# Competitiveness of the Largest Global Exporters of Concentrated Apple Juice

Paweł Kraciński [1,*] , Paulina Stolarczyk [2] and Łukasz Zaremba [3]

[1] Department of Economics and Organization of Enterprises, Faculty of Economics, Institute of Economics and Finance, Warsaw University of Life Sciences SGGW-Warsaw, ul. Nowoursynowska 166, 02-787 Warszawa, Poland

[2] Department of Development Policy and Marketing, Faculty of Economics, Institute of Economics and Finance, Warsaw University of Life Sciences—SGGW, ul. Nowoursynowska 166, 02-787 Warszawa, Poland; paulina_stolarczyk@sggw.edu.pl

[3] Institute of Agricultural and Food Economics—National Research Institut, ul. Świętokrzyska 20, 00-002 Warszawa, Poland; lukasz.zaremba@ierigz.waw.pl

* Correspondence: pawel_kracinski@sggw.edu.pl; Tel.: +48-225934235

**Abstract:** Concentrated apple juice (AJC) is a globally traded commodity, with major producers such as China, Poland, and the United States supplying AJC to markets worldwide. The aim of this article is to determine the competitive position of the main global exporters of concentrated apple juice. It also seeks to analyze changes in their positions over the period from 2005 to 2023. Assessing competitive position is important for several economic and business reasons, including identifying leading exporters and recognizing both growing and declining markets. The competitive position was measured using Market Share (*MS*) indicators, Gross and Net Export Orientation indicators ($E_{gr}$, $E_{net}$), and the Revealed Comparative Advantage (RCA) index. The results reveal significant structural shifts in global AJC trade. Most notably, China's declining competitiveness, reflected across all indicators, led to its loss of market leadership. This raises questions about the reasons for this decline and whether it presents opportunities for other exporters. This signals a broader reconfiguration in the global AJC supply chain, driven in part by domestic economic changes, such as rising consumption and decreasing export orientation. Simultaneously, other countries, particularly in Eastern Europe, show varying degrees of competitive growth, with Moldova and Ukraine emerging as key players. These trends suggest a diversification of supply sources and a more fragmented competitive landscape. Although national differences persist, the analysis indicates that structural and economic transformations, rather than short-term price signals, are driving the evolving global competitiveness in the AJC market. The observed weak correlations between prior-year apple prices and RCA confirm that broader market and policy factors play a more decisive role.

**Keywords:** competitiveness; competitive position; apple juice concentrate (AJC); AJC export; comparative advantages

## 1. Introduction

The agri-food sector, similarly to other sectors of the economy, experiences the impact of globalization and trade liberalization processes. These processes have a significant impact on the export possibilities of individual countries and are crucial for shaping the supply and demand balance of internal markets. Eventually they influence the economic situation of particular sectors [1,2]. The fruit juice industry contributes billions of dollars to the global economy through production, sales, and exports. Many countries export

fruit juices, earning foreign exchange and boosting their trade balance. According to Comtrade [3], the total value of the export of fruit and nut juices (CN 2009) increased from a USD 11.2 billion average in 2005–2007 (by 42.9%) to an average of USD 16.1 billion in 2021–2023. In these periods the value of concentrated apple juices rose from USD 2.1 to USD 2.6, and the share of AJC in this product group dropped from 18.9% to 16.2%. Even with the drop observed, the significance of concentrated apple juice remains high and important from an economic point of view. Hence, it seems to be important to conduct a competitive analysis that provides insight into the overall market dynamics, competitive landscape, and factors influencing the industry's success.

Competitiveness is one of the most frequently used terms in international economics, but understanding its essence remains a challenge in research due to the multitude of definitions and the various levels of competitiveness analysis. Despite its popularity, international competitiveness is described as the most misunderstood concept in economics [4,5]. Competitiveness has most often been viewed from two different perspectives: micro (firm) and macro (nation) [6]. However, six levels of analysis are often mentioned: global (world), regional (regions), macro, meso (sector), micro, and micro-micro (individual consumers) [7]. The meso level examines parts of the economy at the industry and sector levels [8]. Although the concept has evolved, a universally accepted definition of competitiveness or a comprehensive index for measuring it has not been established [9].

Competitiveness is relative and requires comparisons with other entities at the same levels of analysis [10,11]. It is also a multidimensional category that is often interpreted based on various economic theories [12–15]. There are several theories explaining the sources of competitiveness in the export of agricultural and industrial products, including the Theory of Comparative Advantage (Ricardo), the Resource Endowment Theory (Heckscher–Ohlin–Samuelson), and the Theory of International Trade (Krugman) [16]. According to the Heckscher–Ohlin–Samuelson theory, countries export goods whose production utilizes factors of production that are more readily available [17,18], while David Ricardo's theory of comparative advantage assumes that goods with a lower opportunity cost of production are exported [19]. Competitiveness, as understood by Krugman, is influenced by a larger number of factors, including technology and market structure and its concentration, as well as product differentiation [20,21].

Analyses of concentrated apple juice (AJC) export competitiveness can be classified at the meso level. A comprehensive approach to factors affecting competitiveness becomes even more challenging when it is applied to specific sectors of the economy [22]. Applying the same methods to measure competitiveness at all levels of analysis can lead to complications due to an oversimplification of the phenomenon [23]. At the meso level, competitiveness is most often measured by a country's export performance [10]. The definitions of competitiveness at this level also refer to many aspects. Competitiveness at the meso level is considered to be an efficient sector that satisfies domestic and foreign demand, generating revenue from exports to cover necessary import expenses while maintaining socially acceptable levels of production, employment, and exchange rates [24]. The competitiveness of the food sector has been more simply defined as the ability of domestic producers to position themselves in foreign markets and increase exports [25].

The international competitiveness of the food sector is determined by many factors [26,27]. These can include the concentration of means of production, advantages in productivity and efficiency, lower labor costs and prices and innovations [15], agricultural technology and farmers' skill [28], agricultural infrastructure [29], and the quality of the resources used in production (land, water, climate). External factors influencing competitiveness include global demand, consumer preferences, and conditions in the international market [30]. In the pro-environmental global market, factors such as natural resource

management and adaptation to climate change are becoming increasingly significant for competitiveness [31]. The importance of political actions that can affect the competitiveness of agricultural markets was also highlighted [32–35]. International competitiveness is also influenced by political or armed conflicts [36,37] causing disruptions in the food supply chain [38]. Some factors affecting competitiveness can be controlled by agri-food producers (size, product specialization, intensity of production factors), while others cannot (climatic conditions, government interventions, consumer demand) [27].

In this study, international competitiveness at the meso level is operationalized as a sector's ability to maintain and expand its position in foreign markets by efficiently meeting global demand, generating export revenue sufficient to support import needs, and sustaining socially acceptable levels of production.

The Revealed Comparative Advantage (RCA) index is a recognized and widely used measure of a country's export competitiveness (competitive position) [39]. It measures comparative advantages in sectors, commodity groups, or service categories [40], based on trade data [41]. It is the most frequently used measure of competitiveness [42–44]. A frequently highlighted drawback of the RCA is that it does not account for the effects of agricultural policy and exhibits asymmetric values [45,46]. Frequently used indicators of the competitive position in the export of food products include trade balance, share in the world exports, the import penetration ratio, the export orientation index, the import coverage ratio, modifications of the RCA, The Grubel–Lloyd index, and others [47–49].

Despite the dynamic structural changes occurring in economies, such as the growing importance of the service sector and high technologies, the food industry is, and will remain, a strategic sector. This is due to its role in meeting basic human needs for food and, at the national level, ensuring food security [15,50–53]. Food security in countries has gained importance due to the COVID-19 pandemic and subsequently the Russian aggression in Ukraine [54,55]. The COVID-19 pandemic had both negative and positive effects on the fruit juice industry. Certain areas, such as logistics and supply chains, were significantly impacted, but the industry as a whole was not severely affected [56]. The war in Ukraine had similarly ambiguous effects. For suppliers from some countries it posed difficulties, while for others, it created opportunities for increased sales. Regardless of ongoing non-economic changes in the world, economic policy remains important not only in relation to agribusiness but also to the broader economy. Governments may provide dedicated funds to support innovation activities in production, as well as investments in research and development (R&D), which can contribute to improving productivity [57].

Apples are a perishable product and it is impossible to store the entire harvest; therefore processing them into juice is a way of managing production [58]. Apple juice concentrate is a product obtained from apples by removing the water—usually through evaporation—which facilitates and reduces the costs of transportation and storage [8]. It is used in the production of drinking juices. Apple juice is the second most frequently consumed juice in the world [59]. An increase in the consumption of juices at the expense of carbonated drinks is being observed, which is caused by the greater demand for healthy food [60]. The consumption of fruits and juices is an important part of a healthy diet and also brings health benefits [61]. Fruits and juices contain vitamins (A, C, E), pectin, selenium [62], and antioxidants [63]. Although juices contain a lot of sugar, of which consumption has tripled over the last five decades, the effects of natural sugars are nonetheless more beneficial compared to refined sugars, which can contribute to health problems [64]. Apple juice has a positive effect on gut microbiota [65], has a protective effect on the cardiovascular system [66], and improves overall health [62].

Studies on the competitiveness of AJC are not among the most common analyses. However, it is possible to find scientific reports on this topic, primarily from researchers in

countries that play a significant role among exporters. The competitive position of AJC has been studied using measures based on the export performance of countries. It has been shown, using the RCA indicator and the share in global exports, that from 2005 to 2009 exports from China exhibited the highest comparative advantage as well as the highest and increasing share in global exports from 2003 to 2009. During this time, the position of China's main competitor—Poland—was declining [67]. Competitiveness analyses of exports using the RCA indicator were also conducted for the years 2002–2014. It was also demonstrated using the RCA indicator that from 2002 to 2014, AJC exports from China had the greatest comparative advantages, and high comparative advantages characterized exports from Poland, Hungary, Chile, Ukraine, Turkey, and Moldova [68]. Among European countries, Poland had the highest market share, but exports from Hungary had a higher comparative advantage. The USA and European Union countries used trade barriers to hinder the influx of Chinese AJC. This made it possible to export within the EU, leading to the growth of the sector in Poland [69]. By examining the competitive position using measures such as trade balance, share in global exports, and RCA from 2004 to 2015, it was shown that AJC exports from Poland were competitive. Poland exhibited an average-to-strong comparative advantage in AJC exports, while China showed a strong advantage. However, the strongest comparative advantage was noted for Moldova and Ukraine [70]. The factors influencing the competitiveness of Polish AJC exports, measured by the RCA index, in the years 2005–2017 were also analyzed. The impact of the exchange rate (EUR/PLN) and the selling prices of AJC on the RCA index was demonstrated. Analyzing competitiveness using the market share in world export and export orientation indices from 2007 to 2022 revealed that the competitive position of AJC exports from Poland, measured by share in world export, increased. However, the export orientation index decreased in the years 2019–2021 compared to 2007–2010 [8].

In recent years, researchers have also focused on the environmental impact of apple and juice production. It has been indicated that it is potentially emission and energy-intensive due to the high use of plant-protection products in the cultivation process and energy in processing [71,72]. The use of plant-protection products is a matter of the production technology applied and, as a result, affects the quantity and quality of the yields obtained. Reduction is potentially possible. In the case of AJC production, modifications that reduce environmental pressure are also likely to occur [68].

The analysis of the concentrated juice market is important. A significant portion of AJC production is exported, as apple juice is one of the most popular drinking juices worldwide [73] and apple production is geographically limited due to natural conditions. Certain countries have become specialized in its production. Therefore, competitiveness analyses of the export of this product are crucial for the economies of both producers and importers.

The aim of the study was to determine the competitive position of concentrated juice exporters and its changes from 2005—the first whole year of Polish (one of the most important apple juice exporters) full-fledged membership in the EU—to 2023—the most recent year for which data was available at the time of writing.

In order to validate the observed patterns and relationships between different competitiveness measures, correlations between individual competitiveness measures were examined. The correlation between AJC export prices and farm-gate apple prices was examined, as well. The analysis was also carried out in relation to GDP per capita of individual countries included in the article. The purpose was to assess the impact of improving the level of economic development of the country on the level of competitiveness measurements of AJC. This activity was carried out with the aim of capturing existing regularities that can be used to forecast changes in international trade.

The article poses the following research questions.

How has the export competitiveness of AJC from countries with the largest share in global exports evolved between 2005 and 2023?

Are the results of different measures of export competitiveness correlated with one another?

Is the level of GDP associated with the competitive position in AJC exports?

There are many works on the biological and technical aspects of the production of apple juice concentrate, but it is difficult to point to a current study in the field of competitiveness at the international level. Meanwhile, the assessment of export competitiveness, especially in relation to the determination of comparative advantages, is a valuable scientific contribution with wide application potential.

## 2. Materials and Methods

The data was sourced from The United Nations Comtrade database (UN Comtrade) and the Food and Agriculture Organization of the United Nations (FAOSTAT). The research period covered the years 2005–2023. Trade data was available up to 2023, while apple production data was available up to 2022. The competitive position was determined by three indicators: the share in global exports, gross and net export orientation indices, and the RCA index. Among the numerous indicators of competitiveness, the selected ones were chosen because they represent distinct approaches to measuring a competitive position. The Market Share (*MS*) is a straightforward metric that reflects the importance of a country's exports, yet it does not account for the country's potential in terms of size or competitive advantages. Export orientation indicators relate the volume of a country's apple juice exports to its domestic apple production, thereby providing insight into the significance of this product's export for the sector. The RCA (Revealed Comparative Advantage) index, in turn, compares a country's exports of apple juice to its exports of other products, relative to the same proportions on the global market. This offers the opportunity to examine competitiveness from three different perspectives.

The competitive position of AJC exports from the countries that are the largest suppliers of this product was measured using several indicators. These indicators include the Market Share (*MS*) index, the Gross and Net Export Orientation indices, and the Revealed Comparative Advantage (RCA) index.

Market Share (*MS*) is

$$MS = \frac{X_{ic}}{X_{iw}} \times 100\%$$

$X_{ic}$—is the export of product *i* from country *c*, and
$X_{iw}$ is the aggregated export of product *i* in the world or a group of countries.

An increase in *MS* is associated with an improvement in competitive position [48,74]. This indicator is often used to determine competitive position. Regarding agricultural products, it is important to be aware that export volumes can depend on yields, which are influenced by external factors (e.g., weather conditions) [49].

Gross and Net Export Orientation indices are

$$E_{gr} = \frac{E_{bc} \times W}{P_{jc}} \times 100\%, \ E_{net} = \frac{E_{nc} \times W}{P_{jc}} \times 100\%$$

$E_{gr}$ is the percentage of domestic apple production exported in the form of AJC from country *c*,
$E_{net}$ is the percentage of domestic apple production exported in the form of AJC, which was produced from domestically sourced raw material from country *c*,

$E_{bc}$ is the gross export volume of AJC from country $c$, and
$E_{nc}$ is the net export volume of AJC from country $c$.
$W$ is the conversion coefficient and
$P_j$ is the apple harvest in country $c$.

The coefficient $W$ represents how many kilograms of apples are required to produce one kilogram of apple juice concentrate (AJC). In studies, a coefficient of 7 is typically assumed. However, in practice, it can range from 6.5 to 8.6 kg, depending on the quality of the raw material [75]. An increasing export orientation ratio indicates growing competitiveness, as domestically produced goods find buyers abroad [5]. However, gross export orientation may overstate actual competitiveness when products are re-exported or rely heavily on imported components. In contrast, the net export orientation indicator offers a more accurate measure of the domestic sector's true contribution to foreign trade. The Revealed Comparative Advantage (RCA) index is

$$CA = \frac{X_{ic}}{X_{iw}} : \frac{X_{jc}}{X_{jw}}$$

$X_{jc}$ is the export of product group $j$ from country $c$, and
$X_{jw}$ is the export of product group $j$ in the world.

The indicator measures the comparative advantage of a country. It was developed in 1965 and Balassa is considered its creator [76]. The literature contains numerous scientific papers in which the RCA indicator has been applied. The Revealed Comparative Advantage (RCA) index has been particularly widely applied in studies of the agricultural sector [77]. A higher RCA value indicates greater international competitiveness of a country's product. The accepted range of values allows for the classification of countries according to their level of comparative advantage:

- 0 < RCA ≤ 1: no comparative advantage;
- 1 < RCA ≤ 2: weak comparative advantage;
- 2 < RCA ≤ 4: moderate comparative advantage;
- RCA > 4: strong comparative advantage [78].

The selection of the indicators used in this study was based on their effectiveness in capturing different dimensions of a country's competitive position in international trade. The Market Share (*MS*) Index, which measures the proportion of a country's exports relative to total world exports in a specific sector, normalizes export performance—unlike absolute export values—thus allowing for cross-country comparisons that are independent of economic size [79–81].

The Gross and Net Export Orientation Indices evaluate the degree of export dependence and the balance between exports and domestic sales. Compared to simple export ratios, these indices take into account both production and trade balance, offering a more nuanced perspective on trade dependence [80,82,83].

The RCA Index measures whether a country has a comparative advantage in a specific product or sector by comparing its export share in that product to the global export share. It is a widely used indicator in trade economics for assessing competitive strengths, as it focuses on actual trade flows, making it especially relevant for evaluating global competitiveness. However, the RCA has certain limitations. It is a descriptive rather than predictive measure. It considers only export performance, omitting import competition and domestic demand. Additionally, the index is sensitive to trade policies and external market distortions [84].

Taken together, the indicators used in this paper measure both absolute and relative competitiveness, trade orientation, and comparative advantage, providing a comprehen-

sive and multi-dimensional evaluation. Unlike raw export figures, these indicators adjust for global trade dynamics, enabling more meaningful cross-country and cross-sector comparisons. Their widespread use in economic research and policy analysis also ensures that the results are both robust and interpretable.

To explore the relationships between the selected competitiveness indicators and economic development measures, the Pearson linear correlation method was applied. This approach made it possible to assess the strength and direction of the associations between variables such as Export Share, Gross/Net Export Orientation, Revealed Comparative Advantage (RCA), Farm Gate Prices from the previous year (n − 1), and GDP per capita. The correlation coefficients were interpreted based on commonly accepted thresholds in the literature, distinguishing between no, weak, moderate, strong, and very strong correlations [85,86].

The article presents export volumes of the leading countries, followed by an assessment of the competitive position of each major exporter. The research section concludes with a correlation analysis of the selected indicators.

Data analysis and hypothesis testing in this study were carried out using SPSS version 25.

## 3. Results and Discussion

### 3.1. The Main Exporters

The global export volume of AJC decreased between 2005 and 2023. On average, the sales volume decline was 20,000 tons per year, assuming a linear trend function. In individual years, export fluctuations were significant, ranging from 3% to 18% year over year. The export volume is determined by the supply and demand for AJC. The export quantity is strongly correlated with AJC production [87]. In years of lower harvests, lower-quality apples and apples from orchards typically geared towards processing are used for production. In seasons with higher yields, apples that cannot be sold in the fresh market are also used for processing [49,88]. Therefore, lower harvests translate into reduced export capabilities. The variability of exports from individual countries was even greater (up to 165 pp) for smaller exporters within the group of the world's main suppliers.

Table 1 presents the countries that were the largest global exporters of AJC in recent years, ranked by sales volume in 2023. In 2023, these countries accounted for 91% of global AJC exports (Table 1). The largest exporters are currently enterprises from China, Poland, Turkey, and Ukraine, which accounted for 63% of the export volume in 2023. Throughout the study period, more than half of the export exchange came from the countries that are the largest global suppliers. Among these countries, the significance of China in terms of export volume has decreased, while that of Poland, Turkey, and Ukraine has increased. The research analyzed primarily those countries that are net exporters of AJC (like Moldova or Hungary).

**Table 1.** Export volume in selected countries (thousand tons). China's export competitiveness measures.

| Country/Year | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| World | 1758 | 1615 | 1858 | 1542 | 1633 | 1690 | 1430 | 1473 | 1583 | 1490 | 1544 | 1333 | 1569 | 1513 | 1462 | 1260 | 1407 | 1520 | 1261 |
| China | 647 | 672 | 1031 | 684 | 795 | 784 | 609 | 587 | 598 | 456 | 474 | 401 | 655 | 558 | 386 | 420 | 419 | 399 | 268 |
| Poland | 203 | 207 | 145 | 208 | 208 | 191 | 165 | 233 | 263 | 259 | 286 | 286 | 215 | 241 | 349 | 209 | 227 | 314 | 273 |
| Turkey | 55 | 40 | 40 | 20 | 35 | 59 | 53 | 38 | 59 | 68 | 71 | 66 | 87 | 95 | 112 | 136 | 201 | 197 | 167 |
| Ukraine | N/A | N/A | N/A | 25 | 44 | 57 | 30 | 79 | 111 | 99 | 100 | 56 | 60 | 65 | 102 | 51 | 63 | 124 | 91 |
| Austria | 104 | 78 | 75 | 82 | 80 | 88 | 77 | 64 | 74 | 73 | 74 | 74 | 67 | 70 | 78 | 57 | 61 | 59 | 50 |
| Chile | 60 | 66 | 36 | 38 | 38 | 38 | 55 | 58 | 54 | 85 | 72 | 63 | 60 | 59 | 41 | 42 | 75 | 45 | 49 |
| Rep. of Moldova | 25 | 11 | 20 | 9 | 23 | 23 | 20 | 20 | 39 | 40 | 40 | 35 | 41 | 35 | 58 | 46 | 42 | 57 | 49 |
| USA | 15 | 19 | 17 | 10 | 10 | 16 | 23 | 13 | 13 | 19 | 21 | 18 | 21 | 21 | 22 | 19 | 32 | 37 | 28 |
| Hungary | 51 | 38 | 31 | 46 | 57 | 41 | 33 | 49 | 51 | 60 | 47 | 45 | 54 | 48 | 42 | 33 | 43 | 41 | 35 |
| Spain | 31 | 37 | 29 | 25 | 22 | 36 | 38 | 32 | 19 | 21 | 19 | 14 | 22 | 17 | 18 | 23 | 20 | 28 | 33 |
| Italy | 54 | 45 | 51 | 40 | 54 | 57 | 54 | 47 | 26 | 41 | 36 | 36 | 40 | 30 | 37 | 34 | 25 | 33 | 28 |

The largest decrease in exports was from China, averaging 26 thousand tons annually. In the peak year of 2007, China exported over 1 million tons of AJC, while in 2023 only 268 thousand tons were exported, causing China's export volume to no longer be the highest for the first time in history. This is due to the growth of domestic consumption of apples in China, as well as a gradual reduction in apple acreage across China observed in recent years. This upward trend aligns with the growing demand for healthy food options among China's expanding middle class. While fresh apples remain the primary choice, there is a notable rise in the consumption of processed apple products, such as juice and dried fruit [81]. Evidence of changes in consumption habits is provided by previous studies. These studies have observed not only an increase in domestic consumption in China but also the adoption of Western habits, including juice consumption [89–93]. When considering export volumes, it is important to recognize that China's production potential significantly exceeds that of the other countries analyzed.

In 2023, larger shipments came from Poland (273 thousand tons). Throughout the study period, an upward trend in exports was observed for Poland and Turkey. The increase was stronger for Turkey (an average of 8.4 thousand tons annually) than for Poland (5.7 thousand tons). An upward trend in exports was also observed for Ukraine and Moldova and the trend was insignificant in the USA, while a downward trend was noted in Austria. The export quantities from Chile, Hungary, and Spain were relatively stable and low compared to the largest exporters.

Throughout the entire period, the USA has been a net importer of concentrated apple juice (AJC) with imports significantly exceeding exports. The USA imported from countries with lower production costs. Initially, most of the volume came from China, while in recent years the main suppliers have been Turkey, China, Poland, Chile, and Ukraine [94]. The production of concentrated apple juice (AJC) in the USA has been declining for decades, while domestic demand has been increasing. This demand was met by more competitive (cheaper) imports from China, which eventually led to the imposition of tariffs on imports from China [95]. The competitiveness of the U.S. industry was lower and the process of domestic producers being pushed out of the market was not halted. Only the structure of imports changed, and this was not solely due to tariffs. Austria was a net importer of AJC for most of the time, except for 2010 and 2011 when it had a small export surplus. Despite being a smaller country with limited raw material, Austria hosted one of the largest global AJC companies, with production facilities in several countries (Poland, Germany, Romania, Ukraine, and China). Initially, part of the AJC export produced in other countries was carried out through Austria (re-export), after achieving the required quality parameters (e.g., color, clarity) [88,96]. In recent years, re-exports from Austria have declined. This could be due to the achievement of higher quality standards at the production subsidiaries or economic factors, such as lower costs. Spain was not a significant net exporter. In some years, the balance of exports and imports was negative.

### 3.2. Competitiveness Measures in Selected Countries

From China, the largest producer and exporter (by 2022) of AJC, the product is sold to over 60 countries, including the USA, South Africa, Russia, Japan, and Australia [56]. In 2023, China exported to 69 countries. The main recipients of Chinese concentrate were the USA (21%), South Africa (17%), Japan (16%), Australia (10%), Canada (10%), and Turkey (7.5%). Only 2% of the export volume from China was sold to Russia and 1.7% to Germany. Smaller quantities of the product were sent to the remaining 61 recipient countries [97] (Figure 1).
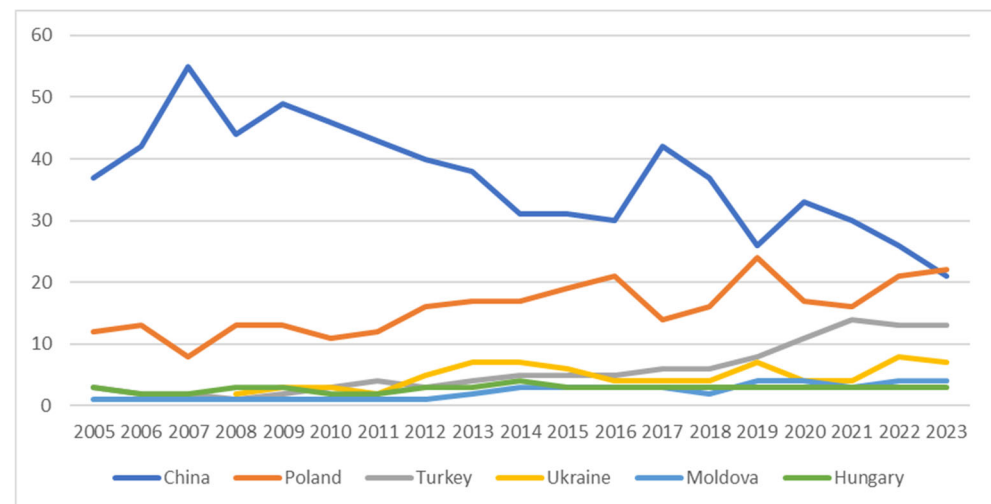
**Figure 1.** AJC export volume.

The competitive position of AJC exports from China declined during the analyzed period (Table 2). This is evidenced by the values of all the adopted indicators. The share in the volume of world exports reached its highest value (55%) in 2007, after which a downward trend began. In the last years of the analyzed period, China's export share fell below 30%, and in 2023 it was only 21% of global turnover. Similarly, the export orientation index decreased. It is worth noting that both the gross and net indices for China had the same values, indicating that AJC imports in China play a minor role relative to domestic production. The maximum values of the E indices reached 25% in 2007, and the minimum values were just under 6% in 2023. Therefore, the export of apples processed into AJC currently constitutes a relatively small percentage of apple harvests in China. Likewise, the comparative advantages of AJC exports from China have been declining. Until 2010, RCA values were >4, indicating that exports from China had strong comparative advantages. From 2010 to 2018, the advantages were average, and since 2019 they have been weak. The decline in the competitive position of China's exports is attributable to multiple factors. Among the most significant are political influences, such as the increase in tariffs introduced in 2019 as a result of the escalating trade war between China and the United States. The improved performance of Chinese exports in the 2017/2018 season was the result of favorable conditions in the international market. In Poland—the world's second-largest exporter—catastrophically low apple yields in 2017 led to reduced AJC production and higher prices, creating an opportunity for Chinese exporters to increase sales at more favorable prices.

**Table 2.** China's export competitiveness measures.

| Indicator/Year | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *MS* | 37 | 42 | 55 | 44 | 49 | 46 | 43 | 40 | 38 | 31 | 31 | 30 | 42 | 37 | 26 | 33 | 30 | 26 | 21 |
| $E_{gr}$ | 18.9 | 18.0 | 25.9 | 16.0 | 17.6 | 16.5 | 11.9 | 10.7 | 10.5 | 7.8 | 8.5 | 6.9 | 11.1 | 10.0 | 6.4 | 6.7 | 6.4 | 5.9 | N/A |
| $E_{net}$ | 18.9 | 18.0 | 25.9 | 16.0 | 17.6 | 16.5 | 11.9 | 10.7 | 10.5 | 7.8 | 8.5 | 6.9 | 11.1 | 10.0 | 6.3 | 6.4 | 6.4 | 5.9 | N/A |
| RCA | 4.3 | 4.4 | 5.5 | 4.7 | 4.2 | 4.0 | 3.7 | 3.5 | 2.9 | 2.3 | 2.3 | 2.5 | 2.8 | 2.4 | 1.9 | 1.9 | 1.6 | 1.5 | 1.3 |
| Average price in USD/1 | 0.71 | 0.88 | 1.20 | 1.64 | 0.81 | 0.94 | 1.76 | 1.92 | 1.50 | 1.39 | 1.18 | 1.36 | 0.99 | 1.11 | 1.10 | 1.03 | 1.02 | 1.16 | 1.65 |

In China, apples are cultivated on the largest area among fruits and have the highest production value, serving as the main source of income for farmers in two primary apple-producing regions: the Bohai Gulf region and the Loess Plateau region [98]. It was predicted that the production and export of apples from China would increase and the industry would be strong [99]. Scientists' predictions regarding exports were rather overlooked, as it was unclear in which direction the market situation would develop. Some pointed out that

domestic demand for AJC in China was increasing, which could lead to a decrease in exports, and attention was drawn to the growing importance of the fresh apple market in China, which is more profitable for apple producers [49,88]. The competitiveness of apple production in China, as demonstrated by previous studies, is varied. The Shanxi and Gansu provinces have shown an increase in indicators considered measures of production competitiveness, as these regions are located in areas with favorable natural conditions. Additionally, there has been technological and scientific progress [100], which can effectively improve the supply chain [101]. Other apple-producing regions in China have exhibited poorer performance [100]. It has been demonstrated that a higher level of scientific and technological innovation in agriculture leads to more significant economic growth and sustainable agricultural development [102].

The large potential of the Chinese market does not exclude problems, as orchardists in the country face sharp fluctuations in purchase prices and, consequently, unstable incomes. In China, a significant portion of apple production takes place on small-scale farms, which additionally results in high transaction costs, limited market access, and restricted access to technology and credit services [103]. This makes it difficult for apple producers to alleviate poverty [104].

Exports from China, during their period of high competitiveness, faced trade barriers. The large share of drops and damaged fruits destined for juice production in China led to an increase in patulin content, which prompted the European Union to impose import restrictions from this country [49]. The large raw-material base, combined with the limited apple-processing capacity in China, resulted in apples often being stored for too long, leading to spoilage and making it impossible to guarantee high quality [105]. Anti-dumping tariffs were imposed by the United States [90].

It is possible that the export of AJC (concentrated apple juice) from China will continue to decline and that its competitiveness in the global market will decrease due to changes in the Chinese economy. This should not be interpreted negatively, as AJC is a semi-finished product, the export of which brings less profit compared to trading in dessert apples and industrial products, especially high-tech ones. The increase in domestic demand for juices and dessert fruits in China, as well as the increase in the export of fresh apples, seems more beneficial for the economy, especially for agricultural producers.

However, it is not excluded that the export of AJC from China will be higher in the coming years, as this will depend on several factors. Firstly, it will depend on the size of apple harvests, which vary from year to year. In the case of good yields, higher production and thus increased exports are possible. Secondly, it will depend on the capacity of the domestic and external markets. The global economic situation, especially in the markets of the main recipients of AJC and dessert apples, will also be significant. Economic policy will also be important. Particularly in the current geopolitical situation, difficulties such as increased tariffs or non-tariff barriers, as well as a decrease in purchasing power in some main markets for AJC (USA, Russia), are possible. It is also possible that the demand for AJC will be reduced in other major markets (e.g., Germany) due to changes in consumption patterns, such as the further increase in the consumption of NFC (not from concentrate) juices.

During the studied period, the competitive position of AJC exports from Poland, measured by Poland's share in global trade, increased (Table 3). However, competitiveness measured by export orientation indicators and RCA declined. Throughout the entire period, AJC exports from Poland were characterized by high competitive advantages (RCA from 11 to 19), but with a slight downward trend. The E indicators also declined slightly but remained at a high level. The average $E_{gr}$ was 59%, and $E_{net}$ was 47%. This significant difference indicates that companies in Poland imported AJC from other countries. The

imported product was often re-exported. The reason for the imports was most often the lower prices of imported AJC [88]. To Poland, AJC was mainly imported from Ukraine and Moldova [106]. The import of AJC results from the declining competitiveness of domestic production due to rising costs, combined with relatively strong export potential in global markets and the expansion strategies of AJC-producing entities operating in Poland. The international trade networks of companies based in Poland facilitate the handling of imported AJC, which in turn contributes to an increase in Poland's net exports.

**Table 3.** Poland's export competitiveness measures.

| Country/Year | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| $MS$ | 12 | 13 | 8 | 13 | 13 | 11 | 12 | 16 | 17 | 17 | 19 | 21 | 14 | 16 | 24 | 17 | 16 | 21 | 22 |
| $E_{gr}$ | 68 | 63 | 97 | 51 | 56 | 71 | 46 | 57 | 60 | 57 | 63 | 56 | 62 | 42 | 79 | 41 | 39 | 51 | N/A |
| $E_{net}$ | 68 | 58 | 70 | 47 | 47 | 54 | 34 | 44 | 39 | 39 | 47 | 45 | 42 | 34 | 67 | 32 | 33 | 42 | N/A |
| RCA | 18.8 | 19.2 | 10.7 | 12.2 | 12.7 | 12.1 | 12.9 | 15.7 | 16.9 | 14.8 | 13.9 | 16.6 | 11.2 | 13.6 | 15.7 | 12.5 | 12.0 | 13.2 | 12.6 |
| Average price in USD/1 | 1.16 | 1.42 | 1.89 | 1.69 | 1.07 | 1.17 | 2.23 | 1.92 | 1.83 | 1.41 | 1.02 | 1.20 | 1.20 | 1.53 | 1.01 | 1.36 | 1.37 | 1.28 | 1.65 |

Poland is the largest apple producer in the European Union and ranks among the top global producers after China, the USA, and Turkey [107]. Apple harvests in Poland have been increasing [108], while consumption has been declining [55,88]. For Polish producers, it is important to acquire new markets and offer apple varieties that meet high consumer demands [109,110], both in fresh and processed forms. The increase in apple production in Poland and problems with marketing the crops in the fresh market led to a rise in the production and export of AJC from Poland. The export orientation index showed a downward trend, but this was due to the growing importance other forms of apple processing. The share of apples directed to processing increased, but the percentage of apples intended for the production of NFC and other applications also grew [106]. A significant portion of NFC juices was also exported, mainly to EU countries, similar to AJC. The main recipient of AJC from Poland throughout the study period was Germany, but the share of sales to this country decreased from over 70% at the beginning of the study period to around 30% in recent years. Meanwhile, the importance of exports to other European countries and the USA increased [97].

The competitive position of AJC exports from Turkey increased during the studied period. Since 2008, the share of AJC supplies from Turkey has systematically grown, exceeding 13% of the global volume in recent years (Table 4). Similarly, export orientation indicators have risen, approaching around 30% in the case of $E_{gr}$ and 20% in the case of $E_{net}$. Turkey also imported AJC, hence the differences between gross and net indicators. Imports mainly came from Iran, China, and Ukraine [97]. The RCA indicator in the early years of the study period fluctuated from weak to strong comparative advantages (RCA from 1.9 to 5.1), but since 2013, it has shown values indicative of strong comparative advantages for Turkey's exports.

**Table 4.** Turkey's export competitiveness measures.

| Country/Year | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| $MS$ | 3 | 2 | 2 | 1 | 2 | 3 | 4 | 3 | 4 | 5 | 5 | 5 | 6 | 6 | 8 | 11 | 14 | 13 | 13 |
| $E_{gr}$ | 15 | 14 | 11 | 6 | 9 | 16 | 14 | 9 | 13 | 19 | 19 | 16 | 20 | 18 | 22 | 22 | 31 | 29 | N/A |
| $E_{net}$ | 15 | 13 | 10 | 5 | 7 | 13 | 13 | 7 | 10 | 15 | 12 | 14 | 13 | 14 | 13 | 16 | 20 | 19 | N/A |
| RCA | 4.5 | 3.5 | 4.1 | 1.9 | 2.8 | 6.0 | 5.1 | 3.1 | 4.5 | 5.4 | 5.7 | 5.6 | 6.6 | 7.6 | 9.2 | 12.2 | 15.3 | 14.8 | 12.7 |
| Average price in USD/1 | 0.85 | 1.07 | 2.05 | 2.10 | 1.05 | 1.37 | 1.96 | 1.99 | 1.71 | 1.52 | 1.30 | 1.33 | 1.30 | 1.46 | 1.33 | 1.37 | 1.41 | 1.68 | 1.96 |

Turkey is characterized by favorable conditions for fruit cultivation and is one of the largest producers of species such as hazelnuts, pistachios, walnuts, apples, pears, quinces, apricots, and sweet and sour cherries [111]. In reference to apples, the climate is more conducive to the production of sweet varieties, which results in lower acidity in the produced juice. This is sometimes perceived as a drawback, although there are also

markets that value apple juice with lower acidity, such as the USA [49]. The upward trend in exports from Turkey is expected to continue, along with the maintenance of high competitiveness, as the current geopolitical and economic conditions are favorable for producers from this country.

The export of AJC from Ukraine was competitive during the studied period. An increase in all competitiveness indicators was noted (Table 5). The share of Ukrainian supplies in the global AJC trade increased to 7% in 2023. The export orientation index showed an upward trend, although it was highly varied, ranging from several percent in the case of $E_{net}$ to 76% in 2022. This may result from less systematic AJC sales from Ukraine and fluctuations in harvests. The indicators of net and gross export orientation were very similar in some years, while in others they reached several percent (e.g., 11% in 2008), which can be linked to lower harvests in this country caused by weather conditions. Some entities producing AJC in Ukraine have their branches in Moldova, from where (along with China) AJC was imported to Ukraine [97], which undoubtedly had an impact on the volume of trade between the countries. The export of AJC from Ukraine throughout the entire period was characterized by high and growing comparative advantages. The RCA index reached 43 in 2022 and 39 in 2023.

**Table 5.** Ukraine's export competitiveness measures.

| Country/Year | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| $MS$ | N/A | N/A | N/A | 2 | 3 | 3 | 2 | 5 | 7 | 7 | 6 | 4 | 4 | 4 | 7 | 4 | 4 | 8 | 7 |
| $E_{gr}$ | N/A | N/A | N/A | 25 | 36 | 45 | 22 | 49 | 64 | 64 | 59 | 35 | 39 | 31 | 62 | 32 | 34 | 77 | N/A |
| $E_{net}$ | N/A | N/A | N/A | 14 | 28 | 39 | 16 | 48 | 63 | 64 | 59 | 35 | 35 | 28 | 60 | 28 | 31 | 76 | N/A |
| RCA | N/A | N/A | N/A | 4.3 | 6.5 | 10.0 | 5.7 | 14.0 | 24.3 | 25.5 | 24.3 | 11.9 | 15.0 | 13.3 | 21.9 | 13.7 | 15.2 | 42.7 | 39.3 |
| Average price in USD/l | N/A | N/A | N/A | 1.91 | 0.75 | 1.06 | 1.96 | 1.92 | 1.94 | 1.59 | 1.01 | 0.82 | 1.13 | 1.00 | 0.96 | 1.19 | 1.30 | 1.35 | 1.57 |

The competitive position of AJC exports from Moldova increased the most significantly. All indicators showed an upward trend. The share in global trade reached 4% of the volume, the export orientation indices approached 90%, and the comparative advantage index was the highest among the studied countries and also showed an upward trend (Table 6). The RCA index ranged from 81 to 202. Imports to Moldova were low, which is why the export orientation indices were similar. Throughout the entire study period, the selling prices of AJC from this country were among the lowest.

**Table 6.** Moldova's export competitiveness measures.

| Country/Year | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| $MS$ | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 3 | 3 | 3 | 3 | 2 | 4 | 4 | 3 | 4 | 4 |
| $E_{gr}$ | 62 | 39 | 65 | 24 | 78 | 77 | 52 | 50 | 89 | 76 | 90 | 60 | 59 | 37 | 67 | 68 | 46 | 89 | N/A |
| $E_{net}$ | 59 | 35 | 60 | 23 | 77 | 76 | 52 | 50 | 88 | 76 | 90 | 60 | 58 | 37 | 67 | 67 | 45 | 88 | N/A |
| RCA | 120.6 | 80.9 | 164.6 | 47.1 | 89.3 | 108.6 | 95.3 | 90.1 | 140.7 | 126.9 | 153.2 | 112.7 | 199.2 | 97.5 | 188.8 | 202.4 | 172.1 | 174.1 | 169.3 |
| Average price in USD/l | 0.75 | 1.06 | 2.01 | 1.43 | 0.63 | 0.87 | 1.59 | 1.53 | 1.23 | 0.85 | 0.83 | 0.69 | 1.22 | 0.78 | 0.80 | 0.97 | 1.05 | 1.18 | 1.42 |

The gradual consolidation of Moldova's position on the international AJC market is primarily due to the relatively low export prices of this product. This is due to low labor costs and lower burdens than in EU countries resulting from the need to apply restrictive environmental standards. It is worth emphasizing that in the adopted research period Moldova systematically increased AJC supplies to the European Common Market. Despite the small area of the country, Moldova has conditions favorable to the development of fruit growing, including both favorable climatic conditions and rich resources of fertile land. Therefore, a further increase in the harvest of apples intended for AJC production can be expected, especially since the production of apples for processing is easier than for dessert apples. In terms of profitability, it is a less risky direction than the production of dessert apples. The quantity of apples directed for processing in Moldova is among the highest in the world. In the case of Moldova, such high indicators result, on the one hand, from the

country's small size and, on the other, from the relatively high significance of AJC exports in relation to its overall export structure.

The competitive position of AJC exports from Hungary can be considered stable during the studied period. A significant part of apple harvests in Hungary is allocated for processing, and a slight upward trend was noted in this regard. On average, over half of the national harvest was exported in the form of AJC, although the values varied depending on the year. AJC exports from Hungary (except for the years 2007 and 2008) had strong comparative advantages, but the RCA values were not high (ranging from 2.8 to 6.6) (Table 7).

**Table 7.** Hungary export competitiveness measures.

| Country/Year | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| MS | 3 | 2 | 2 | 3 | 3 | 2 | 2 | 3 | 3 | 4 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| $E_{gr}$ | 70 | 50 | 37 | 56 | 69 | 58 | 78 | 53 | 60 | 54 | 65 | 64 | 79 | 49 | 59 | 59 | 58 | 83 | N/A |
| $E_{net}$ | 56 | 42 | 21 | 52 | 63 | 54 | 63 | 51 | 54 | 52 | 57 | 55 | 74 | 44 | 51 | 51 | 50 | 62 | N/A |
| RCA | 5.4 | 5.1 | 2.8 | 3.2 | 5.3 | 4.5 | 4.0 | 5.3 | 5.4 | 6.6 | 4.3 | 5.3 | 5.4 | 5.5 | 4.7 | 4.3 | 5.2 | 4.1 | 4.1 |
| Price | 0.93 | 1.40 | 1.60 | 1.29 | 0.99 | 1.22 | 2.04 | 1.76 | 1.62 | 1.41 | 0.98 | 1.26 | 1.18 | 1.46 | 1.20 | 1.40 | 1.40 | 1.33 | 1.84 |

The competitive position of the food industry in the European Union (and not only the European Union) is mainly determined by labor productivity, and to a lesser extent by production potential and labor costs [15]. Labor costs and other factors, however, influence competitiveness, which is why countries with lower costs are advantaged. The production of AJC is not complicated. The production technologies are available, so with comparable efficiency, other costs can play a significant role in shaping competitiveness. Apple prices, the raw material for AJC production, are particularly important. In countries where it is possible to produce cheaper apples, there is a greater likelihood of gaining greater advantages over competitors. From this perspective, the level of development of the country and the availability of relatively cheaper production factors and means of production, such as mineral fertilizers, play a significant role. Lower costs allow for offering cheaper AJC, which translates into a competitive position. This can be seen in the example of exports from Moldova, where the export prices of AJC were the lowest among the studied countries. Lower AJC prices impact competitiveness, as demonstrated in earlier studies [49]. In the case of semi-finished products with standardized parameters, prices play a significant role in shaping competitiveness. Exchange rates also affect export competitiveness [15], which has also been confirmed in the context of the AJC market [49].

Analyses of the competitiveness of countries are subject to certain limitations. As Porter stated, it is companies that compete, not nations or states [112]. This is similar in the case of AJC. In today's globalized world, the connections between countries are complex. Several international entities operate in the AJC market. There are companies that produce in China and Poland, or in Austria and other EU countries, as well as in Ukraine and China simultaneously. However, the competitive conditions between these entities are determined by the natural and economic conditions in specific countries. Countries and economic groups are also subject to trade policies that affect export competitiveness. The article mentions examples of anti-dumping duties and non-tariff barriers that were introduced, disrupting the freedom of competition. Non-tariff restrictions are particularly significant, as it is often difficult to determine whether they are barriers or measures serving other purposes, such as food safety.

In the case of the AJC market, restrictions were often imposed due to the occurrence of harmful substances, mainly patulin, which has a proven negative impact on health [113] and is relatively frequently found in excess in AJC and other apple products [114]. One may ask whether it is fair to impose restrictions on a country for detecting harmful substances in excess. Perhaps restrictions should apply to businesses. Monitoring food safety is very important, but using it as a trade policy is debatable. The same applies to the use

of plant protection products and their residues. Monitoring apples for the quantity and level of pesticide residues and to provide information to exporters and regulators to ensure timely actions for the safe use of pesticides [115] is also an important issue to avoid trade restrictions. The range of trade restrictions that affect international trade, and thus competitiveness [116], is very large [117], making it difficult in the case of global-trade analysis to precisely understand the requirements between individual countries and groups, which is also a major limitation when using econometric modeling. Protectionism slows the growth and development of the agricultural sector [118].

In most countries, fruit farming is fragmented, which significantly affects the bargaining power of producers. The opposite situation is seen in the fresh apple market, where there is a higher degree of supply concentration, either around producer organizations, as in the European Union countries, or around trading companies, as in the Southern Hemisphere countries (New Zealand, Chile, etc.) [49]. Therefore, the fruit juice industry is a source of income for many, mostly small-scale farmers.

A limitation of the study was that the analyses were conducted on an annual basis. During the course of working on the article, a gap was identified—namely, the lack of studies on price volatility in the AJC market. The authors also did not examine trade policy, which has recently gained importance due to increasingly protectionist measures. This is an issue worth addressing in the future, both in relation to AJC and other agricultural products. It is a topic that should be explored in future research.

The authors believe that further analyses are needed to monitor the AJC market and determine the competitiveness of exports from countries. Currently, this market is in a situation where it is difficult to predict future trends with high probability. A difficult but necessary topic seems to be the analysis of barriers in the AJC trade. In the context of environmental research, it seems interesting to determine and compare the energy consumption and emissions of exporting fresh apples and AJC. Fruit juice producers are observing increasing requirements related to sustainable production (environmental/social/economic). They indicate that consumers are the main driving force behind the implementation of sustainable development measures [119].

### 3.3. Assessment of the Relationship Between Selected Competitiveness Indicators

Based on the conducted analysis, a strong positive correlation between Export Share and GDP per capita was observed in Moldova and Poland, whereas in the case of China, this correlation was negative (Table 8). This indicates that despite the increase in GDP per capita, the export position of the first two countries in the context of the AJC has not diminished in significance. The positive correlation observed in the case of Moldova can be attributed to the fact that the country primarily operates in the international market as a supplier of low-cost raw materials to EU countries. Consequently, rising household income does not lead to increased domestic apple consumption, but rather serves as a basis for investments aimed at improving national infrastructure and expanding the raw-material base. In the case of Poland, domestic demand for apples has remained stable for many years. However, through sustained investment in the development of its raw material base, Poland has become one of the key suppliers of apple juice concentrate (AJC) to international markets. In contrast, in China, with the growing affluence of society, the country's importance in AJC exports has declined. It is noteworthy that the correlation between Export Orientation and GDP per capita in China was strongly negative, which can be explained by the decreasing significance of AJC exports alongside improvements in the economic conditions of the population. However, a declining share of exports in production does not necessarily imply a loss of competitiveness among sector entities, especially if it becomes more profitable for producers to supply these goods to an increasingly absorptive

domestic market. A similar interpretation can be applied to the relatively strong negative correlation between these indicators observed in Poland. Interestingly, a weak negative correlation was also found in the case of Moldova.

**Table 8.** Correlations of selected competitiveness measures.

| Country | Export Share & GDP per Capita | Export Orientation & GDP per Capita | Export Orientation & RCA | Farm Gate Prices $(n-1)$ & RCA | GDP Per Capita & RCA |
|---|---|---|---|---|---|
| Moldova | 0.678 (Strong Positive) | −0.169 (Brutto), −0.179 (Netto) (Weak Negative) | 0.302 (Brutto), 0.295 (Netto) (Weak Positive) | 0.224 (Weak Positive) | 0.51 (Moderate Positive) |
| Hungary | 0.017 (Very Weak) | 0.088 (Brutto), 0.022 (Netto) (Very Weak) | 0.104 (Brutto), 0.335 (Netto) (Weak Positive) | 0.286 (Weak Positive) | −0.181 (Weak Negative) |
| Poland | 0.603 (Moderate Positive) | −0.506 (Brutto), −0.616 (Netto) (Moderate Negative) | 0.067 (Brutto), 0.288 (Netto) (Weak Positive) | 0.450 (Moderate Positive) | −0.502 (Moderate Negative) |
| Turkey | −0.001 (No Correlation) | −0.105 (Brutto), −0.228 (Netto) (Weak Negative) | 0.936 (Brutto), 0.840 (Netto) (Strong Positive) | −0.629 (Moderate Negative) | −0.056 (Very Weak) |
| Ukraine | 0.323 (Weak Positive) | 0.306 (Brutto), 0.260 (Netto) (Weak Positive) | 0.920 (Brutto), 0.938 (Netto) (Strong Positive) | −0.357 (Weak Negative) | 0.307 (Weak Positive) |
| China | −0.747 (Strong Negative) | −0.879 (Brutto), −0.879 (Netto) (Very Strong Negative) | 0.951 (Brutto), 0.951 (Netto) (Very Strong Positive) | −0.067 (Weak Negative) | −0.946 (Strong Negative) |

Considering the correlation between Export Orientation and RCA (Revealed Comparative Advantage), a strong positive relationship between these indicators was found in Turkey and Ukraine, while in Poland, Moldova, and Hungary, it was relatively weak. This suggests a significant export potential in the first two countries, underpinned by the achievement of high comparative advantages. It is also worth noting that, despite the strong positive correlation between Export Orientation and RCA in China, the country's role in AJC exports has declined in recent years due to increased domestic demand resulting from the dynamic growth of societal wealth—this is reflected in the decreasing values of the correlated indicators.

An analysis of the correlation between apple procurement prices in the preceding year and the Revealed Comparative Advantage (RCA) in the subsequent year generally did not indicate the presence of strong relationships among the countries included in the study. Only in the case of Turkey was a moderate negative correlation observed, which may suggest that an increase in apple procurement prices could contribute to a decline in the revealed comparative advantage. In Poland, however, the rise in apple procurement prices did not result in a deterioration of the RCA indicator. This phenomenon may be attributed to increased demand for apple concentrate, which likely exerted upward pressure on the price of raw material for production.

It is important to note that in countries located in the northern hemisphere, apple harvests from a given year are largely exported in the following year. Interestingly, in both China and Poland, a negative relationship can be observed between rising levels of societal affluence and RCA in the apple sector. Conversely, in Moldova, an economically less developed country, this effect appears to be reversed.

Significantly weaker correlations between these variables were recorded in Ukraine, as well as in Hungary and Turkey. These findings support the hypothesis that economic

development and growing societal wealth tend to diminish a country's competitive position in the apple juice concentrate (AJC) sector. In such cases, other sectors—typically more technologically advanced—gain in importance and competitive standing, with China serving as a notable example. The situation is different in Moldova, where economic development is at a lower level compared to the fastest-growing economies. In this case, the export of relatively inexpensive AJC has increased, which is why the correlation between GDP and RCA was positive. However, even in the case of Moldova, a global trend becomes evident: economic development—understood more broadly than just economic growth—is associated with a decline in the share of raw material exports in the total value of foreign sales.

## 4. Conclusions

During the studied period, significant changes occurred in the competitiveness of AJC exports. The upward trend in AJC exports and competitiveness from China has reversed. For the first time in 2023, China's export volume was not the largest among the main exporters. Export orientation indicators decreased and comparative advantage indices dropped from strong in 2005–2009 to weak in 2019–2023. During the studied period, the competitive position of AJC exports from Poland, measured by its share in world trade, increased, but the export orientation and RCA indices declined. AJC exports from Poland were characterized by high competitive advantages. The export orientation indicators were at a high level, although the importance of imports from Ukraine and Moldova grew. A rise in the competitiveness of AJC exports from Ukraine was recorded, measured by all indicators. The exports were characterized by strong comparative advantages, but not as significant as in the case of Moldova, where the largest increase in AJC sales competitiveness was observed. Moldova's share in global trade increased, but it remained low due to relatively small production capacities compared to other exporters. The competitiveness of AJC exports from Turkey increased, reaching 13% of the global volume and strong comparative advantages. The importance of imports from Iran, China, and Ukraine also grew in Turkey. Despite the observed decline in China's significance in exports, the global market situation will depend on the development of production and exports in this country. A continuation of the downward trend in AJC exports from China will be a stimulus for export development from minor countries, especially with an already-developed market base such as Ukraine, Moldova, or Poland.

Based on the data analysis, a strong positive correlation was identified between the share of exports and GDP per capita in Moldova and Poland, suggesting that increasing affluence in these countries does not adversely affect their export position in the apple juice concentrate (AJC) sector. In contrast, a negative correlation was observed in China, which may indicate a declining significance of AJC exports as societal wealth increases. Nevertheless, a decrease in export share does not necessarily imply a loss of sectoral competitiveness if producers prioritize sales within a growing domestic market—a phenomenon also observed in Poland.

With regard to the relationship between the export orientation index and RCA, a strong positive correlation was found in Turkey, Ukraine, and China, indicating high levels of comparative advantage. Conversely, this relationship was weaker in Poland, Moldova, and Hungary.

The analysis of the impact of apple procurement prices on RCA revealed no strong correlations in most of the examined countries, except for a moderate negative correlation observed in Turkey. In the case of Poland, rising procurement prices did not have a detrimental effect on RCA, which may be attributed to increased demand for apple concentrate.

Furthermore, in both China and Poland, rising levels of societal affluence are negatively correlated with the RCA level for apples, whereas in Moldova this relationship is positive. Weaker correlations were found in Ukraine, Hungary, and Turkey.

Overall, these findings support the conclusion that increasing economic development and societal wealth may lead to a decline in the competitiveness of the AJC sector, while simultaneously reinforcing the position of other, typically more technologically advanced sectors—China being a prominent example.

This creates an opportunity for producers from less developed countries, such as Moldova, as well as others where production may still be in its early stages, to enter the AJC market. In the case of Moldova, investment in processing infrastructure may represent a significant barrier that could limit the scale of growth in both the volume and competitive position of AJC exports from the country. This barrier could potentially be overcome with the involvement of foreign capital; however, such a solution carries certain drawbacks for the domestic economy. Although investments in technological lines for AJC production are relatively costly, historical examples from countries like Poland and Hungary show that international corporations often invest in processing facilities, while local farmers supply the raw material. This model may represent a significant opportunity for the development of production and income growth among farmers in less affluent countries.

To maintain export competitiveness, it is necessary to minimize production costs; however, this often conflicts with the interests of apple growers. While food security should be an important consideration, it should not be the sole criterion in shaping trade policy, as this may distort global economic processes. In the context of climate policy and environmental sustainability, trade in AJC appears to be more favorable. The export of fresh apples or NFC juice requires greater energy inputs for refrigeration and the transportation of heavier volumes.

**Author Contributions:** Conceptualization, P.K.; methodology, P.K. and Ł.Z.; software, P.K., P.S. and Ł.Z.; validation, P.K. and Ł.Z.; formal analysis, P.K., P.S. and Ł.Z.; investigation, P.K. and P.S.; resources, P.K. and Ł.Z.; data curation, P.S. and P.K.; writing—original draft preparation, P.K.; writing—review and editing, P.K., P.S. and Ł.Z.; visualization, P.S. and P.K.; supervision, P.K., P.S. and Ł.Z.; project administration, P.K. and P.S.; funding acquisition, P.S. and Ł.Z. All authors have read and agreed to the published version of the manuscript.

**Institutional Review Board Statement:** Not applicable.

**Data Availability Statement:** The data is contained within the article.

**Conflicts of Interest:** The authors declare no conflicts of interest.

## References

1. Duong, T.T.; Brewer, T.; Luck, J.; Zander, K. A Global Review of Farmers' Perceptions of Agricultural Risks and Risk Management Strategies. *Agriculture* **2019**, *9*, 10. [CrossRef]
2. Pawlak, K.; Poczta, W. Twenty Years of Poland's EU Membership: What Is Progress in the Agri-Food Sector? *Agriculture* **2025**, *15*, 49. [CrossRef]
3. UN Comtrade. Available online: https://comtradeplus.un.org/TradeFlow (accessed on 30 March 2025).
4. Grauwe, P.D. *Dimensions of Competitiveness*; Grauwe, P.D., Ed.; MIT Press: Cambridge, MA, USA; London, UK, 2010.
5. Krugman, P. Competitiveness—A Dangerous Obsession. *Foreign Aff.* **1994**, *73*, 28–44. [CrossRef]
6. Waheeduzzaman, A.N.M.; Ryans, J.K. Definition, perspectives, and understanding of international competitiveness: A quest for a common ground. *Compet. Rev. Int. Bus. J.* **1996**, *6*, 7–26. [CrossRef]
7. Gorynia, M. Teoretyczne Aspekty Konkurencyjności. In *Kompendium Wiedzy o Konkurencyjności*; Łaźniewska, E.G.M., Ed.; Polish Scientific Publishers PWN: Warsaw, Poland, 2008; pp. 48–99.

8.	Kraciński, P. The competitive position of concentrated apple juice exported from Poland. *Ann. Pol. Assoc. Agric. Agribus. Econ.* **2023**, *XXV*, 161–172. [CrossRef]

9.	Mizik, T. Agri-Food Trade Competitiveness: A Review of the Literature. *Sustainability* **2021**, *13*, 11235. [CrossRef]

10.	Olczyk, M. *Konkurencyjność—Teoria i Praktyka*, 1st ed.; CEDEWU: Warsaw, Poland, 2008.

11.	Javed, I.; Bakhsh, A.; Razzaq, A.; Yasin, M.; Rehman, A.; Mustafa, G. Pakistani Basmati Competitiveness in International Markets and its Macroeconomic Factors. *Sarhad J. Agric.* **2020**, *35*, 303. [CrossRef]

12.	Ko, Y.; Chung, Y.; Seo, H. Coopetition for Sustainable Competitiveness: R&D Collaboration in Perspective of Productivity. *Sustainability* **2020**, *12*, 7993. [CrossRef]

13.	Koprivnjak, T.; Oberman Peterka, S. Business Model as a Base for Building Firms' Competitiveness. *Sustainability* **2020**, *12*, 9278. [CrossRef]

14.	Čamaj, J.; Brumerčíková, E.; Hranický, M.P. Information System and Technology Optimization as a Tool for Ensuring the Competitiveness of a Railway Undertaking—Case Study. *Sustainability* **2020**, *12*, 8915. [CrossRef]

15.	Łukiewska, K.; Juchniewicz, M. Identification of the Relationships between Competitive Potential and Competitive Position of the Food Industry in the European Union. *Sustainability* **2021**, *13*, 4160. [CrossRef]

16.	Lugo-Arias, E.; Lugo-Arias, J.; Vargas, S.B.; de la Puente Pacheco, M.A.; Granados, I.B.; Heras, C.B.; Triana Hernández, D. Determinants of the Competitiveness of World Palm Oil Exports: A Cointegration Analysis. *Transnatl. Corp. Rev.* **2024**, *16*, 200063. [CrossRef]

17.	Samuelson, P.A. Prices of Factors and Good in General Equilibrium. *Rev. Econ. Stud.* **1953**, *21*, 1–20. [CrossRef]

18.	Deb, K.; Basu, P. Indices of Revealed Comparative Advantage and Their Consistency with the Heckscher-Ohlin Theory. *Foreign Trade Rev.* **2011**, *46*, 3–28. [CrossRef]

19.	Deb, K.; Hauk, W.R. RCA Indices, Multinational Production and the Ricardian Trade Model. *Int. Econ. Econ. Policy* **2017**, *14*, 1–25. [CrossRef]

20.	Krugman, P. New Theories of Trade among Industrial Countries. *Am. Econ. Rev.* **1983**, *73*, 343–347.

21.	Bojnec, Š.; Fertő, I. Complementarities of Trade Advantage and Trade Competitiveness Measures. *Appl. Econ.* **2012**, *44*, 399–408. [CrossRef]

22.	Constantin, M.; Sapena, J.; Apetrei, A.; Pătărlăgeanu, S.R. Deliver Smart, Not More! Building Economically Sustainable Competitiveness on the Ground of High Agri-Food Trade Specialization in the EU. *Foods* **2023**, *12*, 232. [CrossRef]

23.	Buitrago, R.R.E.; Torralba Barreto, D.R.; Reyes, G.E. Are Competitiveness Rankings and Institutional Measures Helping Emerging Economies to Improve? *Compet. Rev. Int. Bus. J.* **2023**, *33*, 861–888. [CrossRef]

24.	Singh, A. UK Industry and the World Economy: A Case of de-Industrialization? In *Welfare Aspects of Industrial Markets*; Springer US: Boston, MA, USA, 1977; pp. 183–214.

25.	Woś, A. *Konkurencyjność Polskiego Sektora Żywnościowego*; IERiGŻ-PIB: Warszawa, Poland, 2003.

26.	Lukiewska, K.M.; Juchniewicz, M.G. Factors of International Competitiveness of EU Member States' Food Industries. *Econ. AGRO-Aliment.* **2020**, *21*, 659–676. [CrossRef]

27.	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. [CrossRef]

28.	Muhamediyeva, D.T. *Forecasting Export Options for Fruit and Vegetable Products*; AIP Publishing Krasnodar: Krasnodar, Russia, 2023; p. 020073.

29.	Montes Ninaquispe, J.C.; Pantaleón Santa María, A.L.; Ludeña Jugo, D.A.; Castro Muñoz, W.T.; Farias Rodriguez, J.C.; Maco Elera, B.H.; Vasquez Huatay, K.C. Peruvian Agro-Exports' Competitiveness: An Assessment of the Export Development of Its Main Products. *Economies* **2024**, *12*, 156. [CrossRef]

30.	Zhou, R.; Liu, H.; Zhang, Q.; Wang, W.; Mao, J.; Wang, X.; Tang, D. Improvement of Agricultural Supply Quality in China: Evidence from Jiangsu Province. *Sustainability* **2023**, *15*, 11418. [CrossRef]

31.	Saptana; Sukmaya, S.G.; Perwita, A.D.; Malihah, F.D.; Wardhana, I.W.; Pitaloka, A.D.; Ghaisani, S.A.; Sayaka, B.; Ilham, N.; Karmawati, E.; et al. Competitiveness Analysis of Fresh Tomatoes in Indonesia: Turning Comparative Advantage into Competitive Advantage. *PLoS ONE* **2023**, *18*, e0294980. [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.	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]

34.	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]

35.	Narayan, S.; Bhattacharya, P. Relative Export Competitiveness of Agricultural Commodities and Its Determinants: Some Evidence from India. *World Dev.* **2019**, *117*, 29–47. [CrossRef]

36. Nasir, M.A.; Nugroho, A.D.; Lakner, Z. Impact of the Russian–Ukrainian Conflict on Global Food Crops. *Foods* **2022**, *11*, 2979. [CrossRef]

37. Zhou, X.-Y.; Lu, G.; Xu, Z.; Yan, X.; Khu, S.-T.; Yang, J.; Zhao, J. Influence of Russia-Ukraine War on the Global Energy and Food Security. *Resour. Conserv. Recycl.* **2023**, *188*, 106657. [CrossRef]

38. Jagtap, S.; Trollman, H.; Trollman, F.; Garcia-Garcia, G.; Parra-López, C.; Duong, L.; Martindale, W.; Munekata, P.E.S.; Lorenzo, J.M.; Hdaifeh, A.; et al. The Russia-Ukraine Conflict: Its Implications for the Global Food Supply Chains. *Foods* **2022**, *11*, 2098. [CrossRef] [PubMed]

39. Pilinkienė, V. Evaluation of International Competitiveness Using the Revealed Comparative Advantage Indices: The Case of the Baltic States. *Mediterr. J. Soc. Sci.* **2014**, *5*, 353. [CrossRef]

40. Wosiek, R.; Visvizi, A. The VWRCA Index: Measuring a Country's Comparative Advantage and Specialization in Services. The Case of Poland. *Economies* **2021**, *9*, 48. [CrossRef]

41. Liu, B.; Gao, J. Normality in the Distribution of Revealed Comparative Advantage Index for International Trade and Economic Complexity. *Appl. Sci.* **2022**, *12*, 1125. [CrossRef]

42. Tandra, H.; Suroso, A.I.; Syaukat, Y.; Najib, M. The Determinants of Competitiveness in Global Palm Oil Trade. *Economies* **2022**, *10*, 132. [CrossRef]

43. Kim, M. Export Competitiveness of India's Textiles and Clothing Sector in the United States. *Economies* **2019**, *7*, 47. [CrossRef]

44. Peng, H.; Yang, F. Research on the Competitiveness and Complementarity of Agricultural Trade between China and the Association of Southeast Asian Nations. *Sustainability* **2024**, *16*, 7046. [CrossRef]

45. Török, Á.; Szerletics, Á.; Jantyik, L. Factors Influencing Competitiveness in the Global Beer Trade. *Sustainability* **2020**, *12*, 5957. [CrossRef]

46. Istudor, N.; Constantin, M.; Ignat, R.; Chiripuci, B.-C.; Petrescu, I.-E. The Complexity of Agricultural Competitiveness: Going Beyond the Balassa Index. *J. Compet.* **2022**, *14*, 61–77. [CrossRef]

47. Istudor, N.; Constantin, M.; Privitera, D.; Ignat, R.; Petrescu, I.-E.; Teodor, C. Systemic Competitiveness in the EU Cereal Value Chain: A Network Perspective for Policy Alignment. *Land* **2025**, *14*, 731. [CrossRef]

48. Pawlak, K.; Poczta, W. *Międzynarodowy Handel Rolny. Teorie, Konkurencyjność, Scenariusze Rozwoju*; PWE: Poznań, Poland, 2011.

49. Kraciński, P.; Wicki, L. *Competitive Position of Apples and Concentrated Apple Juice on Foreign Markets*; Wydawnictwo SGGW: Warszawa, Poland, 2020; ISBN 978-83-7583-960-9.

50. Hamulczuk, M.; Pawlak, K. Determinants for International Competitiveness of the Food Industry in 43 Countries World-Wide: Evidence from Panel Models. *Equilib. Q. J. Econ. Econ. Policy* **2022**, *17*, 635–667. [CrossRef]

51. Nowak, A.; Zakrzewska, A. How Competitive Is the Agriculture in European Union Member States? An Assessment of Changes over the Past Decade. *Agriculture* **2024**, *14*, 612. [CrossRef]

52. Constantin, M.; Sacală, M.-D.; Dinu, M.; Piștalu, M.; Pătărlăgeanu, S.R.; Munteanu, I.-D. Vegetable Trade Flows and Chain Competitiveness Linkage Analysis Based on Spatial Panel Econometric Modelling and Porter's Diamond Model. *Agronomy* **2022**, *12*, 411. [CrossRef]

53. Fu, J.; Tong, G. Status of Sino–Russian Trade in Agricultural Products: Dual Consideration Based on Characteristics and Growth. *Sustainability* **2024**, *16*, 822. [CrossRef]

54. Timpanaro, G.; Scuderi, A.; Guarnaccia, P.; Foti, V.T. Will Recent World Events Shift Policy-Makers' Focus from Sustainable Agriculture to Intensive and Competitive Agriculture? *Heliyon* **2023**, *9*, e17991. [CrossRef]

55. Aday, S.; Aday, M.S. Impact of COVID-19 on the Food Supply Chain. *Food Qual. Saf.* **2020**, *4*, 167–180. [CrossRef]

56. Keskin, B. The Effect of COVID-19 Pandemic on the Fruit Juice Industry: Insights from Türkiye. *Heliyon* **2024**, *10*, e29406. [CrossRef]

57. Aldieri, L.; Brahmi, M.; Chen, X.; Vinci, C.P. Knowledge spillovers and technical efficiency for cleaner production: An economic analysis from agriculture innovation. *J. Clean. Prod.* **2021**, *320*, 128830. [CrossRef]

58. Cheng, J.; Wang, Q.; Yu, J. Life Cycle Assessment of Concentrated Apple Juice Production in China: Mitigation Options to Reduce the Environmental Burden. *Sustain. Prod. Consum.* **2022**, *32*, 15–26. [CrossRef]

59. Dziwulski, M. Zmiany w Konsumpcji Soku Pomarańczowego—Analiza Czynników Determinujących Światowy Popyt. *Przemysł Ferment. I Owocowo-Warzywny* **2023**, *1*, 16–18. [CrossRef]

60. Granato, D.; Branco, G.F.; Nazzaro, F.; Cruz, A.G.; Faria, J.A.F. Functional Foods and Nondairy Probiotic Food Development: Trends, Concepts, and Products. *Compr. Rev. Food Sci. Food Saf.* **2010**, *9*, 292–302. [CrossRef] [PubMed]

61. Cywińska-Antonik, M.; Chen, Z.; Groele, B.; Marszałek, K. Application of Emerging Techniques in Reduction of the Sugar Content of Fruit Juice: Current Challenges and Future Perspectives. *Foods* **2023**, *12*, 1181. [CrossRef] [PubMed]

62. Vallée Marcotte, B.; Verheyde, M.; Pomerleau, S.; Doyen, A.; Couillard, C. Health Benefits of Apple Juice Consumption: A Review of Interventional Trials on Humans. *Nutrients* **2022**, *14*, 821. [CrossRef]

63. Miles, E.A.; Calder, P.C. Effects of Citrus Fruit Juices and Their Bioactive Components on Inflammation and Immunity: A Narrative Review. *Front. Immunol.* **2021**, *12*, 712608. [CrossRef]

64. Arshad, S.; Rehman, T.; Saif, S.; Rajoka, M.S.R.; Ranjha, M.M.A.N.; Hassoun, A.; Cropotova, J.; Trif, M.; Younas, A.; Aadil, R.M. Replacement of Refined Sugar by Natural Sweeteners: Focus on Potential Health Benefits. *Heliyon* **2022**, *8*, e10711. [CrossRef]

65. Xu, L.; Yang, S.; Wang, K.; Lu, A.; Wang, X.; Xu, Z. Impact of Clarified Apple Juices with Different Processing Methods on Gut Microbiota and Metabolomics of Rats. *Nutrients* **2022**, *14*, 3488. [CrossRef]

66. D'Elia, L.; Dinu, M.; Sofi, F.; Volpe, M.; Strazzullo, P.; Bordoni, A.; Strazzullo, P.; Cairella, G.; Casiraghi, M.C.; D'Elia, L.; et al. 100% Fruit Juice Intake and Cardiovascular Risk: A Systematic Review and Meta-Analysis of Prospective and Randomised Controlled Studies. *Eur. J. Nutr.* **2021**, *60*, 2449–2467. [CrossRef]

67. Juan, D.; Runping, W.; Xiaoyue, X.; Fuzhong, L. Research on the Influencing Factors of China Apple Juice Trade. *Res. J. Appl. Sci. Eng. Technol.* **2013**, *6*, 691–696. [CrossRef]

68. Kurmai, V. Market Competition and Concentration in the World Market of Concentrated Apple Juice. *Acta Agrar. Debreceniensis* **2016**, *69*, 129–135. [CrossRef]

69. Kurmai, V. Market Competition and Concentration in the Global Market of Apple Juice Concentrate Concerning Hungary, Poland and China. *Ann. PAAAE* **2016**, *18*, 111–118.

70. Kraciński, P. Pozycja Konkurencyjna Polski Na Światowym Rynku Zagęszczonego Soku Jabłkowego. *Zesz. Nauk. SGGW—Ekon. I Organ. Gospod. Żywnościowej* **2018**, 71–81. [CrossRef]

71. Zhu, Z.; Jia, Z.; Peng, L.; Chen, Q.; He, L.; Jiang, Y.; Ge, S. Life Cycle Assessment of Conventional and Organic Apple Production Systems in China. *J. Clean. Prod.* **2018**, *201*, 156–168. [CrossRef]

72. Khanali, M.; Kokei, D.; Aghbashlo, M.; Nasab, F.K.; Hosseinzadeh-Bandbafha, H.; Tabatabaei, M. Energy Flow Modeling and Life Cycle Assessment of Apple Juice Production: Recommendations for Renewable Energies Implementation and Climate Change Mitigation. *J. Clean. Prod.* **2020**, *246*, 118997. [CrossRef]

73. Nehmé, L.; El Tekle, M.; Barakat, N.; El Khoury, A.; Azzi-Achkouty, S.; El Rayess, Y. Alternative Processes for Apple Juice Stabilization and Clarification: A Bibliometric and Comprehensive Review. *Processes* **2024**, *12*, 296. [CrossRef]

74. Zawiślińska, I. *Gospodarka Kanady Przełomu Wieków: Międzynarodowa Pozycja Konkurencyjna*; SGH: Warszawa, Poland, 2003.

75. Kowalczyk, R. Wydajność Tłoczenia i Wskaźnik Zużycia Jabłek w Procesie Wytwarzania Zagęszczonego Soku Jabłkowego. *Probl. Inżynierii Rol.* **2004**, *12*, 21–30.

76. Balassa, B. Trade Liberalisation and "Revealed" Comparative Advantage. *Manch. Sch.* **1965**, *33*, 99–123. [CrossRef]

77. Rossato, F.G.F.S.; Susaeta, A.; Adams, D.C.; Hidalgo, I.G.; de Araujo, T.D.; de Queiroz, A. Comparison of Revealed Comparative Advantage Indexes with Application to Trade Tendencies of Cellulose Production from Planted Forests in Brazil, Canada, China, Sweden, Finland and the United States. *Policy Econ.* **2018**, *97*, 59–66. [CrossRef]

78. Hinloopen, J.; Marrewijk, C. On the Empirical Distribution of the Balassa Index. *Weltwirtsch Arch.* **2001**, *137*, 1–35. [CrossRef]

79. Srinivasan, S.; Hanssens, D.M. Marketing and firm value: Metrics, methods, findings, and future directions. *J. Mark. Res.* **2009**, *46*, 293–312. [CrossRef]

80. Ailawadi, K.L.; Lehmann, D.R.; Neslin, S.A. Revenue premium as an outcome measure of brand equity. *J. Mark.* **2003**, *67*, 1–17. [CrossRef]

81. U.S. Department of Agriculture, Foreign Agricultural Service. Fresh Deciduous Fruit Annual: China—People's Republic of. 2024. Available online: https://apps.fas.usda.gov/newgainapi/api/Report/DownloadReportByFileName?fileName=Fresh+Deciduous+Fruit+Annual_Beijing_China+-+People's+Republic+of_CH2024-0139 (accessed on 3 January 2025).

82. Farris, P.W.; Bendle, N.T.; Pfeifer, P.E.; Reibstein, D.J. *Marketing Metrics: The Manager's Guide to Measuring Marketing Performance*; Pearson Education: Hoboken, NJ, USA, 2010.

83. UNCTAD&WTO. A Practical Guide to Trade Policy Analysis. United Nations Conference on Trade and Development. 2012. Available online: https://unctad.org/system/files/official-document/gds2012d2_en.pdf (accessed on 4 January 2025).

84. Stellian, R.; Danna-Buitrago, J.P. Which revealed comparative advantage index to choose? Theoretical and empirical considerations. *CEPAL Rev.* **2021**, *2021*, 7–28. [CrossRef]

85. Trivic, J. Openness to Trade and Economic Development of Transition Economies. *ЗБОРНИК РАДОВА ЕКОНОМСКОГ ФАКУЛТЕТА У ИСТОЧНОМ САРАЈЕВУ* **2023**, *12*, 19–34. [CrossRef]

86. Sánchez de la Vega, J.C.; Buendía Azorín, J.D.; Calvo-Flores Segura, A.; Esteban Yago, M. A new measure of regional competitiveness. *Appl. Econ. Anal.* **2019**, *27*, 108–126. [CrossRef]

87. Kierczyńska, S. Produkcja, Eksport i Ceny Zagęszczonego Soku Jabłkowego a Ceny Skupu Jabłek Do Przetwórstwa w Polsce. *Rocz. Nauk. Ekon. Rol. I Rozw. Obsz. Wiejskich* **2015**, *102*, 74–81. [CrossRef]

88. Nosecka, B. *Czynniki i Mierniki Konkurencyjności Zewnętrznej Sektora Ogrodniczego i Jego Produktów*; IERiGŻ-PIB: Warszawa, Poland, 2017.

89. Chen, X.; Gao, Z.; House, L.; Ge, J.; Zong, C.; Gmitter, F. Opportunities for Western Food Products in China: The Case of Orange Juice Demand. *Agribusiness* **2016**, *32*, 343–362. [CrossRef]

90. Zhang, Z.; Zeng, X.; Li, M.; Zhang, T.; Li, H.; Yang, H.; Huang, Y.; Zhu, Y.; Li, X.; Yang, W. A Prospective Study of Fruit Juice Consumption and the Risk of Overall and Cardiovascular Disease Mortality. *Nutrients* **2022**, *14*, 2127. [CrossRef]

91.  Zheng, M.-L.; Chen, F.; Yu, H.; Zhang, C.-Y. Eating behaviors, oral health care knowledge, and oral hygiene practices among residents in Fujian province, China: A cross-sectional study. *BMC Oral Health* **2025**, *25*, 446. [CrossRef]

92.  Lu, W.; Zhu, K. Housing Market and Household Consumption in Urban China: A Debt Perspective. *Land* **2024**, *13*, 521. [CrossRef]

93.  Molnar, M.; Chalaux, T.; Ren, Q. Urbanisation and household consumption in China. In *OECD Economics Department Working Papers*; No. 1434; OECD Publishing: Paris, France, 2017. [CrossRef]

94.  UN Comtrade UN Comtrade Database. Available online: https://comtradeplus.un.org/ (accessed on 10 October 2024).

95.  Luckstead, J.; Devadoss, S.; Dhamodharan, M. Strategic trade analysis of U.S. and Chinese apple juice market. *J. Agric. Appl. Econ.* **2015**, *47*, 175–191. [CrossRef]

96.  Bugała, A.; Kraciński, P.; Nosecka, B.; Strojewska, I.; Zaremba, Ł. *Polski i Światowy Rynek Wybranych Owoców, Warzyw i Ich Przetworów*; Nosecka, B., Ed.; IERiGŻ-PIB: Warszawa, Poland, 2017.

97.  Trade Map. Available online: https://www.trademap.org/Index.aspx (accessed on 20 October 2024).

98.  Lijia, W.; Xuexi, H. Transaction costs comparison between cooperatives and conventional apple producers: A case study of northwestern China. *Ann. Public Coop. Econ.* **2014**, *85*, 233–255. [CrossRef]

99.  Wu, Z.; Pan, C. State Analysis of Apple Industry in China. *IOP Conf. Ser. Earth Environ. Sci.* **2021**, *831*, 012067. [CrossRef]

100.  Sun, Y.; Deng, Y.; Lu, Y.; Li, M. Competitiveness and Sustainable Development of Chinableapple Industry. *PLoS ONE* **2022**, *17*, e0268476. [CrossRef] [PubMed]

101.  Shi, C.; Wang, Y.; Zhang, C.; Zhang, L. Spatial-Temporal Differences in Water Footprints of Grain Crops in Northwest China: LMDI Decomposition Analysis. *Water* **2019**, *11*, 2457. [CrossRef]

102.  Zhang, F.; Wang, F.; Hao, R.; Wu, L. Agricultural Science and Technology Innovation, Spatial Spillover and Agricultural Green Development—Taking 30 Provinces in China as the Research Object. *Appl. Sci.* **2022**, *12*, 845. [CrossRef]

103.  Ma, W.; Renwick, A.; Yuan, P.; Ratna, N. Agricultural Cooperative Membership and Technical Efficiency of Apple Farmers in China: An Analysis Accounting for Selectivity Bias. *Food Policy* **2018**, *81*, 122–132. [CrossRef]

104.  Hou, X.; Fahad, S.; Zhao, P.; Yan, B.; Liu, T. The Trilogy of the Chinese Apple Futures Market: Price Discovery, Risk-Hedging and Cointegration. *Sustainability* **2022**, *14*, 12864. [CrossRef]

105.  Qiongyue, Z.; Chuanhui, Z. Study of Influencing Factors of Apple Juice Export of Xinjiang Area. *Adv. Soc. Sci. Educ. Humanit. Res.* **2017**, *168*, 151–154.

106.  Nosecka, B. Rynek Soków Zagęszczonych i Nieskoncentrowanych. *Przemysł Ferment. I Owocowo-Warzywny* **2024**, *1*, 26–30. [CrossRef]

107.  FAO. Available online: https://Www.Fao.Org/Faostat/En/#data/QCL (accessed on 4 November 2024).

108.  Kierczyńska, S. Developmen in Fruit Production in Poland and The Producer Prices For Fruit For Processing. *Rocz. Nauk. Stowarzyszenia Ekon. Rol. I Agrobiznesu* **2017**, *XIX*, 118–123.

109.  Małachowska, M.; Tomala, K. Apple Quality during Shelf-Life after Long-Term Storage and Simulated Transport. *Agriculture* **2023**, *13*, 2045. [CrossRef]

110.  Małachowska, M.; Majak, T.; Krupa, T.; Tomala, K. Increasing Productivity and Fruit Quality of 'Mutsu' Apple Orchard by Dwarfing Treatments. *Agriculture* **2024**, *14*, 1838. [CrossRef]

111.  Gunes, E.; Gunes, N.T. Economic Development of Fruit and Fruit Juice Sector in Turkey. *Acta Hortic.* **2020**, *1292*, 13–22. [CrossRef]

112.  Porter, M. *The Competitive Advantage of Nations*; Free Press: Los Angeles, CA, USA, 1990.

113.  Mafe, A.N.; Büsselberg, D. Mycotoxins in Food: Cancer Risks and Strategies for Control. *Foods* **2024**, *13*, 3502. [CrossRef]

114.  Tangni, E.K.; Masquelier, J.; Van Hoeck, E. Analysis of Patulin in Apple Products Marketed in Belgium: Intra-Laboratory Validation Study and Occurrence. *Toxins* **2023**, *15*, 368. [CrossRef]

115.  Ambrus, Á.; Vásárhelyi, A.; Ripka, G.; Szemánné-Dobrik, H.; Szenczi-Cseh, J. Evaluation of the Results of Pesticide Residue Analysis in Food Sampled between 2017 and 2021. *Agrochemicals* **2023**, *2*, 409–435. [CrossRef]

116.  Matkovski, B.; Zekić, S.; Đokić, D.; Jurjević, Ž.; Đurić, I. Export Competitiveness of Agri-Food Sector during the EU Integration Process: Evidence from the Western Balkans. *Foods* **2021**, *11*, 10. [CrossRef]

117.  Snyder, F.; Ni, L. Chinese Apples and the Emerging World Food Trade Order: Food Safety, International Trade, and Regulatory Collaboration between China and the European Union. *Chin. J. Comp. Law* **2017**, *5*, 253–307. [CrossRef]

118.  Jarosz-Angowska, A.; Nowak, A.; Kołodziej, E.; Klikocka, H. Effect of European Integration on the Competitiveness of the Agricultural Sector in New Member States (EU-13) on the Internal EU Market. *Sustainability* **2022**, *14*, 13124. [CrossRef]

119.  Esturo, A.; Lizundia, E.; Sáez de Cámara, E. Fruit Juice Industry's Transition Towards Sustainability from the Viewpoint of the Producers. *Sustainability* **2023**, *15*, 3066. [CrossRef]