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# The Complexity of Agricultural Competitiveness: Going Beyond the Balassa Index

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## Abstract

Agricultural competitiveness is a complex, multifaceted concept that goes beyond outright economic results. Balassa, in 1965, operationalized one of the most common methods of measuring competitiveness – the revealed comparative advantage (RCA) or the "Balassa Index." However, scholars and practitioners argue for more holistic competitiveness approaches. Thus, this research aimed to add layers to the concept of agricultural competitiveness through a value chain analysis based on national production, trade balance results, and the Balassa Index for the EU-27 countries. Data were extracted from INTRACEN and FAOSTAT databases. Statistical analyses were carried out for two types of products – cereals (raw agricultural products) and cereal preparations (processed foods) – to explain why the Balassa Index alone is not enough to capture, characterize, and ultimately define agricultural competitiveness. Findings confirm comparative advantage trade-offs between raw agricultural products and processed foods, based on a resource management paradox, demonstrated by (a) countries with a trade balance surplus in cereals and low RCA values for cereal preparations and (b) countries with a trade balance deficit in cereals and high RCA values for cereal preparations. The novelty factor of this paper resides in providing a competitiveness assessment framework based on an agri-food value chain analysis that proved that the resource management systems in countries with factor endowments were poor. Tracking value chain flows at all its link levels is essential for better measurement of a sector's degree of competitiveness when compared with other regions. Competitiveness indices must be further developed in this direction. Research findings can support decision-makers in making better strategies for agricultural resource management through efficient food processing and international trading activities.

*Keywords: revealed comparative advantage, foreign trade, food security, raw agricultural products, processed foods, added value*
*JEL Classification: O13, Q17*



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## 1. INTRODUCTION

The concept of competitiveness in the agri-food sector has been discussed by scholars, decision-makers, and economic agents throughout the agri-food chain, including suppliers, producers, storage handlers, distributors, and consumers. Competitiveness is connected with delivering the products and services required by the market at the lowest cost and with a minimum allocation of material or human resources. In certain countries, the competitiveness of agri-food products is one of the main reasons for international competitiveness. Hence, the assessment and investigation of the competitiveness source(s) of a country's foreign trade flow are important economic research topics. Further, in the case of agri-food products, the assessment had numerous layers, the food security layer being one of the most important layers (Campi et al., 2021; Chivu et al., 2021; Zhou & Tong, 2022; Zia et al., 2022). Agriculture and the food industry are strategic economic branches since they contribute to meeting food security and GDP generation with a considerable impact on labor market development (Mejía et al., 2021; Pawlak & Smutka, 2022). In the context of the implementation of the European Green Deal, the competitiveness of agriculture and the food industry becomes more complex and goes beyond socio-economic performances, focusing on the environmental impacts (Veghes & Strâmbu-Dima, 2022). These dimensions, among others, leave the door open for the study of the complexity of competitiveness (Bahrami et al., 2022).

The concept of competitiveness can be approached from multiple perspectives. Drescher and Maurer (1999) defined competitiveness as the ability to protect and improve the market positions of an industry or company as compared to the competitors and adapt market strategies to structural changes caused by the environment. On the other hand, Pitts and Lagnevik (1998) defined industry competitiveness as the capability to actively maintain market shares profitably. Kim and Marion (1997) defined competitiveness as a nation or firm's capability to constantly compete with their international counterparts in domestic and foreign open markets under the condition of free trade.

Regarding the measurement of competitiveness, one of the most popular indices is the revealed comparative advantage (RCA) operationalized by Balassa (1965). It has been widely used to determine a country's high and poor competitive sectors based on its exporting activities (Rousseau, 2019). However, interpreting the Balassa Index can be difficult (Hinloopen & Van Marrewijk, 2001) and may not explicitly help in defining the degree of competitiveness and its dimensions (De Benedictis & Tamberi, 2004). For example, on the one hand, a country may experience a decrease in competitiveness while maintaining a particular product or service advantage; however, on the other hand, it may be competitive without a comparative advantage.

Thus, this research aimed to explore the facets of the Balassa Index in the agri-food sector in the EU-27 countries, focusing on two types of products – (a) raw agricultural products (cereals) and (b) processed foods – cereal preparations. This selection was made to highlight how different processing stages of raw agricultural products impact agricultural competitiveness through the value added while processing and the intensity of international trade flows. This research design exposed multiple facets of competitiveness and explained the importance of trade volumes and food processing while arguing for the need to look beyond the Balassa Index results. In addition, the national production of cereals was taken into account when discussing the results. Finally, the clustering analysis was carried out in this empirical study to add robustness to the findings and

emphasize the multivalence of competitiveness.

This section is followed by a comprehensive review of relevant literature on the complexity of agricultural competitiveness with a special focus on the Balassa Index. The following sections discuss research objectives, methodological explanations, data selection, extraction, and processing techniques. These are followed by the research results and discussions. Finally, the conclusions are presented, which touch upon the current limitations and directions for future research. This research considers previous pieces of scientific literature that elaborated on agricultural competitiveness. However, this article goes beyond by adding more layers to the existing literature by highlighting how traditional competitiveness measurements can be misleading due to the multidimensional facets of competitiveness.

## 2. THEORETICAL BACKGROUND

The link between agricultural competitiveness, international trade flows, and food security has been under consideration by policymakers and scholars for long (Sharples, 1990; van Meijl et al., 2006; Mgeni et al., 2018; Sun et al., 2022). This link becomes more ardent from a scientific point of view, especially in the context of the COVID-19 pandemic, Europe's energy crisis (Blank, 2022) and Russia's invasion of Ukraine (Oxford Analytica, 2022), which can disrupt the agri-food supply chains (Behnassi & El Haiba, 2022; Nekmahmud, 2022; Yin et al., 2022). Although under free trade, countries can specialize in certain goods or services, become net exporters, and achieve comparative advantages, this can be treacherous in the face of global challenges that require political convergence toward a certain path that may cause a loss of competitiveness in certain fields for some countries (Priede & Pereira, 2015; Volintiru et al., 2019). For example, the implementation of the 2030 Agenda for Sustainable Development can cause higher production costs in the transition toward a clean production system (Cepoi et al., 2020; Fonseca et al., 2020; Pătărlăgeanu et al., 2020). This can lead to a decrease in competitiveness (Newall, 1992) while maintaining the same quality levels. Thus, to a certain degree, competitiveness is influenced by the commitment to global visions for a prosperous future (Dima et al., 2018).

At the beginning of the 2020s, the price increase of electricity and natural gas were the first causes of the increase in the production price of agricultural fertilizers, which directly affected the expenditure value of agricultural production and posed risks that must be efficiently managed (Petrescu et al., 2022). In addition, in the first quarter of 2022, the fuel price rises in Europe contributed to the increase in the sales value of agricultural products with direct implications on the level of competitiveness of agri-food chains. These changes, which have occurred within a short period, are estimated to impact both private entities and consumers (Bairagi et al., 2022). It is likely that, in the forthcoming period, the competitive export advantage of countries would be in the spotlight of economic discussions, considering the shortage of agri-food products in Europe, the Middle East or sub-Saharan Africa, which are frequent trade destinations for such products (Andrei et al., 2021). Above all, the competitiveness of agri-food chains would be reshaped due to market unpredictability caused by Russia's Ukraine invasion. According to Cezar Gheorghe (2022), the grain trade expert of the Farmers' Trading House, during his interventions in Ziarul Financiar, said that Russia's Ukraine invasion will cause a period that will

fundamentally change the wheat, maize, and sunflower seeds markets. Furthermore, Russia will continue to show its regional power and consolidate its competitiveness through its cereal market position. Thus, Russia is expected to have a more marked influence on global cereal prices (Lang & McKee, 2022).

However, during such turbulent periods, opportunities, too, occur (Doan, 2022; Petetin, 2020) and the resilient economic sectors capitalize on the opportunity windows (Păunescu & Mátyus, 2020; Tomé et al., 2020) and harness competitiveness (Carraresi & Banterle, 2015; Fonseca & Azevedo, 2020). Nevertheless, measuring competitiveness and its increase is difficult. In 1958, the concept of "revealed" comparative export advantage was first introduced by Liesner, which was later redefined and popularized by Balassa (1965). The design of this technique has been highly debated in the literature (Iapadre, 2001; Hoen & Oosterhaven, 2006; Laursen, 2015; French, 2017), along with similar techniques (Lafay, 1992), which proves the complexity of competitiveness.

The literature is rich in papers dedicated to measuring competitiveness levels based on the Balassa Index. For example, Qineti et al. (2009) investigated the comparative advantage of certain food commodity groups, in the case of the EU's and Slovak trade flows with Russia and Ukraine, through the Balassa Index. Szczepaniak (2018) assessed the comparative advantages of Poland's food product export to the EU through Balassa's approach to measuring competitiveness. Similarly, Firlej et al. (2017) quantified competitiveness through the revealed comparative advantage of innovation for added value creation and competitiveness through Balassa's Index; however, they considered Lafay's index as well. Unlike the papers of Szczepaniak and Qineti et al., the paper of Firlej et al. contains reflexivity regarding the use of the Balassa Index alone to measure the level of competitiveness of specific food commodity groups. Thus, encapsulating all the valences of competitiveness is impossible through a single index and a more comprehensive approach is required.

In addition, the complexity of agricultural competitiveness was emphasized in the work of Esterhuizen et al. (2002), who highlighted the difficulty of quantifying competitiveness and argued that it has caused Balassa to focus on trade patterns instead of underlying resources, subsidies, and prices. Esterhuizen et al. pointed out a weakness in the measurement of competitiveness as defined by Balassa – a country can acquire market share through costly export subsidies. Therefore, the authors argued that a sustainable competitive position cannot be fully defined by the Balassa Index. This point of view is in line with Maqbool et al. (2020).

Ignjatijević et al. (2015) acknowledged some of the limitations of the Balassa Index and explored the level of competitiveness of the Danube region countries based on the trading flows of processed foods by resorting to both the Balassa Index and the trade performance index. Although Balogh & Jámbor (2017) analyzed the global comparative advantage in the EU wine chain through a variety of indices, including the Balassa Index, the same authors intended to test the duration and stability of trade indices. Moreover, Balogh and Jámbor acknowledged that the Balassa Index neglects the effects of agricultural policy and, under certain circumstances, can exhibit asymmetric values. They brought to attention the fact that trade structure can be distorted by state interventions, including trade limitations. Following the same note, Verter et al. (2020) argued that no previous study used competitiveness mapping tools based on the

trade balance, Balassa, and Lafay indices together. Therefore, they mapped trade flows between EU-28 and Nigeria to identify competitive agri-food products, using the mentioned indices independently. Besides these methods, the coefficient of conformity, the export similarity index, the index of a competitive threat, the trade complementarity index, and the static and dynamic index of competitive threat were other relevant methods identified by Stanojević (2022) who assessed the export potential of Serbia's cereals. Although these measurements are efficient for tracking the degree of competitiveness of certain agri-food products or group of products, they lack the ability to holistically capture a chain's level of competitiveness through a complete value chain analysis.

The literature consists of papers dedicated to mapping competitiveness results with factor endowments and national strategies and policies. For example, Klonaris and Agiangkatzoglou (2018) quantified the competitiveness of Greek virgin olive oil based on international trade flows by resorting to Balassa's Index. However, they extended the analysis beyond the Balassa Index and followed Porter's definition of comparative advantage and analyzed price elasticity. Similarly, Constantin et al. (2022) grounded their work of competitiveness assessment on Porter's diamond model (1990), which was complemented by the measurement of competitiveness through the Balassa Index and various econometric modelling techniques. Instead of focusing on measuring the level of competitiveness, these studies applied Porter's diamond model for identifying the competitiveness sources. Consequently, a limitation of the Balassa Index is that it specifically focuses on the performance assessment of trade exports, ignoring the factors that generated competitiveness.

A comprehensive literature review of agri-food trade competitiveness was carried out by Mizik (2021), which concluded that the most frequently-used indices were the Balassa Index and its derived versions, the Grubel-Lloyd index, and the trade balance index. Mizik accepted that the Balassa Index transforms trade flow performance into competitiveness. However, the author hints at the weakness of the Balassa Index in generating a trade results paradox – the interdependency between raw material exports and processed foods imports. The Balassa Index does not track the process of adding value throughout the chain links involved in international trading activities.

Other authors who have acknowledged the critiques of the Balassa Index include Bojnec & Fertő (2015). In their paper, the authors carried out a study of EU-27's agri-food export competitiveness in global markets through the Balassa Index. The Kaplan-Meier survival rates were used along with panel unit root tests. Bojnec and Fertő pointed out that the Balassa Index was considered an export specialization index with asymmetric value issues. A previous study carried out by the same authors (2009) contains an alternative – the relative trade advantage index – which takes both exports and imports into account, as defined by Vollrath (1991).

Costinot et al. (2012) provided an alternative to the Balassa Index by exploring and empirically testing the role of multiple comparative advantage sources in generating competitiveness. The authors considered technology, trade costs, market structure, and consumer preferences as a few influencing factors. Moreover, they argued that these factors were not encapsulated in the Balassa Index, which was one of its limitations.

Although there is a general acceptance of the Balassa Index being one of the most suitable units of competitiveness measurement, it is evident that more is needed to fully capture the essence of competitiveness. Thus, this paper complements existing literature through an empirical study carried out on a particular facet of competitiveness – the added value, which can be observed at the link levels of the agri-food value chain.

## 3. RESEARCH OBJECTIVE, METHODOLOGY, AND DATA

The objective was to revisit the concept of competitiveness and shed new light on a traditional instrument dedicated to assessing competitiveness – the Balassa Index. With practical implications for the agri-food sector, this index was analyzed by resorting to different statistical research instruments that facilitated tapping into agricultural competitiveness complexity. Two types of products were considered for highlighting the competitiveness complexity ¬– cereals and cereal preparations. This selection was made to explain how different processing stages of raw agricultural products impacted agricultural competitiveness.

Data used in this research were extracted from the INTRACEN (International Trade Centre) database and FAOSTAT in March 2022. In harmony with the research objective, the volume of imports and exports of cereals and cereal preparations were taken over and the trade balance was calculated for each EU-27 country and the corresponding RCA value for each agri-food product per country. Ten years were considered for this research (2011-2020) and the trade balance and RCA were calculated for each year for each country for both cereals and cereal preparations. As per the commodity structure of the database, cereals consist of: (a) wheat and meslin; (b) rice; (c) rye; (d) oats; (e) maize or corn; (f) barley; (g) grain sorghum; (h) buckwheat, millet, canary seed, and other cereals. Cereal preparations consist of: (i) bread, pastry, cakes, biscuits, and other bakers' wares, whether or not containing cocoa; (ii) malt extract; food preparations of flour, and groats; (iii) pasta, whether cooked or not or stuffed with meat or other substances, or prepared otherwise; (iv) prepared foods obtained by swelling or roasting of cereals or cereal products; (v) tapioca and substitutes prepared from starch in the form of flakes, grains, or pearls. Data corresponding to the year 2021 was not available for all EU-27 countries at the time of developing this study; hence, 2021 was not included in this research. Data regarding the value of the national production of cereals were extracted from the FAOSTAT database for the same period (2011-2020) and the same countries (EU-27 countries).

Since this research particularly focused on highlighting the different facets of competitiveness, it consists of a case study of two types of products – raw (cereals) and processed foods (cereal preparations) – which were considered optimal for comparatively explaining competitiveness valences through the analysis of the link between production, trade balance, and the RCA in the EU-27 countries.

The RCA measures the position of a country in the international trade of a specific product, group of products, services, or sector; however, it does not focus on analyzing the source(s) of comparative advantage (Smutka et al., 2019). RCA, also known as the Balassa Index, indicates the relation between the export market share of a country, a product, or a group of products and its export market share in the total trade in a set of countries. Thus, since RCA takes the country's total exports into account (Equation 1), the Balassa Index is connected to that specific country's

economic dimension and exporting culture. Hence, the same export market share of multiple countries could lead to issues in defining competitiveness levels (Yu et al., 2009).

$$RCA_{ij} = \frac{X_{ij}}{X_{ik}} \Big/ \frac{X_{nj}}{X_{nk}} \quad (1)$$

Where: X represents the export value, i represents the country of analysis (EU-27 member states; approached systematically), n represents the EU-27, j represents the analyzed group of agri-products (in this paper: 10 cereals and 19 cereal preparations; approached systematically), and k represents all agri-food traded goods (categories 1-24, as classified in the INTRACEN database).

Based on RCA results – (a) values below one justify no comparative advantage; (b) if the value is positioned between one and two, it signals a weak comparative advantage; (c) if the value is positioned between two and four, the comparative advantage can be considered medium; and (d) if the value exceeds four, it signals a strong comparative advantage.

Finally, a clustering analysis was carried out based on five variables: (a) the result of the trade balance with cereals; (b) the result of the trade balance with the preparations of cereals; (c) the value of the national production of cereals; (d) the Balassa Index in the case of cereals; and (e) the Balassa Index in the case of preparations of cereals. The procedure was applied to hierarchically plot-cluster in two directions: one refers to the previously mentioned variables and the other refers to the EU-27 Member States, considered observations. Based on the group average clustering method for variables and observations (rows), clusters were generated systematically and the most similar clusters were joined together, gradually, into single new clusters continuously until all variables and Member States were mapped. Once fused in a cluster, separation was not possible. The Euclidean distance type was considered. As far as validation is concerned, the cophenetic correlation coefficient was taken into account and it was calculated. A value of 0.75 or above can be considered meaningful (Holgersson, 1978). Moreover, Mather (1976) argued for another measure of the adequacy of fit-delta, a test that refers to distortion in terms of clustering, rather than focusing on resemblance levels (as in the case of the cophenetic correlation). Delta coefficients can be determined based on Equation 2:

$$\Delta_A = \left[ \frac{\sum_{j<k}^{N} |d_{jk} - d^*_{jk}|^{1/A}}{\sum_{j<k} (d^*_{jk})^{1/A}} \right]^A \quad (2)$$

A can take the values of either 1 or 0.5. The cophenetic distance obtained from the cluster configuration was named d*jk. As far as results are concerned, values as close to zero are desirable – configurations with the smallest delta values fit the data better.

## 4. RESULTS AND DISCUSSION

The RCA was calculated according to Equation 1 for each year within the analyzed period: 2011-2020 (n=10 years), in the case of each country of the European Union (n=27 countries), for both types of product: cereals and preparations of cereals (n=2 types of products). Results were averaged and graphically represented in Figure 1.

According to the RCA results: (a) in the case of Romania, Bulgaria and Latvia, the export of cereals represents a major component of the competitiveness of the agricultural sector (RCA>3.99); followed by Hungary, Lithuania, France, Slovakia, Croatia and Estonia – with a medium comparative advantage regarding exporting cereals (RCA is positioned between 2 and 4); (b) in the case of Finland and Czechia, the comparative advantage with respect to the export of cereals is weak (RCA is positioned between 1 and 2); while in the case of the rest of the EU-27 countries, the export of cereals does not represent a component of the competitiveness of their agricultural sector (RCA below 1); (c) through the lens of the Balassa Index, Ireland has a moderate comparative advantage regarding exporting preparations of cereals (RCA: 2.50), followed by eight other EU-27 countries: Italy, Malta, Belgium, Germany, Croatia, Sweden, Poland and Czechia with a weak comparative advantage in the same regard (RCA between 1 and 2), while for the rest of the EU-27 countries – the export of preparations of cereals does not represents a component of the competitiveness of their agricultural sector (RCA below 1). Thus, initial findings hint at a paradox regarding agricultural resource management in the EU-27, since competitive countries in terms of export of cereals (Romania, Bulgaria, and Hungary) are not competitive in terms of the chain of processed foods, referring to the preparations of cereals, a category with much more added value than in the case of raw agricultural products (cereals). This resource management paradox can be noticed in Figure 1.

With the aim of better capturing the complexity of the concept of competitiveness, the Balassa Index was analyzed comparatively with the trade balance results per country and type of agri-food products: cereals (raw agricultural materials) and preparations of cereals (processed foods). The reason behind this research design was that of shedding light on (a) how the highest trade balance surplus or deficit volumes at the level of the EU-27 do not necessarily imply the best or worst national Balassa Index scores – see the case of France with seven billion USD surplus resulting from the trade flows with cereals (rank 1 in the EU-27) and the RCA of only 2.511 (rank 6 in the EU-27); (b) how countries with trade balance deficit of cereals (poorly competitive in this regard) manage to export large quantities of processed cereal-based products and registered impressive Balassa Index score – see the cases of Italy, Ireland, Belgium, and the Netherlands as the most representative examples in this regard. Thus, a disadvantage (the lack of raw materials and the dependency on imports) was successfully turned into an advantage by processing the imported raw agricultural products, adding more layers of value at the national level and then exporting them back at a higher price.

Therefore, this is a facet of competitiveness that is not captured by the Balassa Index. Moreover, the nexus of economic competitiveness – trade flows – food security is of major importance in the context of the current energy crisis in Europe and even a possible food crisis as a result of the war between Russia and Ukraine. As far as the value of the national production of cereals is concerned, the European leader in this regard is France with an average of more than 13 billion USD, followed by Germany (average of 9.3 billion USD), Poland and Spain (both with an average of 5 billion USD). However, out of these four leaders in terms of the value of the national production of cereals, only France registered a medium comparative advantage through the lens of the Balassa Index, but only as far as cereals are concerned (2.51), and not the preparations of cereals (0.94).

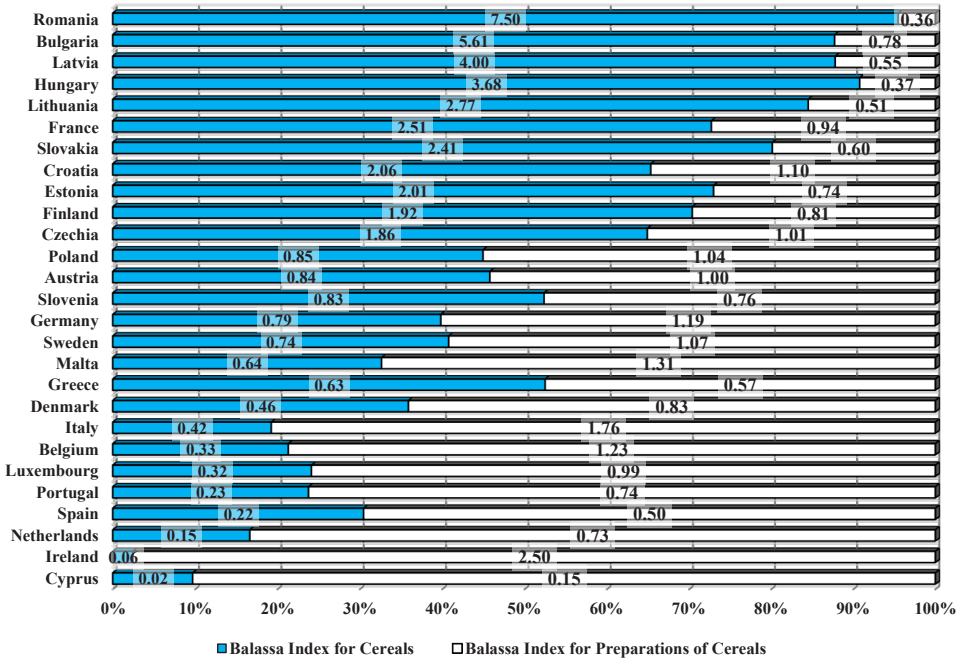


*Fig. 1 – The Balassa Index for cereals and preparations of cereals (average 2011-2020). Source: Authors' calculations based on the International Trade Centre data (2022)*

Following, the clustering analysis was carried out with the purpose of a better understanding of the relations of the Balassa Index with the value of the national production of cereals and the trade balance results. In this regard, Table 1 contains the results of the clustering validation tests according to the five variables and the EU-27 sample, as described in the research methodology.

Tab. 1 – Clustering Validation Tests. Source: Authors' computation

| | Variables | Rows |
|---|---|---|
| Cophenetic Correlation | 0.8320 | 0.8426 |
| Delta (0.5) | 0.0674 | 0.1499 |
| Delta (1.0) | 0.0971 | 0.1832 |

Taking into consideration the cophenetic correlation coefficients: 0.832 in the case of the variables and 0.8426 in the case of rows (the EU-27 Member States), the results are optimal, and the findings are valid. Additionally, the delta values (0.0674 and 0.1499 corresponding to an A value of 0.5) confirm the validity of the clustering model. The mix of variables included in the cluster heat map was aimed at emphasizing the resource management paradox characterized by: (1) countries with positive trade balance results in terms of preparations of cereals, above-the-average Balassa Index values concerning the same commodity group of products, as well as poor competitiveness regarding commodity group 10 – cereals (raw materials) and above-the-average value of the national production of cereals (Germany, Poland, Italy) and (2) countries

with negative trade balance results in terms of preparations of cereals (deficit), but positive when it comes to raw cereals (surplus), above-the-average Balassa Index values concerning the same commodity group of products (cereals) – signaling high levels of competitiveness, yet poor competitiveness as far as the preparations of cereals are concerned (below-the-average Balassa Index values), simultaneously with decent values of the national production of cereals (Romania, Hungary, Lithuania).

The research findings from the clustering analysis justify the necessity for a more complex competitiveness assessment framework. Agri-food products are linked in chains, which makes sectoral competitiveness difficult to compare based on trade performances (Balassa Index) and factor endowments only. The different facets of competitiveness explored through the lens of the cluster analysis in this paper demonstrate that tracking chain flows in the agriculture and food industry is essential for going beyond performance assessments.

The clustering results are convergent with the visions of Esterhuizen et al. (2002), Costinot et al. (2012) Balogh & Jámbor (2017), and Mizik (2021). While it is true that the Balassa Index was and will continue to be, to a certain degree, a good instrument for measuring competitiveness, many other valences of competitiveness remain uncovered by the Balassa Index itself. Through this empirical research, the complexity of agricultural competitiveness was demonstrated. Decision-makers should be aware of the selection of instruments meant to measure competitiveness when designing policies, offering subsidies, or financing certain activities with multisectoral impacts.

Thus, findings show that the Balassa Index alone is not enough to characterize the magnitude of a country's role in the economics of agriculture, neither its competitiveness beyond the national level nor its contribution to ensuring food security globally, which can be interpreted as another facet of agricultural competitiveness. On top of that, the RCA cannot follow the added value chain: while France might have a trade balance surplus of over seven billion USD on average in the case of cereals, these raw materials are not efficiently harnessed into processed foods (for example, preparations of cereals) with higher added value, which represents another of the layers of competitiveness. Similar to France, Bulgaria, Poland, Lithuania, and Denmark are in the same situation but at a smaller scale. Romania, Hungary, Czechia, Latvia, Slovakia, Sweden, Finland, Estonia, and Croatia are somehow in a similar position, but these countries registered a deficit in the trade balance in terms of preparations of cereals, which signals an even worse raw agricultural product management and an agri-food chain competitiveness gap.

## 5. CONCLUSION

Agricultural competitiveness remains an elusive concept full of multidimensional facets that continues to attract the attention of policymakers and scholars in the context of free trade in agri-food products in global markets. Competitiveness is inevitably linked to international trading activities, as well as to the concept of comparative advantage. Balassa operationalized the measurement of the comparative advantage in 1965, and his technique is still considered to be one of the most suitable assessment methods of a nation's competitiveness by focusing on revealing the most significant products in terms of export. However, the Balassa Index alone is not enough to fully capture all valences of a country's competitiveness. One of the main

limitations of the Balassa Index is that it does not encapsulate details of trade flows between countries at different moments, which is essential in agricultural economics. Following the links along the agri-food chains, it is crucial to identify where the greatest generation of added value occurs, and this represents an important facet of competitiveness that is not covered by the Balassa Index.

According to the results from the empirical research developed in this paper and through the analysis of the Balassa Index concerning production capabilities, the agricultural sector was demonstrated to show specific characteristics that cause competitiveness to be difficult to measure, especially with the help of traditional instruments such as the Balassa Index that do not account the contribution of agri-food value chain links in the generation of a whole sector's competitiveness. In this regard, the results from this empirical research stand proof that highly competitive European countries in terms of cereals are not competitive in terms of the preparations of cereals (Romania, Hungary). On the other hand, European countries that are competitive in terms of preparations of cereals are not competitive in terms of cereals (Italy, Netherlands, Belgium). Thus, a specific resource management paradox occurs that is also characterized by: (i) countries with a trade balance surplus in cereals and low RCA values for preparations of cereals; and (ii) countries with a trade balance deficit in cereals and high RCA values for preparations of cereals. Therefore, the traceability of the added value along the agri-food value chains is an important element of competitiveness that the Balassa Index is lacking. Following the track of the added value by all agri-food chain links are crucial for the proper measurement of a sector's competitiveness. This is one of the methods to go beyond the Balassa Index in the measurement of competitiveness and such reporting can be helpful in cross-sectional comparison (for example, the case of the same agri-food chain but different regions/countries/blocs). Consequently, sectoral competitiveness indices should be developed especially in light of the impact of value chain links, among other influencing factors.

The approach in this paper differs from the conventional body of literature dedicated to the measurement of agricultural competitiveness (Balogh & Jámbor, 2017; Bojnec & Fertő, 2015; Constantin et al., 2022; Firlej et al., 2017; Qineti et al., 2009; Verter et al., 2020) by emphasizing on the necessity of tracking agri-food value chain flows for better measurement of a chain's level of competitiveness when compared to that of other regions. The purpose was not to compare the outputs of the primary–secondary sectors and discover which one was more competitive–but to emphasize that agricultural competitiveness is more complex than this comparison and it relies on a comprehensive analysis of the dynamics of agri-food chain links, factor endowments, trade flows, strategies and policies.

Regarding the practical implications of the research findings, results converge with the vision of (Carraresi & Banterle, 2015; Doan, 2022; Păunescu & Mátyus, 2020; Petetin, 2020; Tomé et al., 2020), referring to the fact that during current times of crisis, opportunity windows should be considered and competitiveness should be harnessed through coherent and sustainable governance. The agricultural sector needs to be in the spotlight of the actions of decision-makers, taking into account the price volatility and food security concerns that have intensified at the beginning of the 2020s. Delivering more competitiveness in the case of an agri-food chain implies finding and implementing the set of actions designed to (a) capitalize on production

capabilities and other factor endowments; (b) understand and answer to the needs of each link involved in the agri-food value chain, while focusing on minimizing costs and maintaining, if not improving, the quality of the products; (c) ensure a proper infrastructure for the sustainable development of the agri-food chain; (d) constantly monitor the level of competitiveness, adapt to market needs and take advantage of opportunity windows; and (e) elaborate strategies that consider the sectoral development potential through infrastructure financing, while considering the dynamics from international markets.

The authors acknowledge that this research has some limitations: (a) the agricultural trade flows have not been analyzed concerning the sources and destination of products, which would have contributed to the transparency and the traceability of the added value, referring to the food processing stages (from cereals to preparations of cereals); (b) the average price at export and import was not taken into account and it might have influenced the volume of trade flows, and (d) the production and consumption habits of the analyzed agri-food products were not considered when discussing the facets of competitiveness, but they are factors that influence the dynamics of trade flows and make the subject of directions for future research.

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