agriculture

MDPI

Article

Selected EU Countries Crop Trade Competitiveness from the Perspective of the Czech Republic

Lenka Rumankova, Elena Kuzmenko, Irena Benesova * and Lubos Smutka

Department of Economics, Faculty of Economics and Management, Czech University of Life Sciences Prague, Kamýcká 129, 165 00 Prague, Czech Republic; rumankova@pef.czu.cz (L.R.); kuzmenko@pef.czu.cz (E.K.); smutka@pef.czu.cz (L.S.)

* Correspondence: benesova@pef.czu.cz

Abstract: The question of the sources of agricultural competitiveness is widely discussed on the farm and sectoral levels in the European Union. This paper assesses the competitiveness of the plant production using the combination of trade measures and strategic management measures in the selected European countries related to the Czech Republic. Thus, the paper evaluates and identifies the sources of competitiveness of plant production. In the case of Belgium and the Netherlands, labour and capital factors have a significant influence on production; in the case of the new member states, these factors are less important, and, conversely, market competitiveness factors are more crucial. The continuous convergence process between Belgium and the Netherlands is illustrated. The divergence between the Netherlands and the rest of the countries is also visible. There is a stable connection between the Czech Republic and Austria, France, and Slovakia. It can be mentioned that there is no statistically significant difference in the comparative advantage between 2005 and 2019, except in the case of France. Analysing sources of competitiveness among the countries of interest is a possible tool for the future direction of trade policies.

Keywords: competitiveness indicators; export competitiveness; comparative advantage; agriculture and agri-food sectors; cluster analysis; sources of competitiveness

Citation: Rumankova, L.; Kuzmenko, E.; Benesova, I.; Smutka, L. Selected EU Countries Crop Trade Competitiveness from the Perspective of the Czech Republic. *Agriculture* **2022**, *12*, 127. https://doi.org/10.3390/agriculture12020127

Academic Editor: Gbadebo Oladosu

Received: 30 November 2021
Accepted: 14 January 2022
Published: 18 January 2022

1. Introduction

In the European Union (EU), agricultural trade competitiveness is a crucial concept in the context of the current trend of common agricultural policy (CAP) [1–3]. However, there is no single definition or measure of competitiveness in the economic literature. Consequently, competitiveness is a relative concept, and each study adopts its definition and chooses specific methods to measure it [4]. For this study, competitiveness is a fundamental driver of the individual country's ability to operate at the bilateral or multilateral trade flows. The competitiveness itself results from many specific factors and drivers, e.g., economy, resource availability, technology, production factors availability, subsidies, domestic supports, policy, or climate.

At the European level, an individual country's competitiveness is usually influenced through a unique mix of determinants, including political, production, environmental, and sustainability factors, and the ability of individual farmers to manage the optimal mix of all those factors. Therefore, farmers and food producers face the challenge of choosing the optimum mix of relevant products and activities to manage their agricultural and food production as effectively as possible because productivity and efficiency are vital sources of competitiveness. A country's competitiveness should be measured according to a benchmark [5].

The processed paper analyses the major European countries' agri-food trade competitiveness and their ability to optimize their available production factors concerning their agri-food trade performance.

This paper is a part of the project focusing on the Czech agricultural trade and market development. Therefore, the selected countries are important trade partners of the Czech Republic (70% of the Czech agri-food export value, 64% of Czech agri-food import value). Second, the chosen countries are significant producers and traders in the agri-food market in Central and Western Europe. From 2005 to 2019, their share in intra-EU agri-food trade reached about 68.5% and their share in Western and Central European agri-food trade reached over 90% in the monitored period.

For individual EU countries, including the Czech Republic, monitoring trade partners' productivity and trade competitiveness development are necessary. It is essential to know key development trends and existing threats and opportunities to apply a benchmark approach to fixing and improving competitiveness, agri-food trade, and agri-food production sustainability. Many authors focus on the sources of competitiveness of the European states or the Czech Republic regarding overall export [6–8], the agricultural sector [9–13], food production [4,14,15], or chosen commodities [16–23]. However, none of these papers focus solely on crop production. This topic has not been addressed yet. Therefore, this paper's main purpose is to identify/highlight and evaluate individual countries' trade competitiveness and highlight the source of their competitiveness and the impact of their trade competitiveness on their agri-food trade/export commodity structures regarding crop production.

The present analysis focuses on the crop commodity groups of European markets, combining market and strategic management/productivity measures. Therefore, this paper aims to analyse the interplay (if any) between trade competitiveness in the selected European agricultural crop markets and the main factors of production (disposable land, capital, labour). The analysis provides an insight into the situation within the group of the monitored countries. Based on a review of the state of knowledge, we examine the following research questions on the sources of competitiveness of individual EU countries in agricultural markets:

Research question 1: What are the sources of export measures competitiveness?

Research question 2: Do European countries have similar sources of competitiveness?

Research question 3: Was there any change in the trade competitiveness of individual countries over the period 2005–2019?

2. Literature Overview

2.1. Factors Determining Competitiveness

Many factors determine export competitiveness. As Travkina and Tvaronaviciene [24] explain, understanding foreign trade competitiveness changed in the late '90s. Trade theory altered, according to the Krugman hypothesis, in that period, in which emphasis shifted to consumer preferences and economies of scale instead of focusing on comparative advantage, as explained by Ricardo's theory and the Heckscher–Ohlin model. Despite this fact, many economists analyse foreign trade using comparative advantage concepts. Bojnec and Fertő [25] consider export competitiveness crucial for long-term survival in the global farm business. It fosters opportunities for business prosperity in international markets. In addition, Persson and Wilhelmsson [26], in particular, emphasize the importance of the preferences on export diversification.

As Giurgiu and Dodescu [27] state, globalization has increased the importance of local conditions for the competitiveness of companies and countries, requiring that every country compete based on its productivity as a strategic development platform. Bokusheva and Cechura [28] focus on farm-level productivity. They identify three productivity components necessary for productivity growth—technical change, scale effect, and technical efficiency. Their analysis focuses primarily on crop production.

Jambor and Suresh [29] identify global agricultural trade and competitiveness patterns and use them as a basis for analysing global food security. They also identify countries, regions, and product groups and develop a typology of agricultural competitiveness, giving policy lessons and recommendations for increasing national, regional, or global agricultural

competitiveness to achieve sustainable food security goals. Moon [30] added that countries with a competitive agricultural sector require less state support than countries with a non-competitive agricultural sector. He determined agricultural competitiveness using two primary factors: natural resources endowment and government policies. Zekic et al. [8] emphasized that competitiveness, food security, and food safety are crucial for forming governmental policies. Urban et al. [31] pointed to a connection between governmental policies and the food industry's competitiveness, namely its removal of domestic support payments and the subsequent growth in export value.

On the other hand, Erokhin et al. [32] stress the importance of elaborating policy measures to establish and support the competitiveness of agricultural markets. Narayan and Bhattacharya [33] found that relative export competitiveness (REC) deteriorated due to export restrictions. Singbo and Larue [34] considered that policy and regulatory impediments prevent Canadian dairy farms from exploiting economies of scale to improve competitiveness.

2.2. Sources of Competitiveness

Bezić et al. [35] provide a complete analysis of the comparative advantage and the overall export competitiveness of the food manufacturing sector in 27 EU countries. They conclude that, although positive relative and absolute values of the export activity of the specified industry are apparent, higher absolute and relative values of imports dampen such positive effects. The paper also shows that the European food industry is weak in economies of scale and labour productivity. However, its strengths include attracting sufficient capital and labour, and an openness to global markets. The full exploitation of economies of scale can also be seen as an opportunity. In the case of the Netherlands, farm productivity growth is driven by technical progress [36]. Soo [37] combined comparative advantage and external scale economies to determine that the gains from specialization outweigh gains from comparative advantage.

Similarly, Tvaronaviciene [24] anticipates possible productivity implications that address the impact of labour, capital, and energy intensity on further export competitiveness. Gorton et al. [38] revealed comparative advantage (RCA) and domestic resource cost (DRC) ratios for an examination of the competitiveness of selected agricultural products in the Czech Republic and Bulgaria to international markets and the EU. The results show that cereal producers were competitive at global market prices and EU prices. However, they did not consider RCA in trade with the EU, partially due to trade restrictions.

In addition, Sheetal et al. [39] analysed export competitiveness using an evaluation of RCA and the Hirschman Herfindahl Index. An examination of export performance based on RCA evaluation can also be found in Carraresi and Banterle [40]. Based on the research, only six EU countries were considered relevant in trading competitiveness: Germany, France, Italy, Spain, the Netherlands, Belgium, and the United Kingdom [40].

Bojnec and Fertő [41] investigated the competitiveness of agri-food exports of the European Union (EU-27) countries on global markets, using the revealed comparative advantage concept. Most agri-food products in the EU-27 countries show a comparative disadvantage on international markets. Most of the old EU-15 member states, experienced in trading agri-food products, have revealed comparative advantages longer than most new EU-12 member states. The Netherlands, France, and Spain were among the most successful member states in agri-food and export competitiveness on global markets. Then, Bojnec and Fertő [25] show that the duration of possessing a revealed comparative advantage is heterogeneous at the agri-food product level. The estimated indices indicated that in the long-term, the highest stability in possessing comparative advantage was shown by the Netherlands, France, Belgium, the USA, Argentina, and New Zealand (out of 23 analysed countries in total).

In conclusion, the level of economic development, the share of agricultural employment, subsidies to agriculture, and differentiated consumer agri-food products increase the likelihood of failure in the duration of comparative advantage, while the abundance

of farmland and export diversification reduce that likelihood. Bojnec and Fertő [42] employed the same approach when investigating export competitiveness in the EU-27 fruit and vegetable sectors. The results show that Spain and the Netherlands experienced the most robust effects of the revealed comparative advantages.

2.3. Research Questions

Popescu et al. [43] analyse whether land is cultivated with competitive crops; they argue that land-use changes might increase competitiveness. However, the government must take food security and diet diversity into consideration as well. These two objectives play a crucial role in the agricultural development of many countries [44–46], which makes it possible to consider crop production as a critical factor for economic development.

Competitiveness is a broad measure influenced by many factors. Some of them can be controlled by the farmers or agri-food producers (size, product specialization, factor intensity), while others are not controllable (climatic condition, government intervention, consumer demand). These factors influence farmers' (or agri-food producers') commodity structure and production volume. However, there is no clear view in the literature about the impact of trade competitiveness on agri-food trade commodity structure on the country level.

Based on the above, is it legitimate to ask whether there are differences in competitiveness and sources of competitiveness between the countries? Are only the original EU-15 countries competitive, or can the new countries compete in intra-EU trade? Moreover, has there been a change in competitiveness among the countries under review since the 2004 enlargement? Alternatively, what are the sources of this competitiveness?

Therefore, our analysis mainly focuses on the primary agricultural production associated with agricultural land. This part of agricultural production is vital for two reasons. Firstly, it is a natural link with the soil, and secondly, it is an input variable for livestock production. On the one hand, crop production is characterized by a lower added value than animal production. On the other hand, land is limited and can be considered a common-pool resource [47,48]. The biological limits of land also determine the capital intensity of crop production [44,49,50].

3. Research Methods and Materials

3.1. Measurement of Competitiveness

The previous section defines the term competitiveness and factors that influence it. However, it only touched the measurement of competitiveness. This section summarises the methods used to measure or evaluate the country's competitiveness. The aim is to select the best approach to evaluate the position of the Czech Republic and its major trading partners.

As Ruženková et al. [51] state, competitiveness can be analysed using a term of single- and multi-factor competitiveness indicators that contribute to quantification and a deeper comprehension of both internal and external competitiveness determinants. The assumption of their research was grounded in the notion that a higher quality of the institutional environment is characterized by a higher level of competitiveness and lower transaction costs, based on the belief that export performance is a reliable measure of competitiveness. However, the results demonstrate that export performance is not a universal indicator of competitiveness. Jaksic et al. [8] evaluated the export competitiveness of EU member states based on total factor productivity. The analysis focuses on examining the level of export competitiveness before and after the financial crisis. A significant relationship was found between the ability of individual countries to reach the pre-crisis level of total factor productivity and their export competitiveness.

Stollinger and Holzner [52], based on an expanded macro-economic export function (to investigate the relationship between state aid for the manufacturing sector and member states' export performance) and comparative advantage approach, found limited evidence for a significant impact of state aid on manufacturing value-added exports.

Fojtíková and Staníčková [53] analysed the export competitiveness of EU member states using data envelopment analysis (DEA). The trade analyses confirmed that export competitiveness is different in the individual EU member states and has also changed. The results pointed more to economic convergence in the trade area between the new and old EU member states rather than to export productivity. In conclusion, the development of EU trade has been influenced by globalization processes, accompanied by trade liberalization and the EU integration process

Huo [54] presents a link between the export of agricultural products and the export of the agricultural industry and its competitiveness. The paper analyses the competitiveness of the agricultural industry using RCA, regression analysis, and factor analysis. The results show that the export of agricultural products, arable land, and the exchange rate positively correlate with the export competitiveness of the farming industry. At the same time, labour cost and domestic demand have a negative relationship. Lately, Huo et al. used fuzzy cluster analysis to find the distribution of emerging markets with a higher level of export competitiveness. [55]

Buturac et al. [56] employed the constant market share model (CMS) to examine the international competitiveness of the Croatian food industry. Based on the quantification of the export performance of the food industry compared to the rest of the world and individual foreign markets (the EU 27, new member states), along with an evaluation of comparative advantage, recommendations for export reorientations were formulated. Gilbert and Muchova [57] employed the CMS approach to decompose changes in the export shares of the Central and Eastern European (CEE) economies since the fifth enlargement of the European Union and measure changes in export competitiveness. The analysis shows that the CEE transition economies generally increased their export competitiveness on the global market. Nevertheless, gains in market share were tempered by a poor match between most CEE economies' commodity and regional export profiles. They concluded that changes in export competitiveness in the region are primarily driven by expansions of market share within the EU. Capobianco-Uriarte [58] also employed the CMS approach to examine the European tomato market.

A summary of the methods mentioned above is included in Appendix A.

As evident, there are many measures of competitiveness. The first group is based on strategic management measures derived from cost, profitability or productivity, and efficiency. The second group deals with trade measures of competitiveness or export competitiveness. This group is based on the concept of comparative advantage. All the methods based on this theory help measure international competitiveness and compare countries. Probably the most used method is the revealed comparative advantage which is well used despite its critique [59,60]. Therefore, the combination of the strategic management measures and trade measures may give a clear picture of the Czech Republic's position and the competitiveness of the major trading partners of this country.

3.2. Data Description

Nine European countries were chosen in the same climatic zone, covering 2005 through 2019. Within this period, we picked the years 2005, 2010, 2015, and 2019. The year 2005 was the first full year of membership of the Laeken group of countries in the European Union. The following year, 2010, was after the economic crisis. The year 2015 was connected with the impact of Russian sanctions, and the year 2019 represented the latest available data.

The article is being processed as part of a grant project analysing Czech agricultural market specifically. Therefore, the choice of countries results from the territorial structure of Czech agrarian foreign trade. The Czech Republic has suffered because of extreme trade territorial concentration as a landlocked country. The selected countries represent nearly 75% of the Czech agricultural export value to the European Union. They have also been competing for a significant share in the European agri-food market. According to the plant production, their production structure could be considered homogenous. Individual

countries are forced to compete mainly through their production-added value, ability to optimize available production factors, and production efficiency and competitiveness.

Thus, the group of EU countries selected for the analysis consists of Austria (AT), Belgium (BE), the Czech Republic (CZ), Germany (DE), Denmark (DK), France (FR), the Netherlands (NL), Poland (PL), and Slovakia (SK). The original set had also included Italy and Hungary.

For the quantitative analysis, secondary sources and data were used. Trade data from the UN COMTRADE database were obtained. The market analysis is based on the annual Harmonized System (HS) 2007. Thirty-two commodity aggregations or sub-aggregations were chosen, listed in Table 1 and Appendix A. Two- and four-digit codes were used (Appendix B). The selection was based on the importance of these commodities for Czech agricultural foreign trade. The choice of two-digit and four-digit codes results from the effort to focus attention on individual crops related to agrarian trade aggregations, including all relevant trade sub-items (at two-digit code level). The selected combination of commodity aggregations represents a relatively homogeneous mix of products. The researchers intended to analyse the trade competitiveness of the most important Czech agrarian trade items/sub-aggregations (four-digit code level) connected to local crop production and representing Czech crops' core related agrarian exports. Selected four-digit code aggregations represent about 55% of Czech crops related to agrarian exports.

Table 1. Selected commodity aggregates and sub-aggregates.

H3-07	H3-1003	H3-1210	H3-1510	H3-1514	H3-17	H3-20	H3-2203
H3-08	H3-1005	H3-1507	H3-1511	H3-1515	H3-1701	H3-22	H3-2205
H3-10	H3-12	H3-1508	H3-1512	H3-1517	H3-19	H3-2201	H3-23
H3-1001	H3-1205	H3-1509	H3-1513	H3-1518	H3-1901	H3-2202	H3-2309

Note: a description of the codes is included in Appendix C.

The selection does not include husbanded animal production. The analysis was not conducted for the two-digit commodity aggregate H3-15 because of the inability to exclude re-exports from the study. This group consists of both animal husbandry and plant production.

The data for agricultural land, employment in agriculture (labour), and consumption of fixed capital for agriculture, forestry, and fishing (capital) in agriculture were obtained from the FAOSTAT database. Initial monetary values, given in current prices, were recalculated using corresponding price indices (real price-adjusted indices of agricultural products, output, annual data, 2010 = 100) to use monetary values in constant 2010 prices for all further analysis. Price indices for each country were taken from Eurostat.

Based on the gathered data, several new variables were created to recalculate volumes of Crop exports per a corresponding unit of the main production factors in individual countries (due to a substantial difference in the extent to which the countries were selected for analysis possess production factors). The following Table 2 includes a summary of the newly created variables.

All the data available and derived this way, along with constructed variables, were compared and balanced to avoid a lack of observations and represent the same period for each country. Hungary and Italy were excluded from the analysis, since price indices from 2005/2007 to 2010 were unavailable for these countries.

The descriptive statistics of the created variables are displayed in Table 3. Land has the highest standard deviation. The most extensive standard deviation between the calculated variables of productivity analysis per production unit is for crop exports per person employed. The standard deviation of the other variables (crop exports per ha, and crop exports per 1 USD of fixed capital consumption) is around five.

Table 2. Summary of created variables.

Variable	Label	Units of Measurement
crop exports	cEx	bln. USD, constant 2010 prices
agricultural land	land	1000 ha
employment in agriculture	labour	1000 persons
consumption of fixed capital (agriculture, forestry, and fishing)	capital	mln. USD, constant 2010=100 prices
crop exports per ha	cEx.p.ha	1000 USD/ha, constant 2010=100 prices
crop exports per person empl.	cEx.p.worker	1000 USD/worker, constant 2010=100 prices
crop exports per $1 USD of fixed capital consumption	cEx.p.capital	USD/USD, constant 2010=100 prices

Table 3. Descriptive statistics of productivity variables.

Variable	Obs	Mean	Std. Dev.	Min	Max
land	135	8313.63	9173.162	1314.512	29,390.4
labour	135	457.338	592.779	42.989	2452.089
capital	135	4718.78	4879.544	408.88	15,674.72
cEx	130	12.477	11.166	0.662	39.072
cEx.p.ha	130	4.212	6.127	0.222	21.245
cEx.p.worker	130	74.024	102.15	1.442	436.009
cEx.p.capital	130	4.228	4.837	0.902	21.342

3.3. Methodology Used in the Study

The analysis has two levels: to analyse the position of individual European countries within the group of other EU countries selected for the analysis and the relationships between commodity aggregates. We have chosen different approaches for the study.

The analysis is based on several consecutive steps. The first part of the analysis focuses on the position of individual countries compared with other chosen countries regarding their trade competitiveness.

To address the issue of the sources of competitiveness in the European agricultural market, we used different indices of comparative advantage and specialization. The analysis identifies the significant commodity groups important for foreign trade. The first indicator used is the Balassa index [61,62], calculated according to Laursen [63], called the RCA index. This index is suitable for defining the level of export specialization. We use data on the mutual trade between the selected countries only. X_{ij} represents the export of a country i for a commodity j. The Balassa index is a relative index that identifies whether this country has a comparative advantage for a given commodity (RCA > 1) or does not (RCA < 1). If RCA = 1, the trade share of a given commodity would correspond to the average group values. The RCA index describes the bilateral relationship between the countries and commodity aggregates.

$$RCA_{ij}^{1} = \frac{x_{ij}}{\sum_i x_{ij}} \Big/ \frac{\sum_j x_{ij}}{\sum_i \sum_j x_{ij}} \quad (1)$$

The Grubel–Lloyd index [64,65] is used to calculate the ratio of intra/industry trade to total trade, where X_i is exports, M_i is imports, and i stands for a particular country. Its value ranges <0.1>. If in the selected sector a particular country only exports or only imports, the value of the index will be equal to 0 and will indicate the absence of intra-industry trade. Conversely, if both exports and imports occur within a given sector, the value will be close to one. However, the GLI problem is the level of production aggregation used. Therefore, it is necessary to use the same level of aggregation for all countries studied [66].

$$GLI = \frac{(X_i + M_i) - (X_i - M_i)}{X_i + M_i} \quad (2)$$

Another indicator used to evaluate mutual trade is the Lafay index [67–69]. The Lafay index seeks to reveal a commodity aggregate's comparative advantage or disadvantage. It takes the values $<-\infty, \infty>$. If LFI > 0, it can be said that a given country has a comparative advantage for a given commodity compared to its competitors exporting the same products. As the Lafay index considers both imports and exports, it is more appropriate for evaluating countries that conduct intra-industry trade [70].

$$LFI = C * \left[(X_{di} - M_{di}) - (X_d - M_d) * \left(\frac{X_{dj} + M_{di}}{X_d + M_d} \right) \right] \quad (3)$$

where the constant $C = \frac{1000}{X_d + M_d}$, d means country, i commodity group, X exports, and M imports.

Based on the performed analyses of trade competitiveness (LFI and RCA), two-digit commodity groups (according to UN COMTRADE) are divided into four primary groups [71,72]. The first group includes commodity aggregates that achieve comparative advantages and, at the same time, are competitive within the framework of common foreign trade. These commodity aggregates gain a general comparative advantage. The commodity aggregates are included in the upper right quadrant (Scheme 1). The second group comprises commodity aggregates without a general comparative advantage but competitive one. These groups are involved in the lower right quadrant.

RCA	IV.	RCA > 1 LFI < 0	I.	RCA > 1 LFI > 0
	III.	RCA < 1 LFI < 0	II.	RCA < 1 LFI > 0
		LFI		

Scheme 1. Division of quadrants Source: [71,72].

These commodity groups do not generally have a comparative advantage but can achieve it at the bilateral level. In the lower-left quadrant, the third group comprises commodity aggregates that do not achieve a comparative advantage for a given product or are not competitive. In the upper left corner, the last quadrant includes commodity aggregates with a comparative advantage, but it is impossible to discuss competitiveness. These commodity groups generally achieve a comparative advantage but not over-selected partners.

By comparing the years 2005 and 2019, we will capture fundamental changes in the comparative advantages of the monitored countries at the general (EU-28) and bilateral levels.

In the second step, we focus on the different positions of countries regarding their productivity indicators. We use cluster analyses to determine the similarity of the analysed countries in individual commodity aggregations. The aim is to create a group of countries whose degree of similarity will be higher than that of other groups.

Explanatory cluster analysis allows the use of natural clustering principles, based on similar models of behaviour or individual characteristics [73], to sort and allocate observations to groups [74]. Hierarchical cluster analysis will be applied to determine the most appropriate number of clusters. The Ward method (also called the square increment method) will be used for the agglomeration methods. This method is based on distances inside and outside clusters [75], aiming to minimize cluster heterogeneity. The data entering cluster analysis can be divided into productivity and competitiveness data. Productivity data were used on a logarithmic scale to avoid distortion due to differences in measures. Correlation analysis is applied before the cluster analysis to identify the magnitudes of correlation between variables to prevent distortion of our results [76]. A pairwise comparison was used to determine similar countries based on the cluster analysis results. Using cluster analysis, we identify countries (or groups of countries) with similar sources of competitiveness.

For the final evaluation of the positions of individual countries, we use the principle of ranked-choice selection [77,78]. The RCA index calculated for 2005 and 2019 for each commodity aggregate and country is used. As the RCA index can only take on positive values, this feature compares individual countries within commodity aggregates according to the RCA value. Subsequently, we assign the respective countries an order, where the highest RCA value is equal to the first place and the second-highest value to the second, and the country with the lowest value is in the last position. We compiled the order of individual commodity aggregations according to the RCA index for 2005 and 2019. This procedure is done for each commodity aggregate.

Subsequently, a non-parametric test [79] tests for possible changes between the two monitored years, 2005 and 2019. The significance level is 0.05. Based on the calculated test statistics, the null hypothesis may be rejected.

Table 4 provides an overview of the research questions, indicators, data, and methods described in the previous section.

Table 4. Summary of the methods and data used.

Research Question	Data	Indicators	Methods
What are the sources of export measures competitiveness?	Comtrade data (two-digit)	trade measures—RCA, LFI	division of quadrants
Do European countries have similar sources of competitiveness?	FAOSTAT Comtrade data (whole sample)	strategic management measures—cEx.p.ha, cEx.p.worker, cEx.p.capital trade measures—RCA, LFI, GLI,	cluster analysis
Has there been any change in the trade competitiveness of individual countries in the period 2005–2019?	Comtrade data (whole sample)	trade measure—RCA	ranked-choice selection, non-parametric test

4. Results

The position of the countries within the European crop trade is summarized in Appendix D. The share of the countries is rather heterogeneous. According to the commodity structure, the commodity aggregates H3-22 and H3-19 play a crucial role, while the group H3-12 and subgroup H3-1001 are less significant. Countries like the Czech Republic equally distributed the group's exports; Austria realized 63% of exports through just four commodity aggregates in 2005. In 2019 the situation was less pronounced.

The share of the new member states on the export of these commodity aggregates was much lower than the original EU member states in 2005.

4.1. What Are the Sources of Export Measures Competitiveness?

The crucial question related to this part of the paper is determining the natural sources of trade competitiveness. Is it a bilateral comparative advantage or competitiveness on a general (EU-28) level? Two indicators can give us an insight into this question–the RCA and LFI indices. The first step of our analysis is to classify countries according to their level of trade competitiveness (regarding RCA and LFI). A graphical illustration of the relationship between RCA and LFI for commodity aggregates is displayed in Figure 1. The results significantly differ if the focus is solely on the two-digit code or the whole sample of the commodity aggregates.

Based on the RCA and LFI, the countries are classified into four quadrants regarding their competitiveness. The highest number of commodity aggregates were in quadrants I and III in 2005 (Table 5). At the beginning of the period, all the countries had three or four commodity aggregates in the first quadrant, except Austria (just one commodity aggregate). Commodity aggregations H3-17 and H3-12 had a comparative advantage for more than half of the countries at the general and bilateral levels.

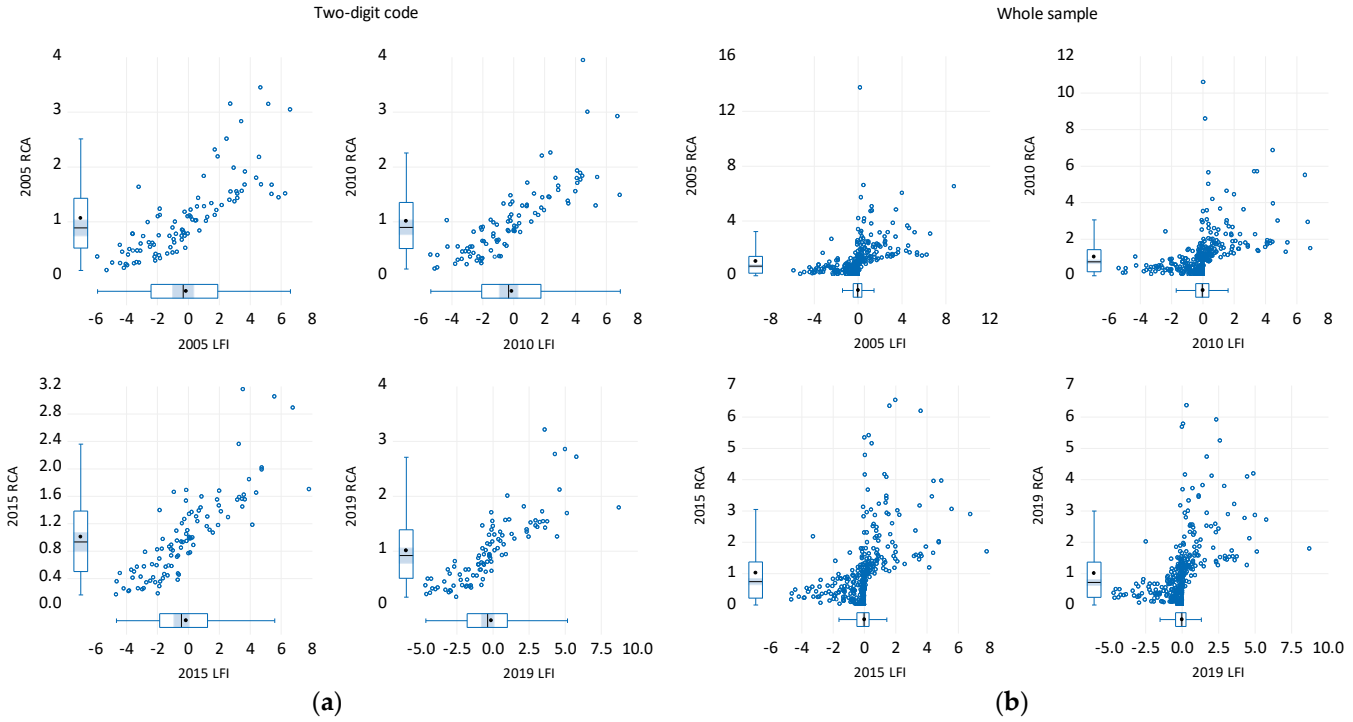

Figure 1. Comparison of the combination of the LFI and RCA of the two-digit code and whole sample. (**a**) Two-digit code; (**b**) Whole sample.

Table 5. Distribution of countries according to their LFI and RCA (2005).

2005	I	II	III	IV
H3-23	BE DE DK NL		AT CZ FR PL SK	
H3-22	AT FR		BE CZ DE DK NL PL SK	
H3-20	BE NL PL		CZ DK FR SK	AT DE
H3-19	BE DE DK PL			AT CZ FR NL SK
H3-17	CZ DE DK FR PL SK		NL	AT BE
H3-12	CZ DK FR NL SK		AT BE DE PL	
H3-10	CZ DE FR SK	AT	BE DK NL PL	
H3-08	BE NL		AT CZ DE DK FR SK	PL
H3-07	BE NL PL		AT CZ DE DK FR SK	

The lowest distribution is in the second quadrant, including countries with positive LFI and RCA lower than 1. These countries do not have a comparative advantage; however, they might be competitive on the bilateral level. This group has similar frequencies as in the case of analyses carried out on a group of post-Soviet countries [71]. Interestingly, in the case of the second quadrant, it is just the commodity aggregate H3-10 that is located in this group for both years (Tables 5 and 6).

Commodities situated in the third quadrant neither have a comparative advantage nor are competitive. Therefore, an increase in this group might signal problems for countries and given commodity groups, especially if these commodities are crucial for their foreign agricultural trade. In the case of more than half of the countries, the H3-22, H3-08, and H3-07 commodity aggregations occur most frequently in this quadrant.

Commodity aggregates in the last quadrant do not have a comparative advantage on the bilateral level. However, these countries may have a growing share of the markets of their trading partners in connection with their specialization and market realization, which we consider a source of competitive advantage. In 2005, H3-19 commodity aggregation occurred most frequently in this quadrant.

Table 6. Distribution of countries according to their LFI and RCA (2019).

2019	I	II	III	IV
H3-23	AT BE DE NL		FR SK	PL CZ DK
H3-22	AT FR		BE CZ DE NL PL SK	DK
H3-20	BE DE NL PL		AT CZ DK FR SK	
H3-19	BE DE PL		DK FR NL SK	AT CZ
H3-17	BE CZ DE FR PL SK		AT NL	DK
H3-12	CZ DK FR NL SK		AT BE DE PL	
H3-10	CZ FR SK	DK PL	AT BE DE NL	
H3-08	NL		AT BE CZ DE DK FR PL SK	
H3-07	NL		AT CZ DE DK FR SK	PL BE

Based on Tables 5 and 6, differences in trade competitiveness indicators can be identified and changes between the monitored years. It is evident that those countries located in the first quadrant had a bilateral comparative advantage and were also competitive. Austria improved its position in the first quadrant between 2005 and 2019. The rest of the countries remained in the same position (CZ, DE, FR, NL, SK) or even lost their bilateral comparative advantage and competitiveness on a general level (BE, DK, PL). Whereas in 2005, Denmark had four commodity aggregates located in the first quadrant, in 2019, this number was just one. Two of these commodity aggregates (H3-23 and H3-17) lost their comparative advantage on the bilateral level, and H3-19 lost both a bilateral and general comparative advantage. Group H3-17, in particular, including Sugar and sugar confectionery, was significant for Denmark. In the best position was the Netherlands, with five commodities located in the first quadrant in 2019.

The commodity aggregate H3-17 (sugar and sugar confectionery) has the highest number of countries that were both competitive and had a comparative advantage in 2005. This group is followed by H3-12 (oil seeds and oleaginous fruits), including six countries. It is rather interesting that the Netherlands was the only country with a comparative advantage in the case of the commodity aggregate H3-07 (vegetables) and H3-08 (Fruit) in 2019.

The third quadrant is the most occupied one, and the number increased during the period, up to 41 in 2019. Whereas in 2005, three countries (CZ, DK, SK) had five commodity aggregates in this group, in 2019, there were already two countries (AT, SK) with six commodity aggregates. Since these countries did not have a comparative advantage at a general or bilateral level, it is impossible to identify their sources.

4.2. Do European Countries Have Similar Sources of Competitiveness?

The second part of the paper focuses on the sources of competitiveness. The analysis focuses on 32 commodity aggregates or sub-aggregates. The original idea was to apply cluster analysis to all the newly created variables described in the data description section, plus trade competitiveness indicators. Two groups of variables were analysed. The first group included three variables representing the productivity indicators (related to strategic management measures): crop exports per ha (cEx.p.ha), crop exports per person employed (cEx.p.worker), and crop exports per USD 1 of fixed capital consumption (cEx.p.capital). The second group of variables represents the competitiveness of foreign trade: GLI, LFI, and RCA. However, we identify a strong correlation between some of them; therefore, we must omit some of these variables.

4.2.1. Strategic Management Measures: Productivity Measures

While exports of crops/workers grew during the whole monitored period, the crop exports per one hectare did not have such an evident development, as seen in Appendix E. Stagnation is apparent in the case of France or even Belgium. A clear growth pattern can be seen in the case of Poland, Austria, the Czech Republic, and Denmark. Consumption of

fixed capital was the last productivity measure applied to the analysis. This indicator grew visibly during the whole monitored period in the case of Poland, Austria, and Denmark. France, Belgium, and lately even the Netherlands demonstrated a declining value for this indicator.

While Czechia, Poland, and Slovakia achieve higher year-on-year growth rates in Crop exports per factor of production, France has the lowest growth rate. The most significant negative year-on-year decline in growth rates in exports per unit of core productive factors (at the level of the analysed countries) was in 2015. This year, the sanction regime with Russia (due to the Crimea annexation) began. Trade sanctions significantly harmed productivity measures in almost all studied countries (see Annex E).

4.2.2. Trade Measures

Three indicators of trade competitiveness were used to evaluate the position of the countries, including the RCA, LFI, and GLI indices. Each country in our selection had commodity aggregates that were more or less competitive during the monitored period. The majority of the indicators fluctuated significantly during the whole period. A detailed analysis of the RCA index indicates that the minimum number was approaching zero in many cases. The maximum is 13.72 for H3-1210 (Hop cones) from 2005; however, this is extreme.

The commodity aggregates H3-1210 (Hop cones) dominated, with the highest RCA value for most years. The top country was, in most cases, the Czech Republic or Poland. The second commodity aggregate with a very high RCA is H3-1508 (Groundnut oil) in the case of Belgium. These two commodity groups and countries interchanged their positions during the monitored years. However, it is interesting that the commodity group H3-1508 had the lowest RCA index in the Czech Republic.

The standard deviation of the LFI is also decreasing, and the index of determination for the whole sample is 0.82. At the beginning of the monitored period, Austria had the highest LFI, with the group H3-2202 (Water) and its parent group H3-22 (Beverages, spirits, and vinegar). In the end, the situation changed, and Slovakia, with the group H3-10 (Cereals), achieved the highest LFI during the years 2014–2019.

The Grubell Lloyd index was higher in the latest monitored year, 2019. The median value of the GLI increased slightly, from 0.56 in 2005 to 0.62 in 2019. The standard deviation fluctuates over the year, with an overall slightly decreasing trend.

4.2.3. Analysis of the Competitiveness of the Commodity Aggregations of the Monitored Countries Concerning Production Indicators

This part of the paper focuses on the different commodity aggregates while considering the analysed indicators. Nine commodity aggregates belong to the two-digit classification and 23 to the four-digit category. The last step is to apply cluster analysis to all commodity aggregates. Based on the cluster analysis results, countries were divided into groups according to their similarity in the abovementioned indicators. However, omitting the Lafay index (LFI) and Crop exports per ha (cEx.p.ha) was necessary due to the high correlation between the variables. Therefore, just four variables enter the cluster analysis (crop exports per person employed, Crop exports per USD 1 of fixed capital consumption, RCA, and GLI). For a description of the various groups, we also use the characteristics of the omitted variables. The analysis identified the commonalities and differences between the countries and commodities during the monitored years.

Using cluster analysis, we can define the position of the countries within the commodity aggregates concerning their productivity and trade indicators. The most heterogeneous commodity aggregates were: H3-22 (beverages, spirits, and vinegar) in 2005 and H3-1518 (animal or vegetable fats, oils, fractions) in 2010. In 2015, there were H3-2205 (vermouth and other wines from fresh grapes) and H3-12 (oil seeds and oleaginous fruits). The latest monitored period also brought the most considerable fragmentation. The commodity aggregate H3-19 (preparation of cereals, flour, starch, or milk) is so fragmented that only

Austria + the Czech Republic and Denmark + France create two groups. The remaining countries are so dissimilar that they cannot be combined. The following section describes the essential commodity aggregates.

The first analysed commodity aggregation was H3-07 (edible vegetables and certain roots and tubers) (Appendix F). The structure of the groups remained highly similar over the monitored years, except for the year 2005. The standard deviation and mean of RCA both decreased. Concerning the year 2019, the first group had a low level of RCA and a negative LFI. The average GLI is 0.3. This group also had lower productivity indicators than Belgium (group 3) and the Netherlands (group 4). It can be said that Belgium had the highest level of capital productivity. The second group with higher RCA, negative LFI, and GLI over 0,9 consists of Denmark and Poland.

Commodity aggregate H3-08 included edible fruit and nuts; peel of citrus fruit or melons. Its standard deviation of LFI was very high for all monitored years (1.95–3.15). However, Belgium and the Netherlands had a very high LFI but different trends (Figure 2). Whereas Belgium's LFI decreased over the monitored years, the situation in the Netherlands was the opposite. There was a similar situation concerning RCA. While the RCA fell for Belgium, it increased for the Netherlands. Belgium lost its comparative advantage in edible fruit and nuts, and the Netherlands gained an additional comparative advantage. The Netherlands had an RCA greater than one from the whole group of countries and a positive LFI during the monitored last year.

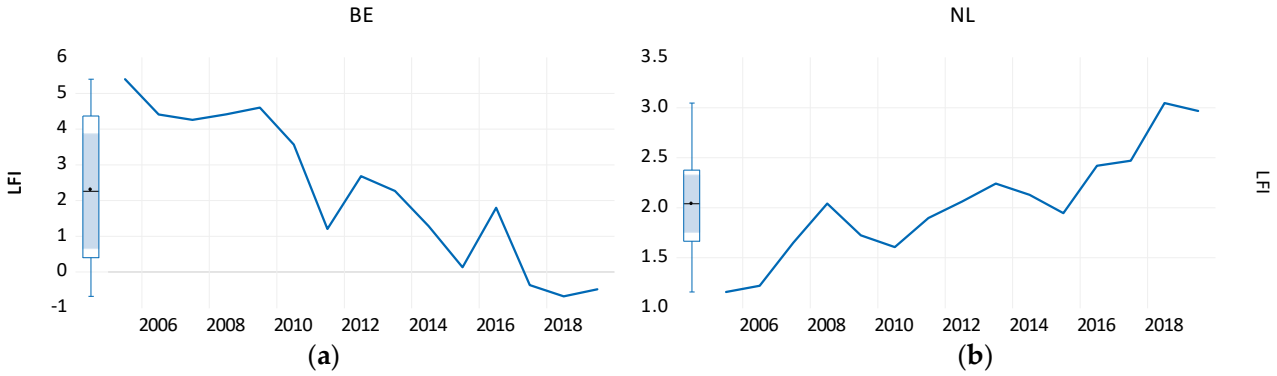

Figure 2. The evolution of LFI. (**a**) LFI—Belgium, (**b**) LFI—The Netherlands.

As is evident, the composition of the groups is relatively diversified. The only two countries remained in the same group for all the monitored years were Czechia and Slovakia.

The commodity aggregate H3-10 (Cereals) included three or four groups of countries; however, the composition of the groups varied during the monitored years (Table 7). The Netherlands and Belgium were always in a separate group. A high level of productivity, and a low RCA index, influenced their position. The Czech Republic and France were very similar; therefore, their situation was somewhat analogous. Both countries achieved a very high level of RCA, as well as of LFI. However, slight differences appear according to productivity measures. In addition, their GLI is relatively low. Therefore, France and Czechia were always in the same group. The position of Austria and Poland was also very similar.

Table 7. H3-10 Cereals.

Year	Group	1	2	3	4
2005 *	H3-10	AT DK PL	CZ FR SK	BE NL	
2010	H3-10	AT PL DE	CZ FR	DK SK	BE NL
2015	H3-10	CZ FR SK	DE DK AT PL	BE NL	
2019	H3-10	AT DK DE PL	CZ SK FR	BE NL	

* Data for Germany are not available.

A detailed analysis of the four-digit code brought slightly similar results in the case of H3-1001 (Wheat and meslin) (Table 8). The RCA and GLI standard deviations increased during the monitored years and countries. The GLI standard deviation rose just in the last year.

Table 8. H3-1001 Wheat and meslin.

Year	Group	1	2	3	4
2005 *	H3-1001	CZ FR	DK PL	AT SK	BE NL
2010	H3-1001	AT PL DE	FR SK CZ DK	BE NL	
2015	H3-1001	AT DE	CZ SK	DK PL FR	BE NL
2019	H3-1001	AT PL DE DK	CZ FR SK	BE NL	

* Data for Germany are not available.

For 2019, countries were divided into three groups. The first group was characterised by the highest level of GLI, a low, positive LFI, and the lowest value of crop exports per $1 of fixed capital consumption. The second group had the lowest level of GLI and the highest level of RCA, while crop exports per person employed and crop exports per hectare are the lowest. The last group consisted of Belgium and the Netherlands. These countries have a negative LFI and a very low RCA; however, their productivity measures were very high.

Commodity group H3-12 includes oil seeds and oleaginous fruits. This commodity group was rather heterogeneous, especially in 2015. For 2019, four groups were formed. The first group had a negative LFI, an RCA above one, and a GLI approaching 1. Crop exports per $1 of fixed capital consumption re higher than others (except BE and NL). The second group consists of Denmark, France, and Slovakia. These countries had the highest LFI and RCA, and their GLI was slightly above 0.5. Crop exports per hectare were the lowest of all monitored groups. Germany's LFI was very low and negative, and the GLI is 0.45.

Commodity aggregate H3-1514 included rape, colza, or mustard oil and their fractions. Austria and France had the lowest RCA during all the monitored years. In more than half of the period, Belgium and the Netherlands also witnessed a low level of RCA. Comparably, the Czech Republic had the highest RCA for 2005–2019.

The situation was similar for LFI. At the same time, Belgium was among the countries with a very high GLI, meaning that intra-industry flows were more common than were inter-industry ones for Belgium's trade. The group structure was somewhat unstable and changes over the monitored years (Table 9).

Table 9. H3-1514 Rape, colza, or mustard oil and their fractions.

Year	Group	1	2	3	4
2005 *	H3-1514	AT FR DK SK	NL	CZ PL	BE
2010	H3-1514	DE FR DK NL	AT SK	BE	CZ PL
2015	H3-1514	DK FR SK	AT NL	BE	CZ DE PL
2019	H3-1514	FR PL AT	DE DK SK CZ	BE NL	

* Data for Germany are not available.

The commodity aggregate H3-17 (sugar and sugar confectionery) had one of the highest ranges of LFI and RCA over the monitored years. Slovakia's highly elevated LFI (average 3.76) and RCA (average 3.21) influence this. Compared to this, Slovakia's GLI was the lowest during nearly the whole monitored period. Except for Austria and the Netherlands, the LFI was positive, and the RCA was higher than one. The group structure was quite diversified, with the unique position of Slovakia and Belgium.

Sub-aggregation H3-1701 included cane or beet sugar and chemically pure sucrose. The group's structure changed significantly over the monitored years (Table 10). Compared to the parent group, no country had a significantly higher or lower LFI value for the analysed period. Slovakia had a higher LFI initially; however, its level gradually deteriorated.

The majority of the countries had a positive LFI and a relatively high RCA, except for the Netherlands.

Table 10. H3-1701 Cane or beet sugar and chemically pure sucrose.

Year	Group	1	2	3	4
2005 *	H3-1701	AT DK NL	BE	FR PL	CZ SK
2010	H3-1701	DE DK CZ PL	AT NL	FR SK	BE
2015	H3-1701	DE DK CZ AT	BE NL	PL SK FR	
2019	H3-1701	DE PL SK	CZ FR	AT DK NL	BE

* Data for Germany are not available.

In the case of the Czech Republic, the commodity aggregate H3-22 (beverages, spirits, and vinegar) is also essential. The range for the LFI was very high. Austria achieved the highest LFI (average 4.38) for this commodity aggregate for the whole monitored period. However, France had the highest comparative advantage, with an average RCA of 1.41. On the other hand, France had the lowest GLI for most of the years, meaning that inter-industry trade flows within H3-22 were more common than intra-industry for France. The diversity of the groups was also very high. In 2019, the first group of countries (AT, FR) had a high positive LFI and a low RCA. In addition, the GLI was the lowest, together with Crop exports per USD 1 of fixed capital consumption. The last group (BE, NL) had the lowest LFI and a lower RCA; however, the productivity measures were the highest.

The next sub-aggregation was H3-2203 (beer made from malt). The RCA and LFI vary significantly during the whole monitored period. The diversity of the countries was very high.. France and Slovakia have a negative LFI during the monitored period, and their RCA was also very low. Denmark and Czechia approached the highest LFI, as well as RCA. Belgium and Germany also achieved a comparative advantage. Czechia (0.21) and Slovakia (0.26) had the lowest GLI, compared to Austria (0.96).

The last commodity aggregation we analysed was H3-23 (food industries, residues, and wastes thereof). The most significant differences were found between the first monitored year and 2010, when the group's structure changed significantly. After that, just Denmark and the Netherlands changed their positions. The LFI index had a very high range during the first year. In addition, the mean of LFI was negative for this year. All the new member states (CZ, PL, SK) had a negative LFI.

The situation between the countries differed significantly for most commodity aggregates. The positions of individual countries, if measured using the productivity indicators and competitiveness indices, changed during the monitored years.

The division mentioned above enabled a comparison of individual countries. We can summarize the relationship between the countries in the selected years (Scheme 2). The numbers on the diagonal indicate the number of commodity aggregations when a given country is so different concerning sources of competitiveness that it is included in a separate group. The numbers indicate how often these countries fit into the same group (in the cluster analysis) for the whole sample of commodity aggregates. The total amount may vary from year to year.

The first analysis was done for the year 2005. The most diverse situation in terms of the variety of outcomes was Belgium. The results show that in 29 cases, Belgium did not fit into any other group; just twice, the indicators were similar to the Netherlands and therefore fit into the same group. Therefore, we consider Belgium as the country most different from the rest. The very high level of capital productivity in Belgium influenced this dissimilarity.

There was also a very high disparity between the Czech Republic and the Netherlands. These two countries fit into the same group in less than 10% of cases. The situation was also similar in the case of Slovakia and the Netherlands (only three commodity aggregates within the same group). Poland and France had just five commodity aggregates in the same group.

2005	AT	BE	CZ	DK	FR	NL	PL	SK
AT	2							
BE		29						
CZ	10		2					
DK	11		8					
FR	9		10	10	2			
NL	11	2	6	14	8	2		
PL	11		15	10	5	10	4	
SK	14		20	13	15	3	9	1

**data for Germany are not available*

2010	AT	BE	CZ	DE	DK	FR	NL	PL	SK
AT	2								
BE		26							
CZ	12		1						
DE	14		10						
DK	4		8	17					
FR	9		15	7	7				
NL	6	5	3	9	11	10			
PL	9		13	14	10	7	5	4	
SK	10		15	6	6	9	3	10	5

2015	AT	BE	CZ	DE	DK	FR	NL	PL	SK
AT	1								
BE		20							
CZ	16		2						
DE	19		12	3					
DK	14	1	12	11	2				
FR	18		17	11	11	3			
NL	3	12	1	3	2	3	9		
PL	10	1	8	8	11	6	4	3	
SK	9		15	6	11	12	2	8	7

2019	AT	BE	CZ	DE	DK	FR	NL	PL	SK
AT	1								
BE		14							
CZ	14	1							
DE	13	1	14	2					
DK	11	1	12	10	1				
FR	9		13	10	13	2			
NL	2	18	3	3	3		8		
PL	15		9	10	14	7		5	
SK	8		14	10	12	17	1	9	4

Scheme 2. Comparison of similarities between countries (2005, 2010, 2015, 2019). Note: The numbers on the diagonal indicate the number of commodity aggregations when a given country is so different concerning sources of competitiveness that it is included in a separate group.

On the other hand, we found strong similarities between the Czech Republic and Slovakia. These two countries fit into the same group for 20 commodity aggregates. Compared with other countries, the similarity was greater than 25%. A substantial similarity can also be seen between the Czech Republic and Poland, with 15 commodity aggregates in the same group, which means more than 20% similarity. Additionally, Denmark and the Netherlands were quite similar, with 14 commodity aggregates in the same groups, as were France and Slovakia, with 15 commodity aggregates. We can also state that the Netherlands had similarities with all other countries. We could not include Germany in our analysis due to the missing data for that year.

In 2010, Germany was included in our analysis. The position of Belgium had slightly changed. The similarity between Belgium and the Netherlands had increased, up to 16%. However, there remained a dissimilarity with the rest of the countries. Germany and Denmark had a substantial similarity, around one-quarter of all monitored commodity aggregations. Germany and Austria were also quite similar. From the perspective of the new EU countries, there remains a substantial similarity between the Czech and Slovak Republics and between the Czech Republic and Poland. Cross-similarities above 20 % between old and new member states could be found between the Czech Republic and France and also Germany and Poland. There is a relatively high similarity among the countries, except for Belgium.

In 2015, the similarity between Belgium and the Netherlands increased to 35%. It can be seen that, compared to the first year of the analysis, the position of these two countries was becoming more similar. The productivity indicators could have influenced this, and also, a possible consequence of the Rotterdam-Antwerp effect could not be omitted [80]. The increasing number of cases have to be mentioned when the Netherlands did not fit into any other group. Therefore, its position, as well as Belgium's, was becoming unique.

Austria was more similar to the Czech Republic, Germany, and France. There was also a similarity between Czechia and France, and Slovakia. Poland's situation changed compared to the previous year. Therefore, Poland was more similar to other countries than in previous years regarding its sources of competitiveness. By comparing the old and new member states, we could conclude that the Czech Republic was more similar to Austria or France in this year. In the case of Slovakia, an equal similarity distribution existed (except for Belgium and the Netherlands). A comparable situation existed in the cases of Poland and Germany.

The latest available data were for 2019; therefore, this is the latest year of the analysis. The convergence process between Belgium and the Netherlands continued. A divergence between the Netherlands and the rest of the countries was also visible. There is a stable connection between the Czech Republic and Austria, France, and Slovakia. Poland had a substantial similarity with Austria and Denmark. The similarity between France and Slovakia also increased.

Significant differences can be seen between the monitored countries based on the performed analysis. Therefore, the countries under review had different sources of competitiveness. Whereas in the case of Belgium and the Netherlands, labour and capital factors had a significant influence on production, in the case of the new member states, these factors are less significant and, conversely, market competitiveness factors are more crucial.

4.3. Were There Any Changes in the Trade Competitiveness of Individual Countries in the Period 2005–2019?

Based on the analyses performed in the previous sections, this part focuses on evaluating the position of the monitored countries and their changes over time. The first step was to analyse the change in the share of the monitored countries on the total trade in the crop products of the EU-28 countries. As is evident from Figure 3, the positions of France and Belgium worsened, while the positions of the Netherlands and Poland improved.

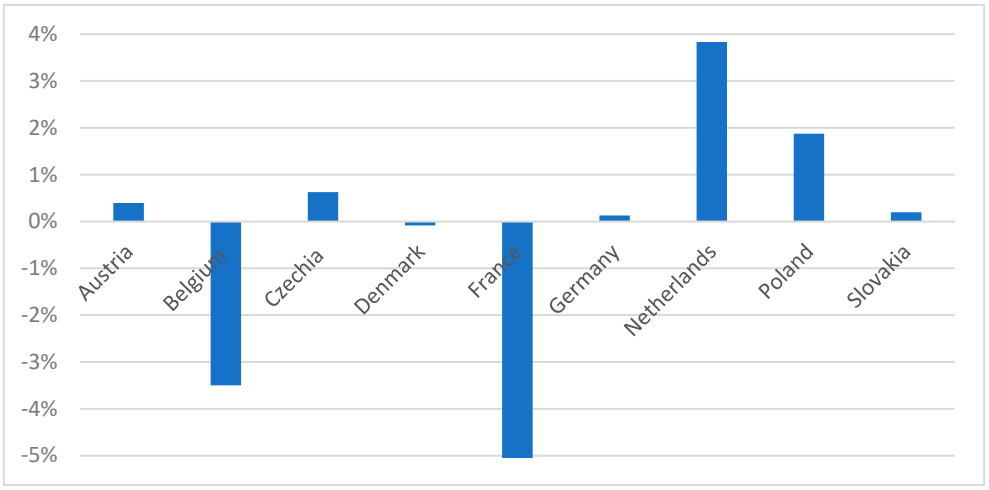

Figure 3. The country's share of intra-trade in the crop commodities of all EU-28 countries: change from 2005–2019.

The most noticeable negative change was recorded in the cases of H3-17 and H3-1701. This decline was due to a change in the sugar regime in the first decade of the 21st century. A significant decrease also occurred in the case of H3-08, where the most significant decrease was recorded in Belgium, followed by Poland and Slovakia. Contrarily, the commodity aggregations H3-19 and H3-23 strengthened the most.

The next step was to analyse the difference in the country's share of individual commodity aggregations in total agri-food exports between 2019 and 2005. It is interesting to note the shift between Belgium and the Netherlands. The first-mentioned country was one of the countries with the most significant decline in individual commodity aggregates

(together with France) and, conversely, the Netherlands recorded the most significant increases. All new member states recorded an increase, although it was low in the case of Slovakia.

The changes in export between 2005 and 2019 are displayed in Figure 4. It is evident that while Denmark and Slovakia changed their share of commodity aggregation on the individual countries' exports, in the case of France, there was a change in the share of the country on the commodity aggregation exports at the level of the EU market. An analogous situation occurred in the case of the Netherlands.

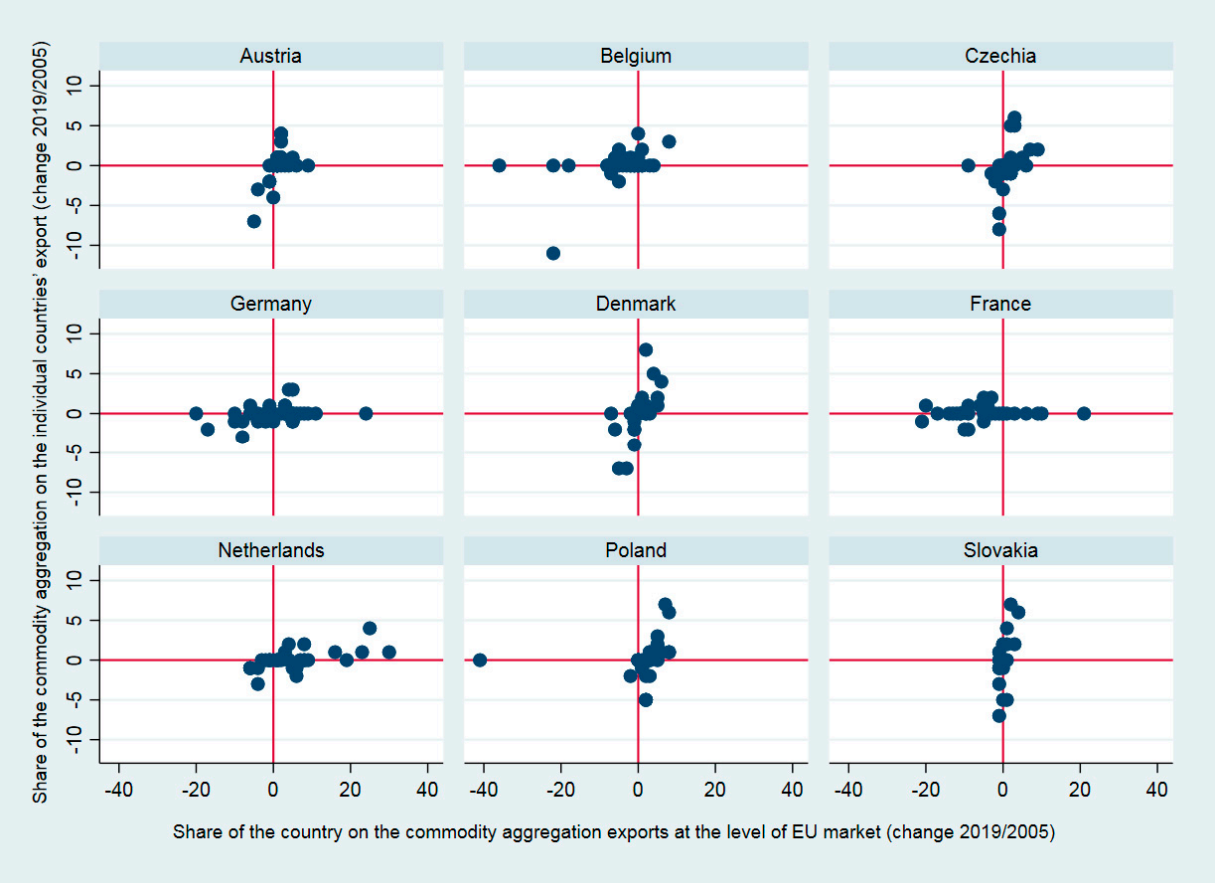

Figure 4. Change in the position of the monitored countries.

Appendix G shows the share of the order of individual commodity aggregations in 2005 and 2019. Slovakia had the highest share of comparative advantages in 2005 and 2019. At the same time, however, Slovakia also ended up in the worst position, with the highest proportion of cases. The improvement position was evident in the case of the Netherlands.

The last step was to assess whether or not the position of the monitored countries differed significantly concerning their trade competitiveness. It was expected that there would be a higher degree of correlation between the monitored variables in the case of repeated measurements. This assumption was confirmed. At the same time, it was clear that the correlation coefficient differed between the monitored countries. Whereas in the case of France, the Netherlands, Slovakia, and Belgium, it was around 0.8, in the cases of Poland and Denmark, it was significantly lower. The highest standard deviation was seen for Poland, Austria, and Denmark. The confidence interval did not include zero in the case of any country pair.

Interestingly, in the case of only a double-digit breakdown, the correlation coefficient's value will increase significantly in most countries. Still, in the cases of Germany, the Czech Republic, Denmark, and Poland, it would not be statistically significant at the level of 0.01, and, in the case of Germany, not even at the level of 0.1.

Figure 5 illustrates the average difference score of the RCA indices between the years 2005 and 2019. In the case of Belgium, Germany, France, the Netherlands, and Slovakia, the positions of these countries deteriorated, while Austria, Czechia, Denmark, and Poland improved their positions.

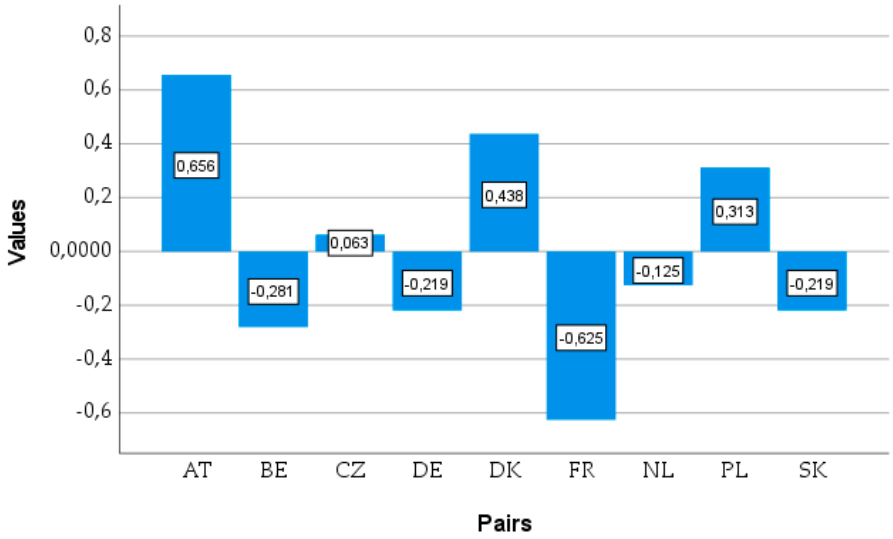

Figure 5. The average difference scores.

The null hypothesis can be rejected at the alpha (0.05) significance level in the case of France (Table 11). In the case of Austria, the null hypothesis would be rejected at a significance level of 0.1. For other countries, the null hypothesis could not be rejected. Therefore, it is clear that the changes in the structure of comparative advantage were not significant in the majority of the monitored countries between the years 2005 and 2019.

Table 11. Test statistics.

	AT_2019–AT_2005	BE_2019–BE_2005	CZ_2019–CZ_2005	DE_2019–DE_2005	DK_2019–DK_2005	FR_2019–FR_2005	NL_2019–NL_2005	PL_2019–PL_2005	SK_2019–SK_2005
Z	−1.762 [a]	−0.913 [b]	−0.209 [b]	−0.934 [b]	−0.724 [a]	−2.310 [b]	−0.530 [b]	−0.695 [a]	−0.521 [b]
asymp. sig. (two-tailed)	0.078	0.361	0.835	0.350	0.469	0.021	0.596	0.487	0.602

[a] Based on positive ranks. [b] Based on negative ranks.

As an answer to the third research question, it can be stated that there was no statistically significant difference in comparative advantage between 2005 and 2019, except for France.

5. Discussion and Conclusions

This article is part of the project dealing with the position of the Czech Republic in European agriculture. Therefore, competitiveness is a line that runs through the whole project. While livestock production was the main area in the previous stages of the evaluation [81,82], we are now supplementing the analysis with plant production.

Three fundamental research issues related to the competitiveness of crop production arose during the paper preparation. The research question was whether European countries have similar sources of competitiveness. The performed analyses showed that the crop trade structure of individual monitored countries changed during the monitored years. These changes may have occurred due to external and internal environmental changes. Productivity and efficiency are often considered standard measures of competitiveness. While productivity is defined as the factors of production to produce the desired output, competitiveness measures are often measures related to trade. The analysis showed a high similarity between the Czech and Slovak Republics. These results are consistent with Bielik et al. [9] and Simo et al. [18]. However, it is necessary to add that according to

Bielik et al. [9], in most commodity aggregations, the Czech Republic gained comparative advantages over Slovak agricultural production. This finding is also consistent with the results of the first research question on sources of export measures competitiveness. However, there was a partial change in the last reporting period. Ignjatijevic et al. [83] focused on individual commodity aggregations and, in the case of Czechia and Slovakia, did not demonstrate a competitive advantage for agricultural commodities. Therefore, it is clear that there is a similarity between the monitored countries, even in this case. However, the findings show that these were very similar countries a year after joining the EU, so in the following periods, this similarity decreased. In the last year, 2019, there was a higher similarity between Slovakia and France than between Slovakia and the Czech Republic. However, it is also important to mention that Czechia is similar to France.

Poland's position was different. Again, at the beginning of the period under review, there was a substantial similarity between Poland and the Czech Republic concerning trade measures; Poland moved closer to Austria or Denmark in the following years. Grodzicky [84] explains the difference between Slovakia, Czechia, and Poland by the size effect of the Polish economy.

The position of the Netherlands and Belgium is primarily influenced by high factor productivity and administrative measures. In the case of Belgium, Ball [85] has already pointed out the high productivity of production factors. The positions of these countries were different at the beginning of the period under review. While the position of Belgium deteriorated, the position of the Netherlands improved during the period considered. Dunmore [86] also pointed out that comparative advantage is determined by the production technique involved and prices for inputs and products. Therefore, high productivity is one of the prerequisites for the different positions of Belgium and the Netherlands.

One problem related to any analysis is the distortion caused by government intervention in agriculture. This analysis has shown that even the administrative way of reporting can significantly impact the positions of countries within regional groupings.

Kutkowska and Szuk [21] assessed competitiveness in the global cereal market given production, export, and import changes. The results showed that China, the USA, and India can be considered the largest producers of cereals; Russia and Ukraine significantly increased their share in production. The research also shows that Poland does not play a significant role; however, it has gradually improved since its accession to the European Union. The Polish position was also evident in the case of our results. However, we expected that the position of Poland would be significantly better due to the importance of agriculture in the Polish economy.

Slaboch and Kotyza [17] analysed the competitiveness of V4 countries relating to the production of the most widely cultivated oil-bearing crops in the region–oilseed rape and sunflower. The results of trade coverage evidenced high competitiveness in the production of oilseed rape through significant exports of raw and processed material to Western Europe. Unlike oilseed rape, the Czech Republic was not self-sufficient in sunflower due to decreased production and increased consumption over the last few years. The results also show that Slovakia was self-sufficient in sunflower production; its competitiveness was underlined by net exports in terms of value and volume. In the case of the commodity aggregation H3-1514 (rape, colza, or mustard oil and their fractions), the Czech Republic had a unique position. With a very high RCA, it was one of the countries with the highest comparative advantage. However, in the case of the commodity aggregation H3-12 (oil seeds and oleaginous fruits), the Czech Republic achieved comparative advantages, but at the same time, negative LFI values.

The last research question concerned changes in competitiveness between 2005 and 2019. Of all the countries monitored, only France recorded a significant change in RCA between 2005 and 2019, and thus in comparative advantage. This significant change has not been confirmed in other countries. Balogh and Jámbor [87] analysed the global competitiveness of European wine producers and referred to the declining comparative advantage of France and other European countries due to the 2008 reform.

This paper assessed the competitiveness of the plant production using the combination of trade measures and strategic management measures in the selected European countries related to the Czech Republic. This research contributed to broadening knowledge in the competition of crop production in two ways. Contrary to other research, it did not focus solely on trade competitiveness measures but combined with those used in strategic management. For this reason, it contributed to a greater understanding of the links between these different indicators. The second factor was the interconnection between old and new EU members tied to Czech agrarian exports.

One of the limitations of the present study was its focus only on the countries that constitute the Czech Republic's most important trading partners. However, Italy and Hungary were omitted from the analysis for lack of data. These countries should also have been included if had been available. Another limitation resulting from the lack of data was the deletion of Germany from the analyses carried out in 2005. For this reason, there may have been a slight bias in the results. The final limitation of the research undertaken is its focus, not considering the consequences of competitiveness. These consequences should be the following research challenge. This article is part of more comprehensive research into the position of Czech agriculture. Since the Czech Republic is part of the EU, it is always necessary to consider the common agricultural policy when making recommendations based on research results. The current European trend is to increase competitiveness, but, concerning the environment. However, as the results showed, the countries surveyed did not always focus solely on the agrarian commodities in which they were competitive. Very often, their decision-making was influenced by subsidy policy [88]. Removing the link between crop subsidies, regardless of competitiveness, should be one of the objectives for policymakers.

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

Funding: The results are part of the solution of project No. QK1920398 "Duality in Czech Agriculture: Advantage or Disadvantage for New Generation Agriculture? ", supported by the Ministry of Agriculture of the Czech Republic, program ZEMĚ.

Data Availability Statement: Data were extracted from COMTRADE database https://comtrade.un.org/Data/ and FAOSTAT database https://www.fao.org/faostat/en/#search/Gross%20Fixed%20Capital%20Formation%20Agriculture%2C%20Forestry%20and%20Fishing (accessed on 15 October 2021).

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

Appendix A

Table A1. Summary of measurement of competitiveness mentioned in the study.

Author(s), Year	Methods Used	Commodities	Region
Narayan and Bhattacharya (2019) [33]	relative export competitiveness	cotton, rice, sugar, wheat	India
Bezić et al. (2011) [35]	comparative advantage, industry trade, and export competitiveness	food manufacturing sector	Croatia
Gorton et al. (2000) [38]	reveal comparative advantage and domestic resource cost	animal husbandry	Bulgaria and the Czech Republic
Sheetal, S., Kumar, R., and Shashi, S. (2020) [39]	reveal comparative advantage and Hirschman Herfindahl index	sugar	India
Carraresi and Banterl (2015) [40]	export market share and reveal comparative advantage	agriculture and food industry	Central and Eastern European Countries

Table A1. *Cont.*

Author(s), Year	Methods Used	Commodities	Region
Bojnec and Fertő (2015) [41]	trade balance and price competition, revealed comparative advantage	agricultural products	new and old EU member states
Bojnec and Fertő (2014) [88]	revealed comparative advantage	dairy products	EU
Bojnec and Fertő (2016) [42]	revealed comparative advantage	fruit and vegetable	EU
Bojnec and Fertő (2017) [25]	revealed comparative advantage	agri-food export	Global level
Ruženková et al. (2020) [51]	multi factor indices	overall trade	OECD countries
Jaksic et al. (2020) [8]	total factor productivity	overall trade	EU new member states
Stollinger and Holzner (2015) [52]	export performance measure	overall trade	EU
Fojtíková and Staníčková (2017) [53]	DEA and factor analysis	overall trade	EU
Huo (2014) [54]	revealed comparative advantage, regression analysis, and factor analysis	agriculture	emerging markets
Huo et al. (2020) [55]	diamond model and spatial modelling, cluster analysis	agriculture	emerging markets
Buturac et al. (2018) [56]	constant market share analysis	food industry	Croatia and EU
Gilbert and Muchov (2018) [57]	constant market share analysis	overall trade	Central and Eastern Europe
Capobianco-Uriarte et al. (2021) [58]	constant market share analysis	tomato	EU

Appendix B

More- and less-detailed analyses using individual system classifications can be found in the literature. The less detailed breakdowns were used in their work by Xiadoi and Xiaozhong [89], who focused only on single-digit sorting in their analysis of Chinese foreign trade comparative advantages. Dnidchenko and Salnikov [90] summarize the one-level code into five groups, including agriculture and food products, energy resources, raw materials and supplies, consumer goods, and capital goods, to evaluate the competitiveness of Russia on foreign markets. Ignjatijevic et al. [83] combine the two-digit commodity groups into four consequent groups (agricultural products, food, primary products, and industrial products) to analyse the competitiveness of the Danube region.

Anderson [91] estimated the terms of trade effects of free trade agreements on bilateral trade volume in a two-digit code. Kudlina-Dimitrova [92] assessed the economic impact of the Russian embargo on certain agricultural products (02–meat and edible meat, 04–dairy products,, 07–edible vegetables, roots, and tubers, 08–edible fruits and nuts, 19–preparation of cereals, flour, starch, etc., 21–miscellaneous edible preparation). In the case of dairy products, edible fruits and nuts, and meat and edible meat, the impact was higher than 20%. Constinot et al. [60] used two-digit manufacturing trade flow data to measure the intra-industry trade between OECD countries. Carraresi and Banterle [40] used two-digit codes to evaluate the competitive agriculture performance of EU countries at the sector level.

Sanidas and Shin [93] used a combination of two-digit HS classifications to analyse the revealed comparative advantage of the three East Asian countries to see how the countries performed from 1995–2008. A similar combination of two- and four-digit codes was used by Leromain and Orece [59] to present a new database on the new Ricardian comparative advantage measure. However, it is essential to mention that they systematically omitted agriculture and natural resources because they are connected with natural resources endowment and climatic conditions. Gnidchenko and Salnikova [94] also used a combination of different levels of aggregation (two- and six-digit codes) to evaluate the price competitiveness of Russian export. A similar combination was chosen by Benesova et al. [95] to evaluate Russian agricultural exports.

A higher level of decomposition was used by Simo et al. [18], Svatoš et al. [96], Smutka et al. [23], Slaboch and Kotyzy [17], Qineti et al. [97], Bojnec et al. [98], or Bojnec and Ferto [25,42,99].

Appendix C

Table A2. Harmonized System Code.

Code	Description
H3-07	Edible vegetables and certain roots and tubers
H3-08	Edible fruit and nuts; peel of citrus fruit or melons
H3-10	Cereals
H3-1001	Wheat and meslin
H3-1003	Barley
H3-1005	Maize (corn)
H3-12	Oil seeds and oleaginous fruits; miscellaneous grains, seeds and fruit; industrial or medicinal plants; straw and fodder.
H3-1205	Rape or colza seeds; whether or not broken
H3-1210	Hop cones, fresh or dried, whether or not ground, powdered or in the form of pellets; lupulin
H3-1507	Soya-bean oil and its fractions; whether or not refined, but not chemically modified
H3-1508	Ground nut oil and its fractions; whether or not refined, but not chemically modified
H3-1509	Olive oil and its fractions; whether or not refined, but not chemically modified
H3-1510	Oils and their fractions n.e.c. in chapter 15, obtained solely from olives, whether or not refined, but not chemically modified, including blends of these oils or fractions with oils or fractions of heading no. 1509
H3-1511	Palm oil and its fractions; whether or not refined, but not chemically modified
H3-1512	Sunflower seed, safflower or cotton-seed oil and their fractions; whether or not refined, but not chemically modified
H3-1513	Coconut (copra), palm kernel or babassu oil and their fractions; whether or not refined but not chemically modified
H3-1514	Rape, colza or mustard oil and their fractions; whether or not refined, but not chemically modified
H3-1515	Fixed vegetable fats and oils (including jojoba oil) and their fractions, whether or not refined; but not chemically modified
H3-1517	Margarine; edible mixtures or preparations of animal or vegetable fats or oils or of fractions of different fats or oils of this chapter, other than edible fats or oils of heading no. 1516
H3-1518	Animal or vegetable fats, oils, fractions, modified in any way, excluding heading no. 1516; inedible versions of animal or vegetable fats, oils or fractions of this chapter, n.e.c. or included
H3-17	Sugars and sugar confectionery
H3-1701	Cane or beet sugar and chemically pure sucrose, in solid form
H3-19	Preparations of cereals, flour, starch or milk; pastrycooks' products
H3-1901	Malt extract; flour/groats/meal/starch/malt extract products, no cocoa (or less than 40% by weight) and food preparations of goods of headings 04.01 to 04.04, no cocoa (or less than 5% by weight), weights calculated on a totally defatted basis, n.e.c.
H3-20	Preparations of vegetables, fruit, nuts or other parts of plants
H3-22	Beverages, spirits and vinegar
H3-2201	Waters, including natural or artificial mineral waters and aerated waters, not containing added sugar or other sweetening matter nor flavoured; ice and snow
H3-2202	Waters, including mineral and aerated waters, containing added sugar or sweetening matter, flavoured; other non-alcoholic beverages, not including fruit or vegetable juices of heading no. 2009
H3-2203	Beer made from malt
H3-2205	Vermouth and other wine of fresh grapes, flavoured with plants or aromatic substances
H3-23	Food industries, residues and wastes thereof; prepared animal fodder
H3-2309	Preparations of a kind used in animal feeding

Appendix D

Table A3. The share of individual countries in intra-EU trade with respect to selected commodity aggregates or sub-aggregates.

2005	AT	BE	CZ	DK	FR	DE	NL	PL	SK	2019	AT	BE	CZ	DK	FR	DE	NL	PL	SK
H3-07	1%	11%	2%	2%	6%	3%	18%	15%	4%	H3-07	2%	11%	2%	3%	6%	3%	16%	10%	3%
H3-08	3%	17%	6%	1%	5%	5%	11%	13%	10%	H3-08	4%	6%	3%	2%	3%	6%	15%	8%	5%
H3-10	5%	2%	9%	4%	12%	6%	1%	4%	9%	H3-10	5%	2%	9%	5%	12%	3%	2%	5%	15%
H3-1001	2%	1%	5%	2%	5%	3%	0%	1%	3%	H3-1001	2%	1%	7%	3%	6%	2%	0%	1%	9%
H3-12	2%	2%	7%	7%	3%	3%	6%	3%	8%	H3-12	4%	2%	6%	7%	5%	3%	6%	4%	11%
H3-1205	0%	0%	3%	1%	1%	0%	0%	1%	3%	H3-1205	1%	0%	3%	1%	2%	0%	1%	1%	5%
H3-1514	1%	1%	2%	2%	1%	2%	1%	2%	1%	H3-1514	1%	1%	4%	2%	1%	2%	1%	1%	0%
H3-17	5%	6%	13%	6%	6%	5%	4%	7%	16%	H3-17	3%	4%	5%	3%	4%	5%	3%	4%	11%
H3-1701	3%	1%	8%	1%	4%	2%	1%	3%	10%	H3-1701	0%	1%	2%	1%	2%	2%	1%	1%	2%
H3-19	10%	12%	6%	13%	7%	16%	5%	13%	7%	H3-19	14%	14%	11%	9%	9%	17%	6%	16%	8%
H3-1901	2%	2%	1%	4%	2%	3%	2%	1%	1%	H3-1901	3%	3%	2%	4%	3%	4%	1%	2%	1%
H3-20	10%	12%	3%	6%	4%	9%	12%	15%	3%	H3-20	8%	13%	3%	4%	4%	8%	12%	10%	3%
H3-22	23%	10%	12%	9%	22%	14%	6%	7%	8%	H3-22	19%	13%	11%	17%	21%	14%	9%	6%	10%
H3-2202	20%	4%	3%	2%	2%	5%	3%	3%	5%	H3-2202	12%	3%	4%	7%	2%	5%	3%	2%	2%
H3-2203	1%	4%	5%	0%	1%	4%	2%	1%	0%	H3-2203	1%	7%	4%	4%	1%	2%	1%	1%	0%
H3-23	5%	7%	5%	21%	5%	9%	13%	5%	3%	H3-23	9%	8%	11%	13%	6%	12%	10%	12%	5%
H3-2309	4%	3%	3%	15%	5%	5%	7%	4%	1%	H3-2309	7%	5%	8%	8%	5%	7%	6%	9%	1%

Note: the calculation is the share of total exports of the analysed commodities.

Table A4. The share of individual commodity aggregates or sub-aggregates in the crop-related agrarian exports of individual EU countries.

2005	AT	BE	CZ	DK	FR	DE	NL	PL	SK	2019	AT	BE	CZ	DK	FR	DE	NL	PL	SK
H3-07	1%	20%	1%	1%	19%	8%	43%	6%	0%	H3-07	1%	15%	1%	1%	16%	8%	49%	8%	0%
H3-08	1%	32%	2%	0%	19%	13%	27%	5%	1%	H3-08	2%	10%	1%	1%	10%	16%	52%	7%	1%
H3-10	3%	5%	3%	2%	59%	20%	4%	2%	1%	H3-10	5%	6%	6%	3%	50%	12%	8%	7%	4%
H3-1001	4%	5%	5%	2%	56%	25%	2%	1%	1%	H3-1001	5%	4%	10%	4%	52%	16%	2%	3%	5%
H3-12	3%	9%	5%	5%	27%	15%	32%	3%	2%	H3-12	4%	4%	5%	5%	24%	13%	34%	6%	3%
H3-1205	1%	4%	10%	3%	61%	11%	1%	5%	4%	H3-1205	2%	2%	10%	2%	41%	5%	23%	8%	5%
H3-1514	3%	13%	3%	4%	23%	29%	18%	6%	0%	H3-1514	5%	13%	12%	5%	10%	38%	13%	4%	0%
H3-1515	2%	42%	0%	0%	14%	17%	25%	0%	0%	H3-1515	6%	20%	1%	6%	19%	20%	26%	2%	0%
H3-17	4%	17%	5%	3%	32%	19%	12%	4%	3%	H3-17	3%	12%	4%	2%	23%	27%	18%	7%	3%
H3-1701	5%	9%	7%	1%	43%	20%	7%	4%	4%	H3-1701	1%	8%	6%	1%	38%	25%	11%	7%	2%
H3-19	4%	20%	1%	4%	22%	33%	11%	5%	1%	H3-19	6%	15%	4%	2%	17%	31%	14%	10%	1%
H3-20	5%	23%	1%	2%	13%	22%	27%	6%	0%	H3-20	4%	18%	1%	1%	10%	21%	35%	8%	0%
H3-22	7%	11%	2%	2%	46%	21%	9%	2%	1%	H3-22	7%	12%	3%	4%	34%	21%	16%	3%	1%
H3-2202	23%	16%	2%	1%	13%	25%	15%	3%	1%	H3-2202	17%	9%	4%	6%	9%	27%	23%	4%	1%
H3-2203	2%	29%	6%	0%	8%	38%	17%	1%	0%	H3-2203	2%	37%	7%	6%	7%	21%	16%	4%	0%
H3-23	3%	14%	1%	7%	19%	22%	31%	2%	0%	H3-23	5%	10%	4%	4%	14%	26%	28%	9%	1%
H3-2309	3%	9%	1%	9%	28%	19%	28%	2%	0%	H3-2309	5%	10%	4%	4%	17%	24%	25%	11%	0%

Appendix E

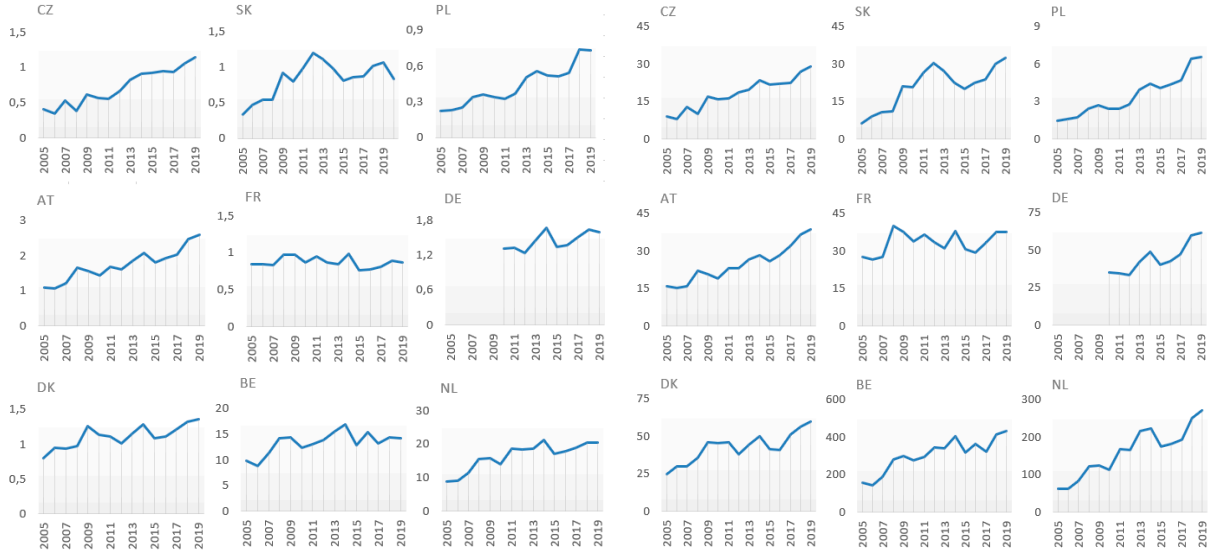

Figure A1. (**a**) Crop exports per 1 ha, 1000 $/ha (constant 2010 prices); (**b**) crop exports per 1 worker, 1000 $/person (constant 2010 prices). Evolution of the productivity indicators.

Table A5. The average values of year-on-year growth rates in crop exports per unit of core productive factors, from 2005 to 2019 [1] (in %).

The Average Growth rate in Crop Exports per 1 ha of Agricultural Land		The Average Growth Rate in Crop Exports per 1 Worker Employed		The Average Growth Rate in Crop Exports per 1 USD of Fixed Capital Consumption	
10.46	SK	15.03	SK	4.99	CZ
10.16	CZ	12.90	NL	7.66	PL
9.79	PL	12.46	PL	7.19	SK
7.34	NL	11.05	CZ	5.79	AT
7.14	AT	8.97	BE	5.72	DK
4.52	DK	7.52	DK	4.52	NL
3.77	BE	7.36	DE	1.92	DE
2.83	DE	7.35	AT	0.77	FR
0.69	FR	3.32	FR	0.38	BE

[1] Note: In the case of Germany, the analysis covers the period from 2010–2019.

Table A6. The most significant negative year-on-year growth rates registered in exports per unit of core productive factors, from 2005 to 2019 (in %).

Maximal Negative Growth Rates in Exports per 1 ha of Agricultural Land			Maximal Negative Growth Rates in Exports per 1 Worker Employed			Maximal Negative Growth Rates in Exports per 1 USD of Fixed Capital Consumption		
CZ	−27.88	2008	NL	−21.40	2015	CZ	−29.49	2008
BE	−23.47	2015	BE	−21.10	2015	NL	−14.45	2010
FR	−21.84	2015	CZ	−20.04	2008	PL	−12.36	2010
DE	−19.85	2015	FR	−19.06	2015	BE	−25.88	2015
NL	−19.53	2015	DE	−18.53	2015	FR	−21.44	2015
SK	−17.03	2015	DK	−18.04	2015	AT	−11.33	2015
DK	−15.90	2015	SK	−17.61	2014	DK	−15.16	2015
AT	−13.37	2015	PL	−8.85	2010	SK	−18.83	2015
PL	−6.65	2015	AT	−8.17	2015	DE	−19.58	2015

Note: In the case of Germany, the analysis covers the period from 2010–2019.

Appendix F

Table A7. H3-07 edible vegetables and certain roots and tubers.

Year	Group	1	2	3	4
2005 *	H3-07	AT DK CZ	FR SK	NL PL	BE
2010	H3-07	AT CZ DE FR SK	DK PL	NL	BE
2015	H3-07	AT DE CZ FR SK	DK PL	BE	NL
2019	H3-07	CZ SK AT DE FR	DK PL	BE	NL

* data for Germany are not available.

Table A8. H3-08 edible fruit and nuts; peel of citrus fruit or melons.

Year	Group	1	2	3	4	5
2005 *	H3-08	PL SK CZ FR	NL	AT DK	BE	
2010	H3-08	AT CZ DE SK	FR PL NL	DK	BE	
2015	H3-08	CZ SK AT FR DE	DK	NL	PL	BE
2019	H3-08	AT FR CZ DE SK DK	PL	BE	NL	

* data for Germany are not available.

Table A9. H3-12 oil seeds and oleaginous fruits.

Year	Group	1	2	3	4	5	6
2005 *	H3-12	CZ DK SK	FR NL	AT PL	BE		
2010	H3-12	AT DE NL	CZ FR PL DK	SK	BE		
2015	H3-12	CZ FR AT	DK PL	NL	DE	SK	BE
2019	H3-12	CZ PL AT	DK FR SK	DE	BE NL		

* data for Germany are not available.

Table A10. H3-17 sugar and sugar confectionery.

Year	Group	1	2	3	4
2005 *	H3-17	CZ SK FR	DK NL AT PL	BE	
2010	H3-17	DE DK CZ PL NL	AT FR	BE	SK
2015	H3-17	AT DK PL CZ FR DE	BE NL	SK	
2019	H3-17	AT PL DE	CZ FR DK	BE NL	SK

* data for Germany are not available.

Table A11. H3-22 beverages, spirits, and vinegar.

Year	Group	1	2	3	4	5
2005 *	H3-22	CZ PL	DE NL	DK SK	AT FR	BE
2010	H3-22	DE DK PL SK	CZ NL	BE	AT FR	
2015	H3-22	CZ PL DE DK	SK	AT FR	BE NL	
2019	H3-22	AT FR	DE DK PL CZ SK	BE NL		

* data for Germany are not available.

Table A12. H3-2203 beer made from malt.

Year	Group	1	2	3	4	5	6
2005 *	H3-2203	AT PL NL	FR SK DK	CZ	BE		
2010	H3-2203	AT DE	FR SK NL PL	CZ DK	BE		
2015	H3-2203	AT DE	NL	FR PL	SK	CZ DK	BE
2019	H3-2203	AT DE PL	NL	CZ DK	FR SK	BE	

* data for Germany are not available.

Table A13. H3-23 food industries, residues, and wastes thereof.

Year	Group	1	2	3	4
2005 *	H3-23	AT FR	CZ PL SK	DK NL	BE
2010	H3-23	CZ SK FR AT PL	DE DK	NL	BE
2015	H3-23	DK FR SK CZ PL AT	DE NL	BE	
2019	H3-23	DK PL AT CZ FR SK	DE NL	BE	

* data for Germany are not available.

Appendix G

Table A14. Country position according to RCA sorting (%).

2005	AT	BE	CZ	DE	DK	FR	NL	PL	SK
1	6.25%	12.50%	15.63%	3.13%	15.63%	9.38%	12.50%	9.38%	15.63%
2	0.00%	6.25%	18.75%	18.75%	3.13%	15.63%	15.63%	9.38%	12.50%
3	3.13%	15.63%	0.00%	31.25%	9.38%	15.63%	12.50%	6.25%	6.25%
4	9.38%	28.13%	15.63%	9.38%	6.25%	9.38%	6.25%	6.25%	9.38%
5	25.00%	6.25%	9.38%	12.50%	12.50%	15.63%	6.25%	9.38%	3.13%
6	6.25%	3.13%	9.38%	15.63%	21.88%	12.50%	6.25%	18.75%	6.25%
7	15.63%	12.50%	15.63%	9.38%	6.25%	15.63%	12.50%	6.25%	6.25%
8	31.25%	9.38%	12.50%	0.00%	9.38%	0.00%	3.13%	28.13%	6.25%
9	3.13%	6.25%	3.13%	0.00%	15.63%	6.25%	25.00%	6.25%	34.38%

Table A15. Country position according to RCA sorting (%).

2019	AT	BE	CZ	DE	DK	FR	NL	PL	SK
1	6.25%	12.50%	12.50%	6.25%	6.25%	12.50%	18.75%	3.13%	21.88%
2	3.13%	9.38%	6.25%	18.75%	25.00%	15.63%	6.25%	12.50%	3.13%
3	18.75%	3.13%	31.25%	12.50%	6.25%	9.38%	3.13%	15.63%	0.00%
4	3.13%	18.75%	6.25%	25.00%	12.50%	3.13%	9.38%	9.38%	12.50%
5	18.75%	18.75%	3.13%	15.63%	3.13%	9.38%	15.63%	12.50%	3.13%
6	18.75%	15.63%	12.50%	3.13%	9.38%	12.50%	9.38%	12.50%	6.25%
7	12.50%	6.25%	15.63%	12.50%	18.75%	9.38%	9.38%	9.38%	6.25%
8	6.25%	6.25%	6.25%	6.25%	12.50%	18.75%	6.25%	15.63%	21.88%
9	12.50%	9.38%	6.25%	0.00%	6.25%	9.38%	21.88%	9.38%	25.00%

Table A16. Paired samples correlation.

	Correlation	*p*-Value	Std. Error	95% Confidence Interval	
				Lower	Upper
AT_2005 & AT_2019	0.517	0.002	0.150	0.170	0.762
BE_2005 & BE_2019	0.787	0.000	0.066	0.641	0.896
CZ_2005 & CZ_2019	0.584	0.000	0.122	0.309	0.787
DE_2005 & DE_2019	0.591	0.000	0.135	0.284	0.820
DK_2005 & DK_2019	0.464	0.007	0.149	0.129	0.710
FR_2005 & FR_2019	0.863	0.000	0.041	0.772	0.929
NL_2005 & NL_2019	0.840	0.000	0.054	0.710	0.924
PL_2005 & PL _2019	0.446	0.011	0.153	0.140	0.723
SK_2005 & SK_2019	0.871	0.000	0.057	0.746	0.955

References

1. Nowak, A.; Rozanska-Boczula, M.; Krukowski, A. Competitiveness of Agriculture in New Member States of the European Union. *Eur. Res. Stud. J.* **2020**, *13*, 160–175. [CrossRef]
2. Kijek, A.; Kijek, T.; Nowak, A.; Skrzypek, A. Productivity and Its Convergence in Agriculture in New and Old European Union Member States. *Agric. Econ.* **2019**, *65*, 1–9. [CrossRef]

3. European Commission. *Evalutation of the Impact of the CAP Measures on the General Objective "Viable Food Production"*; European Commission: Brusells, Belgium, 2021.
4. Latruffe, L. *Competitiveness, Productivity and Efficiency in the Agricultural and Agri-Food Sectors*; OECD: Paris, France, 2010; Volume 30. [CrossRef]
5. Organisation for Economic Co-Operation and Development. *Fostering Productivity and Competitiveness in Agriculture*; OECD: Paris, France, 2011.
6. Ciutacu, C.; Chivu, L. Non-Competitive Evolutions of the Foreign Trade in Romania. *Procedia Econ. Financ.* **2015**, *22*, 216–221. [CrossRef]
7. Bojnec, Š.; Fertő, I. Complementarities of Trade Advantage and Trade Competitiveness Measures. *Appl. Econ.* **2012**, *44*, 399–408. [CrossRef]
8. Jakšić, S.; Erjavec, N.; Cota, B. Export and Total Factor Productivity of EU New Member States. *Croat. Oper. Res. Rev.* **2020**, *11*, 263–273. [CrossRef]
9. Bielik, P.; Smutka, L.; Svatoš, M.; Hupková, D. Czech and Slovak Agricultural Foreign Trade—Two Decades after the Dissolution. *Agric. Econ.* **2013**, *59*, 441–453. [CrossRef]
10. Svatoš, M.; Smutka, L. Influence of the EU Enlargement on the Agrarian Foreign Trade Development in Member States. *Agric. Econ. Czech* **2009**, *55*, 233–249. [CrossRef]
11. Bečvářová, V. Issues of Competitiveness of the Present Agriculture. *Agric. Econ.* **2008**, *54*, 399–405. [CrossRef]
12. Jankowska, A. Agricultural Trade Competitiveness of EU Candidate Countries and Eastern Partnership Countries. *Eur. Res. Stud. J.* **2021**, *14*, 316–334. [CrossRef]
13. Pawlak, K.; Smutka, L.; Kotyza, P. Agricultural Potential of the EU Countries: How Far Are They from the USA? *Agriculture* **2021**, *11*, 282. [CrossRef]
14. Ignjatijević, S.; Čavlin, M.; Đorđević, D. Measurement of Comparative Advantages of Processed Food Sector of Serbia in the Increasing Export. *Econ. Agric.* **2014**, *61*, 677–693. [CrossRef]
15. Rusali, M.-A. Agrifood Competitive Performances within Romania's Foreign Trade Pattern: Evaluation and Alerts. *Procedia Econ. Financ.* **2014**, *8*, 632–639. [CrossRef]
16. Hornowski, A.; Pawlak, K.; Smutka, L.; Kotyza, P. Concentration in the Czech and Polish Sugar Markets. *Sugar Ind.* **2020**, *145*, 224–233. [CrossRef]
17. Slaboch, J.; Kotyza, P. Are V4 Countries Competitive in Production of Main Oil-Bearing Crops in the Perspective of Production Self-Sufficiency and Foreign Trade Development? In *XXIV Global Agribusiness and the Rural Economy, Proceedings of the 24th International Scientific Conference, Prague, Czech Republic, 16–18 September 2015*; Smutka, L., Rezbova, H., Eds.; Czech University of Life Sciences Prague Faculty of Economics and Management: Prague, Czech Republic, 2015; pp. 363–375.
18. Simo, D.; Mura, L.; Buleca, J. Assessment of Milk Production Competitiveness of the Slovak Republic within the EU-27 Countries. *Agric. Econ.* **2016**, *62*, 482–492. [CrossRef]
19. Philippidis, G.; Waschik, R. Melitz Meets Milk: The Impact of Quota Abolition on EU Dairy Export Competitiveness. *J. Agric. Econ.* **2019**, *70*, 44–61. [CrossRef]
20. Lombardi, A.; Verneau, F.; Lombardi, P. Development and Trade Competitiveness of the Italian Tomato Sector. *Agric. Econ. Rev.* **2016**, *17*, 5–19.
21. Kutkowska, B.; Szuk, T. Competitiveness on the Global Cereal Market. *Ann. Pol. Assoc. Agric. Agribus. Econ.* **2020**, *22*, 11. [CrossRef]
22. Pokorná, I.; Smutka, L.; Pulkrábek, J. The World Production of Sugar. *List. Cukrov. Repar.* **2011**, *127*, 118–121.
23. Smutka, L.; Benešová, I.; Pulkrábek, J.; Belova, A.; Urban, J. Development and Position of Sugar Industry in the European Union in 2000–2011. *List. Cukrov. Repar.* **2013**, *129*, 22–27.
24. Travkina, I.; Tvaronavičiene, M. Export Competitiveness and Domestic Productivity Facets: Case of Lithuania. *J. Bus. Econ. Manag.* **2011**, *12*, 49–68. [CrossRef]
25. Bojnec, Š.; Fertő, I. The Duration of Global Agri-Food Export Competitiveness. *Br. Food J.* **2017**, *119*, 1378–1393. [CrossRef]
26. Persson, M.; Wilhelmsson, F. EU Trade Preferences and Export Diversification. *World Econ.* **2016**, *39*, 16–53. [CrossRef]
27. Giurgiu, A.; Dodescu, A. Globalisation and Export Competitiveness: A Theoretical Approach. *Ann. Fac. Econ.* **2009**, *1*, 318–324.
28. Bokusheva, R.; Cechura, L. *Evaluating Dynamics, Sources and Drivers of Productivity Growth at the Farm Level*; OECD Food, Agriculture and Fisheries Papers: Paris, France, 2017; p. 106.
29. Jambor, A.; Babu, S. *Competitiveness of Global: Agriculture Policy Lessons for Food Security*; Springer: New York, NY, USA, 2016. [CrossRef]
30. Moon, W. Conceptualising Multifunctional Agriculture from a Global Perspective: Implications for Governing Agricultural Trade in the Post-Doha Round Era. *Land Use Policy* **2015**, *49*, 252–263. [CrossRef]
31. Urban, K.; Jensen, H.G.; Brockmeier, M. How Decoupled Is the Single Farm Payment and Does It Matter for International Trade? *Food Policy* **2016**, *59*, 126–138. [CrossRef]
32. Erokhin, V.; Diao, L.; Du, P. Sustainability-Related Implications of Competitive Advantages in Agricultural Value Chains: Evidence from Central Asia—China Trade and Investment. *Sustainability* **2020**, *12*, 1117. [CrossRef]
33. Narayan, S.; Bhattacharya, P. Relative Export Competitiveness of Agricultural Commodities and Its Determinants: Some Evidence from India. *World Dev.* **2019**, *117*, 29–47. [CrossRef]

34. Singbo, A.; Larue, B. Scale Economies, Technical Efficiency, and the Sources of Total Factor Productivity Growth of Quebec Dairy Farms. *Can. J. Agric. Econ.* **2016**, *64*, 339–363. [CrossRef]
35. Bezić, H.; Cvecic, I.; Galović, T. The Analysis of the Export Competitiveness of the EU Food Manufacturing Sector1. In Proceedings of the 8th International Conference Economic Integration, Competition and Cooperation, Opatija, Croatia, 6–9 April 2011; University of Rijeka—Faculty of Economics: Opatija, Croatia, 2011.
36. Keizer, T.H.; Emvalomatis, G. Differences in TFP Growth among Groups of Dairy Farms in the Netherlands. *NJAS Wageningen J. Life Sci.* **2014**, *70*, 33–38. [CrossRef]
37. Tong Soo, K. *The Gains from External Scale Economies and Comparative Advantage*; Economics Working Paper Series 2013/007; Lancaster University Management School: Lancaster, UK, 2013.
38. Gorton, M.; Davidova, S.; Ratinger, T. The Competitiveness of Agriculture in Bulgaria and the Czech Republic Vis-à-Vis the European Union (CEEC and EU Agricultural Competitiveness). *Comp. Econ. Stud.* **2000**, *42*, 59–86. [CrossRef]
39. Sheetal, S.; Kumar, R.; Shashi, S. Export Competitiveness and Concentration Analysis of Major Sugar Economies with Special Reference to India. *J. Agribus. Dev. Emerg. Econ.* **2020**, *10*, 687–715. [CrossRef]
40. Carraresi, L.; Banterle, A. Agri-Food Competitive Performance in EU Countries: A Fifteen-Year Retrospective. *Int. Food Agribus. Manag. Rev.* **2015**, *18*, 37–62.
41. Bojnec, Š.; Fertő, I. Agri-Food Export Competitiveness in European Union Countries. *J. Common Mark. Stud.* **2015**, *53*, 476–492. [CrossRef]
42. Bojnec, S.; Ferto, I. Export Competitiveness of the European Union in Fruit and Vegetable Products in the Global Markets. *Agric. Econ.* **2016**, *62*, 299–310. [CrossRef]
43. Popescu, G.H.; Nicoale, I.; Nica, E.; Vasile, A.J.; Andreea, I.R. The Influence of Land-Use Change Paradigm on Romania's Agro-Food Trade Competitiveness—An Overview. *Land Use Policy* **2017**, *61*, 293–301. [CrossRef]
44. Kamaludin, M.; Narmaditya, B.S.; Wibowo, A.; Febrianto, I. Agricultural Land Resource Allocation to Develop Food Crop Commodities: Lesson from Indonesia. *Heliyon* **2021**, *7*, e07520. [CrossRef]
45. Mcdougall, R.; Rader, R.; Kristiansen, P. Urban Agriculture Could Provide 15% of Food Supply to Sydney, Australia, under Expanded Land Use Scenarios. *Land Use Policy* **2020**, *94*, 104554. [CrossRef]
46. Franco-Solís, A.; Montanía, C.V. Dynamics of Deforestation Worldwide: A Structural Decomposition Analysis of Agricultural Land Use in South America. *Land Use Policy* **2021**, *109*, 105619. [CrossRef]
47. Hoenow, N.C.; Kirk, M. Does Competitive Scarcity Affect the Speed of Resource Extraction? A Common-Pool Resource Lab-in-the-Field Experiment on Land Use in Northern Namibia. *World Dev.* **2021**, *147*, 105623. [CrossRef]
48. Grafton, Q.R.; Squires, D.; Fox, K.J. Private Property and Economic Efficiency: A Study of a Common-Pool Resource. *J. Law Econ.* **2000**, *43*, 679–714. [CrossRef]
49. Zhang, Z.; Hu, B.; Shi, K.; Su, K.; Yang, Q. Exploring the Dynamic, Forecast and Decoupling Effect of Land Natural Capital Utilization in the Hinterland of the Three Gorges Reservoir Area, China. *Sci. Total Environ.* **2020**, *718*, 134832. [CrossRef] [PubMed]
50. Dias, T.A.d.C.; Lora, E.E.S.; Maya, D.M.Y.; Olmo, O.A.d. Global Potential Assessment of Available Land for Bioenergy Projects in 2050 within Food Security Limits. *Land Use Policy* **2021**, *105*, 105346. [CrossRef]
51. Ruzekova, V.; Kittova, Z.; Steinhauser, D. Export Performance as a Measurement of Competitiveness. *J. Compet.* **2020**, *12*, 145–160. [CrossRef]
52. Stöllinger, R.; Holzner, M. State Aid and Export Competitiveness in the EU. *J. Ind. Compet. Trade* **2016**, *17*, 203–236. [CrossRef]
53. Fojtíková, L.; Staníčková, M. Konkurenceschopnost a Produktivita Vývozu Členských Zemí Evropské Unie. *Polit. Ekon.* **2017**, *65*, 669–689. [CrossRef]
54. Huo, D. Impact of Country-Level Factors on Export Competitiveness of Agriculture Industry from Emerging Markets. *Compet. Rev.* **2014**, *24*, 393–413. [CrossRef]
55. Huo, D.; Chen, Y.; Hung, K.; Song, Z.; Guan, J.; Ji, A. Diamond Model and the Export Competitiveness of the Agriculture Industry from Emerging Markets: An Exploratory Vision Based on a Spatial Effect Study Using a Genetic Algorithm. *Econ. Res. Istraživanja* **2020**, *33*, 2427–2443. [CrossRef]
56. Buturac, G.; Lovrinčević, Ž.; Mikulić, D. Export Competitiveness of the Croatian Food Industry. *Argum. Oeconomica* **2018**, *41*, 135–156. [CrossRef]
57. Gilbert, J.; Muchov, E. Export Competitiveness of Central and Eastern Europe since the Enlargement of the EU. *Int. Rev. Econ. Financ.* **2018**, *55*, 78–85. [CrossRef]
58. Capobianco-Uriarte, M.d.l.M.; Aparicio, J.; Pablo-Valenciano, J.d.; Casado-Belmonte, M.d.P. The European Tomato Market. An Approach by Export Competitiveness Maps. *PLoS ONE* **2021**, *16*, e0250867. [CrossRef]
59. Leromain, E.; Orece, G. New Revealed Comparative Advantage Index: Dataset and Empirical Distribution. *Int. Econ.* **2013**, *139*, 48–70. [CrossRef]
60. Costinot, A.; Donaldson, D.; Komunjer, I. What Goods Do Countries Trade? A Quantitative Exploration of Ricardo's Ideas. *Rev. Econ. Stud.* **2012**, *79*, 581–608. [CrossRef]
61. Balassa, B. Trade Liberalisation and Revealed Comparative Advantage. *Manch. Sch.* **1965**, *33*, 99–123. [CrossRef]
62. Balassa, B. 'Revealed' Comparative Advantage Revisited: An Analysis of Relative Export Shares of the Industrial Countries, 1953–1971. *Manch. Sch.* **1977**, *45*, 327–344. [CrossRef]

63. Laursen, K. Revealed Comparative Advantage and the Alternatives as Measures of International Specialization. *Eurasian Bus. Rev.* **2015**, *5*, 99–115. [CrossRef]
64. Grubel, H.G.; Lloyd, P.J. The Empirical Measurement of Intra-Industry Trade. *Econ. Rec.* **1971**, *47*, 494–517. [CrossRef]
65. Grubel, H.G.; Lloyd, P.J. *Intra-Industry Trade: The Theory and Measurement of International Trade in Differentiated Products*; Wiley & Sons: Hoboken, NJ, USA, 1975.
66. Markusen, J.R.; Melvin, J.R.; Kaempfer, W.M.; Maskus, K. *International Trade: Theory and Evidence*; McGraw-Hill: New York, NY, USA, 1995.
67. Bojnec, S. Trade and Revealed Comparative Advantage Measures: Regional and Central and East European Agricultural Trade. *East. Eur. Econ.* **2001**, *39*, 72–98.
68. Iapadre, P.L. Measuring International Specialization. *Int. Adv. Econ. Res.* **2001**, *7*, 173–183. [CrossRef]
69. Lafay, J. The Measurement of Revealed Comparative Advantages. In *International Trade Modeling*; Dagenais, M.G., Muet, P.A., Eds.; Chapman and Hall: London, UK, 1992; pp. 209–234.
70. Zaghini, A. *Trade Advantages and Specialisation Dynamics in Acceding Countries*; European Central Bank Working Paper Series 249; European Central Bank: Frankfurt, Germany, 2003.
71. Benešová, I.; Smutka, L.; Hinke, J.; Laputková, A. Competitiveness of Mutual Agrarian Foreign Trade of the Post-Soviet Countries. *E a M Ekon. a Manag.* **2020**, *23*, 49–66. [CrossRef]
72. Benešová, I.; Smutka, L.; Laputková, A. Specifics of the Mutual Trade of the Post-Soviet Countries. *Enterp. Bus. Econ. Rev.* **2019**, *7*, 29–43. [CrossRef]
73. Jain, A.K. Data Clustering: 50 Years beyond K-Means. *Pattern Recognit. Lett.* **2010**, *31*, 651–666. [CrossRef]
74. Fávero, L.P.; Belfiore, P. Cluster Analysis. In *Data Science for Business and Decision Making*; Fávero, L.P., Belfiore, P.B.T.-D., Eds.; Academic Press: Cambridge, MA, USA, 2019; pp. 311–382. [CrossRef]
75. Ward, J.H. Hierarchical Grouping to Optimize an Objective Function. *J. Am. Stat. Assoc.* **1963**, *58*, 236–244. [CrossRef]
76. Meinck, S.; Rodriguez, M.C. Considerations for Correlation Analysis Using Clustered Data: Working with the Teacher Education and Development Study in Mathematics (TEDS-M) and Other International Studies. *Large-Scale Assess. Educ.* **2013**, *1*, 1–19. [CrossRef]
77. Santucci, J. Evidence of a Winning-Cohesion Tradeoff under Multi-Winner Ranked-Choice Voting. *Elect. Stud.* **2018**, *52*, 128–138. [CrossRef]
78. Donovan, T.; Tolbert, C.; Gracey, K. Campaign Civility under Preferential and Plurality Voting. *Elect. Stud.* **2016**, *42*, 157–163. [CrossRef]
79. Ross, A.; Willson, V.L. Paired Samples T-Test. In *Basic and Advanced Statistical Tests*; Sense Publishers: Rotterdam, The Netherlands, 2017; pp. 17–19. [CrossRef]
80. Nicolaides, P.A.; Roy, T. Brexit and Trade: Between Facts and Irrelevance. *Intereconomics* **2017**, *52*, 100–106. [CrossRef]
81. Rumánková, L.; Kuzmenko, E.; Benešová, I.; Smutka, L.; Laputková, A. Animal Husbandry Export Measures Productivity: What Is the Position of the Czech Republic ? *Agris. On-Line Pap. Econ. Inform.* **2020**, *12*, 93–110. [CrossRef]
82. Žáková Kroupová, Z.; Hálová, P.; Rumánková, L. Productivity of Czech Milk Production in European Comparison. *Agris. On-Line Pap. Econ. Inform.* **2020**, *12*, 115–127. [CrossRef]
83. Ignjatijević, S.; Ćirić, M.; Carić, M. International Trade Structure of Countries from the Danube Region: Comparative Advantage Analysis of Export. *Ekon. Časopis J. Econ.* **2013**, *3*, 251–269.
84. Grodzicki, M.J. Global Value Chain and Competitiveness of V4 Economies. In *International Competitiveness in Visegrad Countries: Macro and Micro Perspectives*; Kiendl-Wendner, D., Wach, K., Eds.; FH Joanneum: Graz, Austria, 2014; p. 201.
85. Ball, V.E.; Bureau, J.-C.; Butault, J.-P.; Nehring, R. Levels of Farm Sector Productivity: An International Comparison. *J. Product. Anal.* **2001**, *15*, 5–29. [CrossRef]
86. Dunmore, J.C. Competitiveness and Comparative Advantage of U.S. Agricultures. In *Increasing Understanding of Public Problems and Policies*; 1986; pp. 21–34. Available online: https://ageconsearch.umn.edu/search?ln=en&cc=791&p=&f=&rm=&ln=en&sf=&so=d&rg=10&c=791&c=&of=hb&fct__1=Conference%20Paper%2F%20Presentation (accessed on 15 October 2021).
87. Balogh, J.M.; Jambor, A.; Jámbor, A. The Global Competitiveness of European Wine Producers. *Br. Food J.* **2017**, *119*, 2089. [CrossRef]
88. Filho, W.L.; Pociovalisteanu, D.-M.; Al-Amin, A.Q. *Sustainable Development Economic: Green Economy and Green Growth*, 1st ed.; Springer: Cham, Switzerland, 2017. [CrossRef]
89. Zhang, X.; Li, X. An Empirical Analysis of the Comparative Advantage of Chinese Foreign Trade Products. *Chin. Econ.* **2004**, *37*, 38–61. [CrossRef]
90. Gnidchenko, A.A.; Salnikov, V.A. Dynamics of Russia's Competitive Positions on Foreign Markets. *Stud. Russ. Econ. Dev.* **2013**, *24*, 555–569. [CrossRef]
91. Anderson, J.E.; Yotov, Y.V. Terms of Trade and Global Efficiency Effects of Free Trade Agreements, 1990–2002. *J. Int. Econ.* **2016**, *99*, 279–298. [CrossRef]
92. Kutlina-Dimitrova, Z. The Economic Impact of the Russian Import Ban: A CGE Analysis. *Int. Econ. Econ. Policy* **2017**, *14*, 537–552. [CrossRef]
93. Sanidas, E.; Shin, Y. Convergence towards the Revealed Comparative Advantage Neutral Point for East Asia: Similarities and Differences between the Three Countries. *Seoul J. Econ.* **2011**, *24*, 21–50.

94. Gnidchenko, A.; Sal'nikov, V. Price Competitiveness in Russian Foreign Trade. *Probl. Econ. Transit.* **2014**, *57*, 3–36. [CrossRef]
95. Benešová, I.; Maitah, M.; Smutka, L.; Tomšík, K.; Ishchukova, N. Perspectives of the Russian Agricultural Exports in Terms of Comparative Advantage. *Agric. Econ.* **2017**, *63*, 318–330. [CrossRef]
96. Svatoš, M.; Maitah, M.; Belova, A. World Sugar Market—Basic Development Trends and Tendencies. *Agris. On-Line Pap. Econ. Inform.* **2013**, *5*, 73–88.
97. Qineti, A.; Rajcaniova, M.; Matejkova, E. The Competitiveness and Comparative Advantage of the Slovak and the EU Agri-Food Trade with Russia and Ukraine. *Agric. Econ. Czech* **2009**, *55*, 375–383. [CrossRef]
98. Bojnec, Š.; Čechura, L.; Fałkowski, J.; Fertő, I. Agri-Food Exports from Central- and Eastern-European Member States of the European Union Are Catching Up. *EuroChoices* **2021**, *20*, 11–19. [CrossRef]
99. Bojnec, Š.; Fertő, I. Are New EU Member States Catching up with Older Ones on Global Agri-Food Markets? *Post-Communist Econ.* **2015**, *27*, 205–215. [CrossRef]