ASSESSING THE RESISTANCE OF THE BANK'S INDUSTRIAL LOAN PORTFOLIO TO THE EFFECTS OF THE DYNAMIC MACROECONOMIC ENVIRONMENT

ОЦІНКА СТІЙКОСТІ ПРОМИСЛОВОГО КРЕДИТНОГО ПОРТФЕЛЯ БАНКУ ДО ПРОЯВІВ МАКРОЕКОНОМІЧНОГО СЕРЕДОВИЩА

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The purpose of the study is to develop scientific and methodological foundations for improving the efficiency of the process of managing a bank's corporate loan portfolio, in particular by segregating the industrial loan portfolio as its important structural part and developing a methodical approach to assessing the resistance of the bank's industrial loan portfolio to the effects of the dynamic macroeconomic environment. The article summarizes the results of research by domestic and foreign scholars on the impact of macroeconomic factors on various aspects of a bank's lending activities. The paper briefly considers certain aspects of development and efficiency of bank lending to industrial enterprises for the period 2010–2022. The author's approach to assessing the resistance of the bank's industrial loan portfolio to fluctuations in the macroeconomic environment is proposed. The proposed methodology for assessing the resistance of the foreign currency industrial loan portfolio of Ukrainian banks to effects of the macroeconomic environment for the period 2010–2022 has been tested.

Key words: bank, industrial enterprise, bank lending to industrial enterprises, industrial loan portfolio of the bank, resistance, macroeconomic environment, macroeconomic factors.

Метою дослідження є розвиток науково-методичних засад щодо підвищення ефективності процесу управління корпоративним кредитним портфелем банку, зокрема шляхом виокремлення промислового кредитного портфеля як його важливої структурної частини та розвитку методичного підходу до оцінки стійкості промислового кредитного портфеля банку до проявів динамічного макроекономічного середовища. Узагальнено результати досліджень вітчизняних та зарубіжних науковців щодо впливу макроекономічних чинників на різні аспекти кредитної діяльності банку: зокрема, на ефективність банківського кредитування, на рівень процентних ставок кредитування, на рівень непрацюючих кредитів, на рівень кредитного ризику тощо. Стисло розглянуто окремі аспекти розвитку та ефективності банківського кредитування промислових підприємств за період 2010–2022 рр. Запропоновано авторський підхід до оцінки стійкості промислового кредитного портфеля банку до коливань макроекономічного середовища. Апробовано запропоновану методику для проведення оцінки стійкості валютного промислового кредитного портфеля банків України до проявів макроекономічного середовища за період 2010-2022 р. В якості ключових економічних чинників макроекономічного середовища було прийнято: курс долара США; обсяг ВВП (млрд. грн.); індекс споживчих цін (%); рівень безробіття (%); зведений бюджет (сальдо) у % до ВВП; зведений платіжний баланс (млрд. дол.). В якості проявів макроекономічного середовища в зазначений період аналізу визначено такі епізоди макроекономічних потрясінь: фінансово-економічна криза 2013–2014 рр.; пандемія COVID-19; повномасштабна війна в Україні, з 24.02.2022 р. З'ясовано, які макроекономічні чинники здійснювали визначальний вплив на обсяг валютного банківського кредитування промислових підприємств. Обчислено прогнозні значення обсягу валютного кредитування промислових підприємств та частки непрацюючих валютних кредитів промислових підприємств на період 2023–2025 рр. Здійснено висновки про перспективні напрямки поглиблення та розвитку науково-методичних засад щодо управління промисловим кредитним портфелем банку.

Ключові слова: банк, промислове підприємство, банківське кредитування промислових підприємств, промисловий кредитний портфель банку, стійкість, макроекономічне середовище, макроекономічні чинники.

Introduction. In recent years, the situation around the development of bank lending to industrial enterprises in Ukraine has become more challenging: banks are making significant efforts to reduce the share of non-performing loans of industrial enterprises; the cost of lending to industrial enterprises is higher than for other non-financial corporations; industrial enterprises are going bankrupt and suffering significant material losses as a result of the war. At the same time, given the significant fluctuations in Ukraine's macroeconomic environment, the issue of its impact on bank lending to industrial enterprises is becoming relevant, and, accordingly, there is a need to develop effective monitoring tools to assess the resistance of the bank's industrial loan portfolio to the effects of the macroeconomic environment.

Analysis of recent researches and publications. The theoretical and methodological foundations and practical aspects of the impact of the macroeconomic environment on the lending activities of banks are the focus of scientific interest for many scholars and practitioners. Thus, the impact of macroeconomic factors on the lending activities of banks was studied by L. Smaha and O. Hnativ. [9] In particular, the scientists identified the most sensitive areas of lending activity that undergo significant transformations in the face of changes in the macroeconomic environment, namely: the share of long-term loans in the loan portfolios of banks; the level of liberalization of lending conditions; the level of sectoral concentration of loan portfolios of banks. The impact of a number of macroeconomic factors on the cost of bank loans in Ukraine was studied by S. Ivakhnenkov, S. Glushchenko, and K. Sverenko [3]. The researchers concluded that interest rates on loans are most influenced by inflation and the ease of doing business and least influenced by GDP per capita and the share of loans in GDP. D. Odnorog [4] studied the impact of macroeconomic factors on the efficiency of commercial bank loans on the example of HFC Bank of Ghana and concluded that the determining influence of inflation and Treasury bond rates on the efficiency of bank lending is crucial. Another group of researchers, including S. Ahmed, M. Ejaz, E. Thalassinos and J. Thalassinos, studied the impact of macroeconomic factors on the level of NPLs of banks in Pakistan. The researchers concluded that any increase in GDP is vital for reducing NPLs, while higher interest rates and exchange rates increase NPLs [1]. Similar results regarding the impact of macroeconomic factors on the level of NPLs were obtained by M. Foglia. Using the example of the Italian banking system, the researcher found that GDP and public debt have the greatest impact on the level of NPLs [2].

Identification of previously unresolved parts of the general problem. Paying tribute to and appreciating the contribution of scholars to the development of the issue of the impact of the macroeconomic environment on the lending activities of banks, we believe that certain issues have not yet been highlighted. In particular, it is necessary to highlight the peculiarities of the macroeconomic environment's influence on the development of bank lending to industrial enterprises as the basis of the real sector of the economy. In this segment of the study, it is important to develop methods for assessing the resistance of the bank's industrial loan portfolio to the effects of the dynamic macroeconomic environment.

Formulation of the article's objectives. The purpose of the study is to develop a method for assessing the resistance of the bank's industrial loan portfolio to the effects of the dynamic macroeconomic environment.

Summary of the main research material. Industrial loans account for a significant share of the total bank loan portfolio of non-financial corporations. Over the past ten years, bank loans of industrial enterprises have, on average, accounted for at least one third of the corporate loan portfolio of Ukrainian banks, with a ratio of industrial loans to industrial deposits of more than 290% (Figure 1).

At the same time, foreign currency bank loans of industrial enterprises accounted for about half of the foreign currency corporate loan portfolio of banks. On average, during the period 2014–2022, non-performing loans accounted for a 1/3 of the total volume of industrial enterprise loans. The share of foreign currency non-performing loans in the total amount of foreign currency industrial loans, on average, for the same period was no less than 40%. It should also be noted that the share of bank lending to industrial enterprises in the gross added value of industrial enterprises of Ukraine averaged no more than 51% for the period 2009–2022 and had a steady downward trend [6].

Given the above, it can be pointed out that there is no properly developed methodical approach to assessing the resistance of the bank's industrial loan portfolio to the effects of the dynamic macroeconomic environment.

The development of a methodical approach to assessing the resistance of a bank's industrial
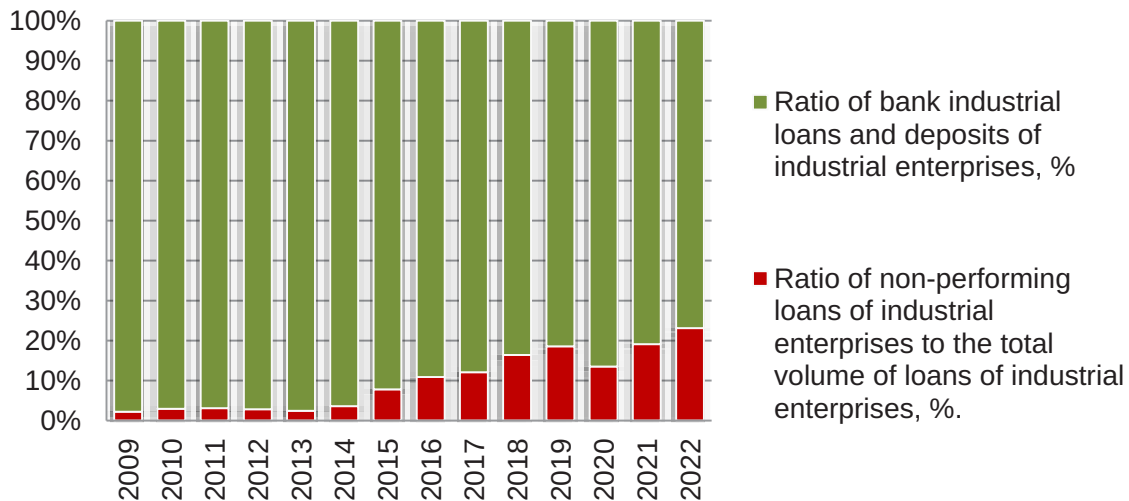
**Figure 1. Dynamics of specific indicators of efficiency of bank lending
to industrial enterprises in Ukraine, % (2009–2022)**

Source: compiled by the author on the basis of [6]

loan portfolio to the effects of macroeconomic environment is primarily aimed at improving the decision-making process of banks in lending to industrial enterprises in a dynamic macroeconomic environment.

A methodical approach to assessing the resistance of a bank's industrial loan portfolio should be considered as an important component of the process of monitoring the bank's overall corporate portfolio, as the results of such an assessment provide the bank's management with an important information and analytical resource on the impact of specific economic factors of the macroeconomic environment on the quality and resistance of the industrial loan portfolio.

We propose to assess the resistance of the bank's industrial loan portfolio to the effects of macroeconomic environment using the method based on the application of mathematical and economic modeling according to the following algorithm:

1. Consideration of a multiple linear regression equation of the following form [8]:

$$Y = \beta_0 + \beta_1 \times x_1 + \beta_2 \times x_2 + ... + \beta_m \times x_m + \varepsilon, \quad (1)$$

Where: Y – output variable; β_0 – coefficient that determines the value of the output variable when all explanatory variables are equal to 0; $x_1,..x_m$ – explanatory variables; $\beta_1...\beta_m$ – coefficients of explanatory variables; m – number of explanatory variables; ε – random error (deviation).

2. Developing the working equation, taking into account that Y – this is the volume of loans of industrial enterprises (monetary units),

explanatory variables $x_1,..x_m$ – macroeconomic indicators. The macroeconomic indicators included in the equation should have significant correlations with the outcome variable Y and have available forecast values. As a general rule, the forecast values of key macroeconomic indicators are published on the official website of the Central Bank or on the official website of the relevant ministry. To perform macro-stress testing, the working equation incorporates dummy factors that correspond to periods of financial and economic shocks (crises) that are considered to be macroeconomic effects and/or shocks. Thus, the working equation of a multiple linear regression with dummy variables is as follows:

$$Y = \beta_0 + \beta_{1\times}x_1 + \beta_{2\times}x_2 + \beta_{3\times}x_3 +$$
$$+\beta_{4\times}x_4 + \beta_{5\times}x_5 + \beta_{6\times}x_6 + \beta_{7\times}F_7 +$$
$$+\beta_{8\times}F_8 + \beta_{9\times}F_9 + \varepsilon, \quad (2)$$

where: Y – volume of loans of industrial enterprises (UAH billion); β_0 – coefficient that determines the value of the output variable when all explanatory variables are equal to 0; $\beta_1...\beta_9$ – coefficients of explanatory variables; x_1, x_2, x_n – relevant factors of the macroeconomic environment for which forecast data is available; F_7, F_8, F_n – dummy explanatory variables that accept the value of "1" in years of financial and economic turbulence (macroeconomic effects and shocks);

3. Assessment of the statistical significance of the equation: the significance level F should be less than 0.05 (1-0.95); p-values for the calculated coefficients $\beta_1...\beta_9$ should be less

than 0.05 (1-0.95); the value of R should be close to "1". When calculating the predicted value of Y, p-values can be ignored.

4. Based on the calculated coefficients β_n for the relevant explanatory variables – $x_1,..x_m$, and the dummy explanatory variables – F_n , calculate the forecast value of the output variable for the relevant forecast period using the formula:

$$Y_{frcN} = \beta_0 + \beta_1 \times x_{1_N} + \beta_2 \times x_{2_N} +$$
$$+\beta_3 \times x_{3_N} + \beta_4 \times x_{4_N} + \beta_5 \times x_{5_N} +$$
$$+\beta_6 \times x_{6_N} + \beta_7 \times F_{7_N} + \beta_8 \times F_{8_N} +$$
$$+\beta_9 \times F_{9\_N} + \varepsilon , \qquad (3)$$

where: Y_{frcN} – predicted volume of loans to industrial enterprises (UAH billion); x_{n_N} – explanatory variables that have been accepted values according to forecast; F_{n_N} – dummy explanatory variables with a value of "0"; N – year of forecast.

5. Visualization of results by graphing the results based on the value (Y_{frcN}).

Given that today, it is foreign currency bank loans of industrial enterprises that account for a high share of non-performing loans of industrial enterprises, we will adapt the above methodology to assess the resistance of the bank's industrial loan portfolio of Ukraine to macroeconomic environment by foreign currency criteria.

In accordance with the above method, the volume of foreign currency loans of industrial enterprises will be taken as the output variable (Y), the explanatory variables will be: x_1 – USD exchange rate; x_2 – GDP volume (UAH billion); x_3 – consumer price index (%); x_4 – unemployment rate (%); x_5 – consolidated budget (balance) as a % of GDP; x_6 – consolidated balance of payments (USD billion). At the same time, this group of macroeconomic indicators is in line with the NBU's publicly available macroeconomic forecasts for 2023–2025. We propose to incorporate the following dummies into the multiple linear regression equation of the form (2): F_7 – is a dummy variable that takes the value "1" during the financial and economic crisis of 2013–2014; F_8 – is a dummy variable that takes the value "1" during the years of the COVID-19 pandemic (2019–2020); F_9 – is a dummy variable that takes the value "1" in the first year of the war (2022).

The input data for the construction and estimation of a multiple linear regression with dummy variables are summarized in Table 1.

Table 1

Input Data for Multiple Linear Regression

Year	Output variable	Explanatory variables						Dummy variables		
N	Y	x1	x2	x3	x4	x5	x6	F7	F8	F9
2010	91,423	7,96	1 079,35	9,4	8,8	-5,94	5,03	0	0	0
2011	95,0803	7,99	1 299,99	8,0	8,6	-1,79	-2,46	0	0	0
2012	94,9803	7,99	1 404,67	0,6	8,1	-3,79	-4,18	0	0	0
2013	111,256	7,99	1 465,20	-0,3	7,7	-4,45	2,02	1	0	0
2014	168,833	15,77	1 586,92	12,1	9,7	-4,98	-13,31	1	0	0
2015	194,259	24,00	1 988,54	48,7	9,5	-2,28	0,85	0	0	0
2016	206,151	27,19	2 385,37	13,9	9,7	-2,94	1,35	0	0	0
2017	204,866	28,07	2 981,23	14,4	9,9	-1,60	2,57	0	0	0
2018	221,291	27,69	3 560,30	10,9	9,1	-1,66	2,88	0	0	0
2019	187,353	23,69	3 977,20	7,9	8,6	-1,96	5,98	0	1	0
2020	186,433	28,27	4 222,03	2,7	9,9	-5,18	1,99	0	1	0
2021	136,118	27,28	5 450,85	9,4	10,3	-3,63	0,49	0	0	0
2022	118,799	36,57	5 191,03	26,6	21,1	-17,62	-2,90	0	0	1
2023*	-	40,70	6524,90	10,6	19,0	19,80	7,40	0	0	0
2024*	-	48,00	7620,30	8,5	16,9	-16,80	1,20	0	0	0
2025*	-	51,20	8830,10	6,0	14,0	-6,50	2,00	0	0	0

Note: *forecast values

Source: compiled by the author on the basis of [5–7]

Variable	Coefficient	Std. Error	t-Statistic	Prob.
X1	8.642398	1.526008	5.663404	0.0109
X2	-0.020860	0.006678	-3.123736	0.0523
X3	-0.062105	0.491465	-0.126366	0.9074
X4	-17.56200	15.29258	-1.148400	0.3341
X5	2.203724	4.760066	0.462961	0.6749
X6	-0.933031	1.430260	-0.652350	0.5607
X7	19.67495	17.29011	1.137931	0.3378
X8	14.43581	15.59705	0.925547	0.4229
X9	111.5727	120.1402	0.928688	0.4216
C	207.8072	106.6348	1.948775	0.1464

R-squared	0.977100	Mean dependent var	155.1418
Adjusted R-squared	0.908400	S.D. dependent var	48.37354
S.E. of regression	14.64050	Akaike info criterion	8.277584
Sum squared resid	643.0325	Schwarz criterion	8.712161
Log likelihood	-43.80430	Hannan-Quinn criter.	8.188259
F-statistic	14.22269	Durbin-Watson stat	1.751300
Prob(F-statistic)	0.025627		

Figure 2. Regression statistics of the multiple linear regression equation

Source: computed by the author in EViews

Assessing the results of the constructed multiple linear regression equation (Fig. 2), it should be noted that this equation is statistically significant (F-statistic 0.025 < 0.05) and describes the influence of explanatory variables on the output variable by 91%. The influence of dummy variables did not show statistical significance, and their values will be used to calculate the predicted value of Y.

Based on the results of the constructed model of multiple linear regression with dummy variables, in order to assess the resistance of the foreign currency industrial loan portfolio of Ukrainian banks to fluctuations in the macroeconomic environment during 2010–2022, it is found that:

– the impact of the dummy variables included in the regression equation, which denote macroeconomic fluctuations, is not statistically significant, so macroeconomic fluctuations were not the determining factors in the volume of foreign currency loans of industrial enterprises;

– the key macroeconomic factor that influenced the volume of foreign currency loans of industrial enterprises in 2010–2022 was the USD exchange rate;

– based on the calculated coefficients of the regression equation and forecast indicators of macroeconomic development, the forecast value of foreign currency lending to industrial enterprises was obtained: an increase of UAH 7.034 billion in 2023, UAH 2.37 billion in 2024, and UAH 75.45 billion in 2025;

– additional calculation of the predicted share of non-performing loans in the total volume of foreign currency loans of industrial enterprises yielded the following results: an increase in the share of non-performing foreign currency loans to 62.48% in 2023, to 70% in 2024, and even to 80% in 2025.

In view of the above, we believe that foreign currency lending to industrial enterprises in future periods should be guided by a conservative credit policy. We support these considerations with the fact that over the period 2010–2022, the share of non-performing foreign currency loans in the total volume of foreign currency loans of industrial enterprises averaged 32%, and during periods of macroeconomic fluctuations and shocks – 45% (starting after the 2013–2014 crisis and before the outbreak of a full-scale war in Ukraine in 2022) [6]. In addition, given the level of dollarization of Ukraine's economy and the geopolitical and military conflicts that are spreading around the world, the scenario of an appreciation of the USD against UAH may become even more pessimistic for Ukraine, and thus trigger a high level of risk of foreign currency lending to industrial enterprises.

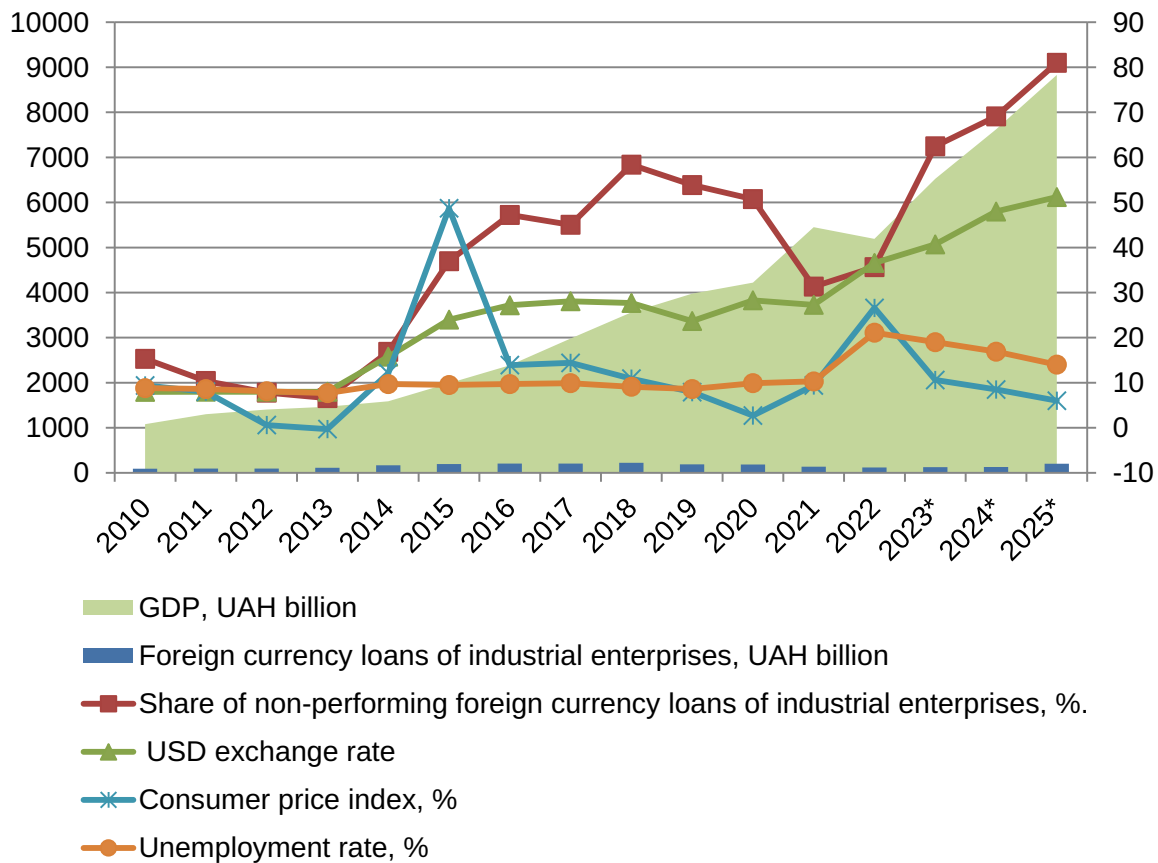**Conclusions.** Thus, we can conclude that it is important and necessary to develop specifically

**Figure 3. Dynamics of factual and predicted values of foreign currency loans
of industrial enterprises and key macroeconomic indicators (2010–2025)**

Source: compiled by the author on the basis of [5–7]

targeted tools for analyzing and assessing individual components of the bank loan portfolio of non-financial corporations. We believe that the dichotomy of the bank's loan portfolio into retail and corporate loan portfolios needs to be revised. Given that the loan portfolio of non-financial corporations consists of loans directed to industries that are interrelated and constitute a separate sector of the economy, we believe that this pool of loans should be segregated for the purpose of in-depth analysis and assessment. Given the sizeable share of industrial loans in the loan portfolio of non-financial corporations and their low quality, an individual approach to analyzing and assessing the pool of industrial loans seems to be rational. The paper proposes

the author's approach to assessing the resistance of the bank's industrial loan portfolio to fluctuations in the macroeconomic environment. The proposed methodology has been adapted to assess the resistance of the foreign currency industrial loan portfolio of Ukrainian banks to fluctuations in the macroeconomic environment in 2010–2022, and it has been found that the determining macroeconomic factor that disrupted the resistance of the foreign currency industrial loan portfolio of Ukrainian banks was the USD exchange rate.

We believe that a promising field of research is the development of scientific and methodological foundations for assessing the overall quality of the industrial loan portfolio of banks.

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