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INTEGRAL ANALYSIS OF THE BAKING SECTOR OF UKRAINE'S ECONOMY AS A BASIS FOR STRATEGIC DECISION-MAKING IN WARTIME

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Abstract. The *purpose of this article* is to provide a comprehensive analysis of the state and development of the baking sector in Ukraine, taking into account economic, production and social aspects. This sector is one of the main links in the agro-industrial complex, providing the population with basic foodstuffs and contributing to employment and social stability, especially in times of crisis. In this regard, it is important to develop scientifically sound tools for analysis as a means of strategic management of development in wartime. *Methodology.* The article uses a combination of quantitative and qualitative approaches to analysis, in particular: comparative analysis, grouping, index analysis and integral assessment methods. The main tool was the creation of an integrated indicator of the development of the baking sector, which covers economic indicators (profitability, consumer price index for bread, net profit of baking sector enterprises and the number of active economic entities), production characteristics (sales price index, sales volumes, sown areas and gross grain harvest) and social factors (employment level, subsistence minimum, population size and consumption of bread products). As part of the study, an integral indicator for Ukraine's baking sector was calculated for the period 2014–2023, which made it possible to track changes in its condition over a ten-year period. To form the integral indicator, data normalisation, weight coefficient determination, and aggregation using the weighted average value were used. *Results.* An analysis of the dynamics of the integral indicator revealed a wave-like nature of the sector's development. In 2014, the indicator stood at 0.58 points, indicating an average level of efficiency of the industry's functioning in conditions of political and economic instability. In the following years (2015–2017), there was a slight decrease in the indicator (to 0.51 points in 2015) with a gradual increase to 0.55 points in 2017. This may indicate a partial recovery in production and the industry's adaptation to new market conditions. The period from 2018 to 2021 is characterised by a gradual improvement in the integral indicator: from 0.60 points in 2018 to a peak value of 0.69 points in 2021. This stage can be considered relatively stable and productive, given the modernisation of production and growth in labour efficiency. It is particularly important that, despite the challenges posed by the pandemic in 2020, the indicator remained at a relatively high level (0.59 points), demonstrating the adaptability of enterprises in the sector. However, starting in 2022, there will be a sharp decline in the integral indicator – to 0.55 points, and in 2023 – to a minimum value of 0.40 points. This negative trend is due to a number of factors: martial law, logistical constraints, resource shortages, declining purchasing power of the population, and a general decline in business activity in the country. The decline in the indicator points to a critical decline in the sector's performance and the need for urgent intervention by the state and the business community. Thus, the results of the study revealed unstable trends in the development of Ukraine's baking sector. The obtained integral indicator not only allows to record these changes, but also serves as an analytical tool for further monitoring the situation, identifying periods of growth and decline, and justifying strategic management decisions at the national level. *Practical significance.* The proposed methodology for integrated assessment of the sector can be used by government agencies to monitor the sector, as well as by enterprises to diagnose their own condition, strategic planning and justification of investment decisions, taking into account the specifics of the type of economic activity. The integrated indicator can serve as a basis for the development of regional programmes to support bakery enterprises, especially in times of war, unstable inflation and resource shortages. *Value/Originality.* The originality of the study lies in combining multi-level indicators into a single analytical system in order to provide a comprehensive description of the sector. The proposed integrated indicator is an effective tool that allows not only to record the current state, but also to identify trends and

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potential threats, forming a basis for forecasting and managing the development of the baking sector of Ukraine's economy. Thus, the article provides a scientifically sound methodology for assessing the efficiency of the baking sector, which has both theoretical and practical value for further research and applied use in the agri-food sector.

Keywords: bread-baking sector of the economy, integral indicator, economic dynamics, assessment methodology, socio-economic factors, production factors.

JEL Classification: L66, Q13, H56

1. Introduction

The relevance of researching the development of the baking sector of Ukraine's economy is due to the fact that bread and bakery products have long played a significant role in the population's diet. Given their stable demand and social significance, ensuring the sustainable production of these products remains a priority area of food policy for any state. In the current environment of significant economic volatility, martial law, rising energy costs and changing consumer preferences, the sector faces new challenges that require a scientifically sound assessment of its development and operational efficiency. At the same time, in order to make strategic decisions at the state and business levels, it is important to have tools that provide a comprehensive picture of the state of the sector and its changes, not based on individual indicators, but on their integrated reflection. The aim of this study is to conduct a comprehensive analysis of the current state of the baking sector of Ukraine's economy, taking into account economic, production and social aspects. To achieve this goal, the following research tasks were identified: to substantiate a system of indicators relevant for assessing the state of the baking sector; to calculate an integral indicator for the baking sector of Ukraine's economy for 2014–2023; analyse the dynamics of the integral indicator and identify key trends and problems in the development of the sector during wartime. The methodological basis of the study is a systematic approach to industry analysis using methods of indicator normalisation and weight coefficient determination. The study also used general scientific approaches to analysis and synthesis, induction and deduction, statistical analysis, graphical presentation of results, comparative analysis methods, and grouping. Thus, the article is an attempt to combine scientific tools with the practical needs of assessment and strategic management of the development of one of the basic sectors of the food industry in Ukraine.

2. Methodology for Calculating the Integral Indicator

To comprehensively assess the state of the baking sector, it is not enough to consider only individual economic or production indicators. Given the multifactorial nature of this sector's development, an approach is needed that allows diverse indicators to be combined into a single numerical measure that reflects the overall level of the sector's development in dynamics and facilitates an objective analysis of the baking industry's performance in the face of internal and external challenges.

The integral indicator allows for the summarisation of multifactorial information about the state of the sector in a single numerical value that takes into account both production and economic and social aspects. This simplifies the comparison of the sector's development dynamics over time and provides a tool for comprehensive analysis.

The methodology for constructing the integrated indicator consists of several blocks:

1. Definition of a block of indicators.

2. Normalisation of indicators.

To ensure the comparability of different types of indicators (with different units of measurement), normalisation is used – converting all values to a dimensionless scale using the formula:

$$x^* = \frac{x_i - x_{min}}{x_{max} - x_{min}}$$ – for stabiliser indicators,

$$x^* = \frac{x_{max} - x_i}{x_{max} - x_{min}}$$ – for destabiliser indicators.

At the same time, the upper formula is used for stabilising indicators, where growth is a positive phenomenon (e.g., production volumes or profitability), and the lower formula is used for destabilising indicators, where growth is a negative phenomenon (e.g., CPI).

3. Aggregation of normalised values.

After normalisation, all indicators are combined into a single integrated index.

$$I = \sum_{i=1}^{n} \omega_i x_i^* \quad (1)$$

where ω_i is a weighting coefficient that reflects the significance of the indicator.

4. Dynamics construction. The values of the integral indicator are calculated separately for each year, which allows tracking the dynamics of the sector's development and identifying stages of growth, stabilisation or decline.

3. Justification of the Set of Indicators

The following analysis will utilise an integral indicator to examine the baking sector. In order to ensure a comprehensive and objective assessment of the state and dynamics of the baking sector, the selected indicators are divided into three key blocks: production, economic and social. Each block represents a separate aspect of the sector's functioning, allowing both internal processes and external socio-economic influences to be taken into account.

1. Production indicators. These reflect the actual state of production, resource use and scale of operations (Table 1) (The State Statistics Service of Ukraine; The Ministry of Finance of Ukraine, 2023). Their selection is based on the importance of the direct results of enterprises' operations, as well as the provision of raw materials.

– Volumes of bakery products sold (a key indicator of the scale and demand for products).

– Agricultural product sales price index (crop production) shows the economic conditions for purchasing raw materials for flour production.

– Sown areas of agricultural crops (winter and spring wheat) (represents the raw material supply potential of the industry).

– Gross grain harvest (shows the actual volume of raw materials harvested and directly affects the volume of flour and bakery products produced).

2. Economic indicators. They were selected based on the principle of reflecting financial performance and the impact of the macroeconomic environment on business activities and consumer behaviour (Table 2) (The State Statistics Service of Ukraine; The Ministry of Finance of Ukraine, 2023).

– Profitability of enterprises producing bread, bakery and flour products (determines the level of profitability and financial stability of the industry).

– Consumer price index for bread (illustrates price dynamics for the end consumer and affects the purchasing power of the population).

– Net profit of enterprises producing bread, bakery and flour products (an indicator of the financial performance of enterprises after deducting all expenses and tax liabilities, illustrating the overall efficiency of the sector).

– Number of active economic entities engaged in the production of bread, bakery and flour products (reflects the degree of entrepreneurial activity, the level of competition in the sector and the supply of bakery products to the population).

3. Social indicators. The choice is justified based on the relationship between the industry and the standard of living of the population, in particular the availability of products and the level of employment (Table 3), (The State Statistics

Table 1

Production indicators of the baking sector of Ukraine's economy

Year	Volumes of bakery products sold, thousand UAH	Sales price index, %	Sown area, thousand hectares	Gross grain harvest, million tonnes
2014	21005840,1	155,9	6144,5	24,1
2015	28200901,2	172,2	6853,6	26,5
2016	28197066,7	107,7	6213,8	26,0
2017	28977119,7	109,3	6368,3	25,8
2018	32945266,6	105,4	6617,3	24,6
2019	37227835,8	85,1	6809	28,3
2020	39748914,9	160,6	6571,3	24,9
2021	53161732,6	117,6	7099,6	32,2
2022	49626938,3	95,2	5281,5	20,7
2023	58937373,3	82,8	4660	21,6

Table 2

Economic indicators of the baking sector of Ukraine's economy

Year	Profitability, %	Consumer price index for bread, %	Net profit, thousand UAH	Number of active economic entities, units
2014	2,5	135,1	-40491,8	5364,0
2015	4,1	144,6	-1404583,7	5382,0
2016	1,9	106,3	-220423,2	5153,0
2017	3,0	110,7	135665,2	5060,0
2018	3,2	114,1	80721,5	5302,0
2019	3,1	109,4	586231,4	5552,0
2020	1,9	109,7	213125	5442,0
2021	0,9	117,3	-114743,7	5286,0
2022	4,9	130,3	991460,6	4633,0
2023	7,4	97,2	2184554,3	5477,0

Service of Ukraine, The Ministry of Finance of Ukraine, Ukrainian Institute of the Future, 2023).

– Subsistence minimum (as of 31 December of the relevant year) demonstrates the economic affordability of bread for the population.

– Number of employees at enterprises producing bread, bakery and flour products is an indicator of the social importance of the industry in terms of providing employment for the population.

– The size of the existing population characterises the general demographic conditions of the market. It helps to avoid distortions when total production/sales volumes decline not because of a crisis, but because of a decrease in the number of consumers.

– Consumption of bread products (indicates real demand among the population, the level of provision of essential goods, and social stability).

The indicators were selected based on the following principles:

Representativeness (coverage of key components of the sector);

– systematicity (structuring by logical blocks);

– interconnection with the final result (actual production, profitability, product availability);

– availability of official statistics (all indicators have a reliable source from the State Statistics Service of Ukraine or relevant agencies).

It should be noted that among the above indicators, there are two destabilising factors, namely the agricultural product price index (since for bakers, an increase in the raw material price index may mean an increase in costs, which is a negative factor) and the consumer price index, the growth of which has a negative impact on the development of the sector.

Table 3

Social indicators of the baking sector of Ukraine's economy

Year	Subsistence minimum, UAH	Number of employees, persons	Current population, million persons	Consumption of bread products, kg per person per year
2014	1176,0	92352	45,4	108,5
2015	1330,0	85232	42,9	103,2
2016	1544,0	80750	42,8	101,0
2017	1700,0	79974	42,6	100,8
2018	1853,0	85346	42,4	99,5
2019	2027,0	85291	42,2	97,6
2020	2189,0	83763	41,9	96,6
2021	2393,0	79955	41,6	92,7
2022	2589,0	69343	41,2	92,7
2023	2589,0	68393	29	78,8

4. Assessment of Ukraine's Baking Sector by Area

Using the above methodology for constructing an integrated indicator, the indicators for the production, economic and social areas were aggregated in order to form a basis for explaining the development of the sector as a whole. An analysis of the dynamics of the integral indicators of the baking sector for 2014–2023 shows unstable but generally clear dynamics of development in three areas: production, economic and social (Table 4).

Production indicators point to a gradual increase in performance until 2021 (to 0.88 points), which was due to equipment modernisation, growing demand and government support for food security. However, a significant decline to 0.46 points is expected in 2022–2023. The main reasons for this are the impact of full-scale war, the destruction of production infrastructure, a reduction in grain cultivation areas, and a shortage of fuel and logistics routes.

Economic indicators show fluctuations with growth until 2019 to 0.63 points, followed by a decline in 2020–2022 due to the economic crisis, hryvnia devaluation and rising production costs. At the same time, 2023 saw rapid growth in the sector to 0.99 points, which may indicate the ability of enterprises to adapt to changed operating conditions, rising prices for bakery products, state aid, or the concentration of production in more stable regions.

Social indicators remain relatively stable in 2014-2021 (from 0.51 points to 0.65 points), showing a gradual improvement in working conditions, employment and social protection for workers in the sector. The peak is in 2022 (0.79 points), possibly due to targeted support for the sector in response to the humanitarian crisis. However, in 2023, the indicator fell to 0.49 points, indicating a reduction in the number of jobs, migration of skilled labour and a decline in social protection against the backdrop of prolonged martial law.

In general, the baking sector was in a state of adaptation, crisis and search for new growth points. The positive changes of 2023 in economic terms are not yet supported by the manufacturing and social sectors, which indicates the need for comprehensive state support.

The next step will be to build a general integrated index for the baking sector based on production, economic and social indicators. Using Statistica 10.0 software, the weights of the indicators were calculated (Table 5), which made it possible to assess the extent of their contribution to the formation of the integrated indicator.

The calculated weights allow the impact of each factor on the overall index to be weighed without creating statistical distortions, since: no indicator dominates too strongly – there are no distortions of 40–50%, which guarantees a balanced approach; social and production factors have a higher weighting, which corresponds to reality, since

Table 4

Dynamics of indicators for integral analysis

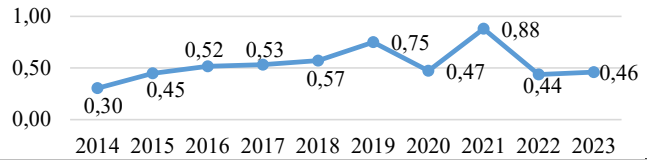
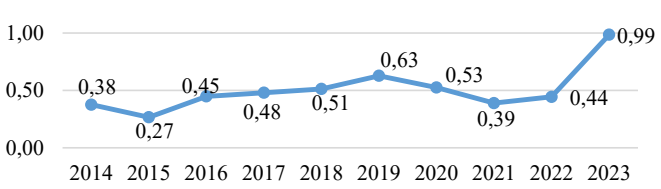
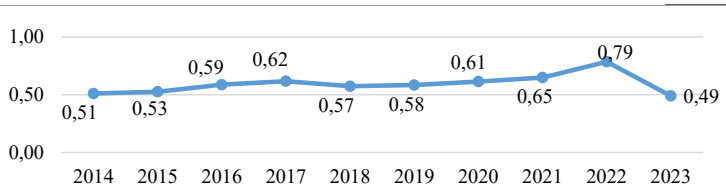
Name	Integral indicator
Dynamics of production indicators	
Dynamics of economic indicators	
Dynamics of social indicators	

Table 5

Interpretation of the obtained weights of the impact of bread, bakery and flour product production indicators on the integral indicator of the baking sector of Ukraine's economy

No.	Indicator	Weight	Interpretation
1	Consumption of bread products	0,1107	Highest weight: this indicator is key because it directly reflects real demand among the population, which is the basis for the sector's activities.
2	Net profit	0,1075	A very important indicator of economic efficiency that reflects the financial results of operations.
3	Number of employees, persons	0,1062	Reflects the scale and social significance of the industry, i.e., how many people it employs.
4	Current population	0,1053	It is important because it determines the level of potential demand, where more people equals more consumption.
5	Sales volumes, thousand UAH	0,0984	High weight, because it is the financial capacity of the market, which shows how much the sector actually sells.
6	Subsistence minimum	0,0975	It has an impact as a social benchmark, because the structure of the consumer basket, including bread, depends on it.
7	Sown area, thousand hectares	0,0954	Indicates the raw material base for bread baking. In terms of weight, it is important, but slightly less so than demand.
8	Profitability, %	0,0872	The financial stability indicator plays a role, but not a critical one.
9	Sales price index	0,0825	It affects producers' revenues, but is not an independent factor in the outcome.
10	CPI for bread	0,0657	Reflects inflationary pressure, but has a relatively lower weight, as it is a consequence rather than a cause.
11	Gross grain harvest	0,0263	Low weight, as raw materials are important but not a bottleneck in bread production (dependence on processing).
12	Number of active economic entities	0,0173	Lowest weight – this indicator reflects the structure, but does not significantly affect overall performance in the short term.

bread is a commodity in mass demand; the low weighting of the "consumer price index for bread" is justified, as it is a derivative rather than the root cause of development.

5. Integrated Assessment of the Ukrainian Bakery Sector

Using the methodology described above, an integrated indicator for the Ukrainian baking sector was constructed (Fig. 1). Analysing its time series dynamics, we can conclude that the indicator remains within the range of 0.45-0.68 points, which corresponds to the average level of efficiency and indicates instability, but also shows potential for growth.

In general, the integral curve shows that the baking sector peaked in 2021, but experienced the sharpest decline in 2022–2023 due to the war. During 2014–2019, there was a gradual increase in the integral indicator from 0.51 points to 0.66 points, indicating an improvement in the sector. The sector recovered after the 2014–2015 crisis, the economy stabilised, and the product range expanded (healthy foods, cereals, gluten-free products). In 2020, the indicator fell to 0.59 points due to COVID-19, quarantine restrictions, a drop in consumer demand, and disruptions in logistics chains. However, in 2021, the indicator recovered to 0.69 points as consumption and production rebounded in

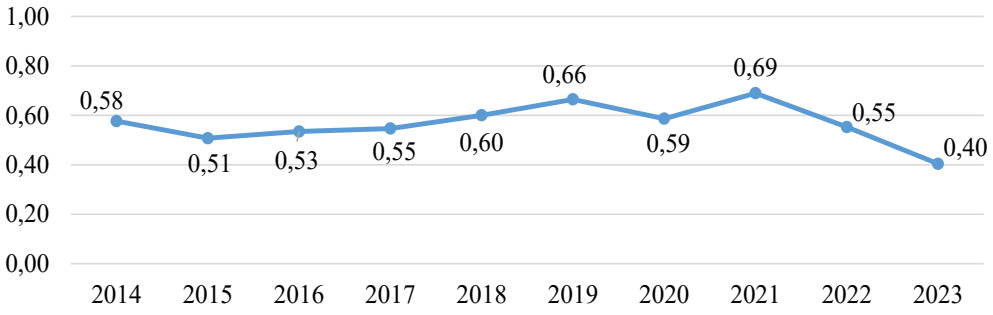


Figure 1. The value of the integral indicator of the baking sector of Ukraine's economy for the period 2014-2023

response to the changes. During 2022–2023, the indicator is expected to decline to 0.55 points and then to 0.40 points as a result of the full-scale war in Ukraine, destruction of infrastructure, rising costs of raw materials and logistics, population migration, and declining domestic demand.

6. Conclusions

Integral assessment remains an effective tool for analysing multifaceted economic phenomena and processes, particularly in the baking sector. The results of the study showed that during 2022–2023, signs of regression in the baking sector of Ukraine's economy were identified, which urgently requires state support, investment and adaptation of production, taking into account the new realities of functioning in wartime. Based on the results of the analysis of the dynamics of the constructed integral indicator for the period 2014-2023, it was established that its value remains at an average level (0.40 points in 2023 compared to 0.58 points in 2014), which indicates that the foundations for further growth and development of the sector have been laid, even during the crisis period.

Provided that the situation in the country stabilises relatively, such an analysis makes it possible not only to assess the current state of affairs, but also to forecast trends in the production of bread and flour products in the future. At the same time, the sector continues to be affected by military risks, fluctuations in raw material prices, high energy tariffs, logistical supply problems, a shortage of personnel with various qualifications, changes in consumer preferences during the crisis period, the need to modernise production and ensure uninterrupted operation, etc. Therefore, when forecasting the results of the analysis, it is necessary to take into account that these external factors can quickly change the market situation, which will be the subject of further research.

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