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Olga Kovalenko, Olena Bokiy, Yaroslav Rybak, Hanna Lysenko, Nataliia Voznesenska

Institute of Food Resources of National Academy of Agrarian Sciences of Ukraine
Ukraine

ASSESSMENT OF EXPORT POTENTIAL AND STATE OF FOREIGN FOOD AND AGRICULTURE TRADE IN THE WORLD

Purpose. *The purpose of the article is to assess the export potential of countries, to determine the directions of food export development and the place of Ukraine in it, taking into account socio-economic factors by applying the authors' methodical approach.*

Methodology / approach. *The article considers world food and agriculture exports, the export potential of countries is assessed taking into account socio-economic factors. The authors select and apply a combination of methods necessary to achieve the goal of the study, which characterize specificities of individual countries of the world: method of systematic generalization, dynamic series analysis, factor analysis, regression analysis, comparisons, rating evaluation, integral approach.*

Results. *With the help of factor and integral analysis of macroeconomic indicators, we established that the structure of world exports and the share of food and agriculture is depended on the level of development and specialization of countries. In particular, the share of food and agriculture exports of developed countries is smaller compared to developing countries. The Netherlands and Germany are the leaders of the ranking in terms of food and agriculture export potential. According to forecasts, based on current trends, the export of bakery products in Ukraine and Poland should increase in 2023 compared to 2020 by 32.7 and 21.6 %, respectively. Effective socio-economic development, balanced export policy, modernization of production and logistics will contribute to the growth of export of food and agriculture with high added value.*

Originality / scientific novelty. *Based on the authors' methodical approach, the work improved the integral indicator of export development and the ranking of countries by export potential, taking into account socio-economic conditions. Factor models were built and the factors of food and agriculture export development were determined.*

Practical value / implications. *The improved methodical approach to evaluating the effectiveness of global food and agriculture exports provides an opportunity to establish competitive advantages in the market and plan exports. Developing countries will have the opportunity to make the right choice of export products, which will provide them with added value and an increase in supply volumes.*

Key words: *international trade, export potential, food and agriculture, integral analysis, forecast, socio-economic development.*

Introduction and review of literature. Modern processes of transformation of world economic processes are aimed at integration and specialization of countries, simplification of borders and conditions of doing business at the international level. A practical example is the Common food policy for the European Union, which contributes to the achievement of food security through the mechanisms of subsidies, price stabilization, and international division of labor. Currently, the development of

the world economy is taking place under conditions of extraordinary challenges, the most acute of which are global and local military conflicts, pandemics, and climate change. According to the UN, the number of hungry people in the world in 2021 are reached 828 million people and increased by 46 million compared to 2020. Experts of the World Food and Agricultural Organization (FAO) is warned in 2021 that 41 million people in the world in need of urgent food aid, primary life support. The aggression of the russian federation against Ukraine in 2022 is caused an unprecedented humanitarian and food crisis not only in Ukraine, but also in many countries of the world, because Ukraine is the world leader in the export of grains, which are vital for the countries of Africa and the Southeast. The importance of international food and agriculture trade is growing. The state of war in Ukraine has made it difficult to export food and agriculture from the country, especially grain. Therefore, the study of food export trends and the impact of macroeconomic factors on its development are relevant and timely [1; 2].

Scientists from many countries highlighted the main points of international food supply, global chains of added value creation and dependence of exports on the macroeconomic situation in their works. Will Snell investigated the price trends of exports of products from the United States, proved the impact of economic and political stability on the exchange rate, the inflation rate, and the state of food exports [3]. S. Fischer evaluated the relationship between the quality of food products (cheese, meat semi-finished products, wine) of five European countries and their export indicators and found the dependence of exports on the category and destination of the product, as well as the independence of exports on the time period [4]. B. Tanrattanaphong and C. Gan explored global food value chains using the example of processed food exports from Thailand. The authors proved that the modernization of such chains has a positive effect on the export of products after a certain time. At the same time, manufacturers and exporters will gain skills in applying international product standards [5].

T. Andrei, B. Oancea, A. Mirica investigated to what extent the accession of Romania and Bulgaria to the EU affected the export of agri-food products. Scientists found out that for the long-term export of food products, it is necessary to diversify the assortment. For Romania, accession to the EU contributed to an increase in food exports, while it had almost no effect on Bulgaria [6]. L. Tamini and A. Valea proved the positive impact of investments in R&D on the export activity of Canadian small and medium-sized agri-food firms. The support of scientific activity by the Canadian government is important [7]. S. Bojnec, I. Ferto investigated the impact on export volumes of factors of improving the quality of exported agri-food products. Scientists proved that the price of exported agri-food products has a direct correlative interdependence with the level of economic development and population, the quality of exports is negatively affected by the growth of trade costs [8].

S. Fluckiger and F. Brill proved that the agricultural sector of Switzerland is greatly increasing its dependence on export orientation. Scientists have proposed tools to increase the sales potential of food and agriculture products based on demand

assessment and economic growth model [9]. G. Van den Broeck and M. Maertens reviewed trends in horticulture export chains, investigated the impact of food exports on components of food security, including availability, access, utilization and sustainability [10]. W. Suanin proved that compliance with international food safety standards affects the export performance of processed food products and affects exports differently depending on the level of development of countries. Compliance of processed food products with international standards has a significant impact on exports from developing Asia countries to the USA and developing countries. However, it has a limited effect on exports to the European Union [11].

O. Shkolnyi et al. researched the regulatory impact of management decisions on food exports in Ukraine. The authors concluded that integrated associations have better competitive export positions. It is necessary to take into account the requirements of consumers [12]. T. Sudarevic and P. Radojevic et al. evaluated the food exports to Europe of small developing countries. The biggest obstacles to exports were uncompetitive prices and insufficient government support [13]. T. Miller, SF. Cao et al. considered the decentralized financing of livestock export chains. The authors found that there are many risks of Decentralized finance (DeFi), developed the DeFi architecture for supply chain financing (SCF), and proposed ways to achieve the benefits of investing in DeFi for small and medium-sized enterprises [14].

D. Karkanis, K. Melfou reviewed Greek agri-food export strategy, taking into account the experience of the EU's Mediterranean exporting countries. The authors came to the conclusion that it is necessary to increase and revise the export strategies of agro-food products of Greece, taking into account the factors influencing the export of the Mediterranean countries of the EU – Italy, France, and Greece. These measures will contribute to the sustainable growth of the economy during the economic and pandemic crisis. The method of applied gravitational model was used to assess the factors of influence on export [15].

J. A. McMahon analyzed what restrictions and prohibitions affect food exports during the war in Ukraine. The author proposed to implement export bans and restrictions in response to current and future food crises. Such a decision will help ensure food security [16]. S. Akter analyzed the impact of food export restrictions on domestic prices and development indicators of exporting countries. The author substantiated the need for food price support programs [17]. M. Markovic et al. studied the indicators of food and agriculture export of the Republic of Serbia in the conditions of Covid-19. Studies have proven the resilience of the agri-food sector to crisis phenomena, the growth of the main export indicators in the crisis year of 2020. The agri-food sector is capable of compensating for the fall in exports of other sectors of the economy [18].

M. Beestermöller et al. studied the impact of European border food safety inspections on the export of agricultural products using the example of Chinese companies. The authors substantiated that the risk of rejection at the border for security reasons deters small exporters, increases turnover between firms with a large

trade margin [19]. Y. Long proved that the competitiveness of agricultural products depends not only on export opportunities, but also on the sustainability of the agricultural sector [20]. S. Islam et al. researched and improved a food export tracking system using shrimp from Bangladesh as an example. The authors proposed a systematic methodical approach to quantitative assessment of information losses and analysis of vulnerable areas of product tracking at the stages of its supply chain [21]. M. Sychevskyi and O. Kovalenko identified the factors of the innovative component of competitiveness in the global environment, which significantly affects the development of food exports. At the same time, the issues of assessing the state of global food exports and assessing the export potential of countries require more in-depth research [22]. The ongoing russian-Ukrainian war affects Ukrainian agriculture and global food security, in particular Ukraine is no longer able to export agricultural products by sea to regional (European) and international markets, although in part it is possible due to the Black Sea Grain Initiative [23].

Evaluating the works of scientists, we came to the conclusion that all the mentioned authors considered various aspects of food exports, current restrictions, the relationship between product quality and export indicators, the influence of macroeconomic and political stability, etc. However, the issues of assessing the export potential of countries, the state of food exports, and methodical approaches to assessment and forecasting are not sufficiently resolved. The assessment of export potential in the period of the COVID-19 pandemic and in the conditions of military confrontation, in particular the one that has been taking place in Ukraine since 2014, requires special attention. Therefore, these problems require more in-depth research.

The purpose of the article was to assess the export potential of countries, to determine the directions of food export development and the place of Ukraine in it, taking into account socio-economic factors by applying the author's methodical approach.

Methodology. The following methods were used in the research:

- systematic generalization – to evaluate methodological approaches and achievements of scientists on the analysis of export development in individual countries;
- dynamic series analysis – to assess the dynamics of the country's share in the value of world exports, the number of products and other export indicators by countries of the world, the dynamics of indicators of the quantitative growth of exports of certain food groups;
- factor analysis, regression analysis – to build factor models of the dependence of the export of food products on macroeconomic factors and forecasts;
- comparison – to compare export indicators in different countries;
- rating evaluation and an integrated approach – to build a rating of countries based on the integral indicator of export potential and apply the author's methodical approach.

The development of exports of certain types of food during the calendar period for each of the countries are estimated by the authors according to an integral indicator that characterizes the trend of export development. The first component of

the indicator contains the integral (geometric mean) value of annual growth indices, the second is formed on the basis of relative indicators. To make management decisions, each component of these indicators (1, 2) is evaluated:

$$I_{integral} = \sqrt[n]{I_1 * I_2 * \dots I_n}, \quad (1)$$

where $I_{integral}$ – integral (geometric mean) value;

$I_1 \dots I_n$ – annual indices of growth for indicators, calculated as the ratio of the current value to the previous one;

n – number of calendar periods [24].

For relative indicators (in particular, shares of the total), the arithmetic mean value is calculated (2):

$$J_{integral} = \frac{J_1 + J_2 + \cdots J_n}{n}, \quad (2)$$

where $J_{integral}$ – integral (arithmetic mean) value;

n – number of calendar periods;

$J_1 \dots J_n$ – annual changes in indicators, calculated as the difference between the current and previous values [24].

For provided set of data, the following was accepted for calculation:

- for absolute indicators (I_1, $\dots I_n$) – growth indices: exports in natural terms; average unit price of the product; general indicator of the value of exports;

- for relative indicators – the change in the country's share in the world export of products.

Data from the Trade map, the State Statistics Service of Ukraine, the FAO, and the World Bank for 2001–2020 and partially for 2021 were used for the authors' research, construction of forecasts and dependence equations. The rating assessment was carried out for 20 countries, the comparison of individual export indicators – from 2 to 20 countries. The macroeconomic factors of the countries' development that affect food exports – GDP per capita (PPP), average wages, inflation and the share of exports in GDP are taken into account in the research. The results of the work confirmed the impact of these indicators on food exports.

Results and discussion. Demand for high-quality food products is increasing due to the strengthening of globalization processes and the opening of borders. Ensuring the food security of countries, achieving comprehensive availability and diversity of food in the world for all segments of the population is the task of the modern millennium, which is consistent with the Goals of Sustainable Development. Therefore, the world food policy is used export levers and tools to ensure the balance of supply and demand of food products, the sale of surpluses and the import of necessary types of food resources. The liberalization of world trade and the opening of borders deepened the internal specialization of the food sector of countries [25].

At the stage of comprehensive globalization of phenomena and processes, international food and agriculture trade is growing. In 2020, compared to 2001, exports are increased by 3.5 times and continued the growth dynamics, despite of the pandemic. During this time, the value of the export of oilseeds and oily fruits increased the most – by 5.3 and 5.4 times, respectively, primarily due to the

promotion and involvement of more layers of the population in a healthy lifestyle. For meat and dairy products, exports are increased by 3.3 and 3.0 times, respectively; grain processing products – 4.6 times. The share of food in total world exports over the past 20 years was the lowest in 2006 – 6.5 % and the highest in 2020 – 9.4 %. Since 2013, this indicator has crossed the 8.0 % mark, due to the increase in food and agriculture prices and the increase in the volume of supplies. Leaders in global export value are electrical machines and equipment; nuclear reactors and boilers (group 84 HS) respectively 16.0 % and 12.1 % of total world sales [26; 27]. The influence of macroeconomic processes, crisis and post-crisis phenomena on the volumes and dynamics of indicators of foreign economic activity is confirmed by the trends of changes in the export of goods in the world. The most significant decrease in the volume of world trade over the last decade occurred in 2015 (by 13.0 % compared to 2014), following growth trends of 1.5–2.5 % in the years preceding the crisis [26].

Volumes of the value of food and agriculture exports depend on the time period. The forecast, based on a significant number of observations for each type of product and the application of regression equations, shows that the value of exports of meat and dairy products in 2025 compared to 2020 may increase by 30.7 %; flour and bakery (group 19 HS – finished products from grain and cereals) – by 24.6 % [26; 27]. In the overall structure of world food and agriculture trade in 2020, the largest share was occupied by meat and meat products (8.4 %), fruits and nuts (8.2 %), cereals (7.4 %), fish (7.0 %) and dairy products (5.5 %) [26].

Despite the pandemic, food and agriculture trade in the world is increased by 1.7 % at the expense of highly profitable food products – fats and oils (by 14–16 %), as well as cereals (7.7 %). The global value of meat and dairy exports decreased to 1 % in 2020, but vital livestock supply chains were disrupted [26].

The boundary between developed and developing countries is usually determined by the criterion of GDP or gross national income (GNI) per capita. According to the UN classification, countries with a developed economy are considered to be the countries of "The Group of Seven" G7, which produce more than 50 % of the world production of industrial products and 25 % of agricultural production. Among them, in particular, Germany, France and Italy. Countries with developed economies – Spain, Portugal and Greece. The countries of Eastern Europe that approached the average level of the economy are Poland, the Czech Republic, Hungary, Romania, and Croatia. Economies in transition include Montenegro and other Balkan states, Ukraine, Georgia and CIS countries. Developing economies include the least developed countries in Asia, Africa and Latin America that need food assistance [28].

Without a sufficient level of national income and GDP, a group of countries in terms of technology development can surpass their achievements and approach the developed ones. At the same time, their sectoral structure, including the predominance of agriculture and dependence on foreign capital, is at the level of developing countries. From the point of view of trends in foreign economic activity, developing countries have the inherent advantage of exporting raw materials with an insignificant level of added value, highly developed countries export high technologies.

Food security of countries is primarily ensured by meat, dairy and flour products (Table 1). In terms of the value share of the world export of meat and edible meat offal (group 02 HS), two European countries, the Netherlands and Spain, are among the TOP 5 leaders. The TOP 5 world exporters of dairy products, eggs, honey and other products of animal origin (group 04 HS) include three European countries – Germany, the Netherlands and France. Ukraine has 0.5 % of the market and ranks 32nd in world exports, without changing its position in recent years.

Table 1

Comparison of Ukraine and the TOP 5 exporters of the main types of food, % of world exports

Place in the world	Country	2016	2017	2018	2019	2020	Change 2020 over 2016, %	Change 2020 over 2018, %
02 – Meat and edible meat offal								
The value of world exports, billion USD		113.0	123.6	128.1	135.2	134.0	18.6	4.6
1	USA	13.0	13.3	13.5	13.1	13.6	0.6	0.1
2	Brazil	11.2	11.3	10.4	11.2	11.8	0.6	1.4
3	Australia	7.3	7.4	8.0	8.6	7.8	0.5	-0.2
4	Netherlands	7.6	7.5	7.5	7.4	7.3	-0.3	-0.2
5	Spain	5.1	5.1	5.2	5.9	7.2	2.1	2.0
28	Ukraine	0.3	0.4	0.5	0.5	0.5	0.2	0.0
04 – Dairy products, eggs and honey								
The value of world exports, billion USD		73.1	86.3	90.1	89.4	89.1	21.9	-1.1
1	New Zealand	11.0	11.9	11.3	11.9	11.9	0.9	0.6
2	Germany	12.0	12.0	11.7	11.8	11.9	-0.1	-0.2
3	Netherlands	11.0	11.4	11.1	10.8	10.7	-0.3	-0.4
4	France	9.0	8.2	8.1	7.9	8.1	-0.9	0.0
5	USA	5.3	5.2	5.1	5.5	6.1	0.8	1.0
32	Ukraine	0.5	0.6	0.5	0.5	0.5	0.0	0.0
1905 – Bakery and flour products								
The value of world exports, billion USD		31.0	33.3	36.4	36.9	36.8	18.7	1.0
1	Germany	11.7	11.5	11.4	11.1	11.6	-0.1	0.2
2	Canada	7.2	7.3	7.8	8.4	8.5	1.3	0.7
3	Italy	6.4	6.7	6.8	7.3	7.5	1.1	0.7
4	France	6.4	6.4	6.5	6.5	6.2	-0.2	-0.3
5	Netherlands	5.6	5.6	5.7	5.7	5.7	0.1	0.0
33	Ukraine	0.4	0.4	0.4	0.5	0.5	0.1	0.1

Source: formed by the authors based on the data of TradeMap [26].

European countries are the leaders in the export of milk and cream. In 2020, Germany provided 11.9 % of the world's exports of dairy products, worsening its position by 0.1 percentage points over the past five years, France – 8.1 %. The TOP 5 exporters also include New Zealand and the Netherlands. Among the five exporters of bakery products, the leader is Germany (11.6 % of world exports), Canada (8.5 %),

Italy (7.5 %), France (6.2 %), the Netherlands (5.7 %). With a share of 0.5 % of exports, Ukraine ranks 33rd in the world [26].

The export potential of the countries, taking into account socio-economic factors, is determined by means of a rating built on the basis of integral indicators of export potential and weighting factors. As indicators of socio-economic development, indicators of the standard of living of the population were chosen – GDP (PPP) per capita and average salary, as well as the inflation rate of countries, which characterizes the volatility of economic processes. For an equal number of points of the integral indicator, priority was given to the country with a larger population. For all indicators, except the inflation rate, the higher the value of the indicator, the higher the rating. The following assumptions are used for the inflation index rating: 1) within a change of 0.5 percentage points, countries are assigned one place, since the changes are insignificant; 2) the lower the inflation, the higher the place in the rating; 3) exclusion – Greece (3rd place, due to anticipatory deflation). The integral rating is formed by the arithmetic sum of places (Table 2).

Table 2

Ranking of countries by the integral indicator of export potential in 2020

Countries	GDP (PPP) per capita, thsd USD	Place in the rating	Inflation, %	Place in the rating	Average salary, USD per month	Place in the rating	Export of goods and services, % of GDP	Place in the rating	Sum of places	Integral rating
Netherlands	59.2	1	101.3	5	4753	3	78.9	2	11	1
Germany	53.7	3	100.5	2	5200	1	43.8	9	15	2
Austria	55.1	2	100.8	4	5190	2	52.6	8	16	3
Lithuania	38.7	8	101.2	5	1632	9	74.1	3	25	4
Czech Republic	41.7	7	103.2	8	1660	8	71.5	4	27	5
Italy	41.8	6	99.9	1	2521	6	29.5	17	30	6
France	46.2	4	100.5	2	2302	7	28.0	18	31	7
Spain	38.3	9	99.7	1	3000	5	30.6	16	31	8
United Kingdom	44.9	5	101.0	5	3142	4	27.4	19	33	9
Hungary	33.1	12	103.3	8	1187	12	79.7	1	33	10
Poland	34.3	11	103.4	8	1325	10	55.6	7	36	11
Portugal	34.5	10	100.0	1	1086	13	36.7	13	37	12
Romania	31.9	13	102.6	7	1228	11	37.3	12	43	13
Bulgaria	24.3	16	101.7	6	710	15	56.2	6	43	14
Greece	28.5	14	98.8	3	1034	14	31.9	15	46	15
Brazil	14.8	18	103.2	8	567	16	69.2	5	47	16
Ukraine	13.1	19	102.7	7	430	20	39.0	10	56	17
Georgia	14.9	17	105.2	10	458	19	37.4	11	57	18
Kazakhstan	26.7	15	106.7	11	516	17	36.4	14	57	19
Moldova	13.0	20	103.8	9	459	18	27.3	20	67	20

Source: formed by the authors based on the data of TradeMap [26], State Statistics Service of Ukraine [29], World Bank [30], Ilostat [31].

The first places in the integrated rating were taken by the countries with the highest

GDP per capita – the Netherlands, Germany and Austria. Countries with an insignificant level of GDP are mostly placed in the last positions. Among countries with an average level of development, high positions are occupied by Lithuania, Czech Republic and Hungary (4th, 5th and 10th place). Great Britain, which ranks 5th in terms of GDP per capita in the sample, ranks 9th in terms of the integrated indicator. The leaders in terms of the share of exports in the GDP were Hungary, the Netherlands and Lithuania. The integral indicator demonstrates the export potential under the conditions of a stable national economy and provides countries with the opportunity to achieve better results.

Food and agriculture export are an important component of the national export of countries, which is formed taking into account the export potential. Among the countries studied above, Ukraine and Moldova export the largest share of food – 45 and 44 %, respectively, as well as other countries with an average and below-average level of development. For the G7 European countries – Germany and Great Britain – food accounts for 6 and 7 % of total exports, respectively, for Italy and France – 11 and 15 % (Figure 1).

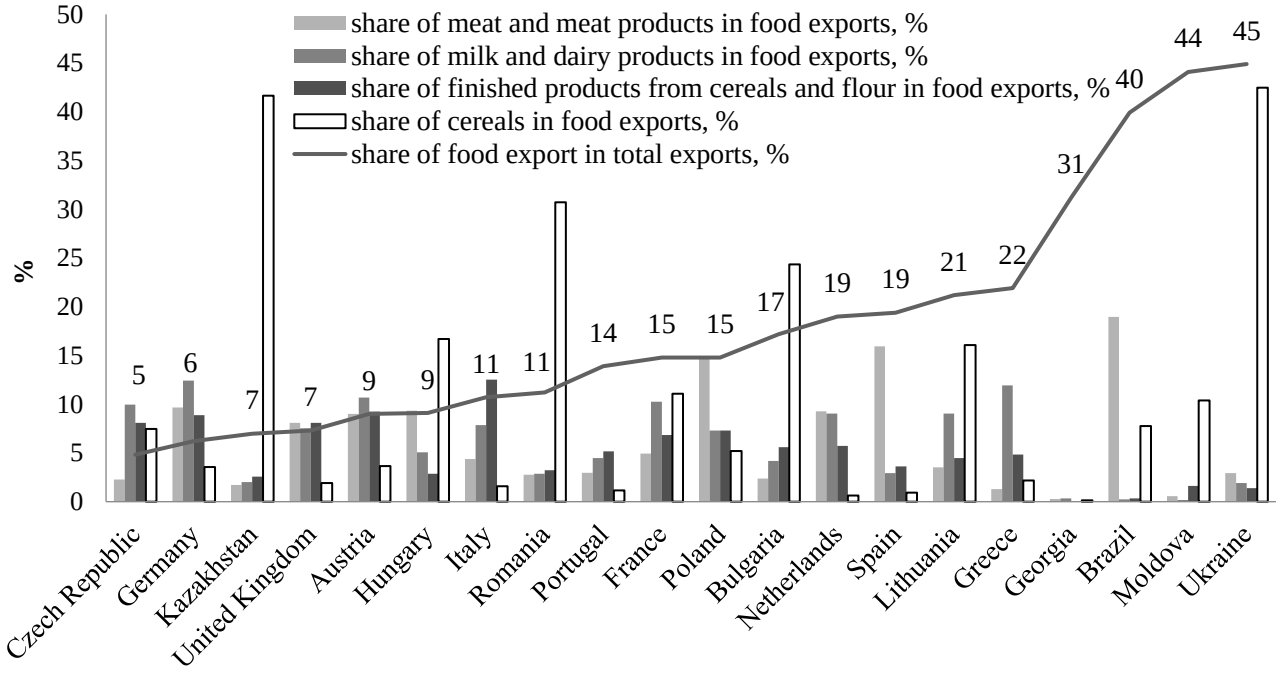

Figure 1. The share of the value of food exports in the value of the countries' exports in 2020, %

Source: formed by the authors based on the data of Trade Map [26].

Highly developed European countries and countries with an average level of development have a small contribution of the food and agriculture component to the total export of the countries – from 5 to 15 %. Post-Soviet Eastern Partnership countries have a share of food exports of more than 20 %. Among the developed countries, the recognized world leaders in food exports of meat and dairy products are the Netherlands and Spain, each of which has a share of 19 % in food and agriculture exports.

According to food groups with a higher added value, the countries export: dairy products – Germany (12.4 % of the country's food exports); ready-made flour products (mainly pasta) – Italy (12.5 %); meat products – Brazil (18.9 %). Developing

countries mostly export raw materials (agricultural products) and have a high share of food in total product exports. Georgia and Moldova mainly export alcoholic beverages and fruits, and Ukraine – cereal grains and oil of primary processing, losing the added value of further processing of raw materials.

The calculation of integrated indicator of the export development regarding bakery and flour products was carried out for the period 2017–2020, using the example of Ukraine and Poland, which have a similar population and border each other (Table 3, 4). The initial data show that Poland's product exports decreased, while Ukraine's exports increased slightly. The average export price for products in Ukraine during 2017–2020 had been increased faster compare with Poland (Table 3).

Table 3

Comparison of the main indicators of the bakery and flour products export in Ukraine and Poland

Indicator	Ukraine				Poland				Change 2020 over 2017, %	
	2017	2018	2019	2020	2017	2018	2019	2020	Ukraine	Poland
Export, thsd t	100.6	104.1	103.5	107.5	553.6	592.0	460.4	468.3	6.9	-15.4
Export, mln USD	139.4	153.1	173.5	197.4	1632.0	1755.5	1407.2	1530.3	41.6	-6.2
Average price of 1 t of export, thsd USD	1.39	1.47	1.68	1.84	2.95	2.97	3.06	3.27	32.4	10.8
Share in value of world export, %	0.4	0.4	0.5	0.5	4.8	4.8	3.7	4.0	0.1	-0.8

Source: formed by the authors based on the data of Trade Map [26], State Statistic Service of Ukraine [29].

The integral indicator of export development (in terms of quantity and price) in Ukraine was the highest in 2020, mainly due to rising prices, in Poland in 2018 (Table 4). At the same time, the share of exported products in its production was higher in Poland.

Table 4

Comparison of integral indicators of export development bakery and flour products in Ukraine and Poland

Indicator	Ukraine			Poland			Integral indicator of export development in 2018–2020	
	2018	2019	2020	2018	2019	2020	Ukraine	Poland
Growth index to the previous year, times								
Quantitative export	1.03	0.99	1.04	1.07	0.78	1.02	1.02	0.95
Average export price	1.06	1.14	1.10	1.01	1.03	1.07	1.10	1.03
Export value (summary indicator)	1.10	1.13	1.14	1.08	0.80	1.09	1.12	0.98
Change to previous year, percentage points								
Share in world export of products	0.0	0.1	0.0	0.0	-1.1	0.3	0.03	-0.27

Source: formed by the authors based on the data of Trade Map [26], State Statistic Service of Ukraine [29].

The dynamics of the main export indicators using the example of products under the code HS 1905 (bread and flour products) shows that during 2018–2020, the integral indicator of the value of exports in Ukraine was the largest (Table 4). For each year, the indicators relative to the previous year are shown, the integral indicators are calculated according to formulas 1 and 2. With the help of the components of the integral indicator, it is advisable to plan price and quantity parameters of food exports in the future.

Forecasts for Ukraine and Poland, built using regression equations, confirmed the dependence of the export of bakery and flour products in Ukraine on GDP per capita, and in Poland – on the mutual influence of GDP and inflation (Figure 2, 3).

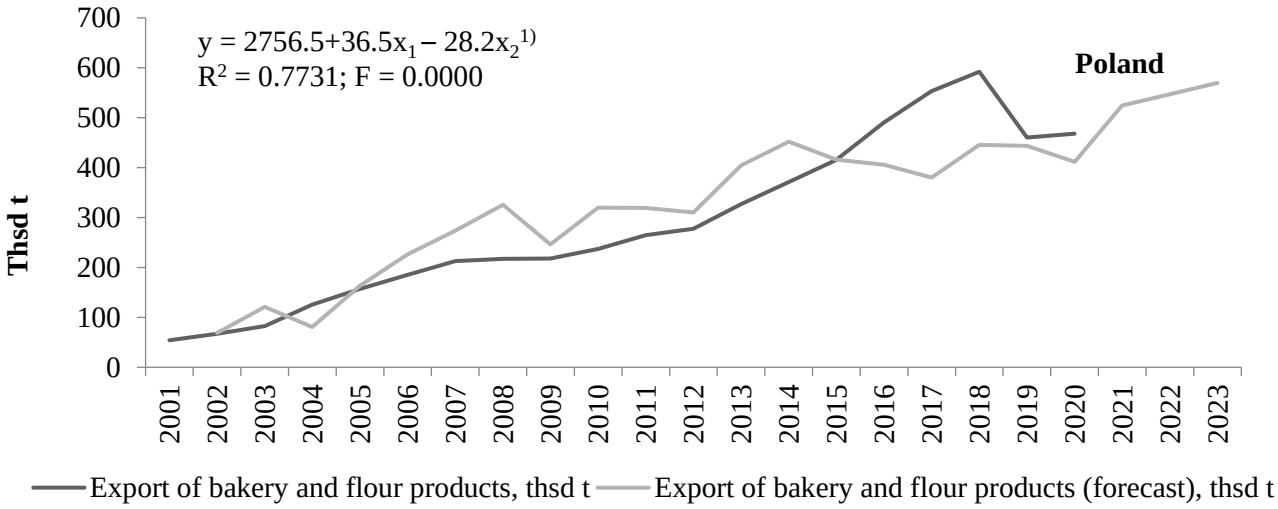

Figure 2. Forecast of the export of bakery and flour products depending on macroeconomic factors in Poland

Notes: [1] *y* – export of bakery and flour production, thsd t; x_1 – GDP per capita, USD; x_2 – inflation index, %; *F* – Fisher's test; *t* – Student's test.

Source: formed by the authors based on the data of Trade Map [26], World Bank [30].

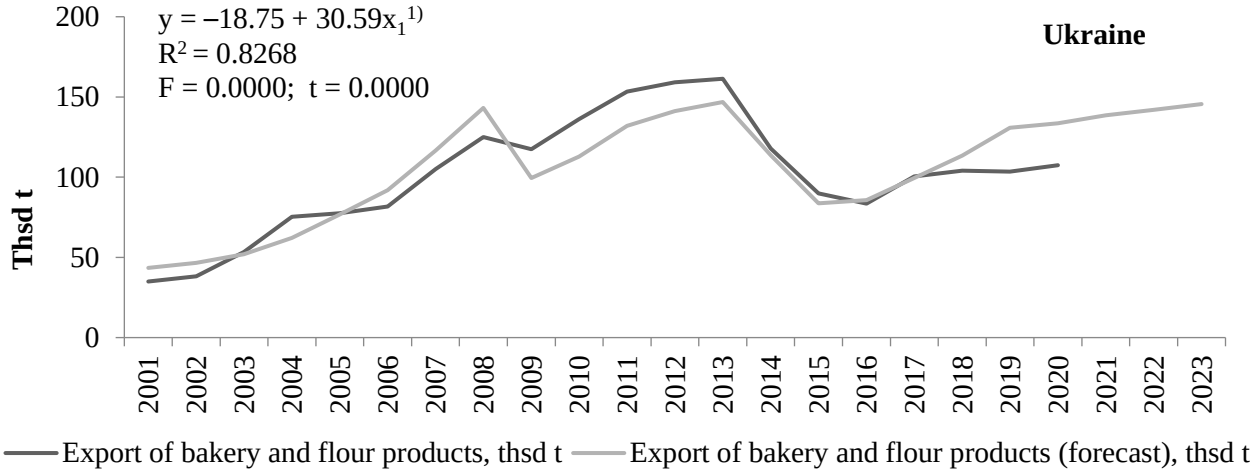

Figure 3. Forecast of the export of bakery and flour products depending on macroeconomic factors in Ukraine

Notes: [1] *y* – export of bakery and flour production, thsd t; x_1 – GDP per capita, USD; *F* – Fisher's test; *t* – Student's test.

Source: formed by the authors based on the data of Trade Map [26], State Statistic Service of Ukraine [29], World Bank [30].

According to confirmed dependencies, in 2023 relative to 2020, under current trends, the quantity of bakery products in Poland may increase by 21.6 %; in Ukraine – by 35.4 % [26]. The reliability of the equations and the reliability of the forecasts are confirmed by the corresponding Fisher's test (0.0000 for Poland and 0.0000 for Ukraine) and Student's test ($t_1 = 0.0000$, $t_2 = 0.024233$ for Poland, $t_1 = 0.0000$ for Ukraine), which are significantly less than the threshold level of p – 0.05.

Using the example of Ukraine, the article considers the factorial influence of macroeconomic factors on the quantitative export of vital food. The results are based on 19 observations during 2003–2021 for each type of product (Table 5). For the analysis of export opportunities, we chose a product that has a significant contribution to the volumes of global and domestic exports – poultry meat. At the same time, the regularities of the macroeconomic factors influence for products with insignificant export volumes were not monitored.

Table 5

The factor model of the dependence of the poultry meat quantitative export on macroeconomic indicators on the example of Ukraine

Impact factor	Dependence equation[1)]	R^2	F – Fisher's test [2)]	t – Student's test [2)]	Forecast of export change 2025 over 2020, %
Exchange rate, UAH/USD	$y = –69.87 + 15.71x_1$	0.8664	0.0000	0.0000	2.21
GDP per capita, UAH	$y = –43.57 + 4.38x_2$	0.9547	0.0000	0.0000	7.37
GDP per capita (PPP), thsd USD	$y = –468.6 + 62.76x_3$	0.8970	0.0000	0.0000	8.32
Number of population, thsd people	$y = 3311.8 – 0.07x_4$	0.8803	0.0000	0.0000	12.96

Note: [1)] y – export of poultry meat, thsd t; $x_1 \ldots x_4$ – relevant influencing factors; [2)] F – Fisher's and t – Student's test (should be less than the marginal level of $p < 0.05$, which confirms the statistical reliability of the dependence equations).

Source: formed by the authors based on the data of Trade Map [26], State Statistic Service of Ukraine [29].

For all equations of dependence, the coefficients of determination R^2 are within 0.87–0.95, F – Fisher's tests and t – Student's tests are significantly less than the marginal level of $p < 0.05$, which indicates that the obtained observations confirm the models.

The factor model of the dependence of the poultry meat quantitative export on macroeconomic indicators are shows that, according to existing trends, product exports may increase in 2025 under the influence of macroeconomic factors (Table 5).

Countries that are focused on agriculture exports have stable product sales markets. Ukraine is the leader in grain exports. In terms of wheat exports, Ukraine took fifth place in 2021 (USD 4.7 billion), corn – third (USD 5.85 billion), barley – third (USD 1.17 billion), rye – fifth place (USD 22.8 billion). Among neighboring European countries, France ranks sixth in the world in terms of wheat exports, Germany ranks eighth. At the same time, countries with a focus on raw materials lose

added value compared to the export of finished products. Instead, our previous research is revealed that in 2020, the unrealized export value of 1 t of finished bakery products was equal to USD 1.57 thsd [32]. With in-depth processing of grain and oilseeds, it is possible to obtain export-oriented products – gluten, biogas, fuel pellets, etc. Therefore, units for the production of deep processing products must be located near the main processing enterprises to optimize logistics.

The dynamics of food and agriculture exports were significantly influenced by crisis phenomena and transformational processes, as well as weather conditions. In the Table 6, on the example of 5 countries (Ukraine, Poland, France, Germany, Romania), growth indicators of quantitative exports of individual food groups were calculated for each interval of the period as a relative deviation of the value between the base and previous indicator of annual sales.

Table 6

Dynamics of indicators of exports quantitative growth of certain food and agriculture groups, %

Country	2008–2009	2009–2010	2013–2014	2014–2015	2015–2016	2016–2017	2017–2018	2018–2019	2019–2020	2020–2021
1001 Wheat and meslin										
Ukraine	72	-62	36	28	33	-3	-5	22	-10	7
Poland	435	-51	88	24	10	-37	-35	16	125	-23
France	4	25	4	-3	-8	-17	24	5	-1	-19
Germany	39	-10	32	-1	-6	-22	-34	6	67	-24
Romania	17	6	4	-28	97	-16	1	5	-30	60
0207 Poultry meat										
Ukraine	134	71	20	-8	49	13	21	26	4	6
Poland	13	29	20	18	17	12	21	11	2	-1
France	-1	5	-8	0	-10	-3	-5	-10	-10	1
Germany	-3	11	6	-6	-3	-2	-6	5	-13	3
1905 Bakery and flour products										
Ukraine	-6	16	-27	-24	-7	21	3	-1	4	4
Poland	0	7	14	12	18	13	7	-22	2	9
France	1	4	-2	1	8	1	3	3	-5	18
Germany	1	8	0	3	5	2	4	3	6	2
Romania	-1	21	16	3	8	3	17	11	3	12

Source: formed by the authors based on the data of Trade Map [26].

Analysis of export supplies of raw materials (wheat and meslin) and finished products (bakery and flour products, poultry meat) by individual exporting countries showed a decrease in annual sales in the crisis and post-crisis years. The global crisis of 2008–2009 caused a significant decrease in wheat sales in Ukraine, Poland and Germany with a time lag – in 2010 for a year by 62 %, 51 and 10 %, respectively. In 2009, in France and Germany are reduced the supply of poultry meat by 1 and 3 %, respectively. Thanks to the introduction of new capacities, in Ukraine the volume of chicken meat supplies to foreign markets increased significantly, it secured leadership in Europe and fifth place in the world (USD 4.5 billion, 414 thsd t of products in 2021). The aggression of the russian federation in Ukraine and the temporary

occupation of the territories in 2014 affected the decrease in the export of chicken meat (by 8 % per year, to 161.2 thsd t) and bakery and flour products (by 24 %, to 127.9 thsd t) in 2014–2015 in Ukraine. Wheat exports were stable due to temporary residues. The COVID-19 pandemic also affected the indicators of the export of raw materials and finished food products, especially the volume of wheat supplies. Restrictions had the least impact on foreign trade in bakery and flour products. The main barriers during the pandemic period were the narrowing and localization of national markets, the difficulty of logistics, the introduction of trade restrictions by countries on food imports, the increase of sanitary and other inspections, the reduction of GDP and income of the population. At the same time, food exports in Ukraine were more resistant to challenges, compared to other sectors of the economy, and the growth of 0.25% was achieved over the year [26; 32].

The extraordinary challenge of our time, the military aggression of the russian federation in Ukraine in 2022 affected the humanitarian, economic and other components of the country's life. Food and agriculture exports were suspended, and the impoverished countries of Africa and South Asia were at risk of starvation. Only thanks to the Black Sea Grain Initiative and the partial reorientation of logistics to rail grain transportation, from the beginning of the invasion in February until the end of 2022, Ukraine exported almost 40 million t of agricultural products to foreign markets [33].

In order to counteract crisis phenomena and processes and ensure an increase in the volume of food exports, it is necessary to innovatively modernize the export infrastructure, provide alternative ways of supplying products to foreign markets, and promote the restoration of the resource and production base.

Thus, the results of the conducted research indicate that food and agriculture export depends not only on the state of food production and consumption, but also on macroeconomic factors and the level of development of countries, which is important for the formation of food policy directions of developing countries. The proposed methodical apparatus provides an opportunity for scientists, branch specialists and university students to apply methodical approaches for analysis, planning and forecasting of food and agriculture export indicators in scientific and practical activities. For the formation of food policy by state administration bodies, it is important to determine the country's place in the European community based on a selected range of indicators and an integral indicator of export development, and to assess the impact of crisis phenomena on export activity. The factor model of the dependence of product exports on macroeconomic indicators demonstrates the different influence of economic development factors on export volumes, which allows taking into account institutional changes when planning and forecasting export activities.

Various researchers solved the scientific problems considered in the study, in particular, regarding the ranking of countries, the assessment of export development. The resilience of the food sector of individual countries to crisis phenomena is analyzed. The authors developed approaches to the analysis and evaluation of the

development of food and agriculture exports. The advantage of this study is a comprehensive approach to the assessment of export potential, which includes the ranking of countries, an indicator of export development, a factor model, and forecast indicators. In addition, the assessment covers crisis periods, in particular the COVID-19 pandemic and the russian invasion of Ukraine.

Conclusions. Despite the pandemic, world trade in food in 2019–2020 did not change significantly, it increased by 1.7 %, despite an overall decrease of 8 % in world exports. Studies confirmed the global leadership of developed countries in the export of food products with added value. The leaders of the export potential rating in 2020 were the Netherlands, Germany and Austria. The share of food exports of developed countries was insignificant, and it was the largest in Ukraine and Moldova. Approaches to determining the integral indicator of food export development were proposed using the example of bakery and flour products. This provides an opportunity to identify competitive advantages in the market. Forecast of the development of the bakery and flour products export is showed that in 2023, in Ukraine can be increase its exports by 35.4 % compared to 2020. Based on the factor model of the dependence of the quantitative export of poultry meat on macroeconomic indicators in Ukraine, the study assessed trends and made a forecast until 2025. Crisis phenomena and transformational processes affect the dynamics of food exports. The increase in production and export of food with high added value will ensure effective socio-economic development of countries, a balanced export policy based on the analysis of the market situation, the country's place in the world distribution of food and the level of modernization of production and logistics. Products in terms of price and quality must meet the consumer demands of the exporting country. On the basis of a methodical approach, the authors determined the factors of food export development and the ranking of countries by export potential, taking into account socio-economic conditions. Improved approaches to determining the integral indicator of export development and forming a rating of countries by export potential will provide an opportunity for industry specialists to form an effective export food policy of countries. The authors' development will contribute to solving the scientific problem of providing monitoring with tools for assessing the state of food exports and the export potential of countries, identifying the most effective options for export development.

The limitations of the authors' research are lack of information, in particular, regarding investments in the food sector by different countries; not always timely presentation of data from various sources. Prospects for further research include an assessment of the peculiarities of the formation of export prices for food products of the countries in the world.

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