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CREDIT RISK MANAGEMENT IN THE BANK'S FINANCIAL STABILITY SYSTEM¹

Abstract. It is considered and updated the model of risk assessment of bank credit portfolio in the article. The profitability and risk are the main parameters of a bank loan portfolio. The ratio of these indicators characterizes the effectiveness of credit and general activity of the bank. The purpose of credit bank portfolio's management is to ensure the highest yield at an acceptable risk of level. It is advisable to carry out the credit portfolio risk assessment in three stages. The first stage consist of using 9 indicators that are directly related to the occurrence of credit risk: credit activity ratio, reserve adequacy ratio, loan quality ratio, overdue loan ratio, maximum risk per one borrower (or group of borrowers), the concentration level of large credit risks, the concentration level of credit risk per one insider, loan ratio of written off from the reserve, the rate of return on credit operations. On the second stage of credit risk assessment, it is performed the scored assessment required to determine the integral credit risk indicator. Depending on whether the calculated indicator falls within the optimal value range, its scores are based on one of four formulas. On the third stage, there is determined the integral risk indicator and the degree of credit risk. The calculation of the integral credit risk indicator is advisable to use for assessment of credit risk in dynamics. Comparing the results of evaluating this indicator during several periods, we can conclude that there is a tendency to change the level of credit risk of a bank. It is analysed the credit risk indicators of JSC CB PrivatBank for 2016—2018 years. According to the evaluation results of the integral index, the authors concluded that the level of credit risk management in the bank was improved. But the values did not reach the maximum scores, so JSC CB PrivatBank is exposed to

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credit risks. It is proposed in the research a number of measures to optimize the credit risk management of bank.

Keywords: credit risks, bank, bank financial stability, valuation model, loan portfolio, integral indicator.

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УПРАВЛІННЯ КРЕДИТНИМИ РИЗИКАМИ

В СИСТЕМІ ЗАБЕЗПЕЧЕННЯ ФІНАНСОВОЇ СТАБІЛЬНОСТІ БАНКУ

Анотація. Розглянута та модернізована модель оцінювання ризику кредитного портфеля банку. Головними параметрами кредитного портфеля банку виступають дохідність і ризик. Співвідношення вказаних показників характеризує ефективність кредитної та загальної діяльності банку. Метою управління кредитним портфелем банку є забезпечення найбільшої дохідності за припустимого рівня ризику. Оцінювання ризику кредитного портфеля доцільно здійснювати в три етапи. Перший етап полягає у використанні дев'яти показників, які безпосередньо пов'язані з виникненням кредитного ризику: коефіцієнт кредитної активності, коефіцієнт достатності резервів, коефіцієнт якості кредитів, коефіцієнт прострочених кредитів, максимальний розмір ризику на одного позичальника (або групу пов'язаних позичальників), рівень концентрації великих кредитних ризиків, рівень концентрації кредитних ризиків на одного інсайдера, коефіцієнт кредитів, списаних із резерву, коефіцієнт прибутковості кредитних операцій. На другому етапі оцінювання кредитного ризику виконується бальне оцінювання, необхідне для визначення інтегрального показника кредитного ризику. Залежно від того, чи потрапляє розрахований показник у проміжок оптимального значення, його бальна оцінка здійснюється за однією з чотирьох формул. На третьому етапі визначається інтегральний показник ризику та ступінь кредитного ризику. Розрахунок інтегрального показника кредитного ризику доцільно використовувати для оцінки кредитного ризику в динаміці. Порівнюючи результати

оцінювання цього показника впродовж кількох періодів, можна зробити висновок про тенденцію до зміни рівня кредитного ризику банку. Проаналізовано показники кредитного ризику АТ КБ «ПриватБанк» за 2016—2018 рр. За результатами оцінки інтегрального показника зроблено висновок щодо поліпшення рівня управління кредитним ризиком у банку. Але значення не досягали максимуму балів, тому АТ КБ «ПриватБанк» наражається на кредитні ризики. Запропоновано низку заходів для оптимізації управління кредитними ризиками банку.

Ключові слова: кредитні ризики, банк, фінансова стабільність банку, модель оцінювання, кредитний портфель, інтегральний показник.

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УПРАВЛЕНИЕ КРЕДИТНЫМ РИСКОМ В СИСТЕМЕ ОБЕСПЕЧЕНИЯ ФИНАНСОВОЙ СТАБИЛЬНОСТИ БАНКА

Аннотация. Рассмотрена и модернизирована модель оценки риска кредитного портфеля банка. Главными параметрами кредитного портфеля банка выступают доходность и риск. Соотношение указанных показателей характеризует эффективность кредитной и общей деятельности банка. Целью управления кредитным портфелем банка является обеспечение наибольшей доходности по допустимому уровню риска. По результатам оценки интегрального показателя сделан вывод по улучшению уровня управления кредитным риском в банке. Предложен ряд мер по оптимизации управления кредитными рисками банка.

Ключевые слова: кредитные риски, банк, финансовая стабильность банка, модель оценивания, кредитный портфель, интегральный показатель.

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Introduction. The banking system of Ukraine is in a state of restructuring today. Today there are gravely concerned before the governmental bodies of both the central bank and commercial banks the issues of effectiveness and adequacy of risk management principles and

instruments. The volumes of credit risk that the bank takes affect directly the level of financial stability. Providing the financial stability of banks is a prerequisite for the efficient functioning of the Ukrainian economy. Nowadays, the strengthening the financial stability of banks in Ukraine, their dynamic development, increasing confidence, and thus maximizing the positive impact of the banking system on economic development processes necessitate the improvement of banking activities as follows to ensure the profitability of the banking business and protection against possible risks, including credit one.

In this regard, the research of credit risk management in the system of providing the financial stability of the bank has a particular importance that determines the relevance of the chosen topic and the feasibility of conducting research to develop this issue.

Research analysis and problem statement. Issues of providing the financial stability of banks have been the subject of serious scientific research and were considered in the works of such domestic and foreign economists: G. Azarenkova, O. Baranovsky, O. Vasyurenko, V. Glushchenko, O. Golovko, S. Drobyshevsky, J. Kaminsky, V. Korneeva, M. Krupki, M. Matovnikov, N. Pogorelenko, L. Primostka, B. Samorodov and others.

The attention to credit risk management of the bank was given by such domestic and foreign scientists: N. Bobil, V. Vitlinsky, N. Volkova, P. Dadashova, V. Dzubyuk, A. Epifanov, M. Kvasniy, O. Klyusko, V. Kovalenko, V. Mishchenko, L. Ostankova, N. Pritula, L. Shvets and other scientists.

However, there are still issues that need attention and resolution. The purpose of the research is to develop recommendations for assessing the risk of the bank's loan portfolio.

Research results. Researching the work of scientists about the credit risk management [1—8], we can conclude that the main parameters of a bank's loan portfolio are profitability and risk. The ratio of these indicators determines the effectiveness of the credit strategy and the overall lending activity of the bank. The main purpose of the process of bank's loan portfolio management is to ensure maximum profitability at an acceptable risk level.

It was considered and updated for calculation a model of risk assessment of bank credit portfolio [9].

We propose to perform credit risk assessment in three stages. The first step is to use certain credit risk indicators — indicators that are directly related to the occurrence of credit risk. We propose to use the following indicators as indicators of the credit portfolio risk level:

1. K_1 — the coefficient of credit activity. Displays the share of the bank's loan portfolio in total assets and is calculated by the formula:

$$K_1 = \frac{LP}{A} \times 100\%, \quad (1)$$

Where LP — bank loan portfolio; A — total bank assets.

It is known that a bank's credit policy is passive one if the lending volume is less than 65%, but if the share exceeds 75%, then the credit policy is aggressive [42]. However, the bank independently sets the limits of this indicator depending on the chosen type of credit strategy.

2. K_2 is the reserve adequacy ratio. Indicates the degree of adequacy of the bank's reserves in case of loan repayment and is calculated by the formula:

$$K_2 = \frac{R}{LP} \times 100\%, \quad (2)$$

where P — is the reserve created for reimbursement of losses on credit operations.

The optimum value of this indicator is considered to be within the limits of 0,9 — 5% [9].

3. K_3 — quality factor of credits. It characterizes the share of bad loans in the total amount of loans and is calculated by the formula:

$$K_3 = \frac{BL}{LP} \times 100\%, \quad (3)$$

where BL — is loans classified as bad.

The lower the value of its indicator, the better is the credit portfolio. The value of the coefficient should not exceed 5%.

4. K_4 — is the ratio of overdue loans. It describes the proportion of overdue loans in total loans. It is calculated by the formula:

$$K_4 = \frac{OL}{LP} \times 100\%, \quad (4)$$

where OL are loans overdue for more than 30 calendar days, according to NBU regulations.

The proportion of overdue loans in the total loan portfolio should not exceed 10% [9].

5. K5 is the maximum amount of risk per one borrower (or group of connected borrowers). It is determined in the order established for the calculation of the obligatory standard H7 «The maximum amount of credit risk per counterparty». The regulatory value of H7 should not be more than 25% [10].

6. K6 — is the level of concentration of high credit risks, is determined in the order established for the calculation of the obligatory standard H8 «Standard of large credit risks». The regulatory value of H8 should not exceed 8 times the size of the bank's regulatory capital [10].

7. K7 — is the level of concentration of credit risks on one insider, is determined in the order established for the calculation of the obligatory standard H9 «Standard of the maximum amount of credits, guarantees and sureties given to one insider». The regulatory value of H9 should not exceed 5% [10].

8. K8 — is the ratio of loans written off from the reserve. It is characterized the share of written-off loss loans that are actually lost for the bank and is calculated by the formula:

$$K_8 = \frac{WR}{LP} \times 100\%, \quad (5)$$

where WR is the write-off of the reserve created to offset losses on the Bank's credit operations.

The optimum value for this indicator is 0,25—1,5% [11].

9. K9 — is the coefficient of profitability of credit operations. It gives an opportunity to estimate the profitability of the bank's loan portfolio and is calculated by the formula:

$$K_9 = \frac{II-IE}{3} \times 100\%, \quad (6)$$

where II — interest bank income; IE — interest expenses of the bank.

The optimum value of this indicator should be not less than 1,4%. For the upper limit of such indicator we take its maximum value for the last five years as a whole on the banking system of Ukraine, which is 7,4% [9].

For each indicator there are limits (limit values), which will allow to ensure the identification of significant credit risks for the bank and timely adequate impact on them. Therefore, since each of the indicators K_i ($i = 1, 2, \dots, 9$) has upper and lower boundary values, then we denote the lower value of K_i as LB_i and the upper one as UB_i .

Thus, we have identified 9 indicators on the basis of which it is advisable to carry out the first stage of credit risk indicators. At this stage, we calculate the values of the main (objective) indicators that characterize credit risk.

The higher the $K_1, K_3 — K_8$ ratios are, the higher is the risk level of the bank's loan portfolio. The indicators K_2, K_9 have some optimal value, which is shown in the relevant scientific papers.

According to the proposed model, for the coefficients K_1, K_2, K_9 the optimal value is in the range from $LB > 0$ to UB . For coefficients $K_3 — K_8$, the lower limit (LB) is 0 and the upper — (UB) is the maximum value. The proposed model also makes it possible to modify the set of indicators and add others if the economic, political or legal situation requires such changes.

On the second stage of credit risk assessment, a risk assessment is performed, which is necessary to determine in the future the integral credit risk indicator. The maximum score (90) is assigned to the critical value of the indicator, and in the case of the critical value interval, the extreme value of the interval.

We propose to calculate the points on the actual value of the indicator as follows: if the coefficient is lower (higher) than the critical value, we add (or subtract) the points. If the critical value is in the range of values, it is added to it the fraction (in percent), which cuts off the calculated value from the interval, and is subtracted — in case of falling beyond the interval.

On the third stage, the integral risk indicator and the degree of credit risk are determined. The credit risk integral index (ICR) is defined as the sum of points weighted by weights,

$$I_{cr} = \sum_{i=1}^n R_i \times l_i \quad (7)$$

where R_1, R_2, \dots, R_n are the indicators of calculated number of points;

l_1, l_2, \dots, l_n — weight of indicators; n — is the number of indicators.

The weight of each indicator is determined by the degree of its impact on the aggregate credit risk. In our opinion, it is advisable to use the peer review method to determine the weight of credit risk indicators. The main advantage of this method is the possibility of application in cases of information deficiency. A prerequisite for qualitative expert evaluation is the involvement of specialists with high professional level and considerable experience in banking [12].

To determine the weight of the indicators, a panel of experts is invited to rank the nine factors that determine the weight of the indicators on the principle that the indicator that most influences the aggregate risk of the credit portfolio is 9; the least affecting factor is 1, the rankings are not repeated. The null hypothesis is accepted: $H_0 = \langle \text{expert opinions agreed} \rangle$ as an alternative: $H_1 = \langle \text{expert opinions differ significantly} \rangle$.

The weighting factors (l) are calculated by the formula:

$$l_j = \frac{S_j^{(R)}}{S_{\text{total}}} = \frac{\sum_{i=1}^m d_{ij}}{\sum_{j=1}^n \sum_{i=1}^m d_{ij}}, \quad (8)$$

where d_{ij} is the estimate given by the i -th expert to the j -th indicator ($i = \overline{1, m}, j = \overline{1, n}$);

m — is the number of ranked rows, that is, the number of experts;

n — is the number of ranking objects, that is, the number of metrics;

$S_j^{(R)}$ — the sum of ranks for the j -th index;

S_{total} — is the total sum of ranks.

To assess the consistency of the experts' opinions, they use a coefficient of concordance (W). The coefficient of concordance is calculated by the formula:

$$W = \frac{S}{S_{\text{max}}}, \quad (9)$$

where S — is the variation relative to the average rank;

S_{max} — is the maximum variation value.

The maximum variation value is calculated by the formula:

$$S_{\text{max}} = \frac{1}{12} m^2 (n^3 - n), \quad (10)$$

The coefficient of variation relative to the average rank is calculated by the formula:

$$S = \sum_{j=1}^n \left(S_j^{(R)} - a \right)^2, \quad (11)$$

where a — is an indicator of the average sum of ranks.

The indicator of the average sum of ranks (a) is calculated by the formula:

$$a = \frac{1}{2} m \times (n + 1). \quad (12)$$

The coefficient of concordance takes a value from 0 to 1. The more is the value of the concordance coefficient, the higher is a degree of experts' opinions agreement. At $W = 1$, there is a complete experts' opinions agreement; if $W = 0$, then the agreement is almost absent. The degree of consistency of experts' opinions is considered acceptable if $W > 0,5$ [13].

Researching the literature [11—17] we can conclude the risk degree of the bank's loan portfolio. The integral credit risk indicator $ICR = 100$ corresponds to the bank's performance indicators, which are equal to the established critical limits. The more is the value of indicator exceeds the limit of 100 points, the less is the risk degree is observed in a bank, and vice versa. It is advisable to use the calculation of the integral indicator to estimate the credit risk in the dynamics. Comparing the results of the evaluation of this indicator over several periods, we can conclude that there is a tendency to change the level of credit risk of a bank.

It is advisable to use the calculation of the integral credit risk indicator to estimate the credit risk in the dynamics. Therefore, we will evaluate this indicator for three years — 2016, 2017 and 2018 and on this basis we will conclude the dynamics of credit risk in a bank.

In the first stage, we calculate the values of the main risk indicators of the bank's loan portfolio.

The bank's financial reporting for 2016—2018 were used to calculate the indicators. The initial data for the calculation of indicators are given in Table 1 [18, 19].

Table 1
Initial data for the calculation of credit risk indicators JSC CB PrivatBank for 2016—2018

Indicator	2016	2017	2018
Total assets (UAH million)	179833	253740	278120
Loan portfolio (UAH million)	227923	237181	291936
Credit risk reserve (UAH million)	195308	198846	241796
Bad loans (UAH million)	206498	202870	244417
Overdue loans (UAH million)	1350	1725	1562
H7 standard, (%)	14,22	5,7	6,26
H8 standard, (%)	119,35	0	0
H9 standard, (%)	2,5	1,3	0,67
Write-offs from the reserve (UAH million)	949	5864	25
Interest income (UAH million)	31560	24485	30754
Interest expenses (UAH million)	29479	18373	16758

On the second stage of credit risk assessment, a scale rate of each calculated risk indicator is performed according to the algorithm developed by us. Depending on whether the calculated figure falls within the optimal value range, its scale rate is performed by one of four formulas:

$$R_i = 100 - 100 \times \left(1 - \frac{K_i}{LB_i}\right), \quad (13)$$

$$R_i = 100 - 100 \times \left(1 - \frac{UB_i}{K_i}\right), \quad (14)$$

$$R_i = 100 + 100 \times \left(1 - \frac{K_i}{UB_i}\right), \quad (15)$$

$$R_i = 100 + 100 \times \left(1 - \frac{|2 \times K_i - (LB_i + UB_i)|}{(UB_i - LB_i)}\right), \quad (16)$$

where R_i — is an indicator of the calculated number of points;

LB_i — is the lower limit of the optimal value of risk indicator;

UB_i — is the upper limit of the optimal value of risk indicator.

Formula 13 is used to calculate the scale rate of K8 in 2018 and K9 in 2016 years;

formula 14 — for indicators K1 (2016—2018), K2 (2016—2018), K3 (2016—2018), K8 in 2017;

formula 15 — for indicators K4 (2016—2018), K5 (2016—2018), K6 (2016—2018), K7 (2016—2018);

formula 16 is used for K (2016), K9 (2017—2018).

We have calculated the score for each indicator in 2016—2018, and the results of calculating points for risk indicators are shown in *Tabl. 2* [18].

Table 2
Score rating of credit risk indicators of JSC CB Privatbank in 2016—2018

Indicator	Number of scored points		
	2016	2017	2018
Credit Activity Ratio (K1)	59,2	80,2	71,5
Reserve adequacy ratio (K2)	5,8	6,0	6,0
Credit Quality Ratio (K3)	5,5	5,8	6,0
Credit default ratio (K4)	194,1	192,7	194,6
Maximum amount of risk per one borrower (K5)	143,1	177,2	175,0
Level of concentration of high credit risks (K6)	80,7	200,0	200,0
Level of concentration of credit risks per one insider (K7)	190,0	194,8	197,3
Reserve write-off ratio (K8)	127,2	60,7	3,4
The profitability ratio of credit operations (K9)	82,7	102,0	107,4

We set weight indicators by the method of expert estimations. Expert estimations are given in the *Tabl. 3*.

To assess the consistency of expert opinions, we calculate the coefficient of concordance (W) according to the formula 9:

$$S_{\max} = \frac{1}{12} 15^2 (9^3 - 9) = 13500$$

The coefficient of variation relative to the average rank is calculated by the formula 11.

Table 3

Experts' estimations of the impact of indicators on aggregate credit risk

Expert	Experts' estimations, d_{ij}									Sum
	K_1	K_2	K_3	K_4	K_5	K_6	K_7	K_8	K_9	
1	8	6	9	5	7	1	2	3	4	45
2	9	4	7	5	6	1	2	3	8	45
3	8	6	7	4	9	2	1	3	5	45
4	8	6	9	4	7	1	2	3	5	45
5	7	5	9	6	8	1	2	3	4	45
6	8	6	9	5	3	1	2	7	4	45
7	9	6	8	5	4	1	2	3	7	45
8	8	6	9	5	7	2	1	3	4	45
9	8	5	9	6	7	1	2	3	4	45
10	8	6	9	5	7	1	2	3	4	45
11	8	6	9	5	7	1	2	3	4	45
12	9	7	5	8	4	3	6	1	2	45
13	7	6	8	5	9	1	2	3	4	45
14	8	6	9	5	7	1	2	3	4	45
15	8	3	9	5	7	2	1	4	6	45
Sum of ranks, $S_j^{(R)} = \sum_{i=1}^{15} d_{ij}$	121	84	125	78	99	20	31	48	69	675
Total rank	8	6	9	5	7	1	2	3	4	-
Deviation of the sum of ranks from a, $S_j^{(R)} - a$	46	9	50	3	24	-55	-44	-27	-6	-
Squares of deviations, $(S_j^{(R)} - a)^2$	2116	81	2500	9	576	3025	1936	729	36	11008

Let's calculate the average sum of ranks (a) by the formula 12:

$$a = \frac{1}{2} 15 \times (9 + 1) = 75$$

From the data of Table 2 we can see that the coefficient of variation concerning the average rank (S) is 11008. Let's calculate the coefficient of concordance:

$$W = \frac{11008}{13500} = 0,82$$

The calculated by us value of concordance coefficient is 0,82, that means it is more than sufficient to accept the hypothesis H0 on the agreement of experts opinion.

Based on the results of the peer review, we calculate the weight values for the credit risk indicators, which are required to calculate the bank's integral credit risk index. The weight factors (l) are calculated by the formula. According to the results of calculations, the total sum of ranks is $S_{full} = 675$.

Thus, the weight coefficients of indicators have the following values (*Tabl. 4*).

Table 4

Value of weight coefficients of credit risk indicators

Experts	Indicator									Sum
	K_1	K_2	K_3	K_4	K_5	K_6	K_7	K_8	K_9	
Weight coefficients, l	0,179	0,124	0,185	0,116	0,147	0,030	0,046	0,071	0,102	1

Calculating a score points for each risk indicator and the weight coefficients of these indicators, we can calculate the integral credit risk indicator (I_c) and conclude about the degree of credit risk in bank.

Let's calculate the value of credit risk integral score in JSC CB Privatbank for 2016, 2017 and 2018 years. For it we assume that experts' estimations about the weight of each indicator have remained constant over the three years. The calculation of I_c is given in the *Tabl. 5*.

Table 5

Calculation of integral credit risk index JSC CB «Privatbank» in 2016—2018 years

Indicator	Weigt	2016		2017		2018	
		Scored points	Weight scores	Scored points	Weight scores	Scored points	Weight scores
K1	0,179	59,2	10,6	80,2	14,4	71,5	12,8
K2	0,124	5,8	0,7	6,0	0,7	6,0	0,7
K3	0,185	5,5	1,0	5,8	1,1	6,0	1,1
K4	0,116	194,1	22,5	192,7	22,4	194,6	22,6
K5	0,147	143,1	21,0	177,2	26,0	175,0	25,7
K6	0,030	80,7	2,4	200,0	6,0	200,0	6,0
K7	0,046	190,0	8,7	194,8	9,0	197,3	9,1
K8	0,071	127,2	9,0	60,7	4,3	3,4	0,2
K9	0,102	82,7	8,4	102,0	10,4	107,4	11,0
Сума	1	888,3	84,5	1019,4	94,2	961,2	89,2

The total amount of credit score weighted on a weight coefficients consist the integral indicator of credit risk. In 2016 $I_{c\text{ was}}$ was 84,5 scores; in 2017 — 94,2 scores; in 2018 — 89,2 scores.

Conclusions. Therefore, according to the results of the evaluation of the integral indicator, we can conclude that the level of credit risk management in the bank has improved during the researching period. But the values did not reach 100 points, from that we can conclude that the Privatbank does not adhere to the regulatory limits of the above indicators. Thus, the bank is exposed to credit risks, and the management should pay more attention to the issue of credit risks.

In addition, based on the activities of domestic banking sector, we can propose a number of the following measures to optimize the credit risk management of the bank:

1. Improvement of the risk management policies. It should envisage measures to overcome the negative situations and mitigate the consequences of those that cannot be completely foreseen. The credit committee of the bank should only consider credit applications that comply with the approved risk management policy.
2. Development of internal system of banking limits. They should ensure the diversification of the credit portfolio of a banking institution by terms, industries, creditors, types of loans, territories and other factors.
3. Collection of credit risk information and the use of its rating system, which provides for:
 - development of a system of quantitative and qualitative indicators by significant risk factors;
 - determination of optimal and critical values for each credit risk factor in particular and in general;
 - development of bank standards for credit quality and compliance with regulatory requirements.
4. Creation of a real-time credit risk monitoring system with the use of special computer accounting and data analysis programs.

Thus, we consider it advisable to carry out an assessment of the level of credit risk management in the JSC CB PrivatBank in dynamics. At the same time, the proposed model allows to add or exclude indicators that affect the level of credit risk. The conducted research showed that the level of credit risk management at Privatbank is satisfactory, but needs considerable attention. The use of the aforementioned instruments should improve the credit risk management level in JSC CB PrivatBank.

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