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METHODOLOGY FOR EVALUATING THE EFFICIENCY OF BANK LENDING TO ENTERPRISES OF THE AGRICULTURAL SECTOR OF THE ECONOMY IN UKRAINE IN THE WAR CONDITIONS[7]

The article is devoted to the development and practical testing of the methodology for determining the efficiency of bank lending, which is based on the economic-mathematical toolkit of structural justification, indicative determination and calculation of the aggregate efficiency indicator. It was established that for 2017-2022, the total volume of loans granted to agricultural enterprises doubled – from UAH 59.7 billion to UAH 118.5 billion. The share of bank lending to agricultural enterprises in the total amount of lending to the branches of the Ukrainian economy increased from 7.2 to 15.7%. During the first year of the war, the cost of loans to agricultural producers in the national currency increased 1.6 times – from 10.5 at the beginning to 16.7% at the end of the year. The credit load indicator for one enterprise during 2017-2022 increased 3 times – from 1.19 to 1.73 million UAH. The credit burden per person employed in agriculture at the end of 2022 amounted to UAH 0.26 million, which is 2.6 times higher than the level of 2017.

The first year of the full-scale war had significant negative consequences on the level of efficiency of lending to the agrarian sector of the economy. In Ukraine, the production of agricultural products per UAH 1,000 of borrowed loans almost halved compared to 2021 – from UAH 8,630 to UAH 4,510).

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The maximum values of the cumulative indicator of lending efficiency were reached in 2021 – 5.37. In 2022, the overall efficiency of lending decreased to a value of 2.29, which is 33.1% below the corresponding levels of 2017. In general, the efficiency of lending to agricultural enterprises of Ukraine during the first year of the full-scale war decreased by 2.3 times – from 5.37 to 2.29 points.

Inflationary processes in Ukraine are intensifying. There is no doubt that this has a negative impact on the economy and its banking sector. In our calculations, we made an adjustment for inflation and determined its negative impact on the efficiency of lending to agricultural enterprises. In 2019-2021, the variation between the actual values of the aggregate lending efficiency indicator and its value adjusted for inflation ranged from 3.5 to 8%, and during the first year of the war, it increased to 18.9%.

Keywords: credit; credit load indicators; credit performance indicators; integral indicator; credit cost; credit profitability; state support

JEL: C10; E50; Q14

1. Introduction

Lending to enterprises of the agrarian sector of the economy of Ukraine was and remains one of the determining factors not only of effective functioning and sustainable development, but also of survival and preservation of its production and resource potential.

With the beginning of a full-scale war, the problem of the lack of financial resources necessary to ensure the current production activity of enterprises in the agrarian sector of the economy became catastrophically worse. The restoration of destroyed and damaged production facilities, objects, and equipment is currently impossible at all.

Currently, the problem of lack of money is catastrophic for domestic farmers. Expanding the real possibilities of access to financing and, mainly, to cheap crediting is a priority problem of rural commodity producers and the state and a guarantee of faster post-war recovery of the economy.

Accordingly, conducting a comprehensive retrospective assessment of the comparative efficiency of lending to the agrarian sector of the economy becomes important. An objective and mandatory condition for the functioning of the financial and credit support of enterprises in the agrarian sector of the economy is the gradual increase in the efficiency of the use of their financial resources and, in particular, credit funds.

The modern practice of the functioning of the system of credit provision of agricultural enterprises has not sufficiently substantiated and elaborated the methodological toolkit for determining the effectiveness of the use of credit resources (in the context of our research – bank loans).

The existing toolkit for evaluating the effectiveness of the bank lending system has a list of imperfect characteristics, which makes it difficult to carry out objective measurement practices. As the researchers of this issue point out, some of the indicators have no theoretical basis, others do not reflect the specifics of the agricultural production sector, and some require information clarification.

Thus, Dzyublyuk (2015) suggests evaluating the effectiveness of crediting through the practical application of a set of the following indicators:

• the sales ratio, which is defined and measured as a calculation of the ratio of the volume of sales of the agricultural enterprise to the amount of payables, which structurally consists of the balances of long-term and short-term credit obligations;

• parametric efficiency index, which is obtained as a result of the ratio of the average rate of profit growth (income from the sale of products of a rural commodity producer to the existing dynamics of credit obligations;

• turnover ratio as the ratio of the turnover indicator of credit resources of an agricultural enterprise to the turnover indicator of its working capital.

Research by Oliynyk & Makogon (2021) focused on evaluating the effectiveness of lending to agricultural enterprises under the conditions of the law of diminishing returns and substantiating methodical approaches for determining the optimal level of their credit provision. The authors proved that the effectiveness of agricultural lending is possible only under the objective conditions of the law of diminishing returns. The proposed methodical toolkit makes it possible to determine the optimal amount of borrowing capital, which ensures the maximization of the profit of the agricultural enterprise, provided that it observes the optimal costs.

Sergienko & Gula (2018) in their research evaluated the efficiency of lending to the agrarian sector of the economy differentiated by regions of Ukraine. The authors proposed and practically tested the method of determining the effectiveness of lending to agricultural enterprises. This approach is based on the methodological tools of cluster analysis and a spatial multi-element matrix, which allows measuring the relationship between the results of agricultural enterprises and the amounts of bank loans involved.

Comparing the research of the authors, we focus on the expediency of substantiating and approving the structured toolkit for calculating credit load indicators and lending efficiency indicators in the agricultural economy of Ukraine, which are expedient to apply both at the micro-level of agricultural enterprises and at the regional level.

In his research, Artemenko (2020) outlined the peculiarities of banks' credit policy when lending to agricultural enterprises and found that large agricultural enterprises are the most attractive for bank lending in terms of production volumes and productivity. As a toolkit for determining the effectiveness of lending, the author used indicators of agricultural production per UAH 1 of bank loans involved.

Emphasizing the high cost of loans for agricultural enterprises, in their study Trusova & Radchenko (2020) analyzed the efficiency of agricultural enterprises, depending on their size. As a tool for evaluating the efficiency of lending, the authors used a comparative analysis of indicators of the cost of loans (interest rate) and the profitability of agricultural enterprises.

Chygrin & Ivakhnenko (2020) thoroughly investigated the main risks of the banking institutions themselves and calculated the relationship between the profitability of agricultural enterprises and the cost of bank loans. The authors determined the positive impact of bank credit on the further development of agricultural enterprises and the agrarian

economy as a whole. In our opinion, such a methodical approach is extremely relevant in today's conditions of a large-scale decrease in the efficiency of the sectoral components of the agrarian sector of the economy and a gradual increase in the cost of credit resources.

Vdovenko (2018) considers the problem of evaluating the efficiency of lending comprehensively, both from the standpoint of a banking institution and from the side of the borrower – an agricultural enterprise. As the main indicator of efficiency, the author proposes an indicator of financial leverage, as a ratio between the profitability of production and the level of the interest rate on loans.

Dumanska (2018) devoted her research to the assessment of credit provision of the innovative process of agricultural enterprises. The author researched modern credit products of banks, which are real sources of replenishment of working capital for enterprises in the agrarian sector of the economy. Studies have established an insufficient level of efficiency in the use of credit resources due to high interest rates that significantly exceed the profitability of agricultural production and the lack of liquid collateral for loans.

Among foreign researchers, the following authors made a significant contribution to the study of the effectiveness of bank lending in the agricultural sector of the economy.

Xiaoxiao Guo (2022) carried out a thorough study of the impact of rural commercial banks in China on the level of rural economic development. Using the method of empirical research, the author determined the positive impact of agricultural business lending by rural commercial banks on the village economy. Based on the results of the research, the author proposed a set of financial innovations that will contribute to the economic development of rural areas of the country.

A comprehensive study of the impact of microfinance activities on rural economic growth and savings in Nigeria was carried out by Chuke Nwude & Kenneth Chikezie Anyalechi (2018). The authors used least squares regression as a methodological tool. The authors concluded that the introduction of microfinance bank lending does not contribute to the growth of agricultural productivity. Based on the results of the study, the authors suggest the government to develop the basic banking infrastructure in rural areas, review the agricultural credit policy and simplify the procedures for providing loans to farmers.

Khanal & Omobitan (2020) investigated the impact of access to credit on the productivity of farms in the state of Tennessee, USA. The authors analyzed the factors affecting credit constraints and found that the financial performance of small farmers limited by credit is inferior to the performance of farmers who use credit resources.

Varga & Sipiczki (2015) devoted their research to solving the structural problems of financial support of agricultural enterprises in Hungary.

The authors emphasize that the need for additional financing (bank loan) indirectly depends on the business activity of the enterprise. After considering the technological and business concepts related to various credit products in agricultural financing, the authors developed adaptive financing models for the Hungarian agricultural sector and determined their effectiveness.

Akwaa-Sakyi (2013) devoted his work to determining the impact of microcredit on the efficiency of Ghanaian farmers. The research results proved the positive impact of agrarian business lending on employment, working capital, production volumes and farmers' incomes.

Zabatantou Louyindoula, Bouity & Owonda (2023) devoted their work to the analysis of the impact of agricultural credit on agricultural productivity in the Congo. The results obtained by the authors show that, on average, the impact of agricultural credit on agricultural productivity is 92.2 %. Most farmers who have received agricultural credit have a high probability of increasing their productivity.

Singh, Misra, Kumar & Tiwari (2019) devoted their study to monitoring and measuring the effectiveness of the US agricultural credit system. The authors determined and measured the factors that influence the financial efficiency of agricultural cooperatives. Panel regression analysis was used as a tool. The authors presented a retrospective assessment of the performance of agricultural credit cooperatives with an emphasis on their sensitivity to the uncertainty of economic policy.

Khanal & Regmi (2017) conducted a thorough study of the impact of bank credit on agricultural productivity in drought-prone areas of Asia. The authors used the stochastic limit approach and non-parametric data coverage analysis as tools. The study showed that financial constraints and liquidity constraints negatively affect production efficiency.

Rivera-Acosta & Xiuchuan (2023) devoted their study to methodological aspects of assessing the impact of bank credit on the efficiency of Colombian farmers. As measurement indicators, the researchers used natural indicators of the return of agricultural production per 1 hectare and per employed worker.

Meutıa & Adam (2019) devoted their work to determining the effectiveness of lending to small and medium-sized agricultural enterprises in Indonesia. As a methodological tool, the authors used multiple linear regressions to identify the impact of financing on productivity (dynamics of crop yields before and after receiving a loan). The researchers concluded that the types of banks and the amount of loans do not affect the increase in productivity and volumes of agricultural production.

Carrer, Gori Maia, Mello Brandão Vinholis, Souza Filho et al. (2020) in their study carried out a thorough analysis of the effectiveness of rural credit policy in the state of São Paulo, Brazil. Research results show that rural lending has a positive impact on the development of integrated crop-livestock systems (ICLS). The authors proved that the implementation of these systems will involve investment in fixed capital and an increase in operating costs, which creates additional demand for rural credit. In turn, the availability of rural loans depends on the income of the farm, the farmer's perception of operating costs and the offer of credit in the municipality.

Shabir, Amin, Muhammad et al. (2020) carried out a comprehensive study of the state, efficiency, current problems and practical solutions for improving the efficiency of lending to rural commodity producers in Pakistan. The authors consider credit as an important factor in increasing the production and profits of farmers. Based on the results of the study, the authors suggest financial institutions and other interested bodies to expand the agricultural lending policy and simplify the procedures for granting loans to farmers.

Thus, we consider it expedient to state that the existing developments require structural systematization, additional methodical substantiation and practical adaptation to extremely difficult economic conditions in which domestic agrarians find themselves during a full-scale war. In our opinion, first of all, a clear differentiation of indicators characterizing the degree of credit burden on an agricultural enterprise and determining the efficiency of the use of credit resources is necessary.

The purpose of the study is to monitor the effectiveness of lending to agricultural enterprises in Ukraine during the war.

To realize the set goal, it is necessary to implement the following tasks:

- to develop a methodical approach to measuring the overall efficiency indicator of bank lending to the agricultural sector of the economy;
- to determine the relevant performance indicators;
- to carry out a retrospective measurement of aggregate performance indicators and outline real prospects for their stabilization.

2. Research Methodology

Credit load indicators are determined using the following formulas (Cheremisina & Tomashuk (2023):

The indicator of credit load in agriculture (per 1 enterprise) is determined by the formula:

$$LW_{eni} = \frac{Lag_i}{NEn_i} \quad (1)$$

where LW_{eni} – credit load of enterprises of the agrarian sector of the economy in the i period, thousand UAH per 1 enterprise; Lag_i – the amount of loans granted to agricultural enterprises in the i period, UAH million; NEn_i – the number of enterprises in the agrarian sector of the economy in the i period, units

The indicator of credit load in agriculture (per 1 employee) is determined by the formula:

$$LW_{emi} = \frac{Lag_i}{NEm_i} \quad (2)$$

where $LWem_i$ – credit load of enterprises of the agrarian sector of the economy in the i period, thousand UAH per 1 employed worker; NEm_i – the number of employed workers in agriculture in the i period, persons.

The development and further testing of the methodological toolkit for assessing the effectiveness of lending to agricultural enterprises focuses on structuring and substantiating the content of the indicators of the aggregate integral indicator. The practical implementation of the improved methodical toolkit of structural substantiation and content filling of the

components of the integral indicator of crediting efficiency of agricultural enterprises in the work was carried out according to the following algorithm:

- calculation of lending profitability indexes based on the financial result from ordinary activities and profit (defined as the ratio of the growth rate of agricultural enterprises' profit to the rate of increase in credit resources);
- determination of lending turnover indices as a ratio of turnover coefficients of credit resources with turnover coefficients of the total volume of working capital, loan capital and payables of agricultural enterprises;
- calculation of lending profitability indicators as a ratio of the production profitability indicator (operating activity of the enterprise) and the average rate for short-term loans. It is clear that the profitability of business operations must exceed the cost of the loan for which it was obtained;
- determination of lending efficiency indicators by the volume of production and sale of agricultural products per unit of loans;
- construction, definition and retrospective analysis of the integral indicator of crediting efficiency of agricultural enterprises.

The determination of lending profitability indices by financial result and net profit is measured as the ratio of the rate of growth of the profit of agricultural enterprises to the rate of increase in loans):

$$\mathbf{LP}_{FRi} = \frac{\boldsymbol{R}_{FRi}}{\boldsymbol{R}_{LVi}} \tag{3}$$

where LP_{FRi} – credit profitability index based on the financial result of agricultural enterprises of Ukraine in the i period; R_{FRi} – the rate of change in financial result of agricultural enterprises of Ukraine in the i period; R_{LVi} – the rate of change in lending to agricultural enterprises of Ukraine in the i period.

$$\mathbf{LP}_{NPi} = \frac{\boldsymbol{R}_{NPi}}{\boldsymbol{R}_{LVi}} \tag{4}$$

where LP_{NPi} – lending profitability index based on the net profit of agricultural enterprises in the i period; R_{NPi} – rate of change in the net profit of agricultural enterprises in the i period.

The effectiveness of lending from the point of view of turnover indicators is measured as the ratio of the turnover coefficients of credit resources with the turnover coefficients of total volumes of working capital, loan capital and accounts payable of agricultural enterprises using the following formulas:

$$\mathbf{IR}_{TLi} = \frac{\boldsymbol{I}_{LIi}}{\boldsymbol{I}_{CAi}} \tag{5}$$

where IR_{TLi} – index of the ratio of loans turnover and current assets turnover of agricultural enterprises in the i period; I_{LIi} – turnover loans index of agricultural enterprises in the i period; I_{CAi} – turnover current assets index of agricultural enterprises in the i period.

$$\mathbf{IR}_{TLCi} = \frac{\boldsymbol{I}_{LIi}}{\boldsymbol{I}_{LCi}} \tag{6}$$

where IR_{TLCi} –index of the ratio of loans turnover and loan capital turnover of agricultural enterprises in the i period; I_{LCi} – turnover index of loan capital of agricultural enterprises in the i period

$$\mathbf{IR}_{TCPi} = \frac{\boldsymbol{I}_{\mathrm{LI}i}}{\boldsymbol{I}_{CPi}} \tag{7}$$

where IR_{TCPi} – index of the ratio of loans turnover and current payables turnover of agricultural enterprises in the i period; I_{CPi} – turnover current payables index of agricultural enterprises in the i period.

The profitability of lending is measured by determining the ratio of the indicator of the profitability of production (operational activity of the enterprise) and the average rate on loans according to the following formula:

$$\mathbf{L}_{pri} = \frac{\boldsymbol{P}_{pri}}{\boldsymbol{L}_{ratei}} \tag{8}$$

where L_{pri} – lending profitability to enterprises of the agrarian sector of the economy in the i period, %; P_{pri} – profitability of production (operational activity) of agricultural enterprises in the i period,%; L_{ratei} – average interest rate on loans taken by agricultural enterprises in the i-th period, %.

The effectiveness of lending (based on agricultural products produced) is calculated according to the formula:

$$\boldsymbol{Lprod}_i = \frac{\boldsymbol{PR}_{voli}}{\boldsymbol{Lag}_i} \tag{9}$$

where $Lprod_i$ – the effectiveness of crediting of agricultural enterprises of Ukraine in the i-th period, (produced agricultural products worth UAH 1,000 of borrowed loans); PR_{voli} – the volume of production of products by agricultural enterprises in the i period, thousand UAH.

The effectiveness of lending (based on agricultural products sold) is calculated according to the formula:

$$Lsold_i = \frac{PS_{voli}}{Lag_i} \quad (10)$$

where $Lsold_i$ – the effectiveness of crediting of agricultural enterprises of Ukraine in the i period, (sold agricultural products worth UAH 1,000 of borrowed loans); PS_{voli} – the volume of agricultural products sold in the i-th period, thousand UAH.

The integral indicator of lending efficiency of agricultural enterprises is defined as the root of the 8th degree from the product of all structural indicators characterizing lending efficiency using the following formula:

$$Ief_i = \sqrt[8]{LP_{FRi} * LP_{NPi} * IR_{TLi} * IR_{TLCi} * IR_{TCPi} * L_{pri} * Lprod_i * Lsold_i} \quad (11)$$

where Ief_i – integral indicator of lending efficiency of the agricultural economy of Ukraine in the i period.

3. The Research Results

A comprehensive analysis of the general and regional dynamics of lending to agricultural enterprises revealed a steady growth trend. During 2017-2022, the total amount of loans granted to agricultural enterprises doubled – from 59.7 to 118.5 billion UAH (Table 1).

The Kyiv region is the leader in terms of the volume of loans involved, which accounts for 31% (or UAH 36.6 billion) of the total volume of lending to the agrarian economy of our country. Other regions in terms of lending to agricultural enterprises have the following indicators: Kharkiv (7.3%), Dnipropetrovsk (6.9%), Odesa (6.1%), Lviv (5.1%), Vinnytsia (4.5%)) and Kirovohrad (4.4%).

A significant increase in the share of bank lending to agrarian enterprises in the total amount of lending to branches of the Ukrainian economy was established. Thus, during 2017-2022, this indicator increased from 7.2 to 15.7%.

In the first year of the war, the amount of agriculture lending increased by 43.4% (or UAH 35.9 billion). This is mainly explained by the availability of effective support for the agricultural sector of the economy, both from the state and from the point of view of credit institutions. The Government and the Ministry of Agrarian Policy, realizing the importance and necessity of supporting domestic farmers, continued the State Program "Affordable Loans 5-7-9%" to facilitate their access to credit resources of banks in the conditions of martial law.

In 2022, 43,648 enterprises used preferential lending for a total amount of UAH 95.5 billion. In 2023, these indicators decreased significantly. The number of agricultural enterprises that received loans under all lending programs decreased to 13,981, and the total amount of agricultural lending amounted to UAH 78.8 billion, including UAH 44.5 billion under the state program "Affordable Loans 5-7-9%".

Table 1. Regional dynamics of lending to agricultural enterprises, 2017-2022 (billion UAH)

Regions of Ukraine	2017	2018	2019	2020	2021	2022	2022 to 2017 (%)	2022. to 2021 (%)
Ukraine	59.71	67.68	61.60	61.49	82.60	118.50	198.5	143.5
Vinnytsya	0.90	1.25	1.66	1.94	2.65	5.27	583.9	199.2
Volyn	0.67	0.78	0.93	0.79	0.91	2.21	328.7	242.8
Dnipropetrovsk	6.97	8.21	8.14	5.12	6.13	8.13	116.6	132.6
Donetsk	0.10	0.24	0.46	0.35	0.87	0.60	600.0	69.1
Zhytomyr	0.36	0.50	0.50	0.52	0.86	1.79	497.5	207.7
Zakarpattya	0.12	0.15	0.16	0.10	0.17	0.25	211.0	148.2
Zaporizhzhya	1.60	1.84	2.19	2.39	3.75	4.29	268.6	114.3
Ivano-Frankivsk	0.20	0.51	0.44	0.52	0.80	1.16	575.7	146.3
Kyiv	30.06	27.94	18.42	19.87	25.23	36.61	121.8	145.1
Kirovohrad	1.37	1.75	1.86	2.10	2.47	5.22	380.3	210.9
Luhansk	0.11	0.18	0.27	0.26	0.52	0.48	421.1	93.0
Lviv	1.47	2.29	2.54	2.97	4.26	6.02	410.0	141.2
Mikolayiv	1.03	1.46	1.75	1.74	2.34	3.34	325.3	143.2
Odesa	2.24	3.60	3.90	4.70	4.42	7.30	325.9	165.1
Poltava	1.69	2.08	2.32	1.78	2.65	4.60	271.6	173.3
Rivne	0.43	0.68	0.68	0.74	0.54	1.09	252.9	201.3
Sumy	1.02	1.42	1.44	1.41	2.30	2.81	276.7	122.2
Ternopil	1.17	1.47	1.74	1.71	2.76	4.70	403.0	170.3
Kharkiv	4.02	5.46	5.63	6.07	9.32	8.69	216.1	93.3
Kherson	0.67	1.19	1.25	1.20	1.84	1.75	261.6	95.4
Khmelnytskiy	1.15	1.56	1.57	1.83	2.98	4.83	422.2	162.2
Cherkasy	1.31	1.61	2.23	1.82	2.47	3.39	259.6	137.1
Chernivtsi	0.19	0.23	0.23	0.26	0.37	0.60	326.5	163.7
Chernihiv	0.87	1.30	1.32	1.32	2.00	3.37	387.2	168.4
Annual inflation indices	113.7	109.8	104.1	105	110	126.6	12.9	16.6
Volume of issued loans taking into account inflation	52.5	61.6	59.2	58.6	75.1	93.6	178.2	124.7
Indicators of credit load in Ukraine								
Per 1 employee, million UAH	0.10	0.12	0.11	0.11	0.15	0.26	260.0	173.3
For 1 enterprise, million UAH	1.19	1.34	1.23	1.24	1.73	3.61	303.4	208.7
Indicators of credit load in Ukraine taking into account inflation								
Per 1 employee, million UAH	0.09	0.11	0.11	0.10	0.14	0.21	233.5	150.6
For 1 enterprise, million UAH	1.05	1.22	1.18	1.18	1.57	2.85	272.5	181.3

Source: calculated based on the statistics of the National Bank of Ukraine (2024) and the State Statistics Service of Ukraine (2024).

Despite the escalation of hostilities and constant shelling, Ukrainian farmers do not abandon their work. However, the lack of financing for the production activities of our farmers continues to increase. During the three months of 2024, 3,517 agricultural enterprises already

received loans to finance their current activities in the total amount of UAH 21.9 billion, including UAH 7.2 billion under the state program "Affordable Loans 5-7-9%".

The dynamics of a gradual decrease in the volume of agricultural lending can be traced in all regions of Ukraine, especially in the front-line regions that are close to hostilities and constantly suffer from shelling and bombing – (Donetsk, Luhansk, Kherson, Zaporizhzhya, Kharkiv regions).

The average cost of loans for agricultural enterprises according to the statistical reporting of Ukrainian banks at the end of 2022 in national currency was 16.7% per annum, in foreign currency – 5%. In the first year of the war, the cost of loans to agricultural producers in the national currency increased 1.6 times – from 10.% at the beginning to 16.7% at the end of the year. The average value of loans in foreign currency has hardly changed.

Loans in the national currency continue to become more expensive. In 2023, the average value of such loans increased by 3% – from 16.7 to 19.7%. The interest rate on short-term loans increased from 16 to 18%, on long-term loans – from 16.8 to 19.4%. Given the disappointing inflation forecasts of the National Bank of Ukraine, this trend will continue and the interest rate on hryvnia loans will increase.

In 2022, the number of agricultural enterprises in Ukraine decreased by 14,909 units, and as of the beginning of 2023, it is 32,844 compared to 47,753 that operated before the start of a full-scale war. The number of workers employed in agricultural production decreased by almost 82 thousand people – from 535.7 to 454.5 thousand. The decrease in the number of enterprises and employed workers affected the dynamics of credit load indicators.

A retrospective analysis of the credit load dynamics of the agricultural sector of the Ukrainian economy revealed the following changes. In 2017-2022, the total credit load per enterprise increased 3 times – from UAH 1.19 to 1.73 million. The indicator of credit load per person employed in agriculture at the end of 2022 was UAH 0.26 million, which is 2.6 times higher than the level of 2017.

In the analyzed period, inflation in Ukraine increased by 12.9% – from 113.7 in 2017 to 126.6 in 2022. During the first year of the war, the increase was 16.6% – from 111.0 to 126.6.

If we take into account the dynamics of inflation, as an objective factor of the functioning of the economy of Ukraine and its banking sector, the total volume of loans issued to agricultural enterprises of Ukraine in 2017-2022 increased by 1.8 times – from UAH 52.59 billion in 2017. to 93.6 in 2022, which worsens the actual dynamics by 20.3%. Accordingly, taking into account the inflation factor, the credit burden per agricultural enterprise increased 2.72 times – from 1.05 million UAH in 2017 to 1.57 million UAH in 2021. In the first year of the war, this indicator doubled – to UAH 2.85 million per enterprise. The credit burden per employed person, taking into account inflation, during 2017-2021 increased by 2.3 times – from 0.09 to 0.14 million UAH. In 2022, this indicator increased another 1.5 times and reached 0.21 million UAH.

Thus, inflation adjusted the credit load indicators. Thus, in 2022, the credit burden on one agricultural enterprise, taking into account inflation, decreased by 21.1% or UAH 0.76 million, and in the calculation per 1 employed person, it decreased by 19.2% or UAH 50,000.

It should be noted that even during the war, state and commercial banks continued active lending activities. It is aimed at ensuring that our farmers are able not only to carry out their current activities, but also to restore and modernize their production facilities and adapt them to new difficult conditions. In the first year of the war, the amount of lending to agriculture increased by 43.4% (or UAH 35.9 billion). At the same time, short-term lending itself increased by 73% (from 37.3 to 64.5 billion UAH).

However, taking into account inflation, the total volume of agricultural lending in 2022 increased by only 24.6% from UAH 75.1 billion to UAH 93.6 billion. During 2023, the credit dynamics slowed down a little. The total amount of loans granted to agricultural enterprises decreased by 1.1% (or UAH 1.235 billion). The inflation rate in Ukraine in 2023 was 105.1%. Taking into account this objective factor, the total amount of agricultural loans amounted to UAH 111.6 billion, which is UAH 5.7 billion less than the actual values.

Today, farmers work in rather complex realities. Credit conditions for agricultural enterprises, during martial law, are significantly different from the usual ones, since the armed conflict seriously affected the economy and financial stability of the country. A decrease in the availability of loans can be attributed to the peculiarities of lending to agricultural enterprises in wartime conditions. Banks are more cautious about granting loans during wartime due to the increased risk of non-return of loan funds.

Compared to the significant growth of the credit burden in agriculture, the performance indicators of lending turned out to be much more modest. The determination of the production coefficient, which is calculated as the ratio of the actual volumes of agricultural production and the average balances of loans, made it possible to determine the following. Production of agricultural products per UAH 1,000 of borrowed loans in Ukraine during 2017-2022 increased by only 8.2% – from UAH 4,170 to UAH 4,510 (Table 2).

Table 2. Dynamics of production indicators of crediting efficiency of agricultural enterprises of Ukraine, 2017-2022 (thousand UAH)

Indicators	2017	2018	2019	2020	2021	2022	2022 to 2017 (%)	2022 to 2021 (%)
Produced agricultural products worth UAH 1,000 of borrowed loans	4.17	3.98	11.05	9.96	8.63	4.51	108.2	52.3
including taking into account inflation	3.67	3.62	10.61	9.49	7.85	3.56	97.1	45.4
Sold agricultural products worth UAH 1.000 of borrowed loans	7.61	7.76	9.03	9.85	11.12	5.51	72.4	49.6
including taking into account inflation	6.69	7.07	8.67	9.38	10.11	4.35	65.0	43.1

Source: calculated based on the statistics of the National Bank of Ukraine (2024) and the State Statistics Service of Ukraine (2024).

The first year of the full-scale war had significant negative consequences on the level of efficiency of lending to the agrarian sector of the economy. In Ukraine, the production of agricultural products per UAH 1,000 of borrowed loans almost halved compared to 2021 – from UAH 8.63 to UAH 4.51). The largest scale of decrease in the efficiency indicator was

recorded in the farms of Kherson (by 95%), Zaporizhzhya (by 82%), Luhansk (by 78%), Donetsk (by 62%), Kirovohrad (by 59%) regions.

Determination and analysis of the dynamics of the sales ratio, as a ratio of the volume of agricultural products sold per unit of loans, revealed a decrease in this indicator by 27.6% – from 7.61 to 5.51 thousand UAH. During the first year of the war, this indicator decreased by half – from 11.12 to 5.51 thousand UAH.

Accordingly, taking into account inflation, the indicator of the production of agricultural products per 1,000 hryvnias of borrowed loans turned out to be significantly lower. So, if during 2017-2022, at actual prices, this indicator increased by 8.2% (from 4.17 to 4.51 thousand UAH), then taking into account inflation, a decrease of 3% was recorded (from 3.67 d 3, 56 thousand UAH). If the product sales ratio calculated per unit of loans at actual prices during 2017-2022 decreased by 27.6% (from 7.61 to 5.51 thousand UAH), then inflation worsened this indicator by another 7.4%. Thus, taking into account inflation, the coefficient of sale of agricultural products calculated per unit of loans decreased by 35% (from 6.69 thousand UAH in 2017 to 4.35 thousand UAH in 2022).

A comparison of the growth rates of financial results and profit with similar lending indicators during 2017-2021 revealed a trend of significant efficiency increase. Thus, the index of profitability of lending to agricultural enterprises of Ukraine according to the financial result for the analyzed period increased 3.1 times – from 0.70 in 2017 to 2.18 in 2021. However, 2022 worsened this indicator by almost 10 times – the ratio rates of change in financial results and lending volume reached a retrospective minimum and amounted to only 0.26 (Table 3).

Table 3. Determination of profitability indicators of lending to agricultural enterprises of Ukraine, 2017-2022

Indicators	2016	2017	2018	2019	2020	2021	2022
Financial results from ordinary activities before taxation, billion UAH	90.1	68.6	70.8	90.8	81.6	238.5	87.3
Profit	103.5	88.7	93.2	114.7	107.5	245.8	126.4
Loss	13.1	20.4	22.8	24.5	26.5	8.2	39.1
The rate of change in the financial result	-	0.76	1.03	1.28	0.90	2.92	0.37
Rate of change in profit	-	0.86	1.05	1.23	0.94	2.29	0.51
Amount of loans granted, billion UAH	55.4	59.7	67.7	61.6	61.5	82.6	118.5
The rate of change in credit resources	-	1.08	1.13	0.91	1.00	1.34	1.43
Profitability index by financial result	-	0.70	0.91	1.41	0.90	2.18	0.26
including taking into account inflation		0.62	0.83	1.35	0.86	1.98	0.21
Profitability index by net profit	-	0.8	0.93	1.35	0.94	1.7	0.36
including taking into account inflation		0.70	0.85	1.30	0.90	1.55	0.28

Source: calculated based on the statistics of the National Bank of Ukraine (2024) and the State Statistics Service of Ukraine (2024).

Measuring the efficiency of lending to agricultural enterprises by the amount of net profit during 2017-2021 established the growth of this indicator by 2.1 and 5 times,

respectively. The results of economic activity of the military year 2022 reduced this indicator by 4.7 times (from 1.7 to 0.36).

Accordingly, taking into account inflation, the index of profitability of lending by financial result during 2017-2022 increased from 0.62 to 1.98, and in 2022 it decreased to a minimum of 0.21 points. The efficiency of lending based on the net profit of agricultural enterprises, adjusted for the inflation index, in 2022 turned out to be lower than the actual result by 21%.

The determination of lending turnover indices as the next structural component of the overall efficiency measurement toolkit revealed a significant deterioration of these indicators (Table 4).

Table 4. Determination of credit turnover indicators of agricultural enterprises of Ukraine, 2017-2022

Indicators	2017		2018		2019		2020		2021		2022	
	Actually	Adjusted for inflation	Actually	Adjusted for inflation	Actually	Adjusted for inflation	Actually	Adjusted for inflation	Actually	Adjusted for inflation	Actually	Adjusted for inflation
Turnover loans index	7.83	6.89	7.98	7.27	9.3	8.93	10.15	9.67	11.12	10.1	5.74	4.53
Turnover current assets index	0.7	0.62	0.8	0.73	0.9	0.86	0.9	0.86	1.1	1.00	0.7	0.55
Turnover index of loan capital	1	0.88	1.1	1.00	1.1	1.06	1.2	1.14	1.4	1.27	1	0.79
Turnover current payables index	1.1	0.97	1.3	1.18	1.4	1.34	1.4	1.33	2	1.82	1.3	1.03
Turnover lending Index by current assets	11.19	9.84	9.98	9.09	10.33	9.92	11.28	10.74	10.11	9.19	8.17	6.45
Turnover lending Index by loan capital	7.83	6.89	7.25	6.60	8.45	8.12	8.46	8.06	7.94	7.22	5.74	4.53
Turnover lending Index by current accounts payable	7.12	6.26	6.14	5.59	6.64	6.38	7.25	6.90	5.56	5.05	4.42	3.49

Source: calculated based on the statistics of the National Bank of Ukraine (2024) and the State Statistics Service of Ukraine (2024).

In Ukraine as a whole, the credit turnover index for current assets of agricultural enterprises during 2017-2021 decreased by only 9.7% (from 11.19 to 10.11). The decrease in turnover indices for loan capital and accounts payable turned out to be more significant – by 58 and 22%, respectively. According to the results of 2022, compared to 2021, these performance indicators further deteriorated by 19.2, 19.6, and 21.4%, respectively, and reached their minimum values.

It should be noted that the objective impact of inflationary processes negatively adjusted these indicators. It was established that during the first year of the war, all lending turnover indices further decreased by 21%.

The calculation of the last structural indicator – the lending profitability indicator – shows the presence of efficiency. During 2017-2021, the profitability of lending to agricultural enterprises of Ukraine increased almost 3 times – from 1.52 to 4.35. Accordingly, during 2022, this indicator decreased to 1.53 percentage points (Table 5).

Table 5. Determination of the lending profitability indicator to agricultural enterprises of Ukraine, 2017-2022

Indicators	2017	2018	2019	2020	2021	2022
Profitability of production (operational activity)	23.2	18.9	19.8	19.1	41.8	20.7
Average interest rate on loans	15.3	17.5	17.9	13.5	9.6	13.5
Lending profitability indicator	1.52	1.08	1.11	1.41	4.35	1.53

Source: calculated based on the statistics of the National Bank of Ukraine (2024) and the State Statistics Service of Ukraine (2024)

Based on the definition of structural indicators characterizing the multifaceted approaches to assessing the effectiveness of lending to agricultural enterprises, the calculation and analytical measurement of its aggregate integral indicator was carried out (Table 6).

Table 6. Integral indicator of lending efficiency of agricultural enterprises of Ukraine, 2017-2022

Indicators	2017	2018	2019	2020	2021	2022	2022 to 2017 (%)
Credit profitability index based on the financial result (LP_{FRi})	0.70	0.91	1.41	0.9	2.18	0.26	37.1
Lending profitability index based on the net profit (LP_{NPi})	0.8	0.93	1.35	0.94	1.7	0.36	45.0
Turnover lending Index by current assets (IR_{TLi})	11.19	9.98	10.33	11.28	10.11	8.17	73.0
Turnover lending Index by loan capital (IR_{TLCi})	7.83	7.25	8.45	8.46	7.94	5.74	73.3
Turnover lending Index by current accounts payable (IR_{TCPi})	7.12	6.14	6.64	7.25	5.56	4.42	62.1
Lending profitability indicator (L_{pri})	1.52	1.08	1.11	1.41	4.35	1.53	100.7
Crediting effectiveness Indicator on the production of agricultural products ($Lprod_i$)	4.17	3.98	11.05	9.96	8.63	4.51	108.2
Crediting effectiveness Indicator on the sale of agricultural products ($Lsold_i$)	7.61	7.76	9.03	9.85	11.12	5.74	75.4
Integral indicator of lending efficiency	**3.38**	**3.25**	**4.32**	**4.11**	**5.37**	**2.29**	**67.9**

Source: calculated by the authors.

The maximum values of the integral indicator of lending efficiency were reached in 2021 – 5.37. During 2022, the overall efficiency of lending decreased to a value of 2.29, which is 33.1% below the corresponding levels of 2017. In general, the efficiency of lending to agricultural enterprises of Ukraine during the first year of the full-scale war decreased by 2.3 times – from 5.37 to 2.29 points.

A similar calculation, taking into account the negative inflationary pressures, is given in the Table. 7.

Table 7. Integral indicator of lending efficiency of agricultural enterprises of Ukraine, 2017-2022 adjusted for inflation

Indicators	2017	2018	2019	2020	2021	2022	2022 to 2017 (%)
Credit profitability index based on the financial result (LP_{FRi})	0.62	0.83	1.35	0.86	1.98	0.21	33.9
Lending profitability index based on the net profit (LP_{NPi})	0.7	0.85	1.3	0.9	1.55	0.28	40.0
Turnover lending Index by current assets (IR_{TLi})	9.84	9.09	9.92	10.74	9.19	6.45	65.5
Turnover lending Index by loan capital (IR_{TLCi})	6.89	6.6	8.12	8.06	7.22	4.53	65.7
Turnover lending Index by current accounts payable (IR_{TCPi})	6.26	5.59	6.38	6.9	5.05	3.49	55.8
Lending profitability indicator (L_{pri})	1.52	1.08	1.11	1.41	4.35	1.53	100.7
Crediting effectiveness Indicator on the production of agricultural products ($Lprod_i$)	3.67	3.62	10.61	9.49	7.85	3.56	97.0
Crediting effectiveness Indicator on the sale of agricultural products ($Lsold_i$)	6.69	7.07	8.67	9.38	10.11	4.35	65.0
Integral indicator of lending efficiency	**3.02**	**3.00**	**4.17**	**3.94**	**4.94**	**1.86**	61.6
Inflationary impact							
absolute value	0.36	0.25	0.15	0.17	0.43	0.43	x
%	-10.72	-7.73	-3.39	-4.15	-8.00	-18.86	x

Source: calculated by the authors.

Calculations have established that the negative impact of inflation significantly reduces the effectiveness of lending. If in 2019-2021 the variation between the actual values of the aggregate lending performance indicator and its value adjusted for inflation fluctuated within 3.5-8%, then in 2022 it increased to 18.9%.

Thus, taking into account inflation, the overall indicator of lending efficiency during 2017-2022 decreased by 39.4% – from 3.02 to 1.86 points.

It was established that in 2017, the inflationary impact on the overall indicator of lending efficiency amounted to 10.7%. Inflation had a minimal impact on the efficiency of agricultural lending in 2019-2022 – 7.7 and 3.4%, respectively. In 2021, the inflationary impact amounted to 8% and reached its maximum in 2022 – 18.9%.

The formation and assessment of the rating of factors that positively and negatively influenced the change in the aggregate efficiency indicator of lending to agricultural enterprises of Ukraine was carried out by calculating the ratio of the influence of each factor on the change in the aggregate efficiency indicator. The algorithm for calculating the influence of factors on the performance indicator is based on the use of chain substitutions and differences. This mathematical toolkit makes it possible to determine the impact of each factor that forms the structure of the overall performance indicator on its overall dynamics in retrospect and for individual periods by gradually replacing the base value of each factor indicator with the actual value in the next period. The practical implementation of this methodical approach made it possible to establish the following dynamics and rating assessment of factor influence (Table 8).

Table 8. The result of the deterministic factor analysis of the impact on the overall indicator of the effectiveness of lending to agricultural enterprises of Ukraine, 2017-2022

Indicators	2018 compared to 2017	2019 compared to2018	2020 compared to 2019	2021 compared to 2020	2022 compared to 2021	2022 compared to 2017
Credit profitability index based on the financial result (LP_{FRi})	0.113	0.183	-0.236	0.480	-1.253	-0.393
Lending profitability index based on the net profit (LP_{NPi})	0.066	0.164	-0.181	0.353	-0.726	-0.283
Turnover lending Index by current assets (IR_{TLi})	-0.050	0.016	0.043	-0.067	-0.089	-0.104
Turnover lending Index by loan capital (IR_{TLCi})	-0.034	0.070	0.001	-0.038	-0.131	-0.099
Turnover lending Index by current accounts payable (IR_{TCPi})	-0.064	0.036	0.044	-0.158	-0.090	-0.144
Lending profitability indicator (L_{pri})	-0.142	0.013	0.121	0.707	-0.377	0.002
Crediting effectiveness Indicator on the production of agricultural products ($Lprod_i$)	-0.746	-0.450	-1.030	-1.411	-0.859	-0.509
Crediting effectiveness Indicator on the sale of agricultural products ($Lsold_i$)	0.735	1.040	1.021	1.396	0.450	0.450
A change in the overall indicator of lending efficiency	-0.122	1.071	-0.217	1.262	-3.074	-1.081

Source: calculated by the authors.

It was established that in 2022, the aggregate credit efficiency index of agricultural enterprises of Ukraine decreased by 1.08 points compared to 2017. The only positive influence on the change of this indicator was the performance indicator for the sale of products ($Lsold_i$) due to the growth of the latter during 2017-2022 by 1.5 times – from 455 to 681 billion UAH. The deterioration of all structural indicators caused a corresponding negative factor impact.

The greatest impact on the reduction of the overall lending efficiency indicator was caused by the efficiency indicators for the production of agricultural products ($Lprod_i$) and the lending profitability index by financial result (LP_{FRi}).

4. Conclusions

In 2017-2022, lending to agricultural business entities showed a stable growth trend from UAH 59.71 to 118.5 billion. In 2022, the volume of agricultural lending increased by 43.4%. The share of agricultural lending in the overall scale of the national economy increased from 7.21% in 2017 to 15.7% in 2022. The share of agricultural loans granted in the national currency increased from 59.1 to 76.4%, and the specific weight of loans in foreign currency decreased from 40.9 to 23.6%. With the beginning of a full-scale war, the cost of loans to agricultural producers in the national currency increased 1.6 times (from 10 to 16.7%).

The credit burden of the agrarian sector of the economy per one enterprise during 2017-2022 increased 3 times – from 1.2 to 3.6 million UAH. The indicator of the credit load per person employed in agriculture at the beginning of 2023 was UAH 0.26 million, which is 2.6 times higher than the level of 2017. During the first year of the war, these indicators increased by 2.1 and 1.7 times in accordance.

During the analyzed period, the aggregate efficiency indicator of agricultural lending in Ukraine increased by 58.9% (from 3.38 to 5.37 points), however, in the first year of the war, the aggregate efficiency of lending decreased to level of 2.29, which is almost a third lower than the corresponding indicator in 2017 and 2.3 times the level of 2021.

Inflationary processes in Ukraine are intensifying. Undoubtedly, this has a negative impact on the economy and its banking sector. In our calculations, we made an adjustment for inflation and determined its negative impact on the efficiency of lending to agricultural enterprises. In 2019-2021, the variation between the actual values of the aggregate lending performance indicator and its value adjusted for inflation fluctuated within 3.5-8%, and in the military year 2022, it increased to 18.9%.

It should be noted that the export potential of agriculture in 2022 provided 53% of all export revenues to Ukraine (41% in 2021). The system of lending to farmers plays an important role in the formation of the appropriate level of competitiveness of domestic agricultural producers on international markets and contributes to the increase of export flows of agricultural products.

In today's extremely difficult conditions, credit funds remain no alternative source of financing agricultural enterprises. Therefore, it is important to monitor the comparative efficiency of lending to the agricultural sector of the economy. In turn, ensuring the effectiveness of lending to agricultural enterprises will contribute not only to their stable functioning, but also to further development in the conditions of the post-war reconstruction of Ukraine's economy.

Complex realities require further improvement and development of state support mechanisms for bank lending to the agrarian sector of the economy. The further practice of improvement and optimization of the regulatory and legal framework, which regulates the processes of credit provision of agrarians by banking institutions, remains necessary. What is necessary is a policy of simplifying and making bank loans more accessible, further optimizing the mechanism of reducing the cost of loans and real stimulation by the state of banks in order to further intensify their credit cooperation with agrarian enterprises.

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