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Sustainability-Related Implications of Competitive Advantages in Agricultural Value Chains: Evidence from Central Asia—China Trade and Investment

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Abstract: More stable value chains in agriculture allow countries to take the best advantage of their factor endowments and thus achieve the UN Sustainable Development Goal on ending hunger. It is, however, difficult to interpret such advantages properly due to the multivariate effects of natural, technological, and economic variables on agricultural output and food supply. The authors attempt to tackle this challenge by developing the approach to the identification of competitive advantages and matching them with the production capabilities of agricultural sectors in Central Asia. The application of Revealed Comparative Advantage (RCA), Relative Trade Advantage (RTA), Lafay Competitive Advantage (LI), and Domestic Resource Costs (DRC) indexes to the array of 37 products results in the revealing of comparative, trade, competitive, and production advantages of five Central Asian economies for labor-intensive horticultural products and grains. Capital and technology-intensive sectors of animal husbandry and food processing are recognized as low competitive. Taking Central Asia–China collaboration as a model, the authors elaborate policy measures aimed at support, promotion, or establishment of competitive advantages. The application of the measures facilitates the concentration of the resources toward competitive and conditionally competitive products, allows to protect fragile advantages in marginally competitive sectors, and contributes to the overall improvement of stakeholders' performance across agricultural value chains in the region.

Keywords: agriculture; Central Asia; food security; sustainability; value chain

1. Introduction

With the dissolution of the Soviet Union in 1991, five countries of Central Asia (Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan, and Uzbekistan) along with other Soviet republics gained independence and entered a period of transition from planned to market-based economies [1]. In the early 1990s, the transition was particularly painful for the newly independent states due to the sharp economic decline, inflation, and disruption of production and trade ties with Russia and other territories of the former Soviet Union [2]. In no time, previously closed markets became open to global trade, but the countries of Central Asia were not able to immediately convert openness to sufficient gains due to the total lack of competitiveness [3]. Market principles called for the establishment of qualitatively new types of linkages and value chains based on competitive advantages rather than command planning and administrated supply networks. Underdeveloped transport infrastructure oriented on central parts of Russia (Soviet heritage), as well as landlockedness and remoteness from major economic centers and trade hubs, contributed to the degradation of the competitiveness of the Central Asian countries [2] and increased economic and social instability in the entire region.

Agriculture was among those sectors where production capabilities, trade links, and competitive advantages were cut in the most severe way. Before the start of the market transition, agriculture had

been one of the major sectors in Central Asian economies and contributed up to 45% of their GDPs and provided employment to almost 50% of the labor force [4]. Despite the launch of agricultural and land reforms in 1992–1993, the performance of the agricultural sector has been rather weak across the region [5]. The volume of production of animal products (various kinds of meat and meat products), and some staple cereals (wheat) has fallen significantly. Apart from the general economic decline in Central Asian countries during the 1990s, the key reasons for such a bad performance are the low competitiveness of the agricultural sector and distortion of competitive advantages for the gain of the command economy. In Soviet times, each country of Central Asia specialized in the production of particular agricultural products according to the general plan (wheat and other grains in Kazakhstan, corn and lamb in Kyrgyzstan, cotton and fruits in Tajikistan, Uzbekistan, and Turkmenistan) [6]. Command allocation indeed took into account available natural resources and capabilities of particular countries but created mono-specialization and did not allow diversification, which negatively affected both the competitiveness positions and flexibility of Central Asian economies when transitioning to the market-based principles of competition.

Along with the structural barriers, the development of competitive advantages in agriculture has been hindered by poor land management [7], land degradation and salinization [8], irrational water use [9], desertification and reduction of the areas under crops in the irrigated lands [10], and climate change effects such as higher temperatures, changing precipitation, and river runoff [11]. Those factors have led to low productivity levels across the entire agricultural sector. As vast territories are regularly used for extensive livestock husbandry, only a small portion of agricultural land can be used for crop production and horticulture [12]. The upshot is that agriculture has become less important as a source of livelihood for many people, agricultural revenues are partially replaced by remittances from labor migrants [13], while the continuing decline in agricultural production aggravates the standards of living and food security problems in rural areas, where over 90% of the population is now defined as poor and food insecure [14].

In recent decades, the food insecurity problem has emerged globally with Asia being one of the regions most critical to meeting the challenge of sustainable food supply [15]. Establishing food security, ensuring sustainable food production systems, ending hunger, and providing access by all people to safe, nutritious, and sufficient food are the targets of the United Nations Sustainable Development Goals to be achieved by 2030 [16]. As a part of the global community, the countries of Central Asia are also committed to achieving the sustainable development goals on the elimination of hunger and improvement of food security along the four dimensions of availability, access, stability, and utilization as prescribed by the Food and Agriculture Organization of the United Nations (FAO) [17]. These efforts resulted in a substantial improvement of food security in the region compared to the 1990s. In particular, the average prevalence of undernourishment decreased from 11% in the early 2000s to 6% in 2017 [18]. Nevertheless, significant levels of poverty along with poor availability and low accessibility of food staples [19] still keep the prevalence of undernourishment an issue of concern in Uzbekistan (7.4%), Kyrgyzstan (6.5%), and Turkmenistan (5.5%) [18]. Among the major threats to sustainable food security in Central Asia, Schroeder and Meyers [20] pointed out inadequate micronutrient intake, growing obesity rates, and high dependence on food imports which posed a risk to sufficient availability and economic accessibility of food products on the domestic markets. In recent years, FAO [18] has reported an increasing prevalence of severe food insecurity (PoSFI) in the region from 1.7% in 2015 to 3.5% in 2017. The PoSFI implies a probability of people having been unable to access nutritious and diverse food and having been forced to reduce the quantities of food eaten as a result of lack of money or other resources [21] and thus demonstrates that the food insecurity problem in Central Asia is primarily associated with economic aspects of sustainable development of the agricultural sector. To date, indeed, the agricultural sector has lost a dominating role in Central Asian economies amid the emergence of oil and gas and other resource-extraction industries. Nevertheless, it still contributes 23.3% of the GDP in Tajikistan, 20.8% in Kyrgyzstan, and 18.5% in Uzbekistan (compared to over 50% in the 1990s), but in hydrocarbon and gas-abundant Kazakhstan and Turkmenistan, its contribution to the GDP is

no longer impressive (5.2% and 7.5%, respectively) [22]. For Uzbekistan, Tajikistan, and Kyrgyzstan, agricultural trade remains one of the major sources of export revenues despite the substantial changes in trade patterns and the directions and structure of exports in the past decades.

According to Kurmanalieva and Parpiev [2], one of the most prominent features of the Central Asian trade since the recovery of the independence in 1991 has been its drastic reorientation from the former Soviet republics to the rest of the world, specifically, to Asia. Since the mid-1990s, the governments in Central Asia have been increasingly undertaking policy measures and activities with the specific goals of trade facilitation and improvement of connectivity with China [1], while China itself has been emerging as one of the key trade partners of Central Asia [23]. China has been gradually occupying those niches and gaps on the market which had been created by the disruption of trade and production ties between Central Asia, Russia, and other former Soviet republics. With the launch of the Belt and Road Initiative (BRI), China declared its commitment to improving infrastructural and trade connectivity along with sustainable value chains in Eurasia with Central Asia being a crucial component in the network. While neither agricultural trade nor food security has been specifically outlined among the BRI goals, both themes are of fundamental importance for China. The country has already made substantial contributions to combating rural poverty and food insecurity and improvement of the global stability of food production and supply through innovations, intensification of farming and agricultural productivity, and food safety [24]. In 2019, in its new National Strategy on Food Security, China declared its further commitment to every possible promotion of agricultural trade, active participation in global food security, and establishment of healthy and sustainable development of food value chains worldwide [25].

Between 2000 and 2018, interregional agricultural trade in Central Asia has been declining while international trade has been experiencing a fast growth of imports but the sluggish real growth of exports [13]. Exports of cotton, fruits, cereals, and some other products have been gradually reoriented from Russia and the EU to China and other Asian markets. Exports reached $230.1 million in 2018, while imports increased from $27.4 million in 2000 to $553 million in 2018 (Table 1). Agricultural trade balance with China is steadily negative for the countries of Central Asia.

Table 1. Agricultural trade between China and the countries of Central Asia in 2000–2018, $ million.

Countries	Years						
	2000	2005	2010	2015	2016	2017	2018
Import to Central Asia from China							
Kazakhstan	13.367	53.388	133.701	231.527	216.610	313.166	322.672
Kyrgyzstan	2.758	21.471	125.332	154.439	101.042	47.277	127.627
Tajikistan	0.248	2.243	13.013	16.675	12.197	21.144	15.153
Turkmenistan	1.690	3.041	5.375	11.677	16.914	9.918	8.023
Uzbekistan	9.381	14.735	29.624	62.527	39.893	53.594	79.702
Total imports	27.444	94.878	307.045	476.845	386.656	445.099	553.177
Export from Central Asia to China							
Kazakhstan	0.105	0.926	12.271	100.797	120.626	175.610	184.477
Kyrgyzstan	0.495	0.067	1.159	4.572	3.108	4.603	2.997
Tajikistan	0.000	0.000	0.312	0.622	0.305	0.366	0.727
Turkmenistan	0.000	0.000	0.000	0.156	0.078	1.119	1.244
Uzbekistan	0.069	0.218	0.594	22.019	27.906	23.007	40.651
Total exports	0.669	1.211	14.336	129.053	152.023	204.705	230.096

Table 1. *Cont.*

Countries	Years						
	2000	**2005**	**2010**	**2015**	**2016**	**2017**	**2018**
Central Asia's trade deficit with China							
Kazakhstan	13.262	52.462	121.430	130.730	95.984	137.556	138.195
Kyrgyzstan	2.263	21.404	124.173	149.867	97.934	42.674	124.630
Tajikistan	0.248	2.243	12.701	16.053	11.892	20.778	14.426
Turkmenistan	1.690	3.041	5.375	11.521	16.836	8.799	6.779
Uzbekistan	9.312	14.517	29.030	39.621	11.987	30.587	39.051
Total trade balance	26.775	93.667	292.709	347.792	234.633	240.394	323.081

Source: Authors' development based on [26].

Low self-sufficiency in staple foods is a challenge for the countries of Central Asia [27]. High reliance on imports hinders the development of disintegrated value chains and heavily subsidized agricultural sector and imposes a threat to sustainable availability and accessibility of food products on the market. Both households and producers experience severe effects of food prices fluctuations as large percentages of households' and state budgets' incomes are spent on food imports [11]. Peyrouse [28] reports that in Tajikistan and Uzbekistan, people spend 80% of their household incomes on food. This corresponds to the fact of Tajikistan's lowest level of food self-sufficiency in the region (31%) and indicates that Central Asian markets are particularly exposed to the instability of the global food market. In response to the increasing dependence on agricultural imports (not only with China but with Russia and the EU as well) and growing food insecurity and poverty levels, some countries of Central Asia, specifically, Kazakhstan and to a certain degree Turkmenistan and Kyrgyzstan, adopted food self-sufficiency policies [29]. For low diversified industries with few competitive products, however, self-sufficiency policy rarely works out as a driver of competitiveness as it diverts resources to lower-efficiency sectors and thus triggers inappropriate use of the country's advantages. Given, first, the emergence of the food insecurity problem in Central Asia, second, food self-sufficiency policies of Central Asian governments, and third, the growing involvement of Central Asian countries in global agricultural market and trade with China, it is imperative to study the most appropriate use of various resources and advantages the countries possess.

With an increased awareness of the link between sustainable development of agricultural production, food security, and competitive advantages in trade [24], reliance on research has become more critical. One branch of studies analyzed trends in the agricultural sector in Central Asia in general and individually in certain countries. Schroeder and Meyers [20] conducted a comprehensive analysis of agricultural production and trade, constraints and bottlenecks in agricultural productivity growth, as well as the policies that may be implemented to shape sustainable food security and reduce malnutrition. Akter et al. [30] synthesized emerging issues and challenges that confronted food sector in Central Asia and called for the identification of competitive advantages, elaboration of development strategies, and setting priorities for future food, agriculture, and natural resource policy agendas for sustainable development of the agricultural sector and rural areas. There have been many studies that drifted away from food production and focused specifically on various dimensions of food security across the region of Central Asia. Thus, Babu and Pinstrup-Andersen [19] identified major challenges to food security across Central Asian countries and suggested the measures and policy transformations to facilitate economic reforms, reduce poverty, increase food security, and ensure sustainable use of natural resources. Akramov [31] addressed the impact of global food prices on the domestic market and policy responses taken by national governments to stabilize food markets.

There is an array of studies that address economic and trade linkages between Central Asia and China, but the majority of them pay inadequate attention to agricultural trade. Bird et al. [32] and Kokushkina and Soloshcheva [33] assessed the participation of Central Asian countries in the BRI based on the revealed comparative advantage and other indicators with a major focus on trade in resources and raw materials. Vakulchuk and Overland [34] analyzed the present state of relations

between the countries of Central Asia and China and systematized the BRI's perceptions on the part of various stakeholders, including local rural communities and farmers, and found that many value chain actors remained weakly connected to Central Asia-China value chains. Another shortcoming is that those few studies related to both the BRI and agricultural collaboration in Central Asia concentrate on individual countries. Carter [35] reviewed the patterns of China's recent trade and investment policies in Central Asia in the cases of Kazakhstan and Tajikistan, Bitabarova [36] conducted similar analysis for Kazakhstan, Babu and Reidhead [37] provided insights into poverty, food insecurity, and malnutrition in Kyrgyzstan, while Asadov [27] searched for possible solutions to critical dependence on food imports and staple food self-insufficiency in Tajikistan.

A specific fragility of the advantages in Central Asia's agriculture calls for a comprehensive analysis on the regional level. The fragility and erosion of the advantages due to a variety of natural, technological, and economic factors bring instability to the entire value chain in agriculture. Reyer et al. [11] studied possible climate change impacts on the agricultural sector in Central Asia and found extreme vulnerability of competitive advantages to even slightest changes in precipitation, rainfall patterns, and heat extremes. Adding value allows to increase the share of processed higher-value agricultural products in export, as well as to improve both self-sufficiency and sustainability through growing farmers' income and more employment opportunities in agriculture [38], but the sustainability of agricultural value chains in Central Asia, nevertheless, remains scantily explored. Discretely, some references to the relevance of sustainable value chains for Central Asia can be found in the studies of Bloch [39], Rakhimov [40], Turaeva and Hornidge [41], and Pomfret [1,42]. Pirmatov et al. [38] attempted to conduct a comprehensive analysis of value-added chains in the production of cotton, wheat, rice, and fruit and found the unrealized potential for storing, freezing, processing, and packaging of even the most competitive products. The study of Pirmatov et al. [38] considered the socio-economic role of value-added agriculture for Central Asian countries but did not link the performance and sustainability of value chains with the exploitation of competitive advantages of particular countries of the region in food production and trade. Similarly, Rillo and Nugroho [43] studied the challenges to the development of integrated value chains without proper previous investigation of competitive advantages in agricultural sectors across the countries of Central Asia. Egilmez [44] covered different regions of the world and scarcely focused on Central Asia, while Hanf and Gadalyuk [45] conducted a detailed analysis of value chains in Kyrgyzstan but limited the study to the sector of small-scale farming.

Summarizing the above, the following gaps in Central Asia-China agricultural trade and the value chains agenda can be identified:

- The research of competitive advantages in agriculture is very scarce for Central Asia. Most commonly, the studies are focused on climate, soil, and irrigation as the major determinants of agricultural productivity in the region, but insufficiently explore economic and trade patterns of the competitiveness.
- Many studies examine revealed comparative advantage as a decisive parameter to identify the competitiveness of agricultural products on the global market. Consideration of other types of strengths (trade, competitiveness, production, among others) could benefit the establishment of truly sustainable advantage in agriculture in the long run.
- Despite the geographical proximity of the five countries of the region, they are rather different in terms of the conditions of agricultural production. Currently, among the countries of Central Asia, Kazakhstan's economy seems the best studied one in terms of comparative advantages while for other countries (particularly, Turkmenistan and Uzbekistan) few studies address the advantages in agricultural value chains.
- In the China–Central Asia agenda, two types of studies prevail: Broad overviews of trade and economic policies (transformation period in Central Asia and China's trade openness policy, most recently, the BRI) and the analysis of trade in resources and raw materials. To the best of the authors' knowledge, there are no comprehensive studies of agricultural trade between China and the countries of Central Asia from the perspectives of competitive advantages and sustainable development of value chains.

In this paper, the authors attempt to bridge these gaps by developing the approach to the identification of existing and potential competitive advantages in the spheres of agricultural production and food supply across the region of Central Asia. In the case of Central Asia-China trade in food and agricultural products, the study aims to elaborate the solutions to the problems of low competitiveness of agricultural sectors and in such a way to contribute to the improvement of the sustainability of agricultural value chains in the macro-region of Eurasia.

The remainder of this paper is divided into four sections. In Section 2, the authors review the most commonly used as well as the most appropriate approaches to the identification of competitive advantages in agricultural value chains. Based on this review, the five-stage methodology for the identification of the advantages is established. In Section 3, the authors present the results of the application of the methodology to the array of major food and agricultural products in Central Asia's export. In Section 4, the findings are discussed through the lens of the correspondence between the competitiveness of Central Asia's agricultural export and the prospects of food demand in China and China's agricultural investment in the region. The discussion concludes with the elaboration of policy measures for the promotion of the revealed advantages and the improvement of the sustainability of agricultural value chains.

2. Materials and Methods

The study is performed in the case of the five countries of Central Asia (Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan, and Uzbekistan) and China in 2000–2018 (Figure 1).

Figure 1. Countries of Central Asia and China. Source: Authors' modification of [46].

The data are obtained from the United Nations Conference on Trade and Development (UNCTAD) [26]. SITC Commodity classification is used. The total volume of agricultural trade in both exports and imports is generalized as SITC "All food items" (SITC 0 + 1 + 22 + 4). The array of the products is built along 37 positions and include major food and agricultural commodities traded between China and the countries of Central Asia. To assess the advantages of the Central Asian economies in agricultural trade, the study employs the five-stage approach.

2.1. Stage 1: Balassa Index

Classical trade theory assumes that the pattern of international trade is determined by comparative advantage [47]. In the attempts to measure the advantages, the scholars have used various techniques, including multivariate data analysis (factor analysis, cluster analysis, and structural equation modeling), trade data on exports and imports [48,49], and descriptive approaches [50,51]. One of the commonly accepted methods to identify the advantages of a country on the global market is the Balassa index of revealed comparative advantage (RCA) [52]. It has been used by many researchers for the identification of the changes in comparative advantages worldwide [53–55]. Porter [56] implemented the RCA index to identify strong sectoral clusters in international trade. Konstantakopoulou and Skintzi [57] used it to discover comparative advantages of the EU countries by sectors and by major product categories, Amiti [58] analyzed the specialization patterns in Europe. In the case of China, Hinloopen and van Marrewijk [59] analyzed the dynamics of comparative advantage as measured by export shares, Chun [60] investigated comparative advantage by studying the correlations between the cost of labor and foreign trade, Shuai and Wang [61] made an empirical analysis of the comparative advantages and complementarity of agricultural trade, while He [62] modified RCA index to the study of the dynamics of agricultural trade patterns.

There are also abundant studies of Central Asia's comparative advantages. One of the earliest and most comprehensive ones is that by Lücke and Rothert [63] who identified the advantages of Kazakhstan, Kyrgyzstan, Tajikistan, and Uzbekistan based on the information about factor prices and transport costs, historical production patterns, and trends in the geographical and product composition of Central Asian external and interregional trade. The study, however, aimed at the suggestion of broad guidelines for the identification of potentially competitive export sectors rather than focused on the determination of comparative advantages at the industry or product level. In the case of Kazakhstan's trade, Bozduman and Erkan [64] analyzed the competitiveness of export products on a sectoral basis and found that the country was competitive in export of hydrocarbons, ores, and other raw material intensive product groups, but excluded agricultural trade from their analysis. Falkowski [65] also excluded agricultural products from the study and approached to the investigation of long-term comparative advantages of Kazakhstan and Kyrgyzstan as the members of the Eurasian Economic Union (EAEU) from a perspective of the Organization for Economic Cooperation and Development (OECD) classification of manufacturing industries based on their technology intensity.

To address the existing shortcomings, at the first stage, the authors employ the Balassa method to reveal the comparative advantage of Central Asian countries in trade in agricultural products:

$$RCA = \frac{\frac{X_{ij}}{X_{it}}}{\frac{X_{nj}}{X_{nt}}} = \frac{\frac{X_{ij}}{X_{nj}}}{\frac{X_{it}}{X_{nt}}} \tag{1}$$

where RCA = revealed comparative advantage; X = export; i = country; j = product group (domestic market); t = product group (international market); n = group of countries.

According to the Balassa method, a country i specializes in the export of a product j if the market share of a product j is above average or, equivalently, if the weight of a product j in the total export of a country i is higher than the weight of a product j in the export of the reference area [66]. Stated differently, $RCA_{ij} > 1$ means a country i enjoys a comparative advantage in trade in a product j, while $RCA_{ij} < 1$ means a comparative disadvantage.

When applying the Balassa index to the measuring of the competitiveness of the products, industries, or countries, a difference between comparative advantage and competitiveness must be considered. The OECD [67] defines competitiveness as an economy's ability to compete fairly and successfully in international goods and services markets, which, as a result, leads to a steady rise in the living standards in the long term. According to Dunmore [68], comparative advantage is a statement about international specialization and trade patterns that would arise in an undistorted

world based on the differences in relative efficiencies between countries in the absence of trade. Competitiveness, on the contrary, is a characteristic of a country on the real global market distorted by various government policies. Dynamic character of competitive advantages under the conditions of an open economy inversely to comparative advantages is stressed by Weresa [69], Carbaugh [70], Collignon and Esposito [71], and Fagerberg [72].

Accordingly, the measurement of competitiveness should include the assessment of the dynamics of comparative advantages influenced by trade policies. Due to the difference between comparative and competitive advantages, the Balassa index is not that effective in the identification of competitive positions of particular products, since it allows to identify revealed comparative advantages rather than to determine the underlying sources of such advantages [66]. Siggel [73], Costinot et al. [74], and Hinloopen and van Marrewijk [75] point out that although the Balassa method allows detecting the advantage of a country in foreign trade as compared to other economies and the world as a whole, it fails to reveal the reasons of such advantage. It does not let divide comparative advantages on natural (for example, increased competitiveness due to technological innovations or improved efficiency) and acquired ones (for instance, state subsidies or alike distorting administrative measures). Understanding the sources of comparative advantages is crucial for such sectors as agricultural production, where government interventions commonly distort market patterns and affect competitiveness. Specifically, a government may provide support for domestic agricultural producers and exporters, subsidize export, increase or decrease customs tariffs, and employ non-tariff regulations to support the competitiveness of particular agricultural products on the external market [76]. In such cases, RCA shows an advantage, but actual competitiveness is distorted [77].

In the region of Central Asia, the employment of RCA in the measurement of competitiveness results in a very rough picture of the advantages due to the following reasons. First, the static nature of the index does not allow us to consider market disturbances and react to the changes in the equilibrium in the long run [77]. In the case of Central Asian economies which are still in a state of transition from distorted (during the Soviet times) and fluctuant (in the 1990s and 2000s) economic environments, low flexibility of the index is a shortcoming. Second, RCA can be inconsistent or misleading for the countries of the region as for smaller economies it demonstrates stronger advantages than there really are [78,79].

2.2. Stage 2: Vollrath Index

Due to the above shortcomings of the Balassa method, at the second stage, the authors check RCA results by measuring relative trade advantages for the same array of 37 product groups:

$$RTA = \frac{\frac{X_{ij}}{X_{it}}}{\frac{X_{nj}}{X_{nt}}} - \frac{\frac{M_{ij}}{M_{it}}}{\frac{M_{nj}}{M_{nt}}} \tag{2}$$

where *RTA* = relative trade advantage; *X* = export; *M* = import; *i* = country; *j* = product group (domestic market); *t* = product group (international market); *n* = group of countries.

The Vollrath index of relative trade advantage is a tool to identify the competitive advantages of the products by measuring their relative portions in trade. It is a comparison of how well a country performs in exporting a particular set of products compared to the total export of all its products [80]. In contrast to RCA, RTA takes account of both exports and imports and thus demonstrates net trade advantages and disadvantages. $RTA_{ij} > 0$ means a country *i* possesses relative trade advantage in a product *j*, while $RTA_{ij} < 0$ demonstrates relative trade disadvantage. After the identification of product groups *j* for which $RTA_{ij} > 0$, the results are applied upon previously calculated RCAs, two sets are compared, and the matches between the two types of advantage are identified. The use of two indexes for the same dataset reduces the risk of random error.

The Vollrath index was used by Rusali and Gavrilescu [81] in discovering competitive advantages and disadvantages in Romania's agricultural trade, by Drabik and Bartova [82] in the study of the

Slovak food trade specialization pattern, and by Carraresi and Banterle [83] in the assessment of the agricultural competitive performance in the EU countries. Similar to RCA, when measuring the competitiveness of agricultural products in an export portfolio of a country through RTA, it is crucial to examine the extent to which trade advantages are consistent with competitiveness [84]. Ballance et al. [85] discovered that results on the consistency of the RCA and RTA indexes are mixed. Khai et al. [86] examined coherence between the RCA and RTA indexes and concluded that despite the high consistency, the competitiveness of some product groups remained unclear. Ferto and Hubbard [87] tested a coherence between RTA and competitiveness in the cases of agricultural exports in Europe and found that the two indexes were not consistent in cardinal and ordinal measures.

2.3. Stage 3: Lafay Index

There have been many attempts to increase the consistency between various measures and improve the relevance of the competitiveness analysis. Since both RCA and RTA are structural, it is important to eliminate the influence of cyclical factors [88]. One of the most promising methods to do that is the Lafay index (LI):

$$LI_{ij} = \frac{1000}{Y_i} \times 2\frac{X_{ij} \times M_i - X_i \times M_{ij}}{X_i + M_i} \qquad (3)$$

where LI = Lafay index; X = export; M = import; i = country; j = product group.

The Lafay index allows to test both RCA and RTA indicators by considering the difference between each product's normalized trade balance and the overall normalized trade balance [89]. It also weights each product's contribution according to the particular importance in trade. $LI_{ij} > 0$ means a country i possesses a competitive advantage in a product j, otherwise, there is a disadvantage. LI captures intra-industry flows by using both the exports and imports variables and controlling the distortions due to the macroeconomic factors with the GDP variable [90]. For the purpose of this study, it is important that LI does not take into account world variables [47], which is crucial in the establishment of a reliable picture of competitive advantages for smaller economies.

So far, the three-indexes approach has not been widely applied in the literature. Ishchukova [91] and Benesova et al. [92] employed consecutive matching of RCA, RTA, and LI indexes to discover comparative advantages of agricultural exports and distinguishing competitive export products based on the parameters of the amount of foreign exchange, comparative advantage, and trade balance. Maitah et al. [89] used a similar approach for the analysis of the positions of agricultural producers both in comparison to domestic producers from other sectors and in relation to their foreign competitors. Erokhin and Gao [66] modified the approach by applying the three indexes to the same dataset and calculating Lafay index for the same array of product groups constituting a country's export portfolio, not for separate territories as compared to the earlier studies.

The application of the three-indexes approach to trade in agricultural products has definite limitations coming from the very nature of agricultural production. As it has been demonstrated by Ishchukova [91], Maitah et al. [89], Ishchukova and Smutka [93,94], and Erokhin and Gao [66], the three-indexes approach allows to check advantages and model policy responses on the potential strengthening of the advantages or evening out the disadvantages. Theoretically, the most obvious response is to reallocate the resources in such a manner as to increase the production and export of those products in which a country enjoys an advantage. In agriculture, though, simple reallocation is not possible due to the natural limitations (available arable lands and other land resources, quality of land, climate conditions), social and economic factors (rural labor, longer return on investment compared to non-agricultural sectors), time (cycles in crop and animal production, seasonality, etc.), and technical constraints (irrigation, transportation, storage, processing, other kinds of infrastructures in rural areas). Moreover, a simple abandoning of the production of non-competitive agricultural products may decrease the availability of these products on the domestic market and in such a way impose a threat to food self-sufficiency and food security of a country. In Central Asia, where agricultural production is additionally hampered by hot and dry climate, desertification [95], scarcity of arable lands, salinization

and land degradation [96], prevalence of small-scale farming, and low diversification of crops [1], among other factors, an establishment of a sustainable value chain requires the matching of competitive advantages with agricultural production capabilities, i.e., production advantages.

2.4. Stage 4: Domestic Resource Costs Index

Considering the existing limitations to the sustainable development of competitive advantages in agriculture, in this study, the authors supplement the three-indexes method by the domestic resource costs index (DRC):

$$DRC_{ij} = \frac{C_{ij}^d}{P_{ij} - C_{ij}^f} \tag{4}$$

where *DRC* = domestic resource cost; C^d = domestic input costs; C^f = foreign input costs; *P* = price of a unit of the output (undistorted border price measured in foreign exchange); *i* = country; *j* = product group.

The domestic resource costs concept originates from the works of Bruno [97], Balassa and Schydlowsky [98], and Banerji and Donges [99]. In the 1970s, it started as an approach to the measurement of real opportunity costs in terms of total domestic resources [97], specifically, primary factors such as labor, capital, and land committed to the production of final product with prices at which these products can be traded internationally with foreign exchange gained or saved [99]. The approach has been further adapted to the evaluation and testing of competitive advantages in agricultural trade. Specifically, Hoang et al. [100] advocated for the use of DRC to address the intrinsic weaknesses of coffee production amid the price fluctuation on the world coffee market and volatile competitive advantages, Yercan and Isikli [101] applied DRC to measure international competitiveness of horticultural products, and Masters and Winter-Nelson [102] demonstrated that the DRC method was biased against agricultural activities that relied heavily on such domestic factors as land and rural labor.

DRC shows the value of the country's resources used to produce one unit of a product *j*. When $DRC_{ij} < 1$, a country *i* enjoys an advantage in producing a product *j* (the smaller the DRC_{ij} the greater the advantage), otherwise, there is a disadvantage in the production [77]. The index is widely used in agricultural trade and policy analysis as it allows to identify efficient production sectors [103]. In this study, an introduction of the DRC index to the model as the fourth criteria allows to match four types of advantages (comparative, trade, competitive, and production) and in such a manner to build a more comprehensive picture of competitive position of a country on the global market and suggest where the policies should be targeted to improve the productivity as a reaction to competitive advantage.

2.5. Stage 5: Competitiveness Ranking

The application of the four indexes results in the identification of the products which demonstrate advantages in all four cases (hereinafter referred to as "competitive"), as well those for which the advantages do not intersect ("non-competitive") and those for which at least one of the parameters shows an advantage ("conditionally competitive" and "marginally competitive" depending on the degree of the production advantage). At stage 5, the products are distributed among the groups according to their competitiveness rankings (Table 2).

When $RCA > 1$, $RTA > 0$, $LI > 0$, and $DRC < 1$, a product *j* is recognized as competitive (C group) with comparative, trade, competitive, and production advantages. If a product demonstrates an advantage on any of RCA, RTA, or LI indexes and at the same time possesses a production advantage, it is defined as conditionally competitive (CC group). For the products for which $DRC > 1$, an arithmetical average of RCA_{MC+NC}, RTA_{MC+NC}, and LI_{MC+NC} is calculated. Those products for which all three values of RCA_{av}, RTA_{av}, and LI_{av} are below RCA_{MC+NC}, RTA_{MC+NC}, LI_{MC+NC}, respectively, are recognized as non-competitive. The products for which at least one of the values of RCA_{av}, RTA_{av}, and LI_{av} is above

RCA_{MC+NC}, RTA_{MC+NC}, LI_{MC+NC}, respectively, are distributed to the MC group. Based on the identified competitiveness parameters, group-differentiated policy measures are suggested to support, promote, and protect the advantages.

Table 2. Grouping of products on their competitiveness.

Groups	Competitiveness Criteria
Competitive (C)	$RCA_{av} > 1$, $RTA_{av} > 0$, $LI_{av} > 0$, and $DRC_{av} < 1$
Conditionally Competitive (CC)	$RCA_i > 1$, or/and $RTA_i > 0$, or/and $LI_i > 0$, and $DRC_i < 1$
Marginally Competitive (MC)	$RCA_{av} > RCA_{MC+NC}$, $RTA_{av} > RTA_{MC+NC}$, $LI_{av} > LI_{MC+NC}$, and $DRC_{av} > 1$
Non-Competitive (NC)	$RCA_{av} < RCA_{MC+NC}$, $RTA_{av} < RTA_{MC+NC}$, $LI_{av} < LI_{MC+NC}$, and $DRC_{av} > 1$

Note: RCA—revealed comparative advantage, RTA—relative trade advantage, LI—Lafay competitive advantage, DRC—domestic resource cost. Source: Authors' development.

3. Results: Central Asia's Perspective

3.1. Revealed Comparative Advantages

At stage 1, the study reveals the comparative advantages of agricultural exports across 37 product groups. Based on the average RCA values in 2000–2018, the most notable advantages are identified for the crop sector and horticulture. Product groups with the highest competitiveness potential in export include wheat and meslin flour, fruits and nuts, vegetables, and other crop products. Among the countries of Central Asia, only Kyrgyzstan possesses a comparative advantage in livestock products (Table 3).

Table 3. RCA_{av} values for selected agricultural products in Central Asia in 2000–2018.

Products	Kazakhstan	Kyrgyzstan	Tajikistan	Turkmenistan	Uzbekistan
Live animals	0.032	2.030	0.042	0.002	0.292
Meat of bovine animals, fresh, chilled or frozen	0.016	0.018	0.000	0.000	0.006
Other meat and edible meat offal	0.036	0.306	0.000	0.010	0.004
Meat, edible meat offal, salted, dried	0.002	0.034	0.000	0.000	0.000
Meat, edible meat offal, prepared, preserved	0.066	0.358	0.000	0.002	0.000
Milk and dairy products	0.104	4.770	0.012	0.000	0.008
Butter and other fats and oils derived from milk	0.218	5.194	0.016	0.004	0.000
Cheese and curd	0.042	2.444	0.008	0.000	0.004
Eggs, eggs' yolk, albumin	0.256	0.136	0.000	0.148	0.288
Fish, fresh, chilled or frozen	0.290	0.034	0.020	0.010	0.058
Fish, dried, salted, smoked	0.120	0.050	0.000	0.000	0.002
Crustaceans, mollusks, and aquatic invertebrates	0.000	0.022	0.000	0.014	0.000
Fish and aquatic invertebrates	0.082	0.038	0.162	0.004	0.000
Wheat and meslin	4.890	0.082	0.010	0.010	0.572
Rice	0.284	0.190	1.626	0.002	0.008
Barley	5.222	0.050	0.000	0.000	0.000
Maize	0.004	0.070	0.002	0.000	0.048
Cereals, unmilled	0.452	0.128	0.002	0.000	0.002
Flour (wheat and meslin)	27.332	3.876	3.564	1.510	2.724
Other cereal meals and flour	0.674	0.044	0.050	0.086	0.004
Cereal preparations, flour of fruits or vegetables	0.134	0.506	0.010	0.004	0.052
Vegetables	0.242	9.112	3.296	0.086	6.610
Vegetables, roots, tubers, prepared, preserved	0.016	0.696	1.394	0.012	2.130
Fruits and nuts	0.062	4.736	6.548	1.042	9.312
Fruit, preserved	0.024	0.304	0.478	0.044	1.002
Fruit and vegetable juices	0.032	0.834	5.636	0.008	2.188
Sugar, molasses and honey	0.304	3.598	0.112	0.032	0.028
Sugar confectionery	0.452	0.324	0.044	0.014	0.516
Coffee and coffee substitutes	0.038	0.098	0.010	0.012	0.000
Cocoa	0.006	0.002	0.000	0.000	0.000

Table 3. *Cont.*

Products	Kazakhstan	Kyrgyzstan	Tajikistan	Turkmenistan	Uzbekistan
Chocolate	0.220	0.456	0.248	0.030	0.262
Tea and mate	0.158	2.194	0.066	0.024	0.002
Spices	0.002	0.272	0.348	0.382	1.470
Feeding stuff for animals	0.168	0.108	0.002	0.182	0.346
Margarine	0.488	2.938	0.000	0.010	0.008
Edible products and preparations	0.126	0.512	0.022	0.002	0.036
Oilseeds and oleaginous fruits	1.274	0.206	0.738	0.044	0.886

Note: Green cells—product groups with comparative advantage. Source: Authors' calculation based on [26].

3.2. Relative Trade Advantages

At stage 2, the study aims at the identification of those agricultural products for which relative trade advantage is positive and then matching average values of trade and comparative advantages (Table 4).

Table 4. RTA_{av} values for selected agricultural products in Central Asia in 2000–2018.

Products	Kazakhstan	Kyrgyzstan	Tajikistan	Turkmenistan	Uzbekistan
Live animals	−0.764	−1.223	1.673	−0.845	−0.394
Meat of bovine animals, fresh, chilled or frozen	−0.499	−0.956	−2.554	−0.391	−0.598
Other meat and edible meat offal	−0.208	−0.591	−1.960	−0.492	−0.492
Meat, edible meat offal, salted, dried	−0.746	−0.443	−1.438	−0.818	−0.694
Meat, edible meat offal, prepared, preserved	−0.552	−0.309	−1.005	−0.738	−0.440
Milk and dairy products	−2.955	1.927	−2.028	−1.118	−0.941
Butter and other fats and oils derived from milk	−1.730	0.770	−2.315	−1.231	−1.329
Cheese and curd	−1.663	−0.301	−1.583	−0.890	−1.226
Eggs, eggs' yolk, albumin	−2.967	−1.609	−0.376	−0.204	−0.845
Fish, fresh, chilled or frozen	1.004	0.098	−2.228	−1.948	−2.380
Fish, dried, salted, smoked	1.291	0.238	−2.392	−1.773	−2.005
Crustaceans, mollusks, and aquatic invertebrates	0.007	−1.224	−3.410	−2.022	−3.538
Fish and aquatic invertebrates	0.019	−1.503	−3.109	−2.118	−3.103
Wheat and meslin	3.438	−0.884	−0.334	0.025	−0.047
Rice	−0.083	−2.361	0.883	−0.444	−0.885
Barley	1.109	−1.330	−0.503	0.117	−0.494
Maize	−1.754	−1.948	−0.991	−0.428	−1.205
Cereals, unmilled	−0.993	0.004	−0.895	0.073	−0.403
Flour (wheat and meslin)	2.291	−0.882	0.649	0.481	0.302
Other cereal meals and flour	0.008	−0.420	0.008	0.365	−0.038
Cereal preparations, flour of fruits or vegetables	0.129	−0.251	0.429	0.522	0.295
Vegetables	0.583	0.529	0.077	1.247	0.038
Vegetables, roots, tubers, prepared, preserved	0.429	0.494	0.012	0.719	0.092
Fruits and nuts	1.530	3.280	1.370	1.009	1.628
Fruit, preserved	0.888	2.425	1.394	0.917	0.944
Fruit and vegetable juices	1.002	1.730	0.641	0.238	0.727
Sugar, molasses and honey	−0.730	1.004	−0.493	−0.371	0.085
Sugar confectionery	−1.628	0.397	−0.648	−1.317	−0.438
Coffee and coffee substitutes	−3.047	−2.092	−3.881	−1.528	−2.225
Cocoa	−1.994	−3.114	−3.202	−2.020	−2.702
Chocolate	−1.703	−2.606	−3.444	−2.418	−2.993
Tea and mate	−2.906	−1.994	−1.820	−0.905	0.066
Spices	−0.839	−0.422	0.553	0.177	0.054
Feeding stuff for animals	0.977	0.575	−1.112	0.883	−0.048
Margarine	0.022	−0.149	−1.284	−0.691	−1.596
Edible products and preparations	0.393	−0.338	−0.404	0.447	−0.330
Oilseeds and oleaginous fruits	1.619	0.792	−0.328	0.303	0.444

Note: Green cells—product groups for which RCA and RTA match; yellow cells—product groups with relative trade advantage. Source: Authors' calculation based on [26].

Comparative and trade advantages overlap largely for crops and horticultural products (fruit, wheat, oilseeds, rice, barley, spices), while do not match in the livestock sector and food processing (particularly, in Kyrgyzstan).

The study also reveals that, in some cases, the countries of Central Asia trade in those agricultural products in which they possess no distinct comparative advantages but only trade ones—aquaculture products in Kazakhstan and Kyrgyzstan, cereal meals and preparations in Turkmenistan and Tajikistan, feeding stuff for animals in Kazakhstan and Turkmenistan, and oilseeds in Uzbekistan and Kyrgyzstan, among others.

3.3. Competitive Advantages

A revealed discrepancy between the advantages attests to the relevance of measuring the competitiveness through several alternative parameters. At stage 3, applying the Lafay index to the established grid of RCA and RTA values, we see that the countries of Central Asia have competitive advantages in labor-intensive horticulture (fresh fruits and nuts) rather than technology-intensive food processing or finance-intensive livestock sector. Even for the production of preserved fruit and fruit and vegetable juices, LI indicators do not fully match previously identified comparative and trade advantages (Table 5).

Table 5. LI_{av} values for selected agricultural products in Central Asia in 2000–2018.

Products	Kazakhstan	Kyrgyzstan	Tajikistan	Turkmenistan	Uzbekistan
Live animals	−0.004	−0.332	−0.446	−0.597	−0.835
Meat of bovine animals, fresh, chilled or frozen	0.041	−0.428	−0.259	−0.886	−0.946
Other meat and edible meat offal	0.007	−0.229	−0.303	−0.365	−0.808
Meat, edible meat offal, salted, dried	−0.021	−0.341	−0.296	−0.496	−0.737
Meat, edible meat offal, prepared, preserved	−0.047	−0.120	−0.199	−0.179	−0.961
Milk and dairy products	−0.110	0.117	−1.037	−1.000	−1.054
Butter and other fats and oils derived from milk	−0.124	0.009	−1.204	−1.202	−1.336
Cheese and curd	−0.099	−0.387	−1.231	−1.269	−1.428
Eggs, eggs' yolk, albumin	−0.162	−0.005	−0.306	−1.200	−0.905
Fish, fresh, chilled or frozen	−0.036	−0.206	−1.267	−1.362	−1.201
Fish, dried, salted, smoked	0.008	−0.113	−1.285	−1.401	−1.312
Crustaceans, mollusks, and aquatic invertebrates	−0.237	−1.299	−1.399	−1.003	−1.444
Fish and aquatic invertebrates	−0.244	−1.005	−1.405	−1.554	−1.396
Wheat and meslin	1.774	0.003	−0.775	0.036	−0.057
Rice	−0.302	−0.113	−0.056	−0.402	−0.043
Barley	−0.013	−0.016	−0.062	0.004	−0.128
Maize	−0.014	−0.299	−0.700	−0.078	−0.224
Cereals, unmilled	0.110	−0.004	−0.055	0.012	−0.065
Flour (wheat and meslin)	0.427	0.007	−0.009	−0.045	−0.071
Other cereal meals and flour	0.090	0.015	0.003	0.026	−0.329
Cereal preparations, flour of fruits or vegetables	−0.012	0.012	0.007	0.018	0.012
Vegetables	0.076	−0.045	−0.034	−0.042	−0.056
Vegetables, roots, tubers, prepared, preserved	0.044	−0.071	−0.067	−0.176	−0.112
Fruits and nuts	−0.002	0.481	0.303	0.419	0.665
Fruit, preserved	−0.017	−0.372	−0.044	0.206	0.393
Fruit and vegetable juices	−0.120	−0.279	0.265	−0.385	−0.004
Sugar, molasses and honey	−0.348	0.218	−0.087	−0.204	0.033
Sugar confectionery	−0.401	−0.054	−0.420	−0.123	−0.013
Coffee and coffee substitutes	−0.906	−1.249	−1.164	−0.206	−1.201
Cocoa	−0.997	−1.303	−1.205	−0.443	−1.006
Chocolate	−1.250	−1.442	−1.228	−1.333	−1.350
Tea and mate	−1.089	−0.558	−0.883	−1.004	0.028
Spices	−0.806	−0.366	0.021	−0.008	−0.013
Feeding stuff for animals	0.166	0.013	−0.772	0.056	−0.442
Margarine	−0.709	−0.447	−0.605	−0.175	−0.600
Edible products and preparations	0.010	0.001	−0.843	−0.118	−0.522
Oilseeds and oleaginous fruits	0.229	0.284	−0.674	0.124	0.052

Note: Green cells—product groups for which all three RCA, RTA, and LI match; yellow cells—product groups with competitive advantage. Source: Authors' calculation based on [26].

3.4. Domestic Resource Costs

At stage 4, for all product groups included in the array, the study identifies the value of the resources employed to produce one unit's worth of that agricultural product and in such a way

reveals the advantages in production. When imposed on the previously identified comparative, trade, and competitive advantages, the parameter of production advantage allows to ascertain positively competitive (four parameters match) and conditionally competitive food and agricultural products (*DRC* < 1), as well as those products recognized as marginally competitive and non-competitive (*DRC* > 1) (Table 6).

Table 6. *DRC*$_{av}$ values for selected agricultural products in Central Asia in 2000–2018.

Products	Kazakhstan	Kyrgyzstan	Tajikistan	Turkmenistan	Uzbekistan
Live animals	1.207	1.173	1.377	1.190	1.032
Meat of bovine animals, fresh, chilled or frozen	0.826	0.331	1.050	1.114	1.125
Other meat and edible meat offal	0.772	0.305	1.195	1.209	1.153
Meat, edible meat offal, salted, dried	0.910	0.343	1.206	1.321	1.097
Meat, edible meat offal, prepared, preserved	0.754	0.682	1.223	1.185	1.088
Milk and dairy products	1.005	0.424	1.300	1.006	1.224
Butter and other fats and oils derived from milk	1.177	1.102	1.312	1.077	1.206
Cheese and curd	1.236	1.299	1.290	1.194	1.255
Eggs, eggs' yolk, albumin	1.048	1.063	1.096	1.087	1.404
Fish, fresh, chilled or frozen	0.829	0.942	1.137	1.226	1.552
Fish, dried, salted, smoked	0.886	1.057	1.229	1.251	1.499
Crustaceans, mollusks, and aquatic invertebrates	1.057	1.222	1.332	1.302	1.500
Fish and aquatic invertebrates	1.109	1.219	1.304	1.343	1.543
Wheat and meslin	0.657	0.940	1.041	0.804	1.012
Rice	1.005	1.109	1.222	1.067	1.110
Barley	0.995	1.085	1.094	1.045	1.016
Maize	1.093	1.226	1.267	1.078	1.055
Cereals, unmilled	1.146	1.054	1.120	1.004	1.014
Flour (wheat and meslin)	0.838	0.938	1.038	0.911	1.020
Other cereal meals and flour	0.807	0.990	1.114	0.932	1.099
Cereal preparations, flour of fruits or vegetables	1.063	1.033	0.883	0.995	0.741
Vegetables	1.112	0.901	0.904	1.154	1.114
Vegetables, roots, tubers, prepared, preserved	1.004	1.106	1.055	1.076	1.127
Fruits and nuts	1.055	0.811	0.268	0.260	0.228
Fruit, preserved	1.197	0.736	1.096	0.776	1.194
Fruit and vegetable juices	1.208	0.683	1.182	0.812	0.997
Sugar, molasses and honey	1.083	0.469	1.228	1.111	0.809
Sugar confectionery	1.115	1.195	1.209	1.137	1.102
Coffee and coffee substitutes	1.306	1.203	1.314	1.290	1.541
Cocoa	1.227	1.224	1.557	1.295	1.526
Chocolate	0.994	1.250	1.506	1.302	1.553
Tea and mate	1.290	1.117	0.905	1.032	0.705
Spices	1.166	1.008	0.880	1.117	0.901
Feeding stuff for animals	0.884	0.900	1.344	1.046	1.117
Margarine	1.306	1.199	1.402	1.261	1.492
Edible products and preparations	0.773	1.023	1.189	1.177	1.203
Oilseeds and oleaginous fruits	0.449	1.112	1.254	0.856	1.188

Note: Green cells—product groups for which all four RCA, RTA, LI, and DRC match; yellow cells—product groups with advantage on domestic resource costs. Source: Authors' calculation based on [26,104–108].

3.5. Competitiveness Distribution

Proceeding from the above results, competitive positions primarily include horticultural products such as apricots and plums (the two most competitive products in Kyrgyzstan, Uzbekistan, Tajikistan, and Turkmenistan), cherries (Kyrgyzstan, Uzbekistan, and Turkmenistan), and grapes (Uzbekistan and Tajikistan) as well as wheat and meslin (Kazakhstan), milk and dairy products (Kyrgyzstan), flour (Kazakhstan), honey (Kyrgyzstan), and walnuts (Kyrgyzstan and Uzbekistan).

There are the products considered conditionally competitive as they obtain any of comparative, trade, or competitive advantage and DRC below market price. Kazakhstan and Kyrgyzstan may potentially promote their meat products (due to the developed livestock sector and cattle farming), fish (fishing and aquaculture production in the Caspian Sea and the lakes of Balkhash, Issyk-Kul, Zaysan, and Alakol), and feeding stuff for animals (abundant pastures). The countries of Central Asia are also

conditionally competitive in the production of various cereals and their preparations, tea, and spices (Table 7).

Table 7. Allocation of agricultural products to competitiveness groups per countries.

Products	Kazakhstan	Kyrgyzstan	Tajikistan	Turkmenistan	Uzbekistan
Live animals	NC	MC	NC	NC	NC
Meat of bovine animals, fresh, chilled or frozen	CC	CC	NC	NC	NC
Other meat and edible meat offal	CC	CC	NC	NC	NC
Meat, edible meat offal, salted, dried	CC	CC	NC	NC	NC
Meat, edible meat offal, prepared, preserved	CC	CC	NC	NC	NC
Milk and dairy products	NC	C	NC	NC	NC
Butter and other fats and oils derived from milk	NC	MC	NC	NC	NC
Cheese and curd	NC	MC	NC	NC	NC
Eggs, eggs' yolk, albumin	NC	NC	NC	NC	NC
Fish, fresh, chilled or frozen	CC	CC	NC	NC	NC
Fish, dried, salted, smoked	CC	MC	NC	NC	NC
Crustaceans, mollusks, and aquatic invertebrates	MC	NC	NC	NC	NC
Fish and aquatic invertebrates	MC	NC	NC	NC	NC
Wheat and meslin	C	CC	NC	CC	NC
Rice	NC	NC	MC	NC	NC
Barley	CC	NC	NC	MC	NC
Maize	NC	NC	NC	NC	NC
Cereals, unmilled	MC	MC	NC	MC	NC
Flour (wheat and meslin)	C	CC	MC	CC	MC
Other cereal meals and flour	CC	CC	MC	CC	NC
Cereal preparations, flour of fruits or vegetables	MC	MC	CC	CC	CC
Vegetables	MC	CC	CC	MC	MC
Vegetables, roots, tubers, prepared, preserved	MC	MC	MC	MC	MC
Fruits and nuts	MC	C	C	C	C
Fruit, preserved	MC	CC	MC	CC	MC
Fruit and vegetable juices	MC	CC	MC	CC	CC
Sugar, molasses and honey	NC	C	NC	NC	CC
Sugar confectionery	NC	MC	NC	NC	NC
Coffee and coffee substitutes	NC	NC	NC	NC	NC
Cocoa	NC	NC	NC	NC	NC
Chocolate	CC	NC	NC	NC	NC
Tea and mate	NC	MC	CC	NC	CC
Spices	NC	NC	CC	MC	CC
Feeding stuff for animals	CC	CC	NC	MC	NC
Margarine	MC	MC	NC	NC	NC
Edible products and preparations	CC	MC	NC	MC	NC
Oilseeds and oleaginous fruits	C	MC	NC	CC	MC

Note: Green cells—competitive (C); yellow cells—conditionally competitive (CC); orange cells—marginally competitive (MC); red cells—non-competitive (NC). Source: Authors' development.

The majority of agricultural products in Central Asia, however, are recognized as either non-competitive (no advantage on any of the four indexes) or marginally competitive (there are advantages, but DRC to produce a unit of a product is higher than the product is worth).

4. Discussion: Matching Central Asia's and China's Perspectives

4.1. Matching 1: Export Competitiveness of Central Asian Countries and China's Food Imports

The study demonstrates that the development of agricultural value chains in the countries of Central Asia is based on a narrow nomenclature of the most competitive products: Fruit, wheat, cereals, and meat. This corresponds with the earlier findings of Rillo and Nugroho [43], Adriano [109], and International Center for Agricultural Research in the Dry Areas [110] who all concluded that value chains in each of the Central Asian countries served their respective competitive sectors and were not deeply integrated with each other due to different competitive advantages.

Both comparative and competitive advantage theories suggest that a country specializes in production and trade in those products in which it possesses an advantage over its competitors. It is natural for a dry and hot region of Central Asia to lose out in the production of cocoa, coffee,

and some crops (rice, maize, and barley) as well as for landlocked Tajikistan and Uzbekistan to be non-competitive in fishing. However, even in the conventional sectors of animal husbandry, fruit and vegetable processing, or edible products preparation, most of the Central Asian economies lose their competitive advantages as corresponds with the World Bank's [77] findings of the erosion of competitive advantages in the region due to the outdated facilities, lack of investment and technologies, underdeveloped infrastructure, low productivity, poor veterinary and phytosanitary systems, and low capacity to comply with packaging, marketing, and other requirements of the contemporary global market.

Apart from a pure trade advantage on one side, an establishment of a sustainable value chain involves the creation of stable demand for a product on the other [111,112]. Demand is one of the four interrelated components of success in international trade in Porter's theory of competitive advantage [113], as well as an integrated element in various value chain concepts, such as global commodity chain [114,115], world economic triangle [116], global value chain [117], Porter's value chain [113], commodity chain [118], and "filiere" approach [119].

On the one side of the chain, there are Central Asian suppliers of fruits, cereals, meat and dairy, and some other products identified as either competitive or conditionally competitive. What is the demand on the other side? China is a country where agricultural sector is intended to feed over 1.3 billion people [120]. This fact alone brings a substantial portion of risk to the stability of agricultural value chains globally. Since the late 1970s, China has been gradually opening its market to food import and external actors [121], as well as encouraging the penetration of its state-backed agricultural companies to value chains abroad. The most recent food security strategy approved in 2019 outlined international collaboration in agriculture as one of the tools to sustain food security of China and thus contribute to the improvement of food security globally [25].

By now, China has achieved self-sufficiency on staple agricultural products on the level above 90% [122]. For some products, nevertheless, the country still depends on imports being the world's top importer of soybeans, cotton, palm oil, and sugar. Oilseeds and oleaginous fruits, in which Kazakhstan and Turkmenistan possess competitive advantages, account for one-fifth of China's total agricultural imports in 2000–2018 (Table 8). Oilseeds and vegetable oils and fats will remain the predominant imported agricultural commodities of China for at least a couple of decades [120]. Currently, self-sufficiency in oilseeds is the lowest among agricultural products in China and is expected to decrease in 2020–2040 [120]. The match between demand and advantage makes soybeans the most perspective crop to produce and export to China. Fruits and nuts, in which all the countries of Central Asia, except Kazakhstan, enjoy the highest advantages, are also perspective for export, but China has been improving its self-sufficiency in fruits since mid-2000s. The demand is still high for exotic tropical fruits not grown in Central Asia. Moreover, there are advantages-demand overlaps for milk and dairy products (Kyrgyzstan), feeding stuff for animals (Kazakhstan and Kyrgyzstan), and sugar and honey (Kyrgyzstan).

Table 8. China's top import products and Central Asia's competitive advantages.

Products	Share in Imports *, Percentage	Imports/GDP Ratio **, Percentage	Competitive Advantage
Oilseeds and oleaginous fruits	20.776	76.183	Kazakhstan, Turkmenistan
Fish, fresh, chilled or frozen	6.450	12.574	Kazakhstan, Kyrgyzstan
Feeding stuff for animals	6.086	20.419	Kazakhstan, Kyrgyzstan
Other meat and edible meat offal	4.807	16.055	Kazakhstan, Kyrgyzstan
Fruits and nuts	4.488	10.038	Kyrgyzstan, Tajikistan, Turkmenistan, Uzbekistan
Edible products and preparations	3.425	13.800	Kazakhstan
Crustaceans, mollusks, and aquatic invertebrates	2.646	7.229	-

Table 8. *Cont.*

Products	Share in Imports *, Percentage	Imports/GDP Ratio **, Percentage	Competitive Advantage
Milk and dairy products	2.571	82.982	Kyrgyzstan
Barley	2.311	6.504	Kazakhstan
Vegetables	2.172	9.336	Kyrgyzstan, Tajikistan
Sugar, molasses and honey	1.683	69.027	Kyrgyzstan
Wheat and meslin	1.489	5.038	Kazakhstan, Kyrgyzstan, Turkmenistan
Rice	1.226	4.930	-
Cereals, unmilled	0.906	6.117	-
Meat of bovine animals, fresh, chilled or frozen	0.981	22.170	Kazakhstan, Kyrgyzstan
Cereal preparations, flour of fruits or vegetables	0.522	7.005	Tajikistan, Turkmenistan, Uzbekistan
Live animals	0.503	18.683	-
Fruit, preserved	0.414	14.864	Kyrgyzstan, Turkmenistan
Margarine	0.414	17.449	-
Chocolate	0.347	38.114	Kazakhstan
Vegetables, roots, tubers, prepared, preserved	0.291	7.385	-
Fish and aquatic invertebrates	0.284	6.910	-
Fruit and vegetable juices	0.244	18.793	Kyrgyzstan, Turkmenistan, Uzbekistan
Cheese and curd	0.221	44.170	-
Butter and other fats and oils derived from milk	0.217	37.372	-
Sugar confectionery	0.188	21.006	-
Fish, dried, salted, smoked	0.138	11.144	Kazakhstan
Tea and mate	0.083	2.378	Tajikistan, Uzbekistan
Spices	0.066	9.993	Tajikistan, Uzbekistan
Flour (wheat and meslin)	0.054	5.709	Kazakhstan, Kyrgyzstan, Turkmenistan
Other cereal meals and flour	0.032	8.225	Kazakhstan, Kyrgyzstan, Turkmenistan
Meat, edible meat offal, prepared, preserved	0.026	13.082	Kazakhstan, Kyrgyzstan
Meat, edible meat offal, salted, dried	0.003	10.663	Kazakhstan, Kyrgyzstan

Note: * share of a product *i* in total agricultural imports of China, average in 2000–2018; ** ratio of import volume of a product *i* to gross domestic output of a product *i*, average in 2000–2018. Source: Authors' calculation based on [26,123].

There is no match between Central Asia's competitive advantage in wheat and China's demand for grain. Currently, China supplies 95% of its own needs for grain [25], but in the coming decades, the demand for and import of grain crops is expected to rise rapidly [120]. Economic development, progressing urbanization and transformation of food consumption patterns along with the degradation of limited arable land and heavy use of fertilizers in China are likely to bring increased demand for all major crops in 2020–2040 [77,122,124]. Zhou [125], Zhou et al. [126], and the World Bank [77] attribute the growth in the consumption of food products of higher quality, nutrient value, and price in China (meat and meat products, milk and dairy products, and seafood) to the prejudice of cheaper and fewer nutrient crops. Consequently, Chinese meat and dairy producers demand more crops as fodder for agricultural animals which is a niche to be potentially occupied by the producers of feeding stuff for animals from Kazakhstan and Kyrgyzstan.

4.2. Matching 2: Production Advantages of Central Asian Countries and China's Agricultural Investments in the Region

How China can meet the challenge of growing demand for food and ensure the stability of food supply chains? As stated in the National Strategy on Food Security [25], among the solutions are the sharing of resources, support of the enterprises in going global, and encouragement of investment in agricultural products abroad. Foreign direct investment became an increasingly important element in sustainable development of agricultural value chains worldwide [127]. Being the most populous country in the world, China has been increasingly concerned in securing sustainable and sufficient food supply for its people. As the economic growth in China brings more purchasing power to the customers, the country has been emerging as a leading importer of food of all kinds, including

high-quality and nutritious products, as well as a major player in outward agricultural investment [128]. According to Zhang and Cheng [129] and Cui and Shoemaker [130], the main task for China's overseas agricultural investment is to establish global value chains that would improve the stability of food supply. The country has been diversifying where it obtains crops that Chinese farmers are not able to grow in sufficient quantities domestically [122].

Many authors, including Bondaz et al. [131], Zhang [132], Shah [133], He et al. [134], and Huang et al. [135] share the vision of the BRI as a driver of China's new approach to its food security strategy and establishment of sustainable agricultural value chains across Eurasia. While the BRI's major focus in Central Asia is on the improvement of connectivity and facilitation of trade, it also involves investment in agriculture. Among the countries of Central Asia, Kazakhstan is most attracting country of foreign direct investment (70% of total investments in the region) [136] and the main recipient of agricultural investments from China (over $1 billion in 17 projects as of 2018) in processing and sale of rapeseed and sunflower seeds, oil crops, and fresh-frozen fish and fish products, construction of slaughterhouses and poultry farms, and establishment of a cluster in sheep farming and enterprises for deep processing of grain, flax, soybeans, and semi-finished meat products [137] (Table 9). In Uzbekistan, Tian Jean Nana and Exim Bank of China invested about $29 million to the establishment of a logistics hub in the Bukhara region for the processing of fruit and vegetables and meat and dairy products and exporting them to China. In Kyrgyzstan, Chinese companies invest to crop production, processing of agricultural products, and food industry [138].

Table 9. Major Chinese investment projects in agriculture * and Central Asia's competitive advantages.

Countries	Sectors with Chinese Investment	Sectors, in Which an Advantage Is Possessed
Kazakhstan	Meat and meat products	Meat and meat products
	Fish and fish products	Fish and fish products
	Wheat and meslin	Wheat and meslin
		Barley and other cereals
	Processing of cereals	
	Vegetables prepared, preserved	
	Sugar, molasses, and honey	
		Chocolate
		Feeding stuff for animals
	Edible products and preparations	
	Oilseeds and oleaginous fruits	
	Meat and meat products	
Kyrgyzstan		Milk and dairy products
		Fresh fish
	Wheat and meslin	
	Processing of cereals	
	Vegetables	
	Fruit and nuts	
		Sugar and honey
		Feeding stuff for animals
	Edible products and preparations	
Tajikistan	Wheat and meslin	
	Maize	
		Cereal preparations
		Vegetables
	Fruit and nuts	
		Tea and mate
		Spices
	Wheat and meslin	
Turkmenistan		Processing of cereals
	Fruits and nuts	Fruits and nuts
		Processing of fruit and vegetables
		Oilseeds and oleaginous fruits

<div align="center">**Table 9.** *Cont.*</div>

Countries	Sectors with Chinese Investment	Sectors, in Which an Advantage Is Possessed
Uzbekistan	Meat and meat products	
	Milk and dairy products	
	Cereal preparations	
	Fruit and nuts	
	Fruit and vegetable juices	
		Sugar and honey
		Tea and mate
		Spices

Note: * this study does not consider the cotton sector, one of the major attractors of Chinese investment in the region, as that not directly related to food production; green cells—C group; yellow cells—CC group; orange cells—MC group; red cells—NC group. Source: Authors' development based on [104–108,123].

In general, the directions of Chinese agricultural investment in the region intersect with competitive advantages of respective counties. In particular, there is a distinct match between the investment and advantages in horticulture. This finding, however, contradicts with Hofman [139], who argued that the investments in the production of unpreserved fruits in Central Asia were disadvantageous for Chinese agro holdings due to the impoverished storage and transport infrastructure and costly shipment to China. Indeed, there are substantial challenges to both the stability and economic efficiency of value chains due to the backwardness of infrastructure, geography, and landlockedness and remoteness of the region, but Chinese investors still enter joint projects in the production of fresh fruits and vegetables and other perishable products. Perspective sectors for Chinese companies to move to are dairy and sugar production in Kyrgyzstan, both in C group. In most of the sectors, where China currently invests to, Central Asian agricultural producers possess conditionally competitive advantages, according to our classification. Moreover, there are investment projects in the sectors where the advantages are either marginal or absent.

4.3. Matching 3: Sustainability of Agricultural Value Chains and Policy Implications of Competitiveness and Trade Potential Assessment

Despite the growing volume of joint agricultural projects, China's investment in the region primarily focuses on mining and construction with limited involvement in agricultural value chains [140]. Kurmanalieva and Parpiev [2] think that it would be difficult for Central Asian economies to diversify their value chains away from primary commodities towards processed goods, including agricultural. Nevertheless, the authorities in all countries of the region expect China to invest more in food production. The use of agricultural land by foreigners, however, remains a controversial topic across social groups in Central Asia. People are becoming concerned that China's growing investment in agricultural sector could result in land grabbing by Chinese companies and the influx of Chinese workers. For instance, in Kazakhstan, the protests forced the government to postpone the extension of the farmland lease period for foreigners from 10 to 25 years until December 2021. Along with economic, infrastructural, environmental, and climate challenges that confront food sector in Central Asia, emerging social issues pose new threats to the sustainability of agricultural value chains in the region and call for adequate policy responses.

Many of earlier studies, including Adriano [109], Pirmatov et al. [38], Akter et al. [30], Foggin [141], and Akramov [31], among others, found that policy efforts aimed at the fostering, coordination, and integration of agricultural value chains in Central Asia would lead to the improved performance of agricultural sectors and more stable food supply. Following on from the results of this study, we propose policy measures to be differentiated in such a way as to support and promote the advantages in C and CC groups and establish and protect those in MC and NC groups (Table 10).

Table 10. Policy measures to improve the sustainability of China–Central Asia agricultural value chains.

Competitiveness Groups	Policy Measures
C group	Diminishing of administrative barriers to export
	Development of production and logistics infrastructure, including as a part of the BRI
	Economic corridor approach to the development of value chains
CC group	PR and promotion of domestic products on Chinese market
	Support of "niche" export-oriented productions
	Subsidized loans for the development of export production
	Subsidized insurance of export-oriented productions
MC group	Income support of agricultural and food producers
	Reduction of production costs
	Programs for sustainable development and diversification of the rural economy
	Measures to prevent and offset the impact of sharp increases in agricultural imports
	Encouragement of Chinese investment in agricultural research and infrastructure, particularly, irrigation, storage, processing, and supply facilities
NC group	Direct payments to the producers of staple crops
	Comprehensive subsidies for agricultural inputs
	Subsidies for farm machinery purchases
	Subsidies for improved crop varieties
	Minimum grain purchasing prices
	Temporary storage options

Source: Authors' development.

For C group products, the competitive environment can be improved by reducing administrative barriers to export and implementing customs and tariff regulations of export. Currently, trade policy regimes in Central Asia vary from fairly liberal in Kyrgyzstan and Kazakhstan to quite restrictive in Uzbekistan and Turkmenistan [142]. According to Raballand and Andresy [143] and Jha [144], the variability of export regimes across the countries in Central Asia very much depends on the membership in the WTO. Kyrgyzstan (the most liberal trade regime among the five economies, WTO member since 1998), Kazakhstan, and Tajikistan have made extensive efforts to improve export regulations and facilitate the development of core automation of trade procedures. Uzbekistan and Turkmenistan (both are still out of the WTO framework of trade regulations), on the contrary, lack transparency and stability in their trade policies. Mogilevskii and Akramov [13] found that Uzbekistan and to a lesser degree other countries in the region extensively introduced export duties and even export bans to reduce or prevent the exports of raw agricultural products which might be processed domestically. These include oilseeds, cereals, fodder crops, vegetable oil, live animals, meat, and sugar. Our study, however, demonstrates lower competitiveness of food processing industries across Central Asia compared to crop production which means such export restrictions favor "managed" trade but distort real competitive advantages and bring instability to value chains.

For a value chain to gain sustainability, it is imperative to develop production, logistics, and supply infrastructure. The potential solutions include the reduction of export transaction costs and the improvement of the access of Central Asian producers to the Chinese market. All countries of the region currently rank low in the Trading Across Borders Indicator of the World Bank's Doing Business Index (Kyrgyzstan ranks the highest among the five, 89th out of 189 economies in 2019) [145] due to the high number of documents and procedures required to conduct an export delivery. Even for high-competitive C group products, these barriers reduce competitiveness and call for a pro-active removal of export constraints for efficient trade facilitation. This agrees with White [146], who demonstrates that lowering the number of documents required to export would yield shorter export times, decrease the opportunity for corruption and other uncertainties along the value chains, and increase the advantage of Central Asian products in the global market.

As this study demonstrates, some of the competitive sectors lack Chinese investments, while in some cases, Chinese companies invest to the sectors where the advantages are marginal or negligible. The BRI as an umbrella initiative aimed at the development of connectivity on the macro level may allow agribusiness to concentrate around major infrastructure investment, potentially, in a form of

the economic corridor, a complex of production, logistics, and trade arrangements. A concept of the economic corridor approach to the development of agricultural value chains in Central Asia is advocated by Rillo and Nugroho [43] and Nogales [147]. Due to the landlockedness and low intraregional and international transport connectivity, economic corridors have been central to the agenda in most of the Central Asian countries. Specifically, Central Asian Regional Economic Cooperation (CAREC) program has laid the groundwork for economic corridor development in Central Asia by mobilizing over $34.5 billion investments in the establishment of multimodal transportation networks [148]. Concerning economic corridor approach, CAREC supports simplification and harmonization of customs procedures, information and communication technology development and data exchange, risk management and post-entry audit, joint customs control, and regional transit development [148]. In relation to C group value chains, the economic corridor approach may allow to attract more investment in the most competitive sectors and stimulate economic activities along the territories in which the corridor is established.

For CC group products, it would be rational to affect the demand side of the value chains. The efforts should be focused on the promotion of CC products outside and creating demand on the Chinese market. Among CC products, the most demanded in China are oilseeds, wheat, and other cereals. In Central Asia, the major hindrances to the stability of value chains in crop production are large distances and high storage and transportation costs due to the scarcity, fragmentation, and deterioration of infrastructure. Kazakhstan is developing its railway and road infrastructures, including in the framework of Nurly Zhol initiative, a national plan to develop and modernize roads, railways, ports, and IT infrastructure, in an attempt to establish a network of multimodal transport hubs and integrate them with China's BRI economic corridors [149]. In other countries of the region, capital stocks devoted to infrastructure development are lower, while the obsolesce of infrastructure appears to affect export-oriented agricultural value chains in a negative way [142]. This is especially relevant for C and CC group products, including such key export items as fruits and vegetables which are perishable and sensitive to delays in transportation [13].

Crop producers may benefit from the investment in grain market infrastructure, subsidized loans, and export insurance programs. These measures correlate with the recommendation of Svanidze et al. [150] to complement trade and infrastructure-enhancing policies with the support of domestic producers in order to bring more stability to value chains in crop production. The establishment of tax incentives along with the allocation of preferential credits for agribusiness are recommended by Pirmatov et al. [38] among the measures to support competitive advantages. Pomfret [42] also advocates technological improvements of grain production and supply infrastructure and financial support of farmers as the conditions of increasing efficiency in the grain sector. Technological improvements, for instance, are required to help to overcome technical barriers for trade established in China and other export markets. They include compliance with health, veterinary, and phytosanitary requirements. Due to the overall underdeveloped veterinary and phytosanitary systems and quality infrastructure in Central Asia, agricultural producers encounter difficulties to comply with safety regulations applied internationally.

For MC products, the aim of policy measures is to protect vulnerable and eroding competitive advantages. This task demands the application of indirect economic measures focused on the increase of competitiveness, for instance, income support or reduction of production costs in agriculture. Measures to prevent and offset the impact of the increases in agricultural imports should be introduced, including anti-dumping measures, countervailing and safeguard measures, and a mechanism to cope with agricultural subsidies. On China's side, there should be a support of agricultural production in Central Asia in the form of agricultural research. It agrees with earlier findings of Babu and Reidhead [37], who propose the investment in information generation and building capacity in farming technologies and knowledge as fundamental aspects of long-term sustainable development of value chains in Central Asia. Along the same line goes the argumentation of Danabayeva [151] who observes

that a major challenge to sustainability and performance of the agricultural sector faced by Central Asian economies is the transformation of existing value chains into the knowledge-based ones.

As regards those value chains which involve non-competitive food and agricultural products, they should be focused on the domestic market in order to improve food security along the availability pillar and increase farmers' incomes through a system of agricultural support policies, including direct payments for the production of major crops, subsidies for agricultural inputs, subsidies for farm machinery purchases and improved crop varieties, minimum purchasing prices for crops and other staple foods, and temporary storage options. Such measures aimed at the support of both non-competitive and marginally competitive agricultural products will establish the conditions for the strengthening of competitive advantages in the long run, improve the performance of agricultural producers, drive them to expand their production facilities, and thus contribute to the improvement of food security and sustainability of agricultural value chains in the countries of Central Asia.

5. Conclusions

The five-stage approach allowed to (1) reveal comparative, trade, and competitive advantages of Central Asian economies in agricultural trade, (2) match those advantages with production capabilities of agricultural sectors, (3) divide products into groups according to the degree of competitiveness. It is revealed that the countries of Central Asia are able to compete internationally in labor-intensive horticultural products and some crops, primarily, wheat and oilseeds. Capital and technology-intensive sectors of animal husbandry, livestock production, and food processing are all low competitive across the region (to a certain degree, the exceptions being Kazakhstan and Kyrgyzstan where some meat and dairy products are recognized conditionally competitive).

The matching between the revealed advantages of Central Asian agricultural sectors and China's current imports, investment in the region, and future demand in food demonstrates several opportunities that can be embraced from closer China—Central Asia collaboration. First, there is a growing demand for diverse food products in China. Currently, Central Asia is indeed a very modest contributor to China's agricultural imports. None of the five countries of the region is now capable to pose any substantial influence on food supply in China. However, at least in C and CC product groups (oil seeds, fruit, wheat, cereals, feeding stuff for animals), Central Asia can become one the sources of food import in the diversified food supply network. Second, closer agricultural ties between China and the countries of Central Asia in the framework of the BRI, economic development corridor, as well as agricultural investment, knowledge-sharing, and technology will ensure regional food supply and enhance the sustainability of agricultural value chains. Third, the development of agricultural value chains between Central Asia and China may have food security and pro-poor benefits as it would involve farmers in the international food supply and provide more jobs and income opportunities to low-income people in rural areas.

To enhance the integration between Central Asia's supply and China's demand sides of the value chains, the authors construct a set of policy responses to major advantage-related challenges. The approach is that the stakeholders in C and CC value chains should be supported to implement or develop competitive advantage and expand exports, while MC and NC value chains should be aimed at the domestic markets to contribute to the solution of the food insecurity problem. It is expected that the implementation of policy measures will facilitate the concentration of the resources toward competitive and potentially competitive products, protect and promote vulnerable competitive advantages in the value-added sectors of animal production and food processing, enhance the competitiveness and productivity of the stakeholders within the chains, thus contributing to better performance of agricultural sectors in Central Asia, agriculture-driven economic growth in rural areas, and more sustainable food supply in the macro-region of Eurasia at the end.

This study is a preliminary attempt to roughly link trade and competitive advantages and production capabilities with the sustainability of value chains in agriculture. Thorough work is required to eliminate the existing limitations and make the approach relevant in a wider sustainability-related

context. Due to the fact that this study considers China as a single trade partner, there is a rationale to extend the research to a wider pool of trade partners of Central Asian economies, for instance, Russia, the Middle East, and the EU. This will allow to assess the degree of diversification in value chains and suggest the responses to possible demand and price fluctuations on particular markets. Intra-regional agricultural trade in Central Asia has been stagnating since the 1990s due to the fact that no country possesses a decisive advantage over the others. In almost similar climate, geographical, technological, and economic conditions of agricultural production, they all produce similar products of a rather narrow assortment. There is no economic basis for intensive exchange then. Still, it is worth studying those marginal competitive advantages which exist outside the traditional sectors of horticulture and crop production in order to understand how they may be promoted for the benefit of intra-regional supply chains. Quality constraints to expanding agricultural exports from Central Asia should be studied primarily in relation to C and CC product groups. Moreover, there is a rationale in analyzing the effects of trade policy constraints (both export restrictions from Central Asia's side and import policies of trade partners) for the stability of value chains.

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