	0.58	3.75	0.09	3.91	1.84	5.83	3.17	1.26	5.10	4.32	7.82
1994	1.71	0.58	4.54	0.08	4.82	2.67	5.64	4.06	1.74	3.46	3.97	8.77
1995	1.58	0.51	3.99	0.11	5.30	3.34	5.27	3.89	1.23	3.76	3.85	9.81
1996	1.95	0.50	3.52	0.05	4.89	2.82	5.51	3.89	1.27	3.24	4.18	9.39
1997	1.86	0.45	4.32	0.14	4.83	2.03	8.98	4.55	0.96	3.64	5.25	9.55
1998	2.30	0.43	4.41	0.16	4.33	3.60	10.52	4.72	1.38	2.79	3.97	9.55
1999	2.21	0.41	3.71	0.17	3.56	2.03	9.07	4.95	1.71	2.51	3.83	10.10
2000	2.33	0.43	3.50	0.10	4.10	0.70	9.26	4.24	1.22	3.34	5.18	10.91
2001	2.61	0.40	3.26	0.17	4.17	0.38	10.48	4.81	1.28	2.10	3.82	6.23
2002	2.80	0.38	3.36	0.15	3.87	0.34	10.09	5.05	1.68	1.89	2.92	11.08
2003	2.43	0.34	3.10	0.18	3.83	0.23	8.24	4.73	1.62	1.81	2.13	11.62
2004	1.98	0.28	3.07	0.16	4.37	0.32	7.53	3.95	1.87	1.92	2.60	6.25
2005	1.84	0.29	3.33	0.15	4.52	0.27	7.13	3.53	1.33	2.43	1.91	6.48
2006	1.52	0.27	3.24	0.06	4.80	0.28	6.52	3.36	0.98	2.81	2.85	14.40
2007	1.56	0.27	3.03	0.15	4.45	0.26	5.64	3.12	1.31	2.64	1.48	12.94
2008	1.74	0.26	2.60	0.10	5.12	0.21	2.08	2.75	1.25	2.58	2.19	12.92
2009	1.86	0.26	2.33	0.10	4.45	0.27	2.48	3.67	2.49	2.65	1.68	10.89
2010	1.77	0.26	1.99	0.05	4.84	0.21	2.65	3.30	1.57	2.80	1.86	10.93
2011	1.78	0.26	1.67	0.03	4.91	0.14	2.15	3.06	2.21	3.26	1.97	10.50
2012	1.90	0.25	1.48	0.04	4.64	0.10	2.60	2.70	1.86	2.95	1.72	11.28
2013	2.06	0.24	1.49	0.02	4.66	0.10	2.53	2.69	2.28	2.75	3.76	11.33
2014	2.06	0.25	1.72	0.05	4.98	0.12	3.01	2.82	2.19	2.32	3.20	12.69
2015	2.25	0.26	2.42	0.03	5.66	0.14	2.75	3.98	2.66	2.39	3.92	11.77

2016	2.27	0.28	2.61	0.04	6.69	0.16	2.57	4.11	2.13	2.08	3.28	6.47
2017	2.00	0.27	2.39	0.03	6.46	0.08	2.76	3.83	2.42	2.16	3.13	5.97
2018	2.10	0.28	2.28	0.03	5.54	0.05	2.67	3.73	2.43	2.17	3.54	5.48
2019	2.26	0.28	2.38	0.02	5.01	0.09	2.54	3.60	2.46	2.34	3.71	7.36
2020	1.93	0.23	2.92	0.05	4.52	0.12	2.53	3.91	2.29	2.38	3.77	5.65

Table 3c

Agricultural competitiveness in developing countries based on RCA values

Year	Fiji	Gabon	Guatemala	Guyana	Haiti	Honduras	Hungary	India	Indonesia	Iran	Iraq	Jamaica
1990	3.97	0.01	7.52	4.25	1.99	8.59	2.64	1.80	1.19	0.22	0.06	2.04
1991	5.23	0.03	7.13	4.61	1.81	7.88	2.73	1.61	1.15	0.33	0.20	2.27
1992	4.33	0.03	6.75	4.91	2.28	6.46	2.60	1.47	1.06	0.33	0.22	2.33
1993	4.33	0.02	6.95	4.41	2.61	6.35	2.45	1.62	1.10	0.46	0.09	2.53
1994	4.17	0.02	7.06	4.47	2.38	4.88	2.39	1.30	1.35	0.55	0.22	2.11
1995	4.49	0.04	7.87	4.73	2.39	5.14	2.61	1.87	1.41	0.62	0.20	2.27
1996	4.03	0.05	6.73	5.11	4.03	4.27	1.98	1.96	1.37	0.51	0.15	1.97
1997	3.67	0.06	7.61	4.67	2.15	4.34	1.80	1.86	1.38	0.51	0.07	2.14
1998	4.48	0.08	7.90	4.71	1.65	6.13	1.48	1.87	1.31	1.02	0.05	2.18
1999	3.85	0.07	8.09	8.46	1.25	5.26	1.24	1.64	1.45	0.67	0.02	2.72
2000	4.35	0.05	9.18	5.65	1.40	6.96	1.22	1.60	1.25	0.54	0.01	2.76
2001	4.16	0.08	8.27	4.65	1.05	7.57	1.18	1.66	1.16	0.64	0.01	2.58
2002	4.58	0.03	4.65	4.73	0.94	5.73	1.13	1.43	1.59	0.61	0.04	3.12
2003	4.08	0.04	4.49	5.17	0.87	6.05	1.09	1.40	1.61	0.67	0.06	2.99
2004	4.37	0.06	4.46	5.56	0.78	7.15	0.97	1.26	2.04	0.50	0.09	2.75
2005	5.66	0.13	5.70	5.16	0.60	7.83	1.02	1.29	2.05	0.56	0.02	2.31
2006	6.00	0.14	5.31	6.28	0.71	7.26	0.97	1.40	2.34	0.59	0.01	2.35
2007	5.64	0.08	6.34	6.46	0.63	7.55	1.02	1.73	2.36	0.61	0.02	2.38
2008	5.40	0.08	6.11	5.93	0.79	3.44	1.07	1.26	3.02	0.44	0.02	2.04
2009	4.68	0.07	6.07	4.38	0.63	3.40	1.01	1.17	2.36	0.27	0.02	3.22
2010	3.33	0.08	6.32	5.74	0.66	3.89	1.10	1.14	2.77	0.76	0.01	3.14
2011	3.16	0.12	6.04	4.80	0.51	4.58	1.15	1.28	2.92	0.51	0.01	2.28
2012	3.43	0.08	6.66	4.26	0.42	4.13	1.29	1.65	2.83	0.56	0.01	3.01
2013	3.74	0.08	6.40	3.55	0.37	3.48	1.23	1.65	2.60	0.77	0.01	2.71

2014	3.61	0.05	5.92	4.64	0.48	3.24	1.15	1.50	2.75	0.92	0.03	2.83
2015	4.13	0.07	5.73	4.26	0.48	3.32	1.07	1.39	2.83	0.68	0.03	2.79
2016	3.54	0.06	5.84	3.10	0.38	3.24	0.99	1.25	2.75	1.00	0.04	3.12
2017	4.38	0.08	6.16	3.85	0.34	3.88	1.02	1.28	2.96	0.80	0.03	3.12
2018	3.92	0.06	6.56	2.95	0.29	3.64	0.99	1.27	2.68	0.44	0.02	2.35
2019	3.86	0.04	6.56	2.10	0.35	3.04	0.99	1.18	2.57	0.61	0.06	2.80
2020	4.40	0.13	6.28	1.55	0.58	3.99	0.97	1.37	2.65	0.65	0.03	2.94

Table 3d

Agricultural competitiveness in developing countries based on RCA values

Year	Jordan	Kenya	Lesotho	Madagascar	Malawi	Malaysia	Mali	Mauritania	Mauritius	Mexico	Mongolia	Nepal
1990	1.13	6.67	2.31	6.04	9.84	1.60	8.05	1.09	3.53	1.18	2.39	1.47
1991	1.86	5.78	1.80	5.42	10.45	1.37	8.08	1.15	3.30	1.27	3.02	1.79
1992	1.53	6.03	1.00	5.44	9.57	1.28	8.30	1.19	3.30	1.14	1.22	1.34
1993	1.66	7.96	0.88	5.81	10.02	1.18	8.85	1.27	3.15	1.33	1.14	1.31
1994	1.34	7.16	0.95	5.87	8.37	1.24	7.93	1.13	3.10	1.29	0.91	0.60
1995	1.47	6.67	0.79	6.22	10.21	1.30	5.73	1.13	3.11	1.36	0.58	0.78
1996	1.15	6.43	0.51	5.15	9.10	1.16	7.16	1.12	3.26	1.09	2.65	1.30
1997	2.11	6.77	0.51	4.90	11.32	1.12	6.17	0.98	3.02	1.17	2.05	1.50
1998	2.11	8.50	0.39	4.23	8.96	1.34	5.40	1.04	2.69	1.33	1.94	1.09
1999	1.85	7.92	0.23	4.86	13.61	1.15	5.78	1.17	2.91	1.30	2.93	1.60
2000	1.97	8.95	0.26	2.87	14.90	0.93	7.30	0.58	2.65	1.34	2.51	0.39
2001	1.69	8.23	0.16	7.04	12.88	0.93	6.00	0.78	3.15	1.37	1.19	0.86
2002	1.71	6.29	0.08	5.61	12.06	1.15	3.62	0.62	3.03	1.38	1.38	2.91
2003	1.87	7.60	0.05	6.89	14.36	1.32	5.96	0.70	2.73	1.42	1.07	2.84
2004	1.64	7.20	0.04	7.96	12.60	1.29	7.40	0.56	2.92	1.46	0.58	1.78
2005	2.11	7.52	0.03	5.94	14.47	1.21	4.56	0.42	2.99	1.44	0.70	2.27
2006	2.03	8.91	0.10	5.50	15.85	1.32	4.61	0.20	2.88	1.60	1.18	1.61
2007	2.12	8.58	0.03	2.21	14.78	1.60	3.33	0.31	2.58	0.84	0.97	2.57
2008	1.89	8.17	0.02	2.23	13.41	1.79	2.55	0.19	2.38	0.81	0.41	2.38
2009	2.11	7.40	0.02	2.37	11.63	1.44	1.44	0.26	2.10	0.88	0.63	4.35
2010	2.17	7.93	0.03	2.13	12.10	1.71	1.51	0.30	2.01	0.81	0.49	3.07
2011	2.07	6.20	0.03	3.05	11.22	2.03	1.91	0.14	2.22	0.84	0.35	2.95

2012	2.40	4.71	0.05	2.87	9.44	1.76	2.92	0.13	1.98	0.81	0.42	3.61
2013	2.65	6.99	0.39	2.61	10.70	1.51	4.91	0.12	2.02	0.83	0.50	3.34
2014	2.62	5.50	0.71	2.70	9.66	1.53	2.56	0.16	1.60	0.83	0.41	3.73
2015	2.56	5.41	0.72	3.63	10.06	1.45	2.20	0.30	1.65	0.88	0.97	3.44
2016	2.05	5.42	0.83	4.20	9.87	1.47	2.83	0.20	1.98	0.93	0.93	3.44
2017	2.03	7.50	0.69	5.06	10.77	1.37	2.23	0.17	2.08	0.96	0.91	3.61
2018	2.07	7.77	0.17	5.39	10.03	1.22	2.94	0.14	1.47	0.98	1.09	4.06
2019	1.75	7.22	0.57	4.33	12.91	1.20	2.71	0.11	1.66	0.98	0.94	6.11
2020	1.67	6.96	1.05	4.70	10.90	1.18	2.14	0.08	1.69	0.98	0.53	6.41

Table 3e

Agricultural competitiveness in developing countries based on RCA values

Year	Nigeria	Pakistan	Panama	Paraguay	Peru	Philippines	Poland	Romania	Russian Federation	Rwanda	Saudi Arabia	Senegal
1990	0.18	2.09	7.71	9.03	0.90	1.63	1.19	0.17	0.24	9.80	0.09	3.20
1991	0.17	1.78	6.81	8.73	1.02	1.53	1.19	0.65	0.41	9.56	0.10	2.23
1992	0.16	1.91	6.34	8.18	0.89	1.48	1.46	0.69	0.23	9.22	0.10	1.97
1993	0.31	1.39	6.89	8.52	0.85	1.32	1.24	0.76	0.18	7.88	0.12	1.45
1994	0.37	1.10	6.27	7.99	1.14	1.18	1.25	0.73	0.26	2.22	0.11	1.76
1995	0.41	1.49	6.11	8.52	1.09	1.26	1.18	0.74	0.18	5.75	0.10	1.38
1996	0.42	1.95	5.93	8.81	1.26	0.99	1.21	1.02	0.22	0.66	0.07	1.09
1997	0.40	1.27	5.98	9.52	1.46	0.87	1.46	0.89	0.20	4.69	0.09	1.21
1998	0.53	1.72	5.18	10.27	1.36	0.74	1.29	0.66	0.18	6.03	0.15	1.58
1999	0.50	2.02	5.92	11.02	1.52	0.51	1.22	0.77	0.11	10.21	0.07	1.86
2000	0.19	1.83	5.77	9.53	1.42	0.61	1.17	0.54	0.14	9.23	0.10	3.55
2001	0.33	1.63	4.95	9.76	1.33	0.66	1.14	0.57	0.16	5.66	0.10	2.47
2002	0.31	1.45	4.61	5.45	1.42	0.61	1.06	0.48	0.25	6.32	0.11	1.93
2003	0.36	1.45	4.43	8.86	1.32	0.76	1.10	0.49	0.22	6.51	0.13	2.17
2004	0.24	1.33	4.90	12.59	1.32	0.79	1.34	0.49	0.18	4.83	0.13	2.02
2005	0.22	1.64	6.04	12.97	1.22	0.92	1.52	0.50	0.22	8.60	0.11	1.49
2006	0.22	1.86	5.98	13.02	1.23	0.86	1.54	0.63	0.24	8.01	0.12	2.98
2007	0.15	1.75	5.96	13.36	1.11	0.87	1.47	0.62	0.35	6.68	0.14	2.86
2008	0.15	1.89	5.32	11.67	1.23	1.01	1.38	0.98	0.25	13.03	0.08	1.78

2009	0.23	2.14	4.02	11.50	1.19	0.88	1.44	1.00	0.33	4.57	0.12	2.00
2010	0.19	2.23	4.68	12.40	1.23	0.93	1.45	1.17	0.21	5.27	0.17	2.28
2011	0.17	2.76	5.52	8.68	1.33	1.34	1.44	1.22	0.25	4.72	0.13	2.67
2012	0.19	2.55	5.93	8.11	1.21	1.07	1.63	1.22	0.37	5.55	0.13	2.30
2013	0.16	2.72	6.00	8.58	1.33	1.15	1.67	1.42	0.35	4.75	0.13	3.04
2014	0.18	2.59	0.39	8.82	1.72	1.23	1.63	1.38	0.43	4.12	0.14	2.90
2015	0.34	2.55	0.38	8.18	1.91	0.89	1.61	1.37	0.50	5.02	0.23	3.23
2016	0.53	2.23	0.35	7.93	1.86	0.93	1.52	1.29	0.61	4.38	0.24	2.82
2017	0.49	2.22	0.35	7.89	1.66	1.04	1.57	1.25	0.61	3.97	0.20	2.65
2018	0.37	2.63	0.39	8.51	1.83	1.04	1.64	1.29	0.62	4.56	0.15	2.57
2019	0.36	2.52	0.55	8.41	1.95	1.09	1.59	1.36	0.62	4.80	0.17	2.56
2020	0.50	2.14	0.49	7.80	2.09	1.01	1.55	1.33	0.83	2.56	0.24	2.27

Table 3f

Agricultural competitiveness in developing countries based on RCA values

Year	South Africa	Sri Lanka	Sudan (former)	Togo	Trinidad and Tobago	Turkiye	United Republic of Tanzania	Uganda	Uruguay	Yemen	Zambia
1990	0.79	4.24	8.41	4.88	0.58	2.59	7.13	9.59	5.00	1.17	0.18
1991	0.76	3.62	8.05	4.28	0.62	2.95	6.98	8.96	4.44	0.92	0.19
1992	0.73	2.72	8.00	4.84	0.64	2.45	7.03	8.11	4.21	1.31	0.34
1993	0.68	1.71	9.37	4.70	0.83	2.57	7.54	9.70	4.64	0.73	0.43
1994	0.89	1.32	8.33	4.50	0.82	2.41	7.95	6.43	4.66	0.87	0.16
1995	0.88	2.02	9.18	6.72	0.88	2.25	7.33	10.00	5.10	0.56	0.30
1996	0.93	2.50	9.61	6.49	0.93	2.29	7.43	9.45	5.35	0.23	0.48
1997	1.04	2.91	9.78	7.05	1.09	2.37	7.22	8.56	5.81	0.15	1.04
1998	1.02	2.84	9.56	7.03	1.25	2.19	10.25	10.39	6.26	0.52	1.25
1999	1.06	2.83	6.49	4.68	1.06	2.15	13.31	10.97	6.66	0.30	1.92
2000	1.10	2.91	3.15	3.41	0.85	2.03	10.54	8.66	6.90	0.26	1.85
2001	1.11	2.95	2.35	4.17	0.83	1.94	6.55	4.40	6.23	0.33	1.59
2002	1.13	3.03	2.81	2.98	0.92	1.41	5.00	7.81	6.67	0.36	1.98
2003	1.16	2.84	2.52	3.21	0.62	1.47	4.45	2.92	7.19	0.41	2.21
2004	1.11	2.97	2.26	3.32	0.54	1.42	4.87	7.08	7.81	0.33	3.45
2005	1.21	3.15	1.87	2.51	0.49	1.67	4.96	6.43	8.33	0.35	2.72

2006	1.05	2.46	1.37	4.31	0.43	1.22	4.81	6.22	8.96	0.33	1.44
2007	0.94	2.32	0.58	4.75	0.40	0.98	4.50	6.03	8.36	0.41	1.36
2008	1.02	3.85	0.60	3.84	0.19	1.19	4.44	7.53	8.79	0.38	1.04
2009	1.17	3.53	0.89	5.54	0.41	1.34	3.58	6.27	8.31	0.41	1.20
2010	1.07	3.96	0.58	4.45	0.33	1.46	3.35	7.09	8.65	0.20	0.98
2011	0.98	3.82	0.80	7.98	0.17	1.44	2.83	7.34	8.48	0.37	1.18
2012	0.92	3.76	2.59	2.90	0.24	1.32	3.91	6.93	9.20	0.41	1.94
2013	1.35	3.62	1.86	2.26	0.25	1.47	3.60	7.28	9.17	0.35	1.58
2014	1.35	3.39	3.14	2.06	0.23	1.47	6.95	7.32	8.97	0.49	1.09
2015	1.28	3.24	7.87	2.85	0.48	1.46	5.47	7.32	8.25	1.20	1.36
2016	1.36	3.15	4.50	2.32	0.45	1.36	4.18	6.29	8.13	2.86	1.31
2017	1.35	3.27	5.66	2.84	0.37	1.29	4.44	6.91	8.23	2.04	1.01
2018	1.44	2.27	6.29	3.03	0.27	1.34	3.38	7.00	8.36	1.96	0.92
2019	1.39	2.18	5.53	3.23	0.47	1.36	3.64	5.42	8.97	1.58	1.08
2020	1.36	3.39	4.57	3.57	0.41	1.37	3.32	4.34	8.04	1.89	0.95

4.2. Agricultural competitiveness in developed countries

Tables 4a-4b depict agricultural competitiveness in developed countries. Developed countries that are categorized as having agricultural competitiveness (ACA > 1) include Australia, Austria, Belgium, Canada, Cyprus, Denmark, France, Greece, Italy, Netherlands, New Zealand, Portugal, Spain, and the United States of America. Meanwhile, developed countries that have lost their agricultural competitiveness (ACA < 1) include Czechia, Finland, Germany, Iceland, Israel, Norway, the Republic of Korea, Sweden, Switzerland, and the United Kingdom of Great Britain and Northern Ireland. Therefore, hypothesis 2 of this study is unproven because there are developed countries that do not have agricultural competitiveness.

Several developed countries that have experienced an increase in agricultural competitiveness in the last 3 decades include Austria (178.38%), Belgium (19.81%), Canada (100%), Finland (25.93%), Germany (33.33%), Iceland (16.67%), Italy (74.29%), New Zealand (37.45%), Norway (50.00%), Spain (41.83%), Sweden (118.18%), and Switzerland (12.50%). Portugal is a developed country with the highest increase in agricultural competitiveness in the last three decades, reaching 2.5 times.

Australia (-56.76%), Cyprus (-43.49%), Denmark (-25.71%), Greece (-25.68%), Israel (-58.41%), and the Netherlands (-27.76%) are countries that have experienced a decline in competitiveness. Countries that have stagnated agricultural competitiveness are the Czech Republic, France, the Republic of Korea, the United Kingdom of Great Britain and Northern Ireland, and the United States of America.

Table 4a

Agricultural competitiveness in developed countries

Year	Australia	Austria	Belgium	Canada	Cyprus	Czechia	Denmark	Finland	France	Germany	Greece	Iceland
1990	3.33	0.37	1.06	0.77	3.38	0.60	2.45	0.27	1.63	0.51	3.31	0.24
1991	2.71	0.36	1.14	0.80	3.66	0.70	2.42	0.27	1.54	0.58	3.40	0.17
1992	2.74	0.40	1.18	0.85	3.79	0.77	2.31	0.27	1.54	0.59	3.56	0.13
1993	2.85	0.40	1.23	0.78	4.28	0.96	2.38	0.35	1.68	0.62	3.47	0.13
1994	2.76	0.43	1.24	0.75	4.80	0.83	2.39	0.37	1.56	0.61	3.45	0.16
1995	2.95	0.49	1.29	0.77	5.90	0.67	2.23	0.27	1.58	0.55	3.50	0.17
1996	3.09	0.52	1.23	0.83	6.99	0.64	2.23	0.32	1.54	0.58	3.74	0.15
1997	3.50	0.57	1.26	0.85	7.23	0.66	2.45	0.34	1.56	0.58	3.19	0.12
1998	3.25	0.56	1.29	0.89	6.33	0.61	2.39	0.29	1.51	0.58	3.39	0.12
1999	3.58	0.71	1.28	0.83	6.50	0.60	2.37	0.25	1.56	0.60	3.69	0.14
2000	4.23	0.79	1.42	0.88	6.81	0.67	2.57	0.27	1.58	0.68	3.40	0.23
2001	3.76	0.80	1.34	0.98	6.13	0.58	2.55	0.28	1.45	0.64	3.47	0.23
2002	3.53	0.78	1.26	0.95	4.24	0.52	2.39	0.29	1.55	0.62	3.50	0.19
2003	2.86	0.84	1.27	0.92	4.05	0.51	2.36	0.28	1.56	0.63	3.15	0.23
2004	3.88	0.96	1.29	0.97	3.57	0.56	2.45	0.29	1.57	0.65	3.01	0.23
2005	3.28	1.11	1.30	0.96	2.45	0.67	2.41	0.29	1.63	0.70	3.35	0.21
2006	3.04	1.21	1.33	1.05	2.79	0.62	2.51	0.30	1.72	0.71	3.31	0.20
2007	2.37	1.05	1.30	1.12	3.00	0.63	2.47	0.30	1.73	0.70	3.00	0.14
2008	1.92	1.05	1.32	1.22	2.64	0.65	2.31	0.30	1.69	0.75	2.95	0.20
2009	1.87	1.04	1.29	1.30	2.66	0.62	2.21	0.32	1.58	0.75	3.15	0.17
2010	1.75	1.04	1.28	1.26	2.65	0.58	2.30	0.34	1.68	0.75	3.34	0.23
2011	1.67	1.02	1.26	1.26	2.37	0.58	2.21	0.37	1.74	0.76	2.23	0.22
2012	2.00	1.04	1.30	1.33	2.30	0.66	2.25	0.37	1.72	0.78	2.31	0.24
2013	2.01	1.03	1.28	1.31	2.40	0.67	2.22	0.38	1.77	0.79	2.36	0.24
2014	2.06	1.00	1.26	1.32	1.46	0.64	2.25	0.47	1.64	0.76	2.23	0.28
2015	2.38	0.98	1.28	1.39	1.17	0.66	2.17	0.49	1.59	0.71	2.56	0.27
2016	2.11	0.97	1.26	1.36	1.46	0.62	2.03	0.40	1.50	0.69	2.67	0.36
2017	2.08	0.97	1.27	1.34	1.50	0.56	2.08	0.39	1.50	0.69	2.35	0.30
2018	1.83	1.01	1.30	1.37	1.23	0.55	2.08	0.35	1.57	0.69	2.31	0.32
2019	1.64	1.02	1.29	1.33	1.74	0.55	1.96	0.36	1.53	0.69	2.25	0.27

2020	1.44	1.03	1.27	1.54	1.91	0.55	1.82	0.34	1.59	0.68	2.46	0.28

Table 4b

Agricultural competitiveness in developed countries

Year	Israel	Italy	Netherlands	New Zealand	Norway	Portugal	Republic of Korea	Spain	Sweden	Switzerland	United Kingdom and Northern Ireland	United States of America
1990	1.13	0.70	2.45	5.50	0.10	0.61	0.19	1.53	0.22	0.32	0.75	1.24
1991	1.04	0.76	2.47	5.19	0.10	0.68	0.16	1.59	0.21	0.34	0.79	1.13
1992	0.86	0.77	2.53	5.38	0.11	0.66	0.16	1.55	0.20	0.33	0.85	1.14
1993	0.79	0.78	2.33	5.16	0.11	0.67	0.15	1.82	0.21	0.35	0.80	1.14
1994	0.74	0.77	2.42	4.86	0.12	0.68	0.15	1.67	0.23	0.36	0.76	1.13
1995	0.83	0.72	2.11	4.98	0.12	0.68	0.15	1.64	0.22	0.37	0.71	1.24
1996	0.74	0.77	2.09	5.15	0.11	0.70	0.16	1.70	0.25	0.36	0.68	1.22
1997	0.66	0.80	1.88	5.89	0.11	0.75	0.16	1.83	0.28	0.36	0.75	1.11
1998	0.63	0.82	1.78	5.85	0.13	0.77	0.16	1.67	0.28	0.35	0.76	1.05
1999	0.65	0.92	2.15	6.00	0.12	0.81	0.16	1.84	0.29	0.36	0.79	1.02
2000	0.45	1.02	1.88	7.67	0.10	0.91	0.14	1.91	0.32	0.42	0.91	1.13
2001	0.52	0.96	1.80	7.07	0.10	0.90	0.16	1.85	0.38	0.39	0.73	1.15
2002	0.50	1.00	1.96	6.45	0.11	0.94	0.15	1.91	0.39	0.39	0.76	1.17
2003	0.53	0.99	2.04	6.60	0.11	0.94	0.14	1.97	0.38	0.39	0.81	1.24
2004	0.55	1.04	2.02	7.54	0.11	1.02	0.13	2.00	0.39	0.40	0.92	1.17
2005	0.48	1.08	2.00	7.94	0.09	1.12	0.13	2.18	0.45	0.43	0.89	1.15
2006	0.58	1.13	2.00	8.62	0.08	1.18	0.12	2.16	0.44	0.48	0.72	1.14
2007	0.61	1.03	1.97	7.95	0.08	1.25	0.11	1.96	0.44	0.51	0.84	1.28
2008	0.50	1.04	1.88	6.97	0.07	1.28	0.11	1.96	0.46	0.53	0.83	1.41
2009	0.55	1.09	1.98	6.93	0.07	1.32	0.11	1.89	0.46	0.53	0.82	1.26
2010	0.53	1.14	1.91	7.47	0.07	1.40	0.12	1.95	0.44	0.54	0.83	1.32
2011	0.48	1.09	1.87	5.63	0.07	1.31	0.11	1.85	0.41	0.53	0.80	1.32
2012	0.52	1.11	1.83	7.52	0.07	1.37	0.13	1.99	0.46	0.53	0.84	1.29
2013	0.51	1.14	1.83	7.70	0.08	1.38	0.13	1.95	0.50	0.56	0.74	1.26
2014	0.44	1.12	1.69	7.83	0.10	1.43	0.13	1.97	0.51	0.42	0.79	1.26

2015	0.40	1.13	1.67	7.50	0.11	1.40	0.13	1.98	0.49	0.40	0.76	1.17
2016	0.39	1.11	1.72	7.20	0.13	1.36	0.15	1.96	0.47	0.37	0.79	1.18
2017	0.43	1.12	1.85	7.48	0.12	1.33	0.14	1.94	0.46	0.39	0.76	1.15
2018	0.43	1.19	1.85	7.98	0.12	1.39	0.14	2.00	0.46	0.42	0.79	1.15
2019	0.45	1.18	1.80	8.12	0.14	1.36	0.16	2.05	0.47	0.40	0.79	1.11
2020	0.47	1.22	1.77	7.56	0.15	1.44	0.17	2.17	0.48	0.36	0.78	1.22

V. IMPACT OF ECONOMIC GLOBALIZATION IN DEVELOPING AND DEVELOPED COUNTRIES

5.1. Impact of economic globalization on agricultural competitiveness in developing countries

The Levin Lin Chu unit root test is used to produce a stationary variable in this study. I ran two-unit root tests, one for developing countries and one for developed countries. Unit root test for developing countries shows that TEMP, ACA, IND, POP, RENEW, RENT, EXC, EGI, IRRI, EMPL, and HCI are stationary at level. At the same time, CONV, CPI, and MOB are stationary at the first-difference level (Table 5).

Table 5
Levin Lin Chu unit root test

Variable	Developing countries	
	Stage	**Statistic**
TEMP	At level	-6.535***
ACA	At level	-4.890***
IND	At level	-6.203***
POP	At level	-7.822***
RENEW	At level	-2.705***
RENT	At level	-4.186***
CONV	1st difference	-10.943***
CPI	1st difference	-4.371***
EXC	At level	-1.797*
EGI	At level	-8.590***
IRRI	At level	-5.864***
MOB	1st difference	-5.852***
EMPL	At level	-5.645***
HCI	At level	-6.715***

The 3SLS model was used to analyze all variables after the data became stationary. Model (2) shows that the significance level of the endogeneity test produces a Hausman statistic of 0.063 in developing countries, while Model (3) shows a significance level of 0.049 in developing countries (Table 6). The significance level of the endogeneity in the models is lower than the 10% alpha level, indicating that the model has endogeneity problems in their respective structural equations. The overidentification test and the weak instrument test show a significant value at the 5% alpha level, meaning that the structural model is included in the over-identified category, and each equation has a strong instrument variable. In addition, the final stage of regression (step 2) shows adjusted R^2 value of 0.243 with an F-statistic value of 60.723 significant at 1% alpha. All statistical tests show that the 3SLS regression model can be used properly in this study.

Table 6
Three-stage least square regression results in developing countries

Variable	Developing countries	
	Coeff.	**Std. Error**
Dependent variable: TEMP		
ACA	0.009 .	0.005
	(1.806)	
IND	-0.001^{ns}	0.005
	(-0.711)	
POP	-0.000009^{ns}	0.00005
	(-0.016)	
RENEW	-0.002***	0.0005
	(-3.852)	
RENT	0.004***	0.001
	(3.205)	
CONV	0.000001^{ns}	0.0002
	(0.057)	
Cons.	0.814***	0.027
	(30.482)	
Adj R^2		0.491
F test		3.988
Overidentification test		11.796
Weak identification test		16.850
Endogeneity test		3.357
Dependent variable: ACA		
TEMP	-0.313 .	0.161
	(-1.941)	
CPI	0.005***	0.001
	(3.809)	
EXC	-0.0006***	0.00002
	(-2.970)	
EGI	-0.026***	0.006
	(-4.667)	
IRRI	-0.046***	0.004
	(-11.467)	
MOB	-0.005***	0.001
	(-3.629)	
EMPL	-0.00001***	0.000001
	(-7.421)	
HCI	-1.610***	0.178
	(-9.028)	
$D_{Albania}$	-2.064***	0.546
	(-3.779)	
$D_{Bangladesh}$	-2.604***	0.451
	(-5.779)	
D_{Benin}	4.469***	0.513

	(8.711)	
$D_{Bolivia}$	0.149	0.670
	(0.223)	
$D_{Botswana}$	-1.929**	0.661
	(-2.918)	
D_{Brazil}	1.410*	0.588
	(2.395)	
$D_{Brunei\ Darussalam}$	-2.177***	0.617
	(-3.529)	
$D_{Bulgaria}$	-0.646	0.709
	(-0.911)	
$D_{Burkina\ Faso}$	4.102***	0.517
	(7.933)	
$D_{Burundi}$	7.887***	0.504
	(15.635)	
$D_{Cambodia}$	-1.128*	0.497
	(-2.267)	
$D_{Cameroon}$	0.957 .	0.533
	(1.795)	
D_{Chile}	-0.529	0.690
	(-0.766)	
D_{China}	-1.968 .	1.179
	(-1.668)	
$D_{Colombia}$	0.354	0.587
	(0.604)	
D_{Congo}	-1.993***	0.566
	(-3.523)	
$D_{Costa\ Rica}$	2.484***	0.611518
	(4.061)	
$D_{Democratic\ Republic\ of\ the\ Congo}$	-1.503**	0.520
	(-2.888)	
$D_{Dominican\ Republic}$	2.661***	0.517
	(5.149)	
$D_{Ecuador}$	0.719	0.534
	(1.348)	
D_{Egypt}	-1.498	1.016
	(-1.474)	
$D_{El\ Salvador}$	1.069 .	0.524
	(2.039)	
$D_{Eswatini}$	1.547**	0.505
	(3.064)	
$D_{Ethiopia}$	7.425***	0.502
	(14.793)	
D_{Fiji}	1.747**	0.642
	(2.719)	
D_{Gabon}	-2.294***	0.605

	(-3.790)	
$D_{Guatemala}$	4.571***	0.471
	(9.694)	
D_{Guyana}	2.124***	0.562
	(3.779)	
D_{Haiti}	-1.229**	0.466
	(-2.638)	
$D_{Honduras}$	3.136***	0.551
	(5.689)	
$D_{Hungary}$	-1.085	0.777
	(-1.396)	
D_{India}	-0.974	0.813
	(-1.199)	
$D_{Indonesia}$	-0.696	0.559
	(-1.243)	
D_{Iran}	-2.819***	0.481
	(-5.857)	
D_{Iraq}	-2.823***	0.407
	(-6.945)	
$D_{Jamaica}$	0.211	0.612
	(0.345)	
D_{Jordan}	-0.276	0.613
	(-0.451)	
D_{Kenya}	4.747***	0.568
	(8.361)	
$D_{Lesotho}$	-1.417*	0.571
	(-2.484)	
$D_{Madagascar}$	2.438***	0.500
	(4.872)	
D_{Malawi}	9.446***	0.521
	(18.125)	
$D_{Malaysia}$	-0.675	0.664
	(-1.015)	
D_{Mali}	3.059***	0.517
	(5.916)	
$D_{Mauritania}$	-1.496**	0.523
	(-2.859)	
$D_{Mauritius}$	0.454	0.495
	(0.916)	
D_{Mexico}	-1.522*	0.601
	(-2.535)	
$D_{Mongolia}$	-1.713*	0.696
	(-2.461)	
D_{Nepal}	-4.579***	1.318
	(-3.473)	
$D_{Nigeria}$	1.032	1.115

	(0.926)	
$D_{Pakistan}$	-7.325***	2.190
	(-3.344)	
D_{Panama}	3.152***	0.415
	(7.601)	
$D_{Paraguay}$	7.997***	0.676
	(11.822)	
D_{Peru}	-1.273*	0.522
	(-2.438)	
$D_{Philippines}$	-1.286*	0.627
	(-2.052)	
D_{Poland}	0.5404	0.520
	(1.038)	
$D_{Romania}$	-4.050***	1.064
	(-3.806)	
D_{Russia}	-0.426	0.544
	(-0.783)	
D_{Rwanda}	4.144***	0.506
	(8.188)	
$D_{Saudi\ Arabia}$	-1.254***	0.366
	(-3.422)	
$D_{Senegal}$	0.066	0.566
	(0.117)	
$D_{South\ Africa}$	-0.882*	0.366
	(-2.406)	
$D_{Sri\ Lanka}$	-2.692*	1.117
	(-2.409)	
D_{Sudan}	2.348***	0.531
	(4.418)	
D_{Togo}	2.455***	0.439
	(5.594)	
$D_{Trinidad\ and\ Tobago}$	-2.668***	0.656
	(-4.067)	
$D_{Turkiye}$	-1.524*	0.607
	(-2.510)	
D_{Uganda}	5.622***	0.736
	(7.641)	
$D_{United\ Republic\ of\ Tanzania}$	6.605***	0.510
	(12.957)	
$D_{Uruguay}$	5.502***	0.397
	(13.856)	
D_{Yemen}	-1.708**	0.555
	(-3.078)	
D_{Zambia}	-6.231***	0.475
	(-13.115)	
Cons.	2.014***	0.597

	(3.375)
Adj R^2	0.810
F test	116.441
Overidentification test	14.722
Weak identification test	20.900
Endogeneity test	3.914

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1.

According to the findings of the analysis, the TEMP variable in developing countries was influenced by ACA, RENEW, and RENT. The rise in ACA in developing countries raises the temperature. Agriculture in developing countries continues to use little environmentally friendly technology, consumes a lot of energy, and is less concerned with energy efficiency (Batmunkh et al., 2022). This phenomenon occurs naturally because agriculture uses chemicals and produces waste, both of which increase methane and CO_2 (Lynch & Garnett, 2021). Furthermore, agricultural products are transported using fossil fuels, which contribute to global anthropogenic emissions (Watanabe & Cavalett, 2022). Whereas, agriculture can help to mitigate the negative effects of climate change if it is managed properly.

RENEW in developing countries can reduce temperature. These findings are consistent with a study from Abbas et al. (2021), which found that traditional energy (natural gas and oil) in developing countries has a significant and positive ecological footprint, whereas renewable energy has a negative and significant relationship with CO_2 and temperature in the long-run period. The potential for this energy development in developing countries is enormous because of the varied sources and the large area of land availability for the cultivation of biofuel crops (Fekete et al., 2021).

RENT, as predicted, will raise TEMP in developing countries. According to Agboola et al. (2021), there is a significant positive relationship between total country natural resource rent and CO_2 emissions in developing countries in the short and long term. The same phenomenon occurs in Sub-Saharan African countries, where natural resource rents increase CO_2 emissions (Adedoyin et al., 2020) and other pollutant emissions over time (Asongu et al., 2020). Finally, RENT has a two-fold environmental impact in developing countries. On the one hand, there is an increase in environmental pressure. On the other hand, this money is employed to enhance the size of the forest by conserving it (Batmunkh et al., 2022). Conversely, IND, POP, and CONV are variables that do not affect TEMP in developing countries.

The next analysis is the factors that influence ACA in developing countries. The CPI coefficient in developing countries is positive, implying that an increase in CPI can increase ACA. ACA will decrease as TEMP, EXC, EGI, IRRI, MOB, EMPL, and HCI rise. The findings indicate that the third hypothesis of this study is unproven since EGI has no positive impact on ACA in developing countries.

The findings of cross-country analysis show heterogeneity in Benin, Brazil, Burkina Faso, Burundi, Cameroon, Costa Rica, Dominican Republic, El Salvador, Eswatini, Ethiopia, Fiji, Guatemala, Guyana, Honduras, Kenya, Madagascar, Malawi, Mali, Panama, Paraguay, Rwanda, Sudan, Togo, Uganda, United Republic of Tanzania, and Uruguay have increased their agricultural competitiveness. Meanwhile, heterogeneity in Albania, Bangladesh, Botswana, Brunei Darussalam, Cambodia, China, Congo, Democratic Republic of the Congo, Gabon, Haiti, Iran, Iraq, Lesotho, Mauritania, Mexico, Mongolia, Nepal, Pakistan, Peru, Philippines, Romania, Saudi

Arabia, South Africa, Sri Lanka, Trinidad and Tobago, Turkiye, Yemen, and Zambia have reduced agricultural competitiveness in each country.

Increasing temperatures have proven to harm business activities including agriculture in developing and developed countries. Despite having the same impact, temperature changes in developed countries are more sensitive to a decrease in agricultural competitiveness than in developing countries (Table 8).

The high temperatures will increase drought periods and pathogens, less water availability, decrease the agricultural area and forage quality, and negatively impact reproduction (Srbinovska et al., 2015; Debaeke et al., 2017). A temperature rise accelerates soil respiration, reducing carbon sinks in the ecosystem. As a result, agricultural production and competitiveness have plummeted dramatically. This phenomenon often occurs in several countries and is exacerbated by several other issues: (1) economic policy crises that fail to account for the cost of environmental services, (2) a lack of community and public sustainability education, (3) an inability to adapt to new challenges, and (4) technological constraints (Silva et al., 1995).

Consumer price increases agricultural competitiveness in developing countries. Consumer price increases have pushed agricultural product prices higher than previously (Maslova et al., 2020). Belton and Nair-Reichert (2007) also stated that growing food inflation has resulted in higher consumer and producer prices. A condition that encourages farmers to boost product yield and competitiveness. Furthermore, CPI can improve product quality because competition to produce the best products is strong (Prasada et al., 2022).

The findings of this study are consistent with Abbas (2022) that EXC depreciation has a significant negative impact on export competitiveness. The depreciation of the domestic currency raises the domestic production cost and the price level, hence deteriorating competitiveness. This situation can get worse when exchange rate volatility is combined with ineffective domestic economic policies or agricultural market failure (Kargbo, 2006; Sarker & Ratnasena, 2014).

Globalization, an external economic factor, harms ACA in developing countries. EGI has encouraged the transformation of land tenure, human resources, and social and financial capital to be open to market intervention in the agricultural sector (Neglo et al., 2021). This situation is still exacerbated by the elimination of various agricultural subsidies and ineffective structural policy. According to Pasara (2020), globalization can reduce export volume and competitiveness for its participants, particularly small countries. On the other hand, developing countries' reliance on global economic conditions is extremely strong, making them vulnerable to even minor external shocks (Nasir et al., 2022).

Developed countries are also aggressively imposing various trade barriers that undermine developing countries' agricultural competitiveness. The introduction of certification has reduced the competitiveness of agricultural and forestry products (Prasada et al., 2022). Meanwhile, food imports in developing countries have increased dramatically due to globalization. The removal of trade barriers and poor logistics performance is responsible for this case (Le, 2021).

Increasing the number of employees is unable to have a positive effect on agricultural competitiveness in developing countries. A greater share of agricultural employment indicates a lower level of economic development, which raises the risk of failure in agri-food revealed comparative advantage (Bojnec & Fertő, 2017). In addition, this is related to the higher wages for labor which weaken agricultural competitiveness (Huo, 2014). Another main issue is a lack of skilled employees which causes slower economic growth and agricultural labor mechanization. However, the agricultural labor migrated to the non-agricultural sector as education levels rose (Wegren, 2014).

The increasing IRRI or MOB will reduce competitiveness. The main impediment in developing countries is a lack of water availability, so irrigation provision is ineffective in increasing competitiveness (Haddad & Shahwan, 2012). Even, most farmers in developing countries irrigate crop fields with untreated wastewater. The lack of proper processing facilities poses health risks to reducing the competitiveness of agricultural products (Biswas et al., 2021). The last reason is inefficient irrigation in developing countries, which results in suboptimal agricultural cultivation (Calzadilla et al., 2013).

Mobile phone use in agriculture is still in its infancy in developing countries, so its effectiveness is limited (Bahn et al., 2021). The provision of information and communication technologies (ICTs) infrastructure in developing countries is also running slowly due to limited funding. This is exacerbated by the majority of agricultural actors' lack of education, which prevents them from properly utilizing ICTs (Nugroho, 2021). Most agricultural business actors in developing countries are elderly, making it difficult for them to use advanced technology. (Wicaksono et al., 2021).

5.2. Impact of economic globalization on agricultural competitiveness in developed countries

Unit root tests for developed countries show that TEMP, ACA, IND, RENT, CPI, EGI, IRRI, MOB, EMPL, and HCI are stationary at level. At the same time, RENEW, CONV, and EXC are stationary at the first-difference level, then the POP is stationary at the second-difference level.

Table 7
Levin Lin Chu unit root test

Variable	Developed countries	
	Stage	**Statistic**
TEMP	At level	-11.520***
ACA	At level	-2.806***
IND	At level	-12.035***
POP	2nd difference	-11.024***
RENEW	1st difference	-22.105***
RENT	At level	-8.605***
CONV	1st difference	-15.021***
CPI	At level	-4.798***
EXC	1st difference	-17.868***
EGI	At level	-8.031***
IRRI	At level	-5.512***
MOB	At level	-5.734***
EMPL	At level	-6.495***
HCI	At level	-9.372***

Model (2) shows that the significance level of the endogeneity test produces a Hausman statistic of 0 0.029 in developed countries, while Model (3) shows a significance level of 0.038 in developed countries (Table 8). The significance level of the endogeneity is lower than the 10% alpha level, indicating that the model has endogeneity problems in their respective structural equations. The overidentification test and the weak instrument test show a significant value at the 5% alpha level, meaning that the structural model is included in the over-identified category, and each equation has a strong instrument variable. In addition, the final stage of regression (step 2)

shows adjusted R^2 value of f 0.169 with an F-statistic value of 19.955 (prob. = 0.000). All statistical tests show that the 3SLS regression model can be used properly in this study.

Table 8
Three-stage least square regression results in developed countries

Variable	Developed countries	
	Coeff.	**Std. Error**
Dependent variable: TEMP		
ACA	-0.090***	0.021
	(-4.294)	
IND	-0.004ns	0.011
	(-0.419)	
POP	-0.000008ns	0.00006
	(-0.970)	
RENEW	0.351*	0.166
	(2.110)	
RENT	0.012ns	0.020
	(0.612)	
CONV	0.000001ns	0.0007
	(0.018)	
Cons.	1.134***	0.105
	(10.780)	
Adj R^2		0.387
F test		11.591
Overidentification test		11.536
Weak identification test		14.627
Endogeneity test		4.803
Dependent variable: ACA		
TEMP	-0.495***	0.093
	(-5.312)	
CPI	0.012**	0.004
	(3.130)	
EXC	-0.002***	0.0003
	(-5.572)	
EGI	-0.015**	0.005
	(-2.799)	
IRRI	0.001ns	0.005
	(0.242)	
MOB	0.003 .	0.002
	(1.649)	
EMPL	-0.0005***	0.0002
	(-3.091)	
HCI	-0.599***	0.155
	(-3.872)	
$D_{Australia}$	-5.075***	0.943
	(-5.379)	

$D_{Austria}$	-4.275***	0.859
	(-4.972)	
$D_{Belgium}$	-4.176***	0.832
	(-5.017)	
D_{Canada}	-4.814***	0.969
	(-4.964)	
D_{Cyprus}	-4.173***	0.706
	(-5.904)	
$D_{Czechia}$	-4.647***	0.950
	(-4.887)	
$D_{Denmark}$	-4.696***	0.892
	(-5.260)	
$D_{Finland}$	-4.240***	0.860
	(-4.929)	
D_{France}	-4.555***	0.868
	(-5.246)	
$D_{Germany}$	-5.130***	1.011
	(-5.073)	
D_{Greece}	-4.686***	0.788
	(-5.946)	
$D_{Iceland}$	-4.141***	0.774
	(-5.350)	
D_{Israel}	-5.365***	0.925
	(-5.795)	
D_{Italy}	-4.704***	0.830
	(-5.663)	
$D_{Netherlands}$	-4.727***	0.874
	(-5.406)	
$D_{New\ Zealand}$	-5.127***	0.873
	(-5.870)	
D_{Norway}	-4.694***	0.909
	(-5.164)	
$D_{Portugal}$	-3.636***	0.649
	(-5.6029)	
$D_{Republic\ of\ Korea}$	-5.381***	1.216
	(-4.423)	
D_{Spain}	-4.334***	0.793
	(-5.459)	
D_{Sweden}	-4.378***	0.873
	(-5.010)	
$D_{Switzerland}$	-4.809***	0.961
	(-5.004)	
$D_{United\ Kingdom\ of\ Great\ Britain\ and\ Northern\ Ireland}$	-5.345***	0.975
	(-5.482)	
$D_{United\ States\ of\ America}$	-6.153***	1.1418
	(-5.389)	

Cons.	6.229***	0.702
	(8.867)	
Adj R^2		0.390
F test		19.955
Overidentification test		6.270
Weak identification test		9.466
Endogeneity test		4.254

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1.

Like in developing countries, the first analysis conducted in developed countries is the factors that influence TEMP. The ACA in developed countries shows a negative regression coefficient, indicating that TEMP has decreased as ACA has increased. TEMP in this area will increase if RENEW increases. The RENT, IND, POP, and CONV variables will have no effect on TEMP in developed countries. The development of agricultural competitiveness in developed countries has been able to reduce TEMP (Debaeke et al., 2017). The developed countries emphasize upgrading the energy industry, increasing efficiency, and diversifying the industry by providing incentives for renewable energy sources (Pfeiffer & Hepburn, 2016). For example, the 2003 EU CAP reform aims to boost ACA while also contributing to environmental protection (Svoboda et al., 2016),

Developed countries are also improving low-carbon agriculture, changing dietary habits and increasing the value of food and agricultural waste to reduce global temperatures. They use food and agricultural waste as new pharmaceuticals, phytochemicals, enzyme immobilization, and cooking oil waste that can be converted to biodiesel (Chen et al., 2022).

Efforts made by developed countries to increase RENEW will have a fragmented and ineffective impact. Excessive demand for RENEW raises the risk of short and long-term environmental damage (Sadiqa et al., 2022). The reason for this is that these countries' efforts are dependent on developing countries and face numerous challenges (Tcvetkov, 2022). For example, the EU must strictly regulate the use of land for food crops and biofuels to simultaneously maintain food and energy security (Paschalidou et al., 2016). Hence, the EU is unable to develop renewable energy sources optimally (Nematchoua et al., 2020).

The next analysis is the factors that influence ACA in developed countries. ACA will increase as CPI and MOB rise. In the meantime, the TEMP, EXC, EGI, EMPL, and HCI show a negative regression coefficient, revealing that ACA has decreased as TEMP, EXC, EGI, EMPL, and HCI have increased. The findings indicate that the third hypothesis of this study is unproven since EGI has no positive impact on ACA in developed countries. The results of cross-country analysis show that heterogeneity in the developed countries sampled in this study has reduced agricultural competitiveness in each country.

As in developing countries, increasing TEMP leads to decreased water availability and drought (Srbinovska et al., 2015; Debaeke et al., 2017). Most of the water evaporates and is not available for vegetation growth because of the high temperatures (Pham et al., 2022). Hence, agricultural production and competitiveness fell precipitously.

CPI increases ACA in developed countries. Consumer price increases have pushed agricultural product prices higher than previously (Maslova et al., 2020). Belton and Nair-Reichert (2007) also stated that growing food inflation has resulted in higher consumer and producer prices. An increase in the CPI encourages producers to produce more goods because they earn more money.

The volatile exchange rates can have a significant effect on bilateral trade flows (van den Heuvel et al., 2011). Hence, exchange rates are important drivers of the international competitiveness of the agricultural sector (Sarker & Ratnasena, 2014). Depreciation of the EXC raises domestic production costs and reduces competitiveness (Abbas, 2022).

EGI has compelled all countries to implement structural changes as soon as possible. Even agricultural business actors in developed countries cannot continuously innovate and ensure their business's sustainability after implementing EGI (Beber et al., 2021). As a result, they are unprepared, and EGI harms agricultural development. Finally, the current EGI implementation is unfair. Subsidies are used by many developing countries to boost agricultural competitiveness (Sanchez-Ancochea, 2006; Pozo et al., 2011; Paus, 2012). As a result, developed-country products find it difficult to compete in developing-country markets because they are more expensive.

There are not many IRRIs in developed countries so they do not have a significant impact on agricultural competitiveness. Countries in this region use more wastewater which has been reprocessed using constructed wetlands, waste stabilization ponds, membrane bioreactors, vermi-biofiltration, and land treatment methods for the removal of chemical and biological impurities. After going through this process, the water is free of contaminants and can be used for watering during plant cultivation (Biswas et al., 2021).

Many developed countries have placed a high priority on technological innovation in their national growth strategies to realize and benefit from an 'innovation-driven' economy (Jung & Park, 2014). The use of MOB in developed countries facilitates farmers' access to agricultural cultivation and post-harvest information and knowledge (Bahn et al., 2021). Other benefits of using MOB include obtaining higher prices and managing sales, finding buyers, creating product conformity to consumer needs, reducing the possibility of asymmetric information in the agriculture market, increasing price transparency, and improving farmers' market participation and bargaining power (Nugroho, 2021).

A greater share of agricultural employment indicates a lower level of economic development and higher wages, which raises the risk of failure in agri-food revealed comparative advantage (Huo, 2014; Bojnec & Fertő, 2017). Another main issue is efforts to improve human capital have had no positive impact on agricultural competitiveness improvement. Improved education has opened up opportunities for regular and high-income jobs rather than work in agriculture where product prices and wages are low and technical support is lacking (Salam & Bauer, 2022).

VI. CONCLUSION AND RECOMMENDATION

6.1. Conclusion

Agricultural competitiveness in both developing and developed countries has fluctuated over the last three decades. Developing countries that are categorized as having agricultural competitiveness (ACA > 1) include Benin, Bolivia, Brazil, Bulgaria, Burkina Faso, Burundi, Cambodia, Cameroon, Chile, Colombia, Costa Rica, Dominican Republic, Ecuador, Egypt, El Salvador, Eswatini, Ethiopia PDR, Fiji, Guatemala, Guyana, Honduras, India, Indonesia, Jamaica, Jordan, Kenya, Lesotho, Madagascar, Malawi, Malaysia, Mali, Mauritius, Nepal, Pakistan, Paraguay, Peru, Philippines, Poland, Romania, Rwanda, Senegal, South Africa, Sri Lanka, Sudan (former), Togo, Turkiye, United Republic of Tanzania, Uganda Uruguay, and Yemen. Meanwhile, countries that have lost their agricultural competitiveness (ACA < 1) include Albania, Bangladesh, Botswana, Brunei Darussalam, China, Congo, Democratic Republic of the Congo, Gabon, Haiti, Hungary, Iran, Iraq, Mauritania, Mexico, Mongolia, Nigeria, Panama, Russian Federation, Saudi Arabia, Trinidad and Tobago, and Zambia. Therefore, hypothesis 1 of this study is unproven because there are developing countries that do not have agricultural competitiveness.

Romania is a developing country that has increased its agricultural competitiveness seven times in the last three decades. Several other developing countries have seen significant increases in agricultural competitiveness over the last three decades, including Brazil, Egypt, Indonesia, Iran, Jamaica, Malawi, Nepal, Russian Federation, South Africa, Uruguay, Yemen, and Zambia. However, developing countries such as Botswana, Brunei Darussalam, China, Dominican Republic, El Salvador, Eswatini, Ethiopia, Guyana, Honduras, Hungary, Lesotho, Madagascar, Mali, Mauritania, Mauritius, Mongolia, Paraguay, Philippines, Rwanda, Senegal, Sudan, Togo, Türkiye, the United Republic of Tanzania, and Uganda have lost their competitiveness. The country with the most drastic decline in agricultural competitiveness in the last 3 decades is Panama. Meanwhile, agricultural competitiveness in countries such as Benin, Bolivia, Fiji, Iraq, Kenya, and Pakistan have stagnated.

Developed countries that are categorized as having agricultural competitiveness (ACA > 1) include Australia, Austria, Belgium, Canada, Cyprus, Denmark, France, Greece, Italy, Netherlands, New Zealand, Portugal, Spain, and the United States of America. Meanwhile, developed countries that have lost their agricultural competitiveness (ACA < 1) include Czechia, Finland, Germany, Iceland, Israel, Norway, the Republic of Korea, Sweden, Switzerland, and the United Kingdom of Great Britain and Northern Ireland. Therefore, hypothesis 2 of this study is unproven because there are developed countries that do not have agricultural competitiveness.

Several developed countries that have experienced an increase in agricultural competitiveness in the last 3 decades include Austria, Belgium, Canada, Finland, Germany, Iceland, Italy, New Zealand, Norway, Spain, Sweden, and Switzerland. Portugal is a developed country with the highest increase in agricultural competitiveness in the last three decades, reaching 2.5 times. Australia, Cyprus, Denmark, Greece, Israel, and the Netherlands are countries that have experienced a decline in competitiveness. Countries that have stagnated agricultural competitiveness are the Czech Republic, France, the Republic of Korea, the United Kingdom of Great Britain and Northern Ireland, and the United States of America.

Several factors impede agricultural competitiveness in both developing and developed countries. One of the causes of decreased agricultural competitiveness is economic globalization. The findings indicate that the third hypothesis of this study is not supported since EGI has no positive impact on ACA in developing and developed countries. Even though Diamond Porter's

theory states that agricultural competitiveness will increase as free trade is implemented. The author believes that two major factors are impeding international trade today: each country's lack of readiness to compete and the imposition of trade barriers. The entry of agricultural products from other countries surprised almost all countries. Imported goods have hampered domestic industry development. As a result, many countries impose trade barriers to reduce agricultural imports and disrupt the agricultural competitiveness of exporting countries. The study also proves that increasing temperature, representing factor conditions in Diamond Porter has disrupted agricultural competitiveness.

The study uses the EKC theory to examine a country's economic progress. Conditions in developing countries indicate a need to accelerate economic growth and income, therefore they lay less focus on environmental sustainability. People in developed countries, on the other hand, have long been aware of environmental issues, therefore economic activity can help to alleviate environmental damage.

The study also discovered that climate change has reduced agricultural competitiveness, with developed countries being more sensitive to temperature changes than developing countries. This seems normal given that most developed countries suffer highly quick seasonal changes each year, thus a disruption in one season will have a big impact on agricultural output and competitiveness. Furthermore, because this region has more industry than developing countries, the risks of pollution and rising temperatures are higher. Meanwhile, climate change is causing concern in developing countries, but seasonal variability allows them to have a wider range of plant species, thus the decline process is less severe than in developed countries. However, the EKC theory has reminded people that economic activity harms the environment. The study also demonstrates the inverse phenomenon, in which environmental degradation disrupts economic activity.

The exchange rate, employment, and human capital are other factors that reduce agricultural competitiveness in developed and developing countries. Agriculture has become unattractive due to the large number of labors and increases in human capital because other sectors can pay higher wages.

CPI is an important factor that can boost agricultural competitiveness because it incentivizes producers to increase production quantity and quality. Meanwhile, the advancement of information technology is one method for increasing agricultural competitiveness in developed countries, but it harms developing countries due to lack of digital literacy.

Cross-section conditions in developing countries show varying impacts on agricultural competitiveness. Variations in socioeconomic conditions and policy can boost or undermine agricultural competitiveness in developing countries. Meanwhile, the same changes in developed countries have disrupted agricultural competitiveness.

6.2. Recommendation

Several recommendations are made to increase agricultural competitiveness in developed and developing countries in the era of economic globalization. First, increase the commitment of developed and developing countries to reduce support prices and trade barriers. In the short run, this approach will harm each country's economy, but it will improve each country's competitiveness in the long run. Business actors will be able to produce efficient agricultural products that can compete on a global scale. Developed countries are also expected to play a larger role in supporting developing countries with agricultural growth via investment schemes and technology transfer. On the other hand, the WTO must ensure that agricultural trade transactions are strictly supervised, impartial, and transparent.

Second, improve agricultural, distribution, and marketing efficiency. As a means of mitigating climate change, current technologies or precision agriculture make this feasible. This stage ensures that agricultural operations provide low-cost, high-quality agricultural outputs (high efficiency). Consumers will be willing to buy it, and producers will be able to make a decent living. Additionally, developing countries must improve their agricultural marketing systems. So far, the marketing system has primarily benefited traders, with farmers obtaining the lowest profit.

Third, improving agricultural business players' educational and technological literacy. The government, the private sector, and non-governmental organizations (NGOs) continue to provide help and training to agricultural business actors to carry out their activities. They must also get familiar with improvements in information and communication technologies (ICTs) to communicate agricultural and non-agricultural information more readily and rapidly. ICTs will provide business actors with a wealth of information, including effective agricultural production methods, the development of new processed products, the identification of consumers, and the promotion of appropriate items. Fourth, prioritizing agricultural infrastructure investment. This is done to increase the quantity, quality, and efficiency of agricultural products, hence increasing producer pricing. These infrastructures include agricultural machinery, dam, transportation, and road construction.

As a researcher, I believe that this study has many limitations. One of the limitations of this study is that no attempt was made to use technology and its literacy. Even though the use of technology is critical in enhancing agricultural competitiveness. Unfortunately, I cannot identify technological variables that apply to a wide range of countries. I expect that future studies will consider the use of technology in increasing agricultural competitiveness.

I also expect that future studies will examine the heterogeneity within each country. In this study, I identified this heterogeneity only with cross-section variables. Even though this is very important for determining agricultural competitiveness. This is because the oversimplification may lead to a lack of nuance in the analysis, as individual country circumstances and characteristics can vary significantly.

VII. NEW SCIENTIFIC FINDINGS

Some new and important findings from the study include:

1. Agricultural competitiveness has differed significantly across developing and developed countries during the previous three decades. Many countries have been able to raise their agricultural competitiveness over the last three decades, while many have decreased.
2. Economic globalization has been linked to a reduction in agricultural competitiveness in both developing and developed countries during the last three decades. The primary reason of this situation is these countries' lack of preparedness for economic globalization. Diamond Porter's theory states that competitiveness must be maintained by domestic and international environmental conditions. The second cause is the rise of various trade barriers throughout economic globalization. Tariff theory states that trade barriers raise a product's price to the point where it cannot compete with similar products in the worldwide market.
3. Climate change has led to a decline in agricultural competitiveness. This is consistent with the Environmental Kuznets Curve theory, which states that economic activity, particularly in developing countries, causes environmental damage. Furthermore, this will disrupt agricultural production and distribution, rendering products inefficient and uncompetitive in international markets.
4. The huge number of agricultural labors is insufficient to boost agricultural competitiveness in both developing and developed countries. This demonstrates that the Ricardian theory of labor productivity applies to this situation. Agricultural labor has low productivity and a low level of education, making it impossible to optimize agricultural performance.
5. According to engagement theory, improving and equalizing the quality of agricultural labor is crucial since human participation in education benefits a sector. Equality of education in agriculture will encourage farmers to make correct decisions and easily adopt technologies. As a result, all of this has the potential to boost agricultural competitiveness.

VIII. LIST OF PUBLICATION

Book chapter (1)

Agus, Dwi Nugroho; Stalbek, Toktosunovich Bopushev; Norbert, Bozsik; István, Fehér; Zoltan, Lakner. Impact of Economic Globalization on Agriculture in Asian Developing Countries. In: Budi, Setiawan; Budi, Mulyana; Edza, Aria Wikurendra (ed.) Economic and Business Trajectory: Indonesia, Asia, and Europe. Sidoarjo, Indonesia: Delta Pijar Publishing (2022) 263 p. pp. 226-244, 19 p.

Conference proceeding (6)

Aisyah, DD; Cahyasita, D; **Nugroho, AD**. Willingness to Pay and Barriers in Gen Z's Pro-Environmental Product Consumption. Bio Web of Conferences, 69 Paper: 04024, 9 p. (2023).

Priya, Rani Bhagat; **Agus, Dwi Nugroho**; Robert, Magda. The Effects of Foreign Company on the Local Economy in Anantapur, India. In: Magda, Róbert (ed.) Conference Proceedings of the 2nd Online International Scientific Conference on Economics, Politics and Management in times of change. Gödöllő, Hungary: Hungarian University of Agricultural and Life Sciences (2021) pp. 61-70, 10 p.m.

Rifani, A; **Nugroho, AD**; Winaryo, D; Tyas, DW; Masduqi, E; Topo, AH; Hidayanti, R; Masithah, RA; Romadhon, RD; Sulissetiyo, T et al. Spatial distribution of agricultural commodities in Cilacap Regency. IOP Conference Series: Earth and Environmental Science, 686: 1 p. 012050, 10 p. (2021).

Imade, Y. Prasada; **Agus, D. Nugroho**. Determinant Factors of the Agricultural Land Sustainability in Indonesia. In: Masaru, Mizoguchi et al. Proceedings of the 2nd International Conference on Smart and Innovative Agriculture (ICoSIA 2021). Paris, France: Atlantis Press (2021) pp. 284-289, 6 p.m.

Agus, Dwi Nugroho; Tutur, Wicaksono; Zoltan, Lakner; Csaba, Balint Illes; Robert, Magda. Determinant Factors of Consumer Purchasing Intention of Environmentally Sustainable Food. In: Miroslav, RUSKO; Lucia, BEDNÁROVÁ; Vojtech, FERENCZ (ed.) Proceedings of the 20th International Conference: Management of Environment 2020. Bratislava, Slovakia : STRIX (2020) 201 p. pp. 116-120, 5 p.

Tutur, Wicaksono; **Agus, Dwi Nugroho**; Csaba, Bálint Illes; Zoltán, Lakner; Anna, Dunay. Revealing Pro-Environmental Business Factors on European Union (EU) SMEs. In: Miroslav, RUSKO; Lucia, BEDNÁROVÁ; Vojtech, FERENCZ (ed.) Proceedings of the 20th International Conference: Management of Environment 2020. Bratislava, Slovakia: STRIX (2020) 201 p. pp. 132-137.

Journal article (27)

Nugroho, Agus Dwi; Ma'ruf, Muhammad Imam; Nasir, Muh Amat; Black Wolf, Maria; Lakner, Zoltan. Impact of global trade agreements on agricultural producer prices in Asian countries. Heliyon, 10: 2 Paper: e24635 (2024). (Scopus Q1).

Mulyo, Jangkung Handoyo; Prasada, Imade Yoga; **Nugroho, Agus Dwi**. Impact of political and security stability on food security in developing countries: Case of Africa, Asia, Latin America and the Caribbean. Agricultural Economics – Zemdelska Ekonomika, 69: 9 pp. 375-384, 10 p.m. (2023) (Scopus Q1).

Nugroho, Agus Dwi; Prasada, Imade Yoga; Lakner, Zoltan. Impact of EU sanctions on EU19 food imports from Russia. Russian Journal of Economics, 9: 3 pp. 271-283, 13 p. (2023) (Scopus Q1).

Nugroho, Agus Dwi; Prasada, Imade Yoga; Lakner, Zoltan. Comparing the effect of climate change on agricultural competitiveness in developing and developed countries. Journal of Cleaner Production, 406 Paper: 137139 (2023). (Scopus Q1).

Agus, Dwi Nugroho; Istvan, Feher; Maria, Black Wolf; Zoltan, Lakner. How to Improve Agricultural Value-Added in the MENA Region? Implementation of Diamond Porter's theory in agriculture. Frontiers in Sustainable Food Systems, 6 Paper: 956701 (2022) (Scopus Q1)

Agus, Dwi Nugroho; Cubillos T., Julieth P; Stalbek, Toktosunovich Bopushev; Norbert, Bozsik; István, Fehér; Zoltan, Lakner. Effects of Corruption Control on the Number of Undernourished People in Developing Countries. Foods, 11: 7 Paper: 924, 24 p. (2022). (Scopus Q1).

Agus, Dwi Nugroho; Zoltan, Lakner. Effect of Globalization on Coffee Exports in Producing Countries: A Dynamic Panel Data Analysis. Journal of Asian Finance Economics and Business, 9: 4 pp. 419-429, 11 p.m. (2022). ESCI.

Batmunkh, Altanshagai; **Nugroho, Agus Dwi**; Black Wolf, Maria; Lakner, Zoltan. Global Challenges and Responses: Agriculture, Economic Globalization, and Environmental Sustainability in Central Asia. Sustainability, 14: 4 Paper: 2455, 21 p. (2022). (Scopus Q1)

Imade, Yoga Prasada; Aura, Dhamira; **Agus, Dwi Nugroho.** Agricultural land availability and farmer's income in Java Island, Indonesia, 1990–2018. Regional Statistics, 12: 3 pp. 85-103, 19 p. (2022). (Scopus Q2).

Jamhari, Jamhari; Nasir, Muh Amat**; Nugroho, Agus Dwi;** Ismiasih, Ismiasih; Yonekura, Hitoshi Does the Sleman Chili Auction Market Affect the Local, Regional and National Market Prices in Indonesia? AGRARIS: Journal of Agribusiness and Rural Development Research, 8: 2 pp. 231-247, 17 p. (2022). (Scopus Q3).

Nasir, Muh Amat; **Nugroho, Agus Dwi**; Lakner, Zoltan. Impact of the Russian–Ukrainian Conflict on Global Food Crops. Foods, 11: 19 Paper: 2979 (2022). (Scopus Q1).

Nugroho, Agus Dwi; Lakner, Zoltan. Impact of economic globalization on agriculture in developing countries: A review. Agricultural Economics – Zemedelska Ekonomika, 68: 5 pp. 180-188, 9 p.m. (2022). (Scopus Q1)

Nugroho, Agus Dwi; Prasada, Imade Yoga; Lakner, Zoltan. Performance and Forecast of Indonesian Rubber Exports to the Central European Countries, 5: 1 pp. 66-81, 16 p. (2022).

Prasada, Imade Yoga; **Nugroho, Agus Dwi**; Lakner, Zoltan. Impact of the FLEGT license on Indonesian plywood competitiveness in the European Union. Forest Policy and Economics, 144 Paper: 102848, 12 p. (2022). (Scopus Q1).

Agus, Dwi Nugroho. Does Covid-19 have effects on the Indonesian horticultural subsector? Bulgarian Journal of Agricultural Sciences, 27: 5 pp. 865-874, 10 p.m. (2021). (Scopus Q3)

Agus, Dwi Nugroho. Agricultural market information in developing countries: A literature review Agricultural Economics – Zemedelska Ekonomika, 67: 11 pp. 468-477, 10 p.m. (2021). (Scopus Q1).

Alia, Bihrajihant Raya; Riesma, Andiani; Abi, Pratiwa Siregar; Imade, Yoga Prasada; Fairuz, Indana; Theresia, Gracia Yunindi Simbolon; Agustina, Tri Kinasih; **Agus, Dwi Nugroho**. Challenges, Open Innovation, and Engagement Theory at Craft SMEs: Evidence from Indonesian Batik. Journal of Open Innovation: Technology Market and Complexity, 7: 2 Paper: 121, 24 p. (2021). (Scopus Q1)

Dewi, Yuniar Mutiara; **Nugroho, Agus Dwi**; Jamhari, Jamhari. Farmers' Perception of Selling Chili to the New Auction Market: A Case at Sleman Regency of Indonesia. Journal of Agricultural Sciences - Sri Lanka, 16: 1 pp. 182-191, 10 p.m. (2021). (Scopus Q3)

D Nugroho, Agus. Development Strategies of the Local Auction Market of Agricultural Products in Indonesia. Reviews in Agricultural Science, 9 pp. 56-73, 18 p. (2021). (Scopus Q3).

Imade, Yoga Prasada; Aura, Dhamira; **Agus, Dwi Nugroho**. Effects of climatic factors on the productivity of smallholder rubber plantations in South Sumatra, Indonesia. Regional Science Inquiry, 13: 2 pp. 109-121, 13 p. (2021). (Scopus Q3)

Jamhari, Jamhari; Gilang, Wirakusuma; **Agus, Dwi Nugroho**; Zoltan, Lakner. Regional market integration, Covid-19, and agricultural trade performance in Southeast Asia. Bulgarian Journal of Agricultural Sciences, 27: 6 pp. 1051-1064, 14 p. (2021). (Scopus Q3).

Nugroho, Agus Dwi; Bhagat, Priya Rani; Magda, Robert; Lakner, Zoltan. The impacts of economic globalization on agricultural value added in developing countries. Plos One, 16: 11 Paper: e0260043, 23 p. (2021). (Scopus Q1).

Nugroho, Agus Dwi; Prasada, IY; Rosyid, AH AI. The efficiency of the auction market of chili in the sandy coastal area of Yogyakarta province, Indonesia. African Journal of Food, Agriculture, Nutrition and Development, 21: 2 pp. 17435-17449, 15 p. (2021).

Siti, Afni Anisah; Lestari, Rahayu Waluyati; **Agus, Dwi Nugroho**. Could a new agricultural auction market implement a good marketing mix? Regional Science Inquiry, 13: 2 pp. 181-191, 11 p.m. (2021). (Scopus Q3)

Wicaksono, Tutur; **Nugroho, Agus Dwi**; Lakner, Zoltán; Dunay, Anna; Illés, Bálint Csaba. Word of Mouth, Digital Media, and Open Innovation at the Agricultural SMEs. Journal of Open Innovation: Technology Market and Complexity, 7: 1, Paper: 91, 22 p. (2021). (Scopus Q1)

Nugroho, Agus Dwi; Prasada, IY. Performance and forecast of Indonesian pepper exports to Italy. Bulgarian Journal of Agricultural Sciences, 26: 5 pp. 927-934, 8 p.m. (2020). (Scopus Q3).

Nugroho, Agus Dwi; Imade, Yoga Prasada; Ali, Hashim Al Rashid. The performance of the auction market of chili in the sandy coastal area of Indonesia. Bulgarian Journal of Agricultural Sciences, 26: 6 pp. 1100-1108, 9 p.m. (2020). (Scopus Q3)

REFERENCES

Abbas, Shujaat. (2022). Global warming and export competitiveness of agriculture sector: evidence from heterogeneous econometric analysis of Pakistan. *Environmental Science and Pollution Research*, *29*(23), 34325–34337. https://doi.org/10.1007/s11356-022-18562-y

Abbas, Sohail, Kousar, S., & Pervaiz, A. (2021). Effects of energy consumption and ecological footprint on CO2 emissions: an empirical evidence from Pakistan. *Environment, Development and Sustainability*, *23*(9), 13364–13381. https://doi.org/10.1007/s10668-020-01216-9

Adedoyin, F. F., Alola, A. A., & Bekun, F. V. (2020). The nexus of environmental sustainability and agro-economic performance of Sub-Saharan African countries. *Heliyon*, *6*(9), e04878. https://doi.org/10.1016/j.heliyon.2020.e04878

Agboola, M. O., Bekun, F. V., & Joshua, U. (2021). Pathway to environmental sustainability: Nexus between economic growth, energy consumption, CO2 emission, oil rent and total natural resources rent in Saudi Arabia. *Resources Policy*, *74*(December 2020), 102380. https://doi.org/10.1016/j.resourpol.2021.102380

Asongu, S. A., Agboola, M. O., Alola, A. A., & Bekun, F. V. (2020). The criticality of growth, urbanization, electricity and fossil fuel consumption to environment sustainability in Africa. *Science of the Total Environment*, *712*, 136376. https://doi.org/10.1016/j.scitotenv.2019.136376

Atici, C. (2005). Liberalization-goals trade-offs. Implications of agricultural trade liberalization for developing countries. *Outlook on Agriculture*, *34*(2), 83–89. https://doi.org/10.5367/0000000054224364

Bahn, R. A., Yehya, A. A. K., & Zurayk, R. (2021). Digitalization for sustainable agri-food systems: Potential, status, and risks for the Mena region. *Sustainability (Switzerland)*, *13*(6), 1–24. https://doi.org/10.3390/su13063223

Balassa, B. (1965). Trade Liberalisation and "Revealed" Comparative Advantage. *The Manchester School*, *33*(2), 99–123. https://doi.org/10.1111/j.1467-9957.1965.tb00050.x

Batmunkh, A., Nugroho, A. D., Fekete-Farkas, M., & Lakner, Z. (2022). Global Challenges and Responses: Agriculture, Economic Globalization, and Environmental Sustainability in Central Asia. *Sustainability (Switzerland)*, *14*(4). https://doi.org/10.3390/su14042455

Beber, C. L., Langer, G., & Meyer, J. (2021). Strategic actions for a sustainable internationalization of agri-food supply chains: The case of the dairy industries from Brazil and Germany. *Sustainability (Switzerland)*, *13*(19), 1–18. https://doi.org/10.3390/su131910873

Belton, W. J., & Nair-Reichert, U. (2007). Inflation regimes, core inflation measures and the relationship between producer and consumer price inflation. *Applied Economics*, *39*(10), 1295–1305. https://doi.org/10.1080/00036840500447682

Biles, J. J., Brehm, K., Enrico, A., Kiendl, C., Morgan, E., Teachout, A., & Vasquez, K. (2007). Globalization of food retailing and transformation of supply networks: Consequences for small-scale agricultural producers in Southeastern Mexico. *Journal of Latin American Geography*, *6*(2), 55–75. https://doi.org/10.1353/lag.2007.0032

Biswas, A., Mailapalli, D. R., & Raghuwanshi, N. S. (2021). Treated municipal wastewater to fulfil crop water footprints and irrigation demand – A review. *Water Science and Technology: Water Supply*, *21*(4), 1398–1409. https://doi.org/10.2166/WS.2021.031

Bojnec, Š., & Fertő, I. (2017). The duration of global agri-food export competitiveness. *British*

Food Journal, *119*(6), 1378–1393. https://doi.org/10.1108/BFJ-07-2016-0302

Calzadilla, A., Rehdanz, K., Betts, R., Falloon, P., Wiltshire, A., & Tol, R. S. J. (2013). Climate change impacts on global agriculture. *Climatic Change*, *120*(1–2), 357–374. https://doi.org/10.1007/s10584-013-0822-4

Camargo, E., & Wang, M. Y. (2015). A pilot study on the internationalization of Taiwanese agri-biotech SMEs: A Technology-Organization-Environment (TOE) perspective. *Portland International Conference on Management of Engineering and Technology*, *2015-Septe*, 1207–1217. https://doi.org/10.1109/PICMET.2015.7273220

Chen, L., Msigwa, G., Yang, M., Osman, A. I., Fawzy, S., Rooney, D. W., & Yap, P. S. (2022). Strategies to achieve a carbon neutral society: a review. In *Environmental Chemistry Letters* (Vol. 20, Issue 4). Springer International Publishing. https://doi.org/10.1007/s10311-022-01435-8

Choi, J., Gu, J., & Shen, S. (2018). Weak-instrument robust inference for two-sample instrumental variables regression. *Journal of Applied Econometrics*, *33*(1), 109–125. https://doi.org/10.1002/jae.2580

Debaeke, P., Casadebaig, P., Flenet, F., & Langlade, N. (2017). Sunflower crop and climate change: Vulnerability, adaptation, and mitigation potential from case-studies in Europe. *OCL - Oilseeds and Fats, Crops and Lipids*, *24*(1), 1–15. https://doi.org/10.1051/ocl/2016052

Ding, X., Qian, Y., & Tong, S. (2016). Globalization, Employment and Agriculture: A Review of the Eleventh Forum of the World Association for Political Economy. *World Review of Political Economy*, *7*(4), 541–555. https://doi.org/10.13169/worlrevipoliecon.7.4.0541

Dreher, A. (2006). Does globalization affect growth? Evidence from a new index of globalization. *Applied Economics*, *38*(10), 1091–1110. https://doi.org/10.1080/00036840500392078

Dunning, J. H. (1993). Internationalizing Porter's Diamond. *Management International Review*, *33*, 7–15.

Fatihudin, D. (2019). Globalization, strengthening of indonesian local market character as consequences and reality of open economic system. *Humanities and Social Sciences Reviews*, *7*(3), 11–16. https://doi.org/10.18510/hssr.2019.732

Fekete, H., Kuramochi, T., Roelfsema, M., Elzen, M. den, Forsell, N., Höhne, N., Luna, L., Hans, F., Sterl, S., Olivier, J., van Soest, H., Frank, S., & Gusti, M. (2021). A review of successful climate change mitigation policies in major emitting economies and the potential of global replication. *Renewable and Sustainable Energy Reviews*, *137*(March 2020). https://doi.org/10.1016/j.rser.2020.110602

Ghosh, B. N. (2009). Globalization and food policy dilemmas in developing countries: Contextualizing the indian scenario. *Journal of Third World Studies*, *26*(2), 107–120.

Greene, W. H. (2003). *Econometric Analysis* (Rod Banister (ed.); 5th ed.). Prentice Hall. https://spu.fem.uniag.sk/cvicenia/ksov/obtulovic/Manaž. štatistika a ekonometria/EconometricsGREENE.pdf

Gupta, D., Fischer, H., Shrestha, S., Shoaib Ali, S., Chhatre, A., Devkota, K., Fleischman, F., Khatri, D. B., & Rana, P. (2021). Dark and bright spots in the shadow of the pandemic: Rural livelihoods, social vulnerability, and local governance in India and Nepal. *World Development*, *141*, 105370. https://doi.org/10.1016/j.worlddev.2020.105370

Haddad, A. M., & Shahwan, Y. (2012). Optimization agricultural production under financial risk of water constraint in the Jordan Valley. *Applied Economics*, *44*(11), 1375–1385. https://doi.org/10.1080/00036846.2010.539550

Hill, A. D., Johnson, S. G., Greco, L. M., O'Boyle, E. H., & Walter, S. L. (2021). Endogeneity: A

Review and Agenda for the Methodology-Practice Divide Affecting Micro and Macro Research. In *Journal of Management* (Vol. 47, Issue 1). https://doi.org/10.1177/0149206320960533

Hoang, H. (2020). The underground economy in transition countries from the perspective of globalization: The case of Vietnam. *Revista Amazonia Investiga*, *9*(29), 234–242. https://doi.org/10.34069/ai/2020.29.05.26

Huo, D. (2014). Impact of country-level factors on export competitiveness of agriculture industry from emerging markets. *Competitiveness Review*, *24*(5), 393–413. https://doi.org/10.1108/CR-01-2012-0002

Jha, P. K., Araya, A., Stewart, Z. P., Faye, A., Traore, H., Middendorf, B. J., & Prasad, P. V. V. (2021). Projecting potential impact of COVID-19 on major cereal crops in Senegal and Burkina Faso using crop simulation models. *Agricultural Systems*, *190*, 103107. https://doi.org/10.1016/j.agsy.2021.103107

Jorgenson, A. K., & Carolina, N. (2008). Foreign Investment Dependence and Agriculture Production: Pesticide and Fertilizer Use in Less-Developed Countries, 1990-2000. *Social Forces*, *87*(1), 529–560.

Jung, J. H., & Park, J. (2014). Outcome measures of agricultural R&D and contributory factors. *Asian Journal of Technology Innovation*, *22*(1), 152–167. https://doi.org/10.1080/19761597.2014.905228

Kamran, A., Syed, N. A., Rizvi, S. M. A., Ameen, B., & Ali, S. N. (2021). Impact of China-Pakistan Economic Corridor (CPEC) on Agricultural Sector of Pakistan. *The Fourteenth International Conference on Management Science and Engineering Management*, *1191 AISC*(July 2020), 538–549. https://doi.org/10.1007/978-3-030-49889-4_42

Kargbo, J. M. (2006). Exchange rate volatility and agricultural trade under policy reforms in South Africa. *Development Southern Africa*, *23*(1), 147–170. https://doi.org/10.1080/03768350600556315

KOF Swiss Economic Institute. (2021). *KOF Globalisation Index*. https://kof.ethz.ch/en/forecasts-and-indicators/indicators/kof-globalisation-index.html

Krugman, P. R., & Obstfeld, M. (2003). International Economics Theory and Policy. In *International Economics sixth edition* (6th ed.). Pearson Education, Inc. https://doi.org/10.4324/9780203462041

Kwon, H. Y. (2011). Globalization, cultural openness, and public preferences for East Asian economic integration in South Korea. *International Journal of Public Opinion Research*, *23*(1), 2–23. https://doi.org/10.1093/ijpor/edq027

Le, D. N. (2021). Globalisation, Logistics and Food Supply: Evidence from Vietnam. *Malaysian Journal of Economic Studies*, *58*(2), 267–291. https://doi.org/10.22452/MJES.vol58no2.5

Levin, A., Lin, C. F., & Chu, C. S. J. (2002). Unit root tests in panel data: Asymptotic and finite-sample properties. *Journal of Econometrics*, *108*(1), 1–24. https://doi.org/10.1016/S0304-4076(01)00098-7

Li, J., Ding, H., Hu, Y., & Wan, G. (2021). Dealing with dynamic endogeneity in international business research. *Journal of International Business Studies*, *52*(3), 339–362. https://doi.org/10.1057/s41267-020-00398-8

Li, L., Liu, J., Cheng, B., Chhatre, A., Dong, J., & Liang, W. (2017). Effects of economic globalization and trade on forest transitions: Evidence from 76 developing countries. *Forestry Chronicle*, *93*(2), 171–179. https://doi.org/10.5558/tfc2017-023

Losch, B. (2004). Debating the multifunctionality of agriculture: From trade negotiations to

development policies by the South. *Journal of Agrarian Change*, *4*(3), 336–360. https://doi.org/10.1111/j.1471-0366.2004.00082.x

Lynch, J., & Garnett, T. (2021). Policy to Reduce Greenhouse Gas Emissions: Is Agricultural Methane a Special Case? *EuroChoices*, *20*(2), 11–17. https://doi.org/10.1111/1746-692X.12317

Mariano, R. S. (2007). Simultaneous Equation Model Estimators: Statistical Properties and Practical Implications. *A Companion to Theoretical Econometrics*, 122–143. https://doi.org/10.1002/9780470996249.ch7

Maslova, V. V., Zaruk, N. ., & Avdeev, M. . (2020). Problems and Directions of the Improvement of Price Relations in the Russian Agricultural Sector of Economy. In A. V. Bogoviz (Ed.), *Complex Systems: Innovation and Sustainability in the Digital Age* (Vol. 1, pp. 549–555). Springer Nature Switzerland. https://doi.org/10.3389/fclim.2022.931514

McBurney, M., Tuaza, L. A., Ayol, C., & Johnson, C. A. (2021). Land and livelihood in the age of COVID-19: Implications for indigenous food producers in Ecuador. *Journal of Agrarian Change*, joac.12417. https://doi.org/10.1111/joac.12417

Meher, R. (2009). Globalization, displacement and the livelihood issues of tribal and agriculture dependent poor people: The case of mineral-based industries in India. *Journal of Developing Societies*, *25*(4), 457–480. https://doi.org/10.1177/0169796X0902500403

Munir, K., & Bukhari, M. (2020). Impact of globalization on income inequality in Asian emerging economies. *International Journal of Sociology and Social Policy*, *40*(1–2), 44–57. https://doi.org/10.1108/IJSSP-08-2019-0167

Mykhailov, A. M., Mykhailova, L., Kharchenko, T., Mohylna, L., & Shestakova, A. (2021). Investment instruments for managing innovative transformations of the agricultural sector to ensure sustainable development in the context of globalization. *Estudios de Economia Aplicada*, *39*(7). https://doi.org/10.25115/eea.v39i7.5068

Nasir, M. A., Nugroho, A. D., & Lakner, Z. (2022). Impact of the Russian–Ukrainian Conflict on Global Food Crops. *Foods*, *11*(19), 1–16. https://doi.org/10.3390/foods11192979

Neglo, K. A. W., Gebrekidan, T., & Lyu, K. (2021). The role of agriculture and non-farm economy in addressing food insecurity in Ethiopia: A review. *Sustainability (Switzerland)*, *13*(7), 1–22. https://doi.org/10.3390/su13073874

Neilson, J., Dwiartama, A., Fold, N., & Permadi, D. (2020). Resource-based industrial policy in an era of global production networks: Strategic coupling in the Indonesian cocoa sector. *World Development*, *135*, 105045. https://doi.org/10.1016/j.worlddev.2020.105045

Nelson, E. J., Helmus, M. R., Cavender-Bares, J., Polasky, S., Lasky, J. R., Zanne, A. E., Pearse, W. D., Kraft, N. J. B., Miteva, D. A., & Fagan, W. F. (2016). Commercial plant production and consumption still follow the latitudinal gradient in species diversity despite economic globalization. *PLoS ONE*, *11*(10), 1–23. https://doi.org/10.1371/journal.pone.0163002

Nematchoua, M. K., Asadi, S., & Reiter, S. (2020). Influence of energy mix on the life cycle of an eco-neighborhood, a case study of 150 countries. *Renewable Energy*, *162*, 81–97. https://doi.org/10.1016/j.renene.2020.07.141

Nugroho, A. D. (2021). Agricultural market information in developing countries: A literature review. *Agricultural Economics (Czech Republic)*, *67*(11), 468–477. https://doi.org/10.17221/129/2021-AGRICECON

Opara, L. U., & Mazaud, F. (2001). Food traceability from field to plate. *Outlook on Agriculture*, *30*(4), 239–247. https://doi.org/10.5367/000000001101293724

Pasara, M. T. (2020). An overview of the obstacles to the African economic integration process in

view of the African continental free trade area. *Africa Review*, *12*(1), 1–17. https://doi.org/10.1080/09744053.2019.1685336

Paschalidou, A., Tsatiris, M., & Kitikidou, K. (2016). Energy crops for biofuel production or for food? - SWOT analysis (case study: Greece). *Renewable Energy*, *93*, 636–647. https://doi.org/10.1016/j.renene.2016.03.040

Paus, E. (2012). Confronting the Middle Income Trap: Insights from Small Latecomers. *Studies in Comparative International Development*, *47*(2), 115–138. https://doi.org/10.1007/s12116-012-9110-y

Pfeiffer, A., & Hepburn, C. (2016). Facing the Challenge of Climate Change. *Global Journal of Emerging Market Economies*, *8*(2), 201–215. https://doi.org/10.1177/0974910116634473

Pham, M. P., Nguyen, K. Q., Vu, G. D., Nguyen, N. T. T., Tong, H. T., Trinh, L. H., & Le, P. V. (2022). Drought risk index for agricultural land based on a multi-criteria evaluation. *Modeling Earth Systems and Environment*, *8*(4), 5535–5546. https://doi.org/10.1007/s40808-022-01376-9

Pirkle, C. M., Poliquin, H., Sia, D., Kouakou, K. J., & Sagna, T. (2015). Re-envisioning global agricultural trade: time for a paradigm shift to ensure food security and population health in low-income countries. *Global Health Promotion*, *22*(1), 60–63. https://doi.org/10.1177/1757975914531029

Polimeni, J. M., Iorgulescu, R. I., & Mihnea, A. (2018). Understanding consumer motivations for buying sustainable agricultural products at Romanian farmers markets. *Journal of Cleaner Production*, *184*, 586–597. https://doi.org/10.1016/j.jclepro.2018.02.241

Porter, M. E. (1990). The Competitive Advantage of Nations. *Harvard Business Review*, *March-Apri*, 73–91. https://doi.org/10.1177/014920639101700113

Pozo, S., Sanchez-Fung, J. R., & Santos-Paulino, A. U. (2011). A note on modelling economic growth determinants in the Dominican Republic. *Macroeconomics and Finance in Emerging Market Economies*, *4*(1), 35–41. https://doi.org/10.1080/17520843.2011.548594

Prasada, I. Y., Nugroho, A. D., & Lakner, Z. (2022). Impact of the FLEGT license on Indonesian plywood competitiveness in the European Union. *Forest Policy and Economics*, *144*(June), 102848. https://doi.org/10.1016/j.forpol.2022.102848

Qiang, W., Niu, S., Wang, X., Zhang, C., Liu, A., & Cheng, S. (2020). Evolution of the global agricultural trade network and policy implications for China. *Sustainability (Switzerland)*, *12*(1), 1–16. https://doi.org/10.3390/SU12010192

Renard, M. C. (1999). The interstices of globalization: The example of fair coffee. *Sociologia Ruralis*, *39*(4), 484–500. https://doi.org/10.1111/1467-9523.00120

Sadiqa, B. A., Zaman, K., Rehman, F. U., Nassani, A. A., Haffar, M., & Abro, M. M. Q. (2022). Evaluating race-to-the-top/bottom hypothesis in high-income countries: controlling emissions cap trading, inbound FDI, renewable energy demand, and trade openness. *Environmental Science and Pollution Research*, *29*(33), 50552–50565. https://doi.org/10.1007/s11356-022-19385-7

Salam, S., & Bauer, S. (2022). Rural non-farm economy and livelihood diversification strategies: evidence from Bangladesh. *GeoJournal*, *87*(2), 477–489. https://doi.org/10.1007/s10708-020-10269-2

Salvatore, D. (2013). *International economics* (11th ed.). Wiley.

Sanchez-Ancochea, D. (2006). Development trajectories and new comparative advantages: Costa Rica and the Dominican Republic under Globalization. *World Development*, *34*(6), 996–1015. https://doi.org/10.1016/j.worlddev.2005.11.012

Sarker, R., & Ratnasena, S. (2014). Revealed Comparative Advantage and Half-a-Century Competitiveness of Canadian Agriculture: A Case Study of Wheat, Beef, and Pork Sectors. *Canadian Journal of Agricultural Economics*, *62*(4), 519–544. https://doi.org/10.1111/cjag.12057

Scholte, J. A. (2005). *Globalization: A Critical Introduction* (2nd editio). Palgrave Macmillan.

Schwarz, J., Mathijs, E., & Maertens, M. (2019). A dynamic view on agricultural trade patterns and virtual water flows in Peru. *Science of the Total Environment*, *683*, 719–728. https://doi.org/10.1016/j.scitotenv.2019.05.118

Silva, E. D., Appanah, S., & Kariyawasam, D. (1995). 95/01613 Sustainable forestry management in developing countries. Experiences from Asia. *Fuel and Energy Abstracts*, *36*(2), 110. https://doi.org/10.1016/0140-6701(95)93278-x

Smit, A. J. (2010). The competitive advantage of nations: is Porter's Diamond Framework a new theory that explains the international competitiveness of countries? *Southern African Business*, *14*(1), 105–130. https://www.ajol.info/index.php/sabr/article/view/76358

Srbinovska, M., Gavrovski, C., Dimcev, V., Krkoleva, A., & Borozan, V. (2015). Environmental parameters monitoring in precision agriculture using wireless sensor networks. *Journal of Cleaner Production*, *88*, 297–307. https://doi.org/10.1016/j.jclepro.2014.04.036

Suranovic, S. (2012). *Policy and Theory of International Economics*.

Svoboda, J., Lososová, J., & Zdeněk, R. (2016). Subsidies on investments in the EU member states. *Agris On-Line Papers in Economics and Informatics*, *8*(4), 153–162. https://doi.org/10.7160/aol.2016.080414

Tcvetkov, P. (2022). Engagement of resource-based economies in the fight against rising carbon emissions. *Clean Energy and Electrical Systems*, *8*, 874–883. https://doi.org/10.1016/j.egyr.2022.05.259

van den Heuvel, F. P., de Langen, P. W., van Donselaar, K. H., & Fransoo, J. C. (2011). Identification of Employment Concentration and Specialization Areas : Theory and Application. *Beta Working Paper*, *354*(August), 26p. https://doi.org/10.1002/agr

Watanabe, M. D. B., & Cavalett, F. C. O. (2022). Climate change mitigation of drop-in biofuels for deep-sea shipping under a prospective life-cycle assessment. *Journal of Cleaner Production*, *364*(132662), 1–11.

Wegren, S. K. (2014). Human capital and Russia's agricultural future. *Post-Communist Economies*, *26*(4), 537–554. https://doi.org/10.1080/14631377.2014.964467

Wicaksono, T., Nugroho, A. D., Lakner, Z., Dunay, A., & Illés, C. B. (2021). Word of mouth, digital media, and open innovation at the agricultural smes. *Journal of Open Innovation: Technology, Market, and Complexity*, *7*(1), 1–22. https://doi.org/10.3390/joitmc7010091