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IMPORT DEPENDENCE OF THE EUROPEAN ORGANIC MARKET AND THE ROLE OF UKRAINIAN EXPORTS

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Abstract. The European market for organic products has been expanding, with a persistent difference between the growth rates of organic retail trade (actual demand for organic products) and the growth rates of organic agricultural land areas (potential supply of organic products). This makes the European Union (EU) dependent on global imports. This research focuses on the import of organic products from Ukraine. To understand the underlying factors of the EU-27 countries' import dependence on Ukrainian exports, this article proposes the following: 1) an analysis of Ukraine's contribution to the total import volume to EU-27 countries by categories of organic products that have the most significant share in overall imports from Ukraine (these categories include: cereals, other than wheat and rice; soybeans; wheat; oilseeds, other than soybeans); 2) a study of the general trends of the European organic market's import dependence on imports from Ukraine by the categories with the highest contribution; 3) clustering of the EU-27 countries based on organic market indicators; 4) an analysis of the European organic market using Ukrainian imports as an example. Ukrainian imports do not threaten the domestic European market; instead, countries with the highest level of dependence can use Ukrainian organic raw materials for processing and further re-export.

Keywords: import dependence coefficient; EU-27 countries; organic products; foreign trade.

JEL Classification: F14, Q13, Q17, Q56.

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1. Introduction

The brisk pace of developing organic agricultural products in European countries can be explained by the support for organic farming as an agri-environmental measure in the European Union (EU) since the early 1990s. The European market for organic products continues to develop within the framework of the Common Agricultural Policy (CAP), the essential payments of which are aimed at supporting organic farming. According to this policy, CAP national budgets allocate funds for organic farming across all member states to reach the EU Farm to Fork and Biodiversity Strategy's average target of 25% organic land by 2030 (IFOAM Organics Europe, 2021). In particular, the experience of Poland and Latvia demonstrate a sustained increase in organic production following the implementation of these measures (Pawlewicz et al., 2020; Wrzaszcz, 2023). A review of organic farming policies in the EU (Lampkin & Sand-

ers, 2021) found that in 2018, 8.8 million hectares of organic land (64% of certified organic areas) were supported with payments of over €1.8 billion, about 3% of the CAP budget. In the international context, the organic sector of the EU is well developed, as confirmed by the relatively high share of organic agricultural land, the constant increase in organic acreage and the number of organic market operators. The average consumption of organic products per capita in the EU in 2021 reached 101.8 euros, 21% higher than the previous year (Research Institute of Organic Agriculture FiBL, 2022).

Agricultural trade is impacted by policies in the participating countries (Li et al., 2022). Thus, it is important to consider agricultural trade flows in the EU to understand the possibilities for the development of the agricultural sector in general. As retail sales have grown to an impressive €45.1 billion in 2022, the growth of organic farmland in the EU has not been as fast (+5.3%) (Statista, 2024). As such, there is a difference between the rate of growth of the organic retail trade (actual demand for organic products) and the growth rate of organic agricultural land area (potential supply of organic products). Simultaneously, Muller et al. (2017) showed that a complete transition to organic production in the agricultural production system is unsustainable and will lead to an increase in the agricultural land use. First, the problems facing the global transition to organic agriculture are related to the growing demand for land, the need to achieve high proportions of leguminous cultivation and the significant reduction in feed use. Second, research (Bernstein, 2010) emphasises the need balance between expanding agricultural production and reducing environmental damage, that is, a balance between 'growth' and 'nature' (Gerber, 2020). Such restrictions still leave the EU's agro-industrial model dependent on global imports.

The existing literature primarily focuses on the internal dynamics of the European organic market and its policy frameworks, such as the CAP strategy and the EU Farm to Fork initiative (Boix-Fayos & De Vente, 2023; Nifatova & Danko, 2024). Some studies have examined the impact of external suppliers, such as Ukraine, on the agricultural market within the EU-27 (Dankevych et al., 2018). Previous research has also analyzed the resilience of organic farming in the EU and its reliance on imports (Calabro & Vieri, 2023), but a comprehensive assessment of Ukraine's contribution remains absent. In this context, a key question remains: what is the contribution of Ukrainian organic exports to the EU-27 market, and how does this influence the dependence on organic agricultural imports in Europe? This research fills this gap by exploring the role of Ukraine's exports in the organic market and their impact on the European organic sector. Accordingly, the motivation for this study arises from the increasing significance of Ukraine as an agricultural exporter to the EU, particularly in the organic sector. The main research objectives were: 1) to evaluate Ukraine's role in the EU-27 organic imports, identifying the organic product categories with the highest contribution; 2) to analyze general trends in import dependence on the European market for these categories; 3) to calculate import dependence coefficients for the organic product categories with the highest contribution and conduct a cluster analysis of EU-27 countries; 4) to investigate correlations between market indicators and import dependence, interpreting the results for different clusters.

This study introduces the application of import dependence coefficients to measure the reliance of the European organic market on Ukrainian exports, with a focus on soybeans and

oilseeds as the product categories with the highest contribution. By combining cluster analysis and correlation matrices, the research identifies groups of EU countries with similar market dynamics and varying levels of dependence on Ukrainian imports. The unique contribution of this study lies in providing actionable insights for both European policymakers and Ukrainian exporters, facilitating more targeted policy interventions and trade strategies.

2. Literature review

The positive impact of organic farming on sustainable development has been widely acknowledged by society, resulting in the extensive adoption of organic production and the formation of a new perspective on agricultural practices, as confirmed by numerous studies. (Mondelaers et al., 2009; Marja et al., 2014; Tuomisto et al., 2012; Muller et al., 2017; Kurdyś-Kujawska et al., 2021). Organic production aims to ensure access to sufficient sustainable and healthy food. In this context, organic farming is understood as a system that contributes to sustainability (Sumberg & Giller, 2022). When considering the potential of organic production to address global food challenges, it is important to acknowledge the ongoing debate surrounding the productivity and sustainability of organic agriculture. Some researchers (Badgley et al., 2007) have challenged the prevailing view, arguing that organic methods can provide food security for the current global population without the need for expanding agricultural land. This potential is particularly relevant for developing countries, where organic practices may outperform conventional systems. However, as noted by Connor (2008), such claims may be overly optimistic, as the productivity of organic farming, especially in developed countries, is constrained by the absence of synthetic fertilizers and pest control measures, limiting its scalability.

It is important to understand that organic production is vital both as human food and as feed for organic livestock. One of the key conditions for organic livestock farming is the availability of organic feed, which directly affects the productivity and sustainability of these systems. However, the limited availability of land may significantly influence the choice of which organic products to produce. Research by (Karlsson & Röös, 2019) emphasizes that it is crucial for organic livestock farming to avoid competition between animal feed and food for human consumption. At the same time, a number of studies (Gaudaré et al., 2021) highlight that organic livestock systems tend to have lower productivity, with yields being approximately 12% lower compared to conventional systems. A key characteristic lies in the differences in feeding strategies: organic livestock farming, particularly in the dairy industry, uses fewer concentrated feeds that do not compete with human food consumption. The study by (Notz et al., 2013) examines the impact of reducing the share of concentrated feeds in organic dairy farming in Switzerland, showing that even with a 24% reduction in concentrates, there was no negative effect on animal health or fertility. However, a significant challenge remains the availability of sufficient organic concentrated feeds to sustain the organic livestock sector. This deficit is compensated by imports of various products (Chander et al., 2011), including soybeans (Karlsson et al., 2021; Smolii & Mostoviak, 2024).

The Russian military invasion of Ukraine has had a significant impact on international agricultural markets, an effect that will manifest both in the present and over the long term

(Robu et al., 2024). The shift in Ukraine's agricultural potential (Szajner et al., 2024) is influencing markets in the European Union and other countries (Braun et al., 2023; Andrusenko et al., 2022), as well as global food security (Lin et al., 2023; Feng et al., 2023). A by-product of war, as argued by Kemmerling et al. (2022), Lin et al. (2023), Kozielec et al. (2024) and de Gourcuff et al. (2023), is food insecurity, and as such, the impact of the military conflict in Ukraine on food security should be considered in the context of access to sufficient quantities of sustainable and healthy food for import-dependent countries. In 2021, two positive sustainability changes were noted, as follows. European Commission (20221) published an emergency action plan to ensure food supply and food security in times of crisis, named the European Food Security Crisis Preparedness and Response Mechanism (EFSCM), which has become helpful in light of the challenges associated with the COVID-19 pandemic and the Russian aggression against Ukraine. However, the gap remains.

3. Methods

The research methodology involved the sequential completion of the following stages: 1) analysis of Ukraine's contribution to the total import volume of EU-27 countries by categories of organic products that are most significant in terms of overall imports from Ukraine; 2) examination of general trends in the import dependence of the European organic market on imports from Ukraine by product categories with the highest contribution; 3) clustering of EU-27 countries based on six organic market indicators; 4) construction and analysis of correlation matrices for each cluster; 5) interpretation and discussion of the results obtained.

The study focused exclusively on categories of organic products imported to EU countries from Ukraine. Among the nine categories imported from Ukraine to the EU-27 countries, four categories were identified as accounting for the largest share of the total import volume (categories with the highest contribution). These categories include: cereals, other than wheat and rice; soybeans; wheat; and oilseeds, other than soybeans.

At the next stage, the general trends of import dependence in the European organic market were identified. The import dependence coefficient has been used in previous studies. For instance, in the study by (Pankova et al., 2017), the import dependence coefficient was applied to measure the relationship between food security and inflationary processes. Unlike that study, this research employs the import dependence coefficient to assess the level of dependency of the European organic market on imports from Ukraine. The analysis was conducted for the four organic product categories with the highest contribution. The import dependence coefficients were calculated as:

$$I_d = \frac{\text{Import} - \text{Export}}{\text{Production} + \text{Import} - \text{Export}} \times 100. \quad (1)$$

The interpretation of the import dependence coefficient is as follows: its negative value reflects the absence of import dependence, and its positive value reflects the presence of import dependence (Pankova et al., 2017). The calculation of this coefficients was initially conducted based on the aggregated import volumes of all EU-27 countries. Next, the research

focused on the categories of organic products with positive import dependence coefficients (soybeans and oilseeds other than soybeans). For the organic product categories soybeans and oilseeds other than soybeans, this coefficient was calculated separately for each EU-27 country. In the subsequent research stage, the average values of the coefficients were used to perform the clustering of the EU-27 countries.

In the next stage of the research, a cluster analysis was conducted using the k-means clustering method to analyze multidimensional data, aiming to identify groups of similar objects based on selected variables (Lipsey & Wilson, 2009). Cluster analysis is a common tool for studying trade relations and economic interactions between countries, allowing researchers to group objects based on similar characteristics and uncover patterns in large datasets. For example, in the work by (Dankevych et al., 2018), cluster analysis was used to classify Ukraine's trade partners and EU countries by the level of agricultural product exports and imports. Meanwhile, in the study by Saka et al. (2024), it was applied to assess trade transparency across a wide range of goods and countries. Huo (2013) used cluster analysis to identify key markets among developing countries and their economic characteristics.

The essence of the iterative method of k-means cluster analysis is that the classification process begins with determining the initial conditions, that is, the number of clusters. First, n observations are chosen, each characterised by m indicators X_1, X_2, ..., X_n and these observations must be classified into k clusters. From n observations, k objects defined as standards are randomly selected. Next, each standard is assigned a serial number, the cluster number. From $(n-k)$ objects, a point X_i with coordinates $(x_{i1}, x_{i2}, ..., x_{im})$ is selected and its Euclidean distance to each cluster centroid is calculated and compared. The point is assigned to the cluster whose centroid is the closest, determined by the minimum Euclidean distance. Next, point $X_{i+1.}$ is selected, for which all procedures are repeated. Then, after performing $(n-k)$ iterations, all objects are assigned to one of the k clusters. Cluster analysis was applied to divide the EU-27 countries into distinct groups.

Finally, the identified clusters were examined individually through the analysis of correlation matrices between the indicators of the European organic market and the import dependence coefficient on imports from Ukraine.

4. Data

For the analysis of Ukraine's contribution to the total import volume to EU-27 countries and the identification of organic product categories with the highest contribution, data from European Commission reports (European Commission, 2022b, 2023) were used. The data covered the years 2020–2022.

For the study of general trends in the import dependence of the European organic market on imports from Ukraine by product categories with the highest contribution, data from the European Commission (2022a) were used. The data covered the years 2010–2021.

For the dataset used in the cluster analysis, data were sourced from the official Eurostat website (Eurostat, 2022) and IFOAM Organics Europe reports (IFOAM Organics Europe, 2021). The clustering was conducted based on the following indicators:

1) *I_d*: Coefficient of dependence on Ukrainian imports of organic soybeans and oil seeds. This indicator was initially calculated separately for each EU-27 country. It measures the level of dependence of the European organic market on Ukrainian imports of soybeans and oilseeds.
2) *O_ret*: Share of organic retail sales. This indicator represents the share of organic products in the total retail sales of food products in EU-27 countries. The growth of the organic products' share reflects increasing consumer interest in organic goods and their relative importance in the market compared to conventional products.
3) *O_proc*: Share of organic processors. This indicator reflects the proportion of organic processing enterprises within the total number of food industry enterprises in the EU-27 countries. An increase in the share of organic processors indicates the growing importance of organic products in the manufacturing sector and the development of infrastructure to support the rising demand for organic products. This trend also underscores the expanding role of organic production within the broader food industry.
4) *O_prod*: Share of organic producers. This indicator represents the proportion of organic producers relative to the total number of agricultural enterprises in the EU-27 countries. An increase in this indicator suggests that a growing number of farmers are transitioning to organic production, which may signal the sustainable expansion of the organic sector.
5) *O_anim_held*: Share of animals held by organic farmers. This indicator represents the share of animals raised by organic farmers relative to the total livestock population on farms in the EU-27 countries.
6) *O_area*: Share of organic area. This indicator reflects the share of agricultural land dedicated to organic production in relation to the total agricultural land area in the EU.

The presented indicators can be considered fundamental for characterizing the organic market, as they comprehensively reflect key aspects of its development, including its dependence on external factors and the internal infrastructure supporting it.

5. Results and discussion

5.1. Ukraine's contributions to EU-27 imports of organic products

The most significant shares of imports of organic products to EU-27 countries in 2022 were delivered to Ecuador (13%), the Dominican Republic (9%), Ukraine (8%), Peru (7%) and China (7%). Ukraine is one of the largest suppliers of certified organic products to the EU (European Commission, 2022b), and most of the organic grains consumed in Europe, such as wheat and corn, are imported from Ukraine. In addition, Ukraine is a leading producer of organic oil crops and soya beans, placing among the top-5 suppliers of organic products in the EU; more specifically, in 2022, Ukraine placed third overall and first among non-tropical countries in terms of the volume of organic products imported to the EU, according to a 2022 EC report (European Commission, 2023).

The import volumes of organic products from Ukraine in comparison to the total import volumes by product categories are shown in Table 1.

Table 1. Ukraine's contribution to the total imports of organic products by EU-27 countries by product categories for 2020–2022 (source: European Commission, 2022b, 2023)

Product category	2020 imports, thousand t (Ukraine)	2020 imports, thousand t (total)	2021 imports, thousand t (Ukraine)	2021 imports, thousand t (total)	2022 imports, thousand t (Ukraine)	2022 imports, thousand t (totals)	Change 2022/2021 (%) Ukraine	Change 2022/2021 (%) total
Cereals, other than wheat and rice	82.9	111.3	89.5	113.05	93.1	120.7	4.0%	6.8%
Soyabeans	28.7	137.3	17.2	126.8	30.7	191.9	77.9%	51.3%
Wheat	39.3	85.7	11.2	50.2	20.8	31.8	85.3%	–36.6%
Oilseeds, other than soyabeans	19.3	137.1	16.7	144.7	20.4	92.7	22.5%	–35.9%
Fruits, fresh or dried, except citrus and tropical fruits	15.5	131.9	20.1	142.6	16.2	119	–19.3%	–16.6%
Oilcakes	7.4	23.2	13.1	208.9	13.7	223	4.4%	6.8%
Vegetable oils other than palm & olive oils	5.8	17.3	5.6	16	8.2	16.6	45.6%	4.2%
Fruit juices	*	76.05	3.3	84.6	5	80.3	52.6%	–5.1%
Flours and other products of the milling industry	4.6	22.3	4.5	21.6	3	15.2	–33.7%	–29.5%

Note: * Data not available.

According to Table 1, four categories of organic products contribute the most to the import volumes from Ukraine to the EU-27 countries: cereals (other than wheat and rice), soybeans, wheat, and oilseeds (other than soybeans). Despite the war, Ukraine managed to continue increasing its export volumes of organic products to the EU-27 countries across most product categories in 2022. In 2022, a sowing campaign was carried out, alternative routes were developed for the supply of Ukrainian agricultural products abroad, and the EC abolished import tariffs and quotas for goods from Ukraine and suspended additional control measures applied to organic products from Ukraine. Amid the general trend of declining imports in categories such as wheat, oilseeds, and fruit juices, Ukraine succeeded in increasing its export volumes. Overall, imports from Ukraine in the product categories with the highest contribution increased by 22.6% compared to 2021, while the total import volume for these product categories grew by only 0.05% (Figure 1).

5.2. General trends in the import dependence of the European organic market on imports from Ukraine by product categories with the highest contribution

According to Ukraine's contributions to the total imports of organic products to EU-27 countries, the most significant product categories in terms of volume are cereals other than wheat and rice, wheat, soyabeans and oilseeds other than soyabeans. Therefore, the import dependence coefficients are calculated for the aforementioned categories (Figure 2).

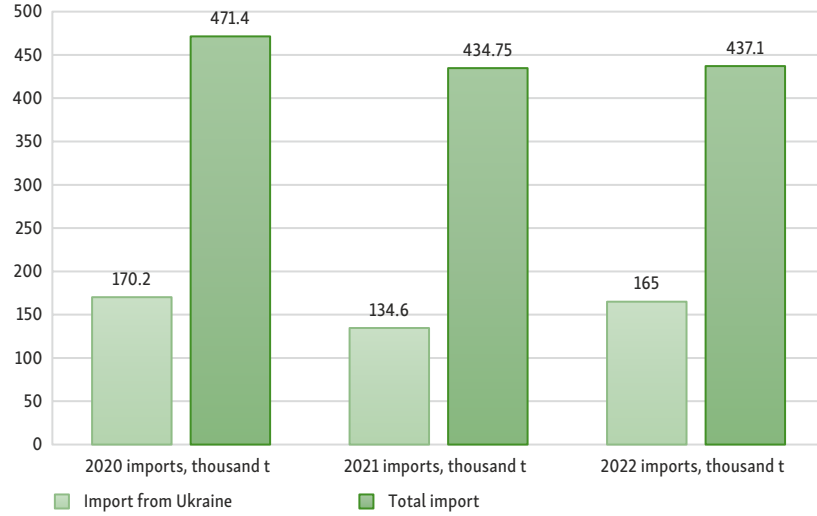

Figure 1. The import volume of organic products from Ukraine and the total import volume, aggregated by the categories with the highest contribution (cereals, other than wheat and rice; soyabeans; wheat; oilseeds, other than soyabeans)

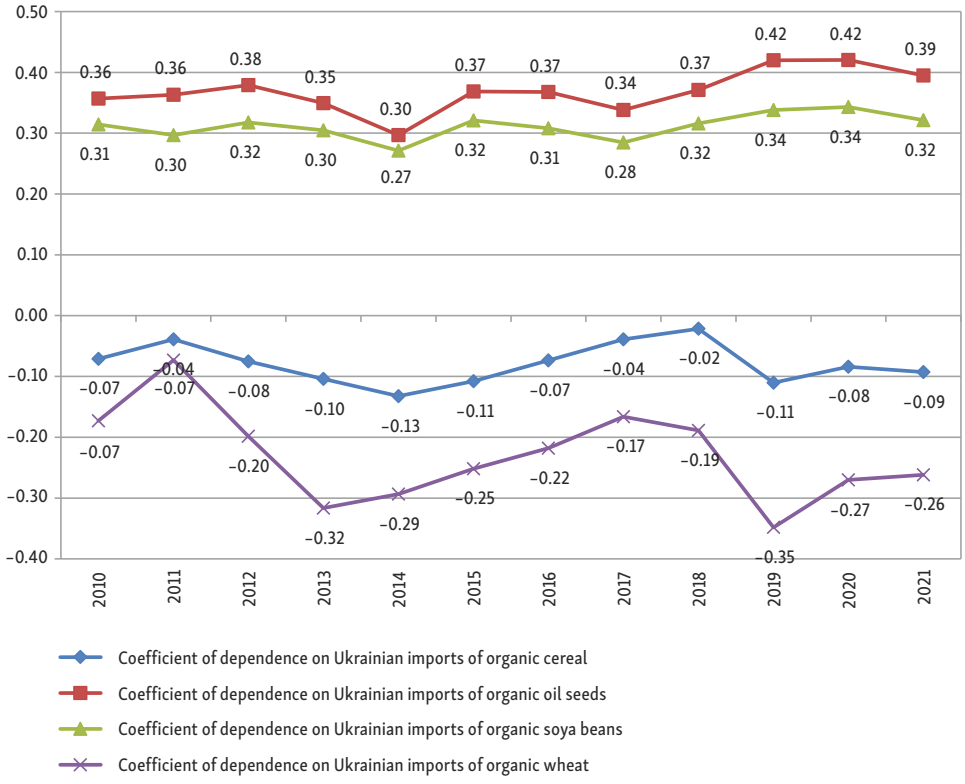

Figure 2. The dynamics of import dependence coefficients for EU-27 countries receiving Ukrainian imports by product categories with the highest contribution

The results demonstrate that for such product categories as cereals other than wheat and rice and wheat, a dependence among EU-27 countries on Ukrainian imports is not observed (the values of import dependence coefficients during the period from 2010 to 2021 are negative). Meanwhile, in the period 2014 to 2018, there was a trend of increasing import dependence, followed by a sharp drop in the coefficient in 2019 and a return to average values in 2020. This means that for these categories of organic products, the risks associated with a shortage of Ukrainian imports were insignificant. Thus, EU-27 countries can meet their domestic demand either by reducing their own exports (from countries having their own potential) or by importing from within the EU (for countries that having little potential).

Quite the opposite situation is observed within such categories of organic products as soyabeans and oilseeds other than soyabeans. The coefficients of import dependence of the EU-27 countries on Ukrainian imports were positive over the last 10 years, with the latter category having the highest indicators of import dependence, meaning that for these categories of organic products, the risks associated with a shortage of Ukrainian imports are significant. Therefore, future research should focus attention on the categories of organic products that have positive coefficients of import dependence (soybeans and oilseeds other than soyabeans). Thus, for further analysis, the categories of organic products that are most sensitive to import dependence are selected.

The import dependency coefficients are calculated for all EU-27 member states for the two most import-sensitive categories of organic products (soybeans and oilseeds). The results of the calculations are presented as the average values of the import dependence coefficients (Table 2).

Attention should be paid to the value of import dependence coefficients in countries such as Cyprus and Malta, which have the highest coefficient value of import dependence. This can be explained by the fact that in these countries, there is a complete lack of production and export of organic products from the soyabeans and oilseed categories. Accordingly, the coefficient of import dependence is determined exclusively by the presence of any imports of organic products from these categories. However, such countries as Finland and Luxembourg have the lowest import dependence coefficients, which can be explained by the fact that in these countries, there is a complete lack of imports and exports of organic products from the soyabean and oilseed categories, and the coefficient of import dependence is determined exclusively by the volume of the countries' own production.

Table 2. Coefficients of import dependence for EU-27 member countries for the most sensitive categories of organic products (soybeans and oilseeds)

Country	*I_d*	Country	*I_d*	Country	*I_d*
AUSTRIA	0.046	FRANCE	0.156	MALTA	1.000
BELGIUM	0.972	GERMANY	0.153	NETHERLANDS	0.995
BULGARIA	0.043	GREECE	0.297	POLAND	0.285
CROATIA	0.000	HUNGARY	0.011	PORTUGAL	0.869
CYPRUS	1.000	IRELAND	0.144	ROMANIA	0.010
CZECH REPUBLIC	0.010	ITALY	0.324	SLOVAKIA	0.156
DENMARK	0.003	LATVIA	0.025	SLOVENIA	0.0000
ESTONIA	0.097	LITHUANIA	0.083	SPAIN	0.431
FINLAND	0.001	LUXEMBOURG	0.000	SWEDEN	0.0152

5.3. Clustering of EU-27 countries according to indicator homogeneity

A study by Smutka and Abrhám (2022) based on cluster analysis quantified the impact of the ban on imports to the EU and individual member states by the Russian Federation due to sanctions imposed. Instead, cluster analysis is proposed to identify the homogeneity of market indicators of organic products for the EU-27 countries. Based on the clustering results, four groups of countries were identified according to the homogeneity of market indicators of organic products (Figure 3).

The variance analysis of the results of clustering the EU-27 countries (Table 3) according to the system of indicators of organic products market shows that the clustering performed is correct: the values of intergroup variance (between SS) exceed the values of intragroup variance (within SS), and the p-value for all indicators does not exceed 0.0001. Therefore, the obtained clustering results can be considered statistically significant.

The results of clustering the EU-27 countries according to the system of organic product market indicators are given in Table 4. The first cluster is determined by the largest values according to such indicators as share of organic retail sales, share of organic processors, share of organic producers. This cluster includes countries with the most developed markets for organic products, both in terms of the production and the consumption of organic products. The import dependence index for the categories of such organic products as soyabeans and oilseeds for this group of countries is determined at an average level, where the peculiarity of the second cluster demonstrates the lowest import dependence among EU countries. In addition, the countries included in Cluster 2 are characterised by a low level, according to the 'Share of organic producers' indicator.

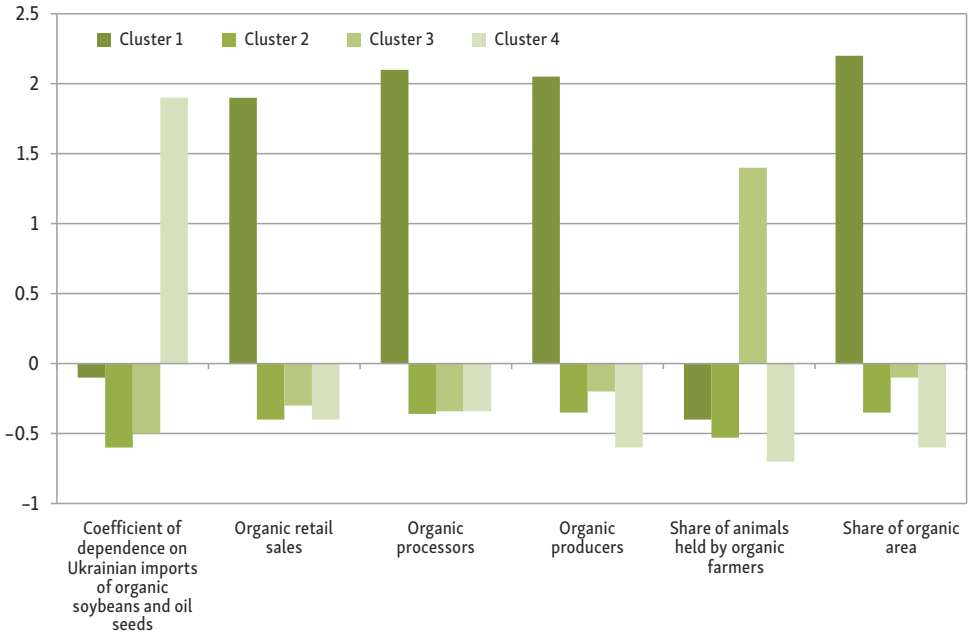

Figure 3. Average values of the selected indicators of the organic products market across the cluster

Table 3. Analysis of variance across the clusters of EU countries according to the selected indicators of the organic products market (source: designed by the authors)

Variable	Between SS	df	Within SS	df	F	p-value
The coefficient of dependence on Ukrainian imports of organic soya beans and oil seeds (I_d)	23.6062	3	2.3937	23	75.6042	0.0000
Share of organic retail sales (O_ret)	16.4204	3	9.5795	23	13.1414	0.0000
Share of organic processors	21.5535	3	4.4464	23	37.1630	0.0000
Share of organic producers	20.6824	3	5.3176	23	29.8189	0.0000
Share of animals held by organic farmers (O_ anim_held)	21.0891	3	4.9108	23	32.9233	0.0000
Share of organic area (O_area)	22.9362	3	3.0637	23	57.3941	0.0000

Table 4. Clustering the EU-27 countries according to the system of indicators of the organic products market

Clusters	*I_d*	*O_ret*	*O_proc*	*O_prod*	*O_anim_held*	*O_area*
Cluster 1 France, Germany, Italy, Spain	–0.1042	1.8678	2.1413	2.0697	–0.4463	2.1779
Cluster 2 Bulgaria, Croatia, Denmark, Hungary, Ireland, Lithuania, Luxembourg, Poland, Romania, Slovakia	–0.5593	–0.3657	–0.4083	–0.4104	–0.5575	–0.4219
Cluster 3 Austria, Czech Republic, Estonia, Finland, Greece, Latvia, Slovenia, Sweden	–0.4591	–0.2717	–0.3434	–0.1626	1.3573	–0.1714
Cluster 4 Belgium, Cyprus, Malta, Netherlands, Portugal	1.9364	–0.3281	–0.3470	–0.5748	–0.6995	–0.6243

The third cluster is characterised by the highest level according to the indicator 'Share of animals held by organic farmers. The countries in this cluster have an average level of development within the organic products market from the viewpoints of both the production and consumption of organic products. As such, the indicator of their import dependence is determined at a level below the average. Finally, the fourth cluster is determined by the indicator with the highest level of import dependence, and the values of such indicators as 'Share of organic producers', 'Share of animals held by organic farmers' and 'Share of organic area' are lowest among EU countries.

5.4. Identification of correlations among the main indicators of the European organic products market

In this section, correlations between the main indicators of the European organic market are identified separately for each cluster. Thus, for the first cluster, a correlation is observed between the indicator 'Share of animals held by organic farmers' and two other indicators, 'Id' and 'Share of organic processors' (Table 5). The negative value of the correlation coefficient 'Id' shows that an increase in the level of import dependence will lead to a decrease in the indicator 'Share of animals held by organic farmers. Further, a positive correlation coefficient value was identified for the 'Share of organic processors' indicator; therefore, an increase in the 'Share of organic processors' indicator will lead to an increase in the 'Share of animals held by organic farmers' indicator. Accordingly, it can be assumed that the countries in Cluster 1 are the most dependent on importing organic soyabeans and oilseeds from Ukraine, such that through the example of this cluster, one can observe movement of the chain of creation of organic products: the use of organic soyabeans in animal feed on organic farms. Therefore, for the countries in Cluster 1, the import of Ukrainian organic products forms an intermediate link with the European organic market and indirectly affects the final consumer ('Share of organic retail sales indicator'). This assumption is also confirmed by the direct impact of 'Share of organic processors' on the 'Share of animals held by organic farmers' indicator.

Therefore, the determining indicators for the countries in Cluster 1 are 'Share of animals held by organic farmers', 'Id' and 'Share of organic processors', between which there is a close correlation.

For Cluster 2, a correlation is observed between the 'Share of organic producers' indicator and two other indicators, 'Id' and 'Share of organic area' (Table 6), and the correlation coefficients between these indicators have a positive value, so an increase in the level of import dependence and in the area of organic land will lead to an increase in the number of organic producers. In addition, a positive correlation is observed in this cluster between share of organic processors and share of organic retail sales.

Table 5. Correlation matrix for Cluster 1 (source: designed by the authors)

Variable	Id	Organic producers	Share of animals held by organic farmers	Organic retail sales	Organic processors	Area of organic land
Id	1.0000	0.2760	–0.7888	–0.8972	–0.5540	0.6444
Share of organic producers	0.2760	1.0000	0.1710	–0.4718	0.5562	0.3963
Share of animals held by organic farmers	–0.7888	0.1710	1.0000	0.6992	0.9063	–0.7023
Share of organic retail sales	–0.8972	–0.4718	0.6992	1.0000	0.4154	–0.6612
Share of organic processors	–0.5540	0.5562	0.9063	0.4154	1.0000	-0.3932
Share of organic area	0.6444	0.3963	–0.7023	–0.6612	–0.3932	1.0000

Thus, for Cluster 2, the formation of a supply of organic products take place due to the expansion of their own organic areas and to increases in the volume of imports of organic soyabeans and oilseeds from Ukraine, provided the 'Share of animals held by organic farmers' indicator increases.

For Cluster 3, a correlation is observed between the 'Organic processors' indicator and two other indicators, 'Share of organic producers' and 'Share of organic area' (Table 7), the correlation coefficients between which have a positive value, so an increase in the number of organic producers and in the area of organic land will lead to an increase in the number of organic processors. In addition, a positive correlation is observed in this cluster between the indicators 'Share of organic retail sales' and 'Share of organic are', characterising this cluster by the following features: the area of organic land is higher than the average level for EU-27 countries.

For Cluster 4, correlation is observed between the indicator 'Share of organic area' and two other indicators, 'Id' and 'Share of organic producers' (Table 8). The negative value of the correlation coefficient shows that a decrease in the level of import dependence requires

Table 6. Correlation matrix for Cluster 2 (source: designed by the authors)

Variable	Id	Organic producers	Organic retail sales	Organic processors	Share of animals held by organic farmers	Area of organic land
Id	1.0000	0.7159	–0.0796	0.0954	–0.1363	0.4956
Share of organic producers	0.7159	1.0000	0.0046	0.3849	–0.2959	0.7943
Share of organic retail sales	–0.0796	0.0046	1.0000	0.8181	0.4044	0.1732
Share of organic processors	0.0954	0.3849	0.8181	1.0000	0.2300	0.4613
Share of animals held by organic farmers	–0.1363	–0.2959	0.4044	0.2300	1.0000	–0.0193
Share of organic area	0.4956	0.7943	0.1732	0.4613	–0.0193	1.0000

Table 7. Correlations matrix for Cluster 3 (source: designed by the authors)

Variable	Id	Organic producers	Share of animals held by organic farmers	Organic retail sales	Organic processors	Area of organic land
Id	1.0000	0.6855	–0.3401	–0.2291	0.4448	0.1610
Share of organic producers	0.6855	1.0000	0.0407	0.2590	0.8585	0.6287
Share of animals held by organic farmers	–0.3401	0.0407	1.0000	0.4414	0.1950	0.3782
Share of organic retail sales	–0.2291	0.2590	0.4414	1.0000	0.6044	0.7232
Share of organic processors	0.4448	0.8585	0.1950	0.6044	1.0000	0.9088
Share of organic area	0.1610	0.6287	0.3782	0.7232	0.9088	1.0000

an increase in the 'Share of organic area' indicator, and the correlation coefficient between the 'Share of organic area' and 'Share of organic producers' has a positive value. Therefore, the expansion of the market of organic products in the countries of Cluster 4 (increase in the number of organic producers) requires expanding the areas of organic land. In addition, a positive correlation is observed in this cluster between the indicators 'Share of organic processors' and 'Share of animals held by organic farmers', and the following features are characteristic of this cluster: the lowest indicators for the 'Share of organic area' for EU-27 countries. Concerning the level of import dependence, this cluster includes antagonistic countries (Cyprus and Malta, countries with a zero-level of import dependence; Belgium, the Netherlands and Portugal, countries with the highest level of import dependence). The low level of the 'Share of organic retail sales' indicator is a factor reducing the value of the 'Share of organic area' indicator, and dependence on Ukrainian imports in Belgium, the Netherlands and Portugal is a decisive factor due to the insufficient level of development of the 'Share of organic area' indicator.

Table 8. Correlations matrix for Cluster 4 (source: designed by the authors)

Variable	Id	Organic producers	Share of animals held by organic farmers	Organic retail sales	Organic processors	Area of organic land
Id	1.0000	–0.9471	–0.1197	0.755	–0.3693	–0.9773
Share of organic producers	–0.9471	1.0000	0.2626	–0.0539	0.5360	0.9732
Share of animals held by organic farmers	–0.1197	0.2626	1.0000	0.5763	0.9029	0.2238
Share of organic retail sales	0.2755	–0.0539	0.5763	1.0000	0.6776	–0.0736
Share of organic processors	–0.3693	0.5360	0.9029	0.6776	1.0000	0.5123
Share of organic area	–0.9773	0.9732	0.2238	–0.0736	0.5123	1.0000

Composite indicators for each cluster are presented in Table 9.

Table 9. Composite indicators for each cluster

Clusters	Coefficient of dependence on Ukrainian imports of organic soybeans and oil seeds	Share of organic retail sales, %	Share of organic processors, %	Share of organic producers, %	Share of animals held by organic farmers,%	Share of organic area, %
Cluster 1	0.27	3.63	3.41	9.33	0.06	0.11
Cluster 2	0.07	2.38	0.92	3.18	0.05	0.09
Cluster 3	0.06	3.96	1.02	6.78	0.2	0.18
Cluster 4	0.95	1.67	1.75	3.88	0.04	0.06

The following features are characteristic for Cluster 1: the countries of this cluster have a developed network of organic producers and organic processors, but the area of organic land is a limiting factor forming a prerequisites for import dependence. Simultaneously, the internal consumption of organic products in these countries is at an average level among EU-27 countries. Thus, the action of this factor balances import dependence to an average level among EU countries. However, assuming the further development of organic consumption in the countries of this cluster, especially an increase in the share of animals held by organic farmers, the indicator of import dependence may change.

The formation of the final consumer market for Cluster 2 is determined by the low share of organic producers and organic processors. This cluster is characterized by the following features: with the exception of Denmark and Luxembourg, the countries in this cluster have a poorly developed level of final organic consumption, and their organic land areas are average for the EU-27 countries. The low level of the 'Share of animals held by organic farmers' indicator reduces the significance of import dependence for this group of countries. However, Denmark and Luxembourg should be highlighted separately, as they have a sufficiently high level of organic product consumption, although dependence on Ukrainian imports is not a decisive factor in the level of final organic consumption.

The level of import dependence of the countries in Cluster 3 is expected to be minimal and mostly explained by the available area of organic land. The level of final organic consumption in the countries of this cluster is average, except for Austria and Sweden, where the level of final organic consumption is high. Cluster 3 countries have a high level of the 'Share of animals held by organic farmers' indicator, but the dependence of this indicator on Ukrainian imports is not a decisive factor. As such, the countries of this cluster are capable of independently meeting their needs by filling the intermediate link in the formation of organic products.

By analysing the situation of Ukrainian exports to countries with a high coefficient of import dependency, can predict several development scenarios for the countries in Cluster 4, whose coefficient is the largest. The first is to strengthen the competitive advantages of local manufacturers to 'squeeze' importers out of the market. This option is unlikely to be of interest to European farmers, especially concerning growing soybeans or oilseeds, as these plants have a rather ambiguous effect on the soil, in some cases depleting it, particularly with such a culture as sunflower. The large areas, fertile soils and favourable climate in Ukraine provide natural advantages for the cultivation of these crops, making them more profitable, even when considering transport costs.

The second option is to increase the volume of imports from Ukraine, which will first provide an opportunity to cover the deficit of organic products within the country, which will also grow according to the steady trends of market growth. Second, it will account for the raw nature of Ukrainian exports, so it is advisable to focus specifically on additional processing of the specified products to add value. Another option may be to strengthen the investment presence in the Ukrainian organic sector. Considering forecasts (Global and United States Organic Soybean Market Report & Forecast 2022–2028, 2022), the size of the organic soybean market will grow annually by 10%, and in 2028, it will reach a volume of USD$2,550.4 million, so these investments will pay off.

Our findings confirm the general trends outlined by Pawlewicz et al. (2020) and Lampkin and Sanders (2021), who highlight the steady growth in demand for organic products in the EU, particularly for soybeans and oilseeds. As demonstrated by Calabro and Vieri (2023), organic farming has significant potential to support the sustainable development of Europe's agri-food system, aligning with our conclusions about the increasing demand for organic products in the EU, especially during crises. Similarly, the findings by Dankevych et al. (2018) underscore the importance of trade relations between Ukraine and the EU, particularly in the agricultural sector, emphasizing the role of Ukrainian exports in supplying organic products to European markets. However, unlike previous research, our study places a specific focus on Ukraine's role as a major supplier of organic raw materials to the EU-27, highlighting the issue of import dependence more prominently.

5.5. Understanding export benefits to prevent artificial barriers

Understanding the benefits that European countries gain from importing from Ukraine is crucial. Misinterpretations can be exploited in the political sphere, leading to economic repercussions. An example is the Polish-Ukrainian grain conflict that began in the spring of 2023, which had negative consequences for the entire international trade system (Pietrzak, 2024). Simultaneously, economic analysis indicates that the supply of Ukrainian grain to Poland and other EU countries can yield several positive effects. This diversification enhances resilience against supply disruptions and market volatility.

Ukrainian grain exports often offer competitive prices, providing cost-efficient options for EU countries to meet grain demand, helping stabilise prices in the domestic market and ensuring affordability for consumers and businesses. One of the key benefits of the Ukrainian grain supply is its contribution to enhancing food security in Poland and other EU countries. By providing a steady and reliable source of essential commodities, it helps mitigate the risk of shortages during times of geopolitical instability or adverse weather conditions. Importing Ukrainian grains supports the agricultural sector in EU countries by providing a crucial source of feedstock for livestock farming, food processing, and other industries. This support helps sustain farm incomes, rural livelihoods, and agricultural productivity.

Increased competition from Ukrainian grain suppliers stimulates innovation and efficiency in the EU agricultural sector. This competition encourages farmers and agribusinesses to adopt advanced technologies, improve practices, and enhance productivity to remain competitive.

The trade in grains, particularly from Ukraine, plays a crucial role in fostering economic cooperation and strengthening diplomatic relations between Ukraine and EU countries. Positive trade relations facilitate dialogue, collaboration, and mutual benefits, contributing to stability and prosperity in the region.

In regions with fertile soils, Ukrainian grain production practices can align with sustainable agricultural practices. Importing grains from Ukraine may indirectly support environmentally friendly farming methods, contributing to broader sustainability goals in the EU. This directly correlates with the issue of supplying European markets with organic products, as previously discussed. Obtaining organic products is considerably more feasible given the high fertility of Ukrainian black soils.

The SWOT analysis method was used to understand all potential reflections on grain imports (Table 10). This analysis helps stakeholders in the grain trade to formulate strategies to mitigate risks and capitalize on opportunities.

Table 10. SWOT analysis of the Ukrainian grain supply to EU countries

Strengths	Weaknesses
Abundant Production: Ukraine is one of the world's largest grain producers. Its fertile agricultural land and favourable climatic conditions enable it to produce large quantities of grains such as wheat, corn, and barley. *Cost-Competitive*: Ukrainian grain exports often offer competitive prices compared to other suppliers, providing cost advantages for importers in Poland and other EU countries. *Geographical Proximity*: Ukraine's geographical proximity to Poland and other EU countries reduces transportation costs and lead times, making it a convenient and accessible source of grain supply. *Diverse Grain Portfolio*: Ukraine produces a diverse range of grains, allowing importers to diversify their grain sources and reduce dependency risks on a few key suppliers.	*Infrastructure Challenges*: Ukraine faces infrastructure challenges, including inadequate transportation networks and logistical bottlenecks, which can lead to delays and disruptions in grain shipments to Poland and other EU countries. *Political Instability*: Political instability in Ukraine can lead to uncertainty and disruptions in grain supply chains, impacting reliability and consistency in exports to Poland and other EU countries. *Quality Concerns*: Variations in grain quality standards and regulatory compliance may pose challenges for Ukrainian exporters in meeting the stringent quality requirements of importers in Poland and other EU countries. *Dependency Risks*: Over-reliance on Ukrainian grain exports may expose Poland and other EU countries to risks in times of supply shortages or disruptions, highlighting the importance of diversification and strategic planning for food security.
Opportunities	**Threats**
Market Expansion: Growing demand for grains in Poland and other EU countries presents opportunities for Ukrainian exporters to expand their market share and increase export volumes. *Investment in Infrastructure*: Improving transportation infrastructure and logistics in Ukraine could enhance efficiency and reliability in grain supply chains, strengthening Ukraine's competitiveness as a grain exporter to the EU. *Trade Agreements*: Bilateral or regional trade agreements between Ukraine and the EU can facilitate smoother trade relations and reduce trade barriers, creating favourable conditions for increased grain exports. *Sustainable Farming Practices*: Adoption of sustainable farming practices in Ukraine can enhance the environmental and social sustainability of grain production, appealing to consumers and importers in Poland and other EU countries.	*Geopolitical Tensions*: Geopolitical tensions between Ukraine and its neighbours and broader geopolitical conflicts can disrupt grain supply chains and create uncertainty for importers in Poland and other EU countries. *Trade Barriers and Tariffs*: The imposition of trade barriers, tariffs, or sanctions on Ukrainian grain exports by importing countries or Ukraine's trading partners can hinder market access and affect the competitiveness of Ukrainian grains in the EU market. *Climate Change*: Adverse weather conditions, such as droughts or floods, resulting from climate change can impact grain production in Ukraine, leading to fluctuations in supply and potential price volatility in the EU market. *Competitive Pressure*: Competition from other grain-exporting countries, such as Russia, the United States, and Canada, poses a threat to Ukraine's market share in Poland and other EU countries, especially if these competitors offer lower prices or better-quality grains.

In conclusion, the Ukrainian grain supply to Poland and other EU countries not only ensures food security but also brings significant economic benefits. These include stabilising prices, enhancing agricultural productivity, and fostering innovation in the sector. These positive impacts contribute to the overall well-being and resilience of the EU economy.

6. Conclusions

The European market's need for organic products of Ukrainian origin will contribute to maintaining the trends of increasing imports, and it is expected that the EU's domestic demand for organic products will grow; accordingly, the deficit can be met at the expense of imports. Ukraine meets the need for unique products of plant origin, such as grains (wheat, corn, spelled, millet, rye), oilseeds (soybeans, sunflower), processed and frozen berries and fruits, oil, nuts, cereals and oatmeal.

The need for Ukrainian exports will contribute to the adaptation of the Ukrainian agrarian organic sector, even under wartime conditions. Some of the farms specialising in the production of soybeans, sunflowers and other oilseeds are in the western part of Ukraine, but following the war, we foresee a change to the geographical structure of the production of other types of organic products and its localisation in the central and western regions of Ukraine. Of course, the question of time is important in this case, as the process for preparing the land for certification takes several years. The re-localisation of organic production will contribute to reductions in transport costs due to bringing production closer to the border.

The production of organic livestock products by European countries depends on the availability of organic raw materials of Ukrainian origin, particularly soybeans. This is especially true of the Cluster 4, particularly the Netherlands and Belgium, where the number of organic livestock farms is increasing every year. Livestock farms are changing their status to organic and, accordingly, they will need more organic feed, the main importer of which is Ukraine. However, it is exceedingly difficult for these countries to increase their own area, as shown by the calculations. As for the countries of Cluster 1, in Germany in particular, 90% of the demand for organic soybeans was covered by imports, whereas France also has a certain shortage of organic soybeans for animal husbandry, which can be supplied by Ukrainian exports.

Economy constraints amid wartime conditions forced Ukrainian manufacturers and the authorities to respond to the needs of European markets, including for organic products. In parallel with the introduction of national organic legislation, it is being adapted to the new EU regulation in the field of the production, circulation and labelling of organic products. A countermeasure is that the EC cancelled import tariffs and quotas for goods from Ukraine and suspended additional control measures applied to organic products from Ukraine since 2015. Simultaneously, in connection with the adoption of Commission Delegated Regulation 1450 on the use of inorganic protein feeds in organic animal husbandry, the Ministry of Agrarian Policy and Food of Ukraine appealed to EU countries and the EC with assurances about the ability of Ukrainian organic operators to fulfil their export commitments in 2022–2023 regarding the supply of organic protein feeds to EU countries.

At the same time, Ukrainian producers need to be prepared for the barriers that may arise when entering the European market. These barriers can be due to protectionist measures

aimed at ensuring the economic security of European farmers. However, sometimes these problems have an exclusively political basis, as in the situation with Poland.

The limitations of this study lie in the use of a narrow range of products for analysis, specifically those classified as most sensitive to import dependence, such as soybeans and other oilseeds. The market for these products can be characterized as raw material-based, which does not account for processing opportunities either in Ukraine or in importing countries. Consequently, there is an issue with motivating Ukrainian exporters, which may be linked to the potential for gaining added value through exports. Furthermore, the findings of this study cannot be extrapolated to the markets for finished organic products. This area will require further research that takes into account market trends, seasonality, and the specific development of the corresponding industry in the context of global organic trade trends. Such research would provide more accurate data on the demand dynamics for processed organic products and the opportunities for Ukrainian exporters to enter new markets with high value-added products.

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