

**BANK'S CREDIT AND INVESTMENT PORTFOLIO STRUCTURE OPTIMIZATION**

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**Methods.** The theoretical and methodological basis of the study includes the following methods: analysis and synthesis, theoretical generalization to study the process of managing the loan and investment portfolio of the bank; comparative analysis – to establish more efficient uses of the bank's financial resources; formalization (for setting the task of mathematical modeling); generalization and synthesis to substantiate the scientific approach in determining the optimal structure of the credit-investment portfolio of the bank.

**Results.** It was found that with the significant increase in bank deposits, lending to the economy continues to decline. This is facilitated by the current economic situation, which is characterized by further decline. Recovery of positive dynamics is impossible without structural changes. In the banking sector, changes are related to the development of global stock markets and investment activities of banks. A significant potential of commercial banks in intensifying investment activities is the ability to act simultaneously in two important areas – in the securities market and in the credit market, which are responsible for converting savings into investments.

**Novelty.** A strategy for managing the bank's loan and investment portfolio is proposed in order to maximize profits under different conditions of supply and demand of free banking resources ratio. An economic and mathematical model for optimizing the structure of the bank's loan and investment portfolio has been developed.

**Practical value.** The usage of economic-mathematical model to optimize the structure of the bank's loan and investment portfolio in order to maximize profits under different conditions of free banking resources supply and demand allows the bank to choose what to focus on –the securities market or credit market.

**Keywords:** credit and investment portfolio management, economic-mathematical model, target function, optimal structure, NBU standards.

**Statement of problem.** The effective functioning of Ukraine's banking system is the basis for the growth of its economy and social sphere. Therefore, increasing the efficiency of the banking sector is a priority for the progressive development of the national economy.

The main areas in which banks address involved resources for the purpose of their profitable use is the formation of balanced credit and investment portfolios.

If we consider the structure of assets of Ukrainian banks (Table 1), it can be noted that with the overall increase in bank assets by 37%, the amount of loans ranges from 963664–1118618 million UAH with the lowest amount of loans in 2021.

The share of loans in total banking assets has been declining over the last four years (from 82% to almost 53%) and this is a negative trend, which shows insufficient lending activity of banks.

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Total assets of Ukrainian commercial banks, UAH million [9]

Indicator	01.01.2018	01.01.2019	01.01.2020	01.01.2021
Assets (total)	1336358	1360764	1494460	1822814
Foreign currency assets	506533	494820	491855	585349
Total assets (unadjusted for reserves)	1848333	1911093	1982628	2209287
Total assets (not adjusted) in foreign currency	755091	778722	717422	745788
cash	44564	2029	56878	73348
bank metals	344	344	369	572
Funds in the NBU	37357	1997	76126	2002
Correspondent accounts opened with other banks	96280	86547	118221	176041
Time deposits in other banks and loans to other banks	28350	1992	1995	2037
Securities	425790	480608	538943	791345
Loans provided	1042798	1118618	1033539	963664
loans to public authorities	1517	2865	4724	11545
loans to business entities	870302	919054	822020	752503
loans to individuals	170938	196634	206761	199556
loans to non-banking financial institutions	42	66	33	60
Reserves for banks' active operations	516985	555871	492069	375459

The analysis of bank liabilities, in turn, shows a positive trend of growth of economic entities funds (more than 1.5 times), while another positive point is the growth of term funds (Table 2).

If we consider the changes in the liabilities of banks and the amount of loans, it can be noted that with the increase in liabilities of banks by 13.75% over the past four years, the amount of loans decreased by almost 18%.

Table 2

Total liabilities of Ukrainian commercial banks, UAH million [9]

Indicator	01.01.2018	01.01.2019	01.01.2020	01.01.2021
Liabilities (total)	1336358	1360764	1494460	1822814
Capital	163597	155650	200854	210640
share capital	495377	465532	470712	479932
Bank liabilities	1172761	1205114	1293606	1612174
Bank liabilities in foreign currency	613696	587929	568561	647002
Time deposits of other banks and loans from other banks	50240			
funds of business entities	403927	406166	498156	646491
including time deposits of business entities	108214	110359	103191	147871
funds of individuals	478565	508869	552592	682029
including time deposits of individuals	325411	327615	336663	344353
funds of non-banking financial institutions	22907	23794	26885	34704
including time deposits of non-banking financial institutions	15225	15224	17397	17573

Therefore, we can conclude that against the background of a significant increase in bank deposits, lending to the economy continues to decline. This is caused by the current economic situation, which is characterized by further decline. This is a decrease in the purchasing power of the population due to reduced real incomes; and complicating relations with major trading partners, and the outflow of investment.

Restoration of positive dynamics is impossible without structural changes. Structural changes are impossible without investment processes that require the restoration of financial capacity and positive expectations of domestic and foreign investors.

**Analysis of recent papers.** Issues related to the credit policy of banks and ways to optimize it were studied by such scientists as: Vasurenko O. V. [2], Vladychin U. V. [3], Vovk V. Yu. [4], Vovchak O. D. [5], Hrushko O. I., Ivanenko T. I. [6], Lavrushina O. I. [7], Liubar O. O. [8] and others. However, most research does not pay enough attention to the main ways to optimize credit and investment policy. All this indicates the relevance of the topic, and therefore led to the choice of research direction in scientific and practical aspects.

**Aim of the paper.** The purpose of this article is to improve the management of credit and investment policy of commercial banks, develop practical recommendations for improving the mechanism for optimizing the structure of the bank's loan and investment portfolio to maximize bank profits at a given level of risk with maintaining bank liquidity.

**Materials and methods.** Changes in the banking sector are related to the development of global stock markets and investment activities of banks. A significant potential of commercial banks in intensifying investment activities is the ability to act simultaneously in two important areas – in the securities market and in the credit market, which are responsible for converting savings into investments.

Referring again to table.1. it should be noted that the amount of securities in the assets of Ukrainian banks increased 1.86 times from 2018 to 2021; at the same time, its share in total banking assets increased from 31.86% in 2018 to 43.41% in 2021.

Considering the loan and investment portfolio of Ukrainian banks over the past four years,

the share of loans decreased from 71% in 2018 to 55% in 2021 with a corresponding increase in the investment part of the portfolio to 45%.

According to the consolidated financial statements provided by the main regulator of the banking system of Ukraine, the following portfolios are allocated in which securities of commercial banks can be stored [1]:

- financial assets at fair value through profit or loss (trading securities) - securities acquired by the bank for resale in order to gain profit from short-term fluctuations in its price or dealer margin;

- securities at fair value through other comprehensive income (securities for sale) – securities purchased by the bank for a short period (up to 1 year) for future resale;

- securities carried at amortized cost (securities to be repaid) – purchased debt securities with fixed or determinable payments, also with a fixed maturity;

- investments in associates and subsidiaries are investments for the purpose of participation in capital. These are long-term investments of the bank.

To optimize the loan and investment portfolio, we will determine the tasks priority that the country's economy faces.

For companies it is more important to get a loan if necessary to support their core business, so the bank has to put the speculative income from exchange rate fluctuations to the second place.

In this case, the goal function in the task of maximizing (Z) the net interest income of the loan and investment portfolio will be the following:

$$Z = Z_{loan} + Z_{sec} = \sum_{i=1}^n \sum_{j=1}^m \sum_{k=1}^K \sum_{v=1}^V \frac{P_{ij} \times X_{ij}}{100} + \frac{CS_v \times S_v}{100} - \frac{P_{li} \times Y_{li}}{100} - \frac{C_{ki} \times D_{ki}}{100} \rightarrow \max \quad (1)$$

$Z_{loan}$  – net interest income from credit operations;

$Z_{sec}$  – net interest income from securities transactions;

$P_{ij}$  – interest rate on the loan for the j –th borrower in the currency of the i-th type;

$x_{ij}$  – the amount of credit allocated to the j – th borrower in the i-th type of currency;

where  $CS_v$  – interest rate on debt securities of the  $v$ -th type;

$S_v$  – the amount of investment in securities of the  $v$ -th type;

$C_{ki}$  – interest rate on the  $k$ -th deposit in the currency of the  $i$ -th type;

$D_{ki}$  – the amount of the  $k$ -th deposit in the currency of the  $i$ -th type;

$L$  – index of the bank where the loan was taken, and  $L$  – set of supplier banks;

$Y_{il}$  – the volume of interbank credit taken in the  $l$ -th bank of the  $i$ -th type of currency;

$P_{il}$  – interest rate on interbank credit for the  $l$ -th bank in the currency of the  $i$ -th type.

At the same time, securities provide interest income, and they have one-time costs when buying them. These costs will be reimbursed with maturity.

If the task of satisfying the demand for credit resources is put at first place, its solution has the following ways:

– in case of insufficient resources – attract interbank loans,

– when the supply of resources exceeds the demand – look for the best option for investing free resources in the investment securities portfolio.

The scheme of solving this problem is presented in Fig.1.

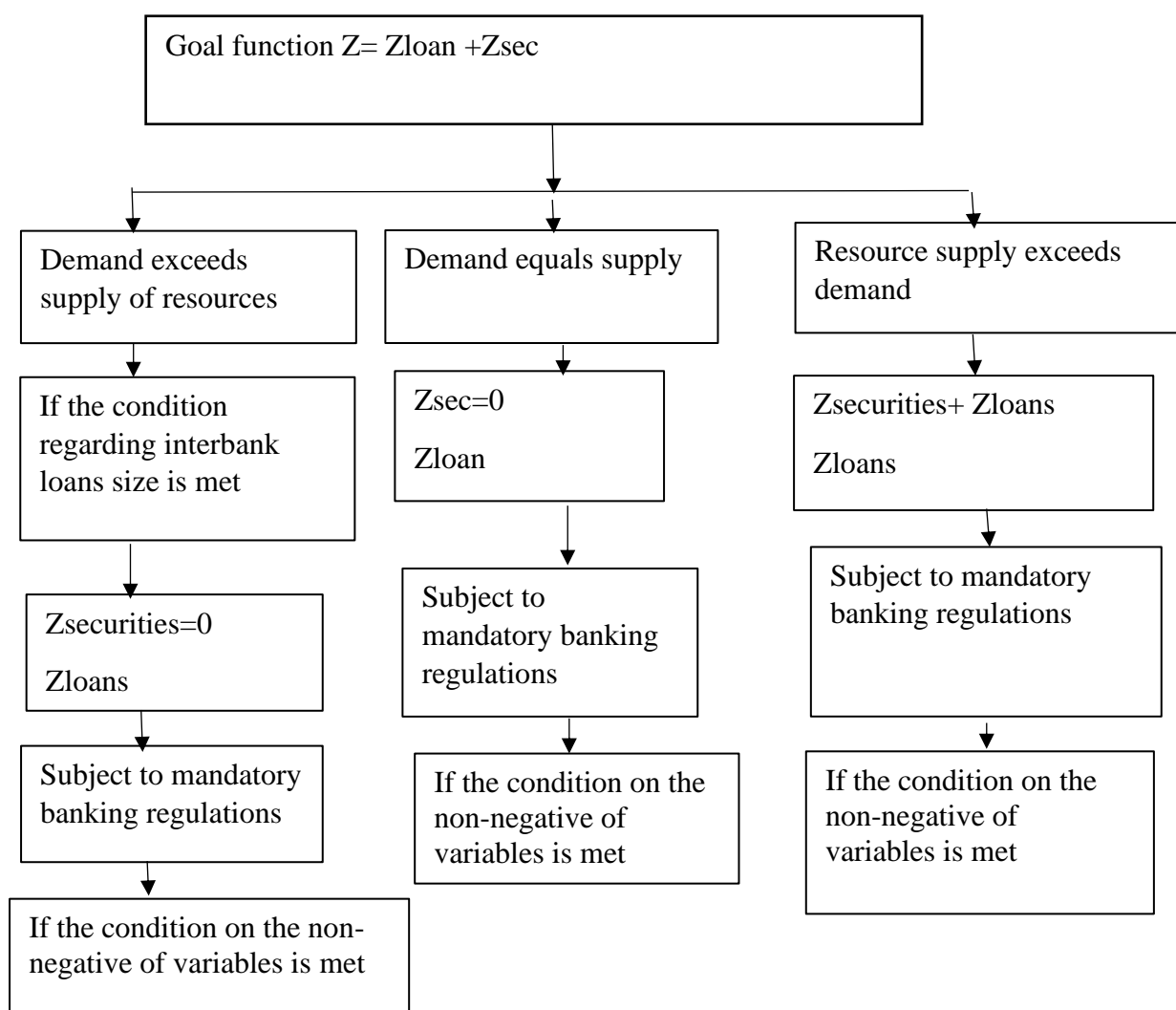


Fig.1. The scheme of solving the problem of maximizing the bank's net interest income by optimizing the bank's loan and investment portfolio

To build an economic-mathematical model of the problem, we introduce the following marking:

$b$  – offer of free financial resources of the bank;

$Q_{il}$  – the maximum possible amount of interbank credit in the  $l$ -th bank in the currency of the  $i$ -th type.

$Q_i$  – the amount of free resources of the bank in the  $i$ -th type of currency.

It is needed to find the optimal structure of the loan and investment portfolio, which will ensure the maximum profit of the bank from both credit operations and securities transactions under the following conditions:

- 1) by the amount of free resources of the bank, taking into account the interbank loan

$$\sum_{i=1}^n X_{ij} = Q_i + Q_{li} \quad i = 1 \dots \bar{n} \quad (2)$$

- 2) on the ratio of supply and demand of free financial resources

$$\text{if } \sum_{i=1}^n X_{ij} \geq b, \text{ то } Z_{\text{цп}} = 0, \quad j = 1 \dots \bar{m} \quad (3)$$

3) non-negative variables

$$X_{ij} \geq 0; \quad Y_{il} > 0 \quad (4)$$

The author of the article analyzes the credit and investment portfolio of OTP Bank in order to optimize its structure. The structure and quality of the bank's loan portfolio largely determine its stability, reputation and financial success.

Analysis of the structure of the bank's OTP loan and investment portfolio shows that the bank is increasing its funds in banks and investing in securities (Table 3).

Table 3

Investments measured at fair value through other comprehensive income [10,11,12]

Indicator	31.12.2018	31.12.2019	31.12.2020
Investments measured at fair value through other comprehensive income			
Debt securities: Government	1 133 150	3 647 425	6 710 631
Debt securities: Corporate and banking	734	730	953
Debt securities measured at fair value through other comprehensive income	1 133 884	3 648 155	6 711 584
Provision for expected credit losses	(31 664)	(35 690)	(109 327)
Total investments measured at fair value through other comprehensive income – Sv	1 102 220	3 612 465	6 602 257
Interest income on investments measured at fair value through other comprehensive income	120 349	233 685	374 216
Return on investments measured at fair value through other comprehensive income – CSv	19.92	6.47	5.67
Investments measured at amortized cost			
Government debt securities – Sva	3 677 428	7 212 296	5 901 418
Interest income on investments measured at amortized cost	366 983	433 937	540 223
Return on investment, measured at amortized cost – CSva	9.98	6.02	9.15

The analysis of Table 3 showed that the growth of investments measured at fair value through other comprehensive income by 6 times compared to 2018 provided an increase in accrued interest on them by 3.12 times, while the growth of investments measured at amortized cost in 1.5 times led to a similar increase in interest income by 1.5 times compared to 2018.

This indicates a decrease in the yield of government debt securities, which are measured at amortized cost.

Analysis of the structure of the bank's loan portfolio showed that the largest share of loans falls on loans to legal entities: from 63% in 2018 to 68% in 2020 of the total loan amount (Table 4).

The bank's loan portfolio structure [10,11,12]

Indicator	31.12.2018	31.12.2019	31.12.2020
Loans to legal entities and individual entrepreneurs	17 495 830	18 008 447	21 393 884
Consumer loans to individuals	6 106 219	7 989 370	8 197 852
Mortgage loans to individuals	3 359 928	2 420 805	1 371 488
Debts on financial lease	583 837	542 564	385 275
Loans granted under REPO transactions	184 113	696 130	-
Other loans to individuals	1 287	4 022	3 478
Total loans to clients before deducting the provision for expected credit losses	27 731 214	29 661 338	31 351 977
Expected credit losses	(5 672 162)	(4 349 945)	(3 713 784)
Excluding the provision for expected credit losses	22 059 052	25 469 028	27 797 157
Interest income on loans to clients	4 283 419	4 034 660	3 923 031
Loan portfolio yield, %	19.42	15.94	14.19

From March 10, 2020, the reserve requirements of banks depend on the currency of borrowed funds, not on their maturity, as it was before. A zero provisioning rate has been set for hryvnia funds, and 10% for foreign currency funds. This contributes to the two strategic goals of the National Bank – the intensification of bank lending and dedollarization of the economy.

In the studied bank, with the increase in the amount of loans, the reserves for covering the expected credit losses decrease annually. This change is due to a change in the reserve requirements for banks and contributes to the growth of the bank's loan portfolio. OTP Bank offers a loan program, which, depending on the terms of lending and the type of borrowers, consists of  $n = 32$  types of credit (Table 5).

Table 5

Types of loans offered by OTP Bank [10,11,12]

Type of the loan	Terms of the loan					
	Annual rate, %	Loan term, months	Loan amount, thousand UAH	Commission, %		Insurance, %
				Monthl y	One-time	
1	2	3	4	5	6	7
Loans to individuals: Product line 'Cash loan'						
1. «Prosto tak»	60	up to 36	up to 15	0	0	0.2% for repeated credit + grace period –1 month of interest-free use
2. «All inside» – for the bank's salary customers	45	up to 36	up to 50	0	0	0.2% for repeated credit + grace period –1 month of interest-free use
Express						
Standart cash						
3. Express	10	up to 36	up to 30	3.3	0	1
4. Express XXL	36	up to 36	up to 50	0.85	0	0,2

1	2	3	4	5	6	7
5. Idea challenge	10	up to 36	up to 30	3,99	0	0,5
6. Express 1000	39	up to 36	up to 20	0	5	optional
7. Big cash	36	up to 84	up to 1000	0,85	0	0,2
<b>Loyalty program</b>						
8. Big cash loyal	28.8	up to 84	up to 750	0,85	0	0,2
9. Big cash VIP – for salary clients of the bank with a salary above UAH 20,000	18	up to 84	up to 1000	0,85	0	0,2
<b>Product line «Universal»</b>						
10. XXXL for salary clients of the bank with a salary above UAH 35,000	27	up to 84	up to 1000	0	3	0,2
11. XXXL+	29,9	up to 84	up to 1000	0	3	0,2
<b>Product line «Financial vaccination»</b>						
12. Financial vaccine	39	up to 60	up to 100	0	3	0,2
13. Financial vaccine VIP	29	up to 84	up to 750	0	3	0,2
<b>Product line «New building Universal»</b>						
14. XXXL	27	up to 84	up to 1000	0	3	0,2
<b>Product line «No limits CLASSIC»</b>						
15. Money for cars and motorcycles	29,9	up to 84	up to 1000	0	3	0,2
16. Money for the car without limits FIX	0,01	3	up to 300	0	5,99	0,2 – optional
17. Money for the car without limits FIX	0,01	6	up to 300	0	9,99	0,2 – optional
18. Money for the car without limits FIX	0,01	9	up to 300	0	14,99	0,2 – optional
19. Money for the car without limits FIX	0,01	12	up to 300	0	18,99	0,2 – optional
20. Money for the car without limits FIX	0,01	18	up to 300	0	27,99	0,2 – optional
21. Money for the car without limits FIX	0,01	24	up to 300	0	33,99	0,2 – optional

1	2	3	4	5	6	7
22. No limits Grace2	29,9	up to 84	up to 750	0	6	0,2 + grace period 2 months at 0.01%
23.No limits Chal- lenge	29,9	up to 36	up to 30	0	3	0,2
Cash loans for individual entrepreneurs						
24.Cash PE loan+	36	up to 60	up to 500	0,85	-	0,2
25.Cash loan PE New	36	up to 60	up to 500	0	-	0,2
26.Cash for PE 150	36	up to 60	up to 150	0,85	-	0,2
27.Express PE Challenge	10	up to 36		3,99	-	0,2
Loans for business						
28. Overdraft «Hospitable»	14,9	up to 36	up to 15000	0,5		Note: up to 40% of account receipts. Up to UAH 5 million without collateral
29.Overdraft «In- stant»	15,9	up to 36	up to 15000	0,5		Note: up to 40% of account receipts. Up to UAH 5 million without collateral
30.Overdraft «Guaranteed pay- ments»	15,5	up to 3	up to 2500	0,2		Note: No collateral No commission
31. Financing of agribusiness «AG- ROcredit Instant»	from 12	36	up to 15 000	0,5		Note: Basic require- ments for the bor- rower: the presence of a land bank – from 400 hectares
32. Other term loans	13	up to 60	up to 400 МЛН. ГРН	1		0,2

Finding the optimal structure of the bank's loan portfolio.

The calculation used data on the bank's expenses, published in the report on financial results for 2020:

– interest expenses – 1 386 122 thousand UAH;

– commission costs – 506 572 thousand UAH;

– administrative and other operating expenses – 2 147 005 thousand UAH;

– deductions to the allowance for loan impairment – 836 210 thousand UAH

Thus, according to the results of 2020, the total amount of expenses (C) = 4,875,909 thousand UAH. For more accurate results, it is preferable to take into account only that part of the costs that are related to lending activities, but

the published financial statements do not contain such data. Suppose the bank's risk management sets the following values of shares:

$d\% = 1\%$ ,  $h\% = 50\%$ ,  $g\% = 33\%$ . High-risk loans include cash loans with a credit card, car loans for up to 7 years, mortgages for up to 20 years, consumer loans for up to 10 years, blank overdrafts and express loans without collateral.

Low-efficiency loans include those with effective rates below 15%. At the same time, the total amount of the loan portfolio does not exceed the entire resource base of the bank, according to the bank's balance sheet as of December 31, 2020, its liabilities and equity amount to UAH 27,797,157,000.

The regulatory capital of the bank as of December 31, 2020 is 8,621,466 thousand UAH,



the share capital is 6,893,567 thousand UAH, respectively. To increase the accuracy of calculations, we take into account only the share of resources that the bank intends to invest in lending operations, because from year to year the share of resources that the bank invests in securities is growing.

The calculation will be carried out under the following conditions:

– in order to ensure a sufficient level of diversification of the loan portfolio, the share of each type of loan should not be less than a certain share (d%) of the total loan portfolio.

$$X_i \geq 0.01 \times \sum_i^n X_i \quad (5)$$

– the share of loans with a repayment period of more than 5 years, blank loans, cash loans, the intended use of which cannot be controlled by the bank, must exceed the share (d) but not more than the share (h): otherwise it may worsen financial results.

$$\sum_{\sigma=1}^l X_{risk} \leq 0.5 \times \sum_i^n X_i \quad (6)$$

where  $\sigma$  – type of risky loans;

l – number of risky loans.

– excessive prudence in lending activities can lead to insufficient or even negative financial results, so the share of low-performing loans should not exceed g% of the bank's loan portfolio:

$$\sum_1^m X_j \leq 0.3 \times \sum_i^n X_i \quad (7)$$

where j – type of low-performing loans;

m – number of low-performing loans.

– the amount of all loans may not exceed the available resources of the bank, if the bank is not able to attract interbank loans.

$$\sum_i^n X_i \leq P \quad (8)$$

where P – available resources of the bank.

– constraints of the National Bank, set in the form of credit risk standards

– standard of maximum credit risk per counterparty (H7):

$$X_{ij} \leq 0,25PK \quad j = 1, \dots, v \quad (9)$$

– High credit risk ratio (H8):

$$\frac{\sum_i^n X_{ik}}{PK} \times 100\% \leq 800\% \quad k=1, \dots, s \quad (10)$$

– Standard for the maximum amount of loans, guarantees and sureties granted to one insider (H9):

$$\frac{X_{il}}{CK} \leq 0.05 \quad l=1, \dots, m \quad (11)$$

– Standard of the maximum total amount of loans, guarantees and sureties provided to insiders (H10).

$$\frac{\sum_{i=1}^n X_i}{CK} \leq 0.3 \quad (12)$$

$$\sum_{j=1}^v X_{ij} + \sum_{k=1}^s X_{ik} + \sum_{l=1}^m X_{il} = \sum_{i=1}^n X_i \quad (13)$$

$$v+s+m=n \quad (14)$$

Using the tool «Solver» of the Microsoft Office Excel environment, we find the optimal structure of the bank's loan portfolio by solving the optimization model, which is compiled using an array of data from table 5:

$$Z = 0.6X_1 + 0.45X_2 + 0.1X_3 + 0.36X_4 + 0.1X_5 + 0.39X_6 + 0.36X_7 + 0.288X_8 + 0.18X_9 + 0.27X_{10} + 0.299X_{11} + 0.39X_{12} + 0.29X_{13} + 0.27X_{14} + 0.299X_{15} + 0.01X_{16} + 0.01X_{17} + 0.01X_{18} + 0.01X_{19} + 0.01X_{20} + 0.01X_{21} + 0.299X_{22} + 0.299X_{23} + 0.36X_{24} + 0.36X_{25} + 0.36X_{26} + 0.1X_{27} + 0.149X_{28} + 0.159X_{29} + 0.155X_{30} + 0.12X_{31} + 0.13X_{32} - 4\,875\,909 \rightarrow \max$$

$$X_i \geq 0.01 \times \sum_{i=1}^n X_i$$

$$X_7 + X_8 + X_9 + X_{10} + X_{11} + X_{13} + X_{14} + X_{15}$$

$$+ X_{22} + X_{31} \leq 0.5 \times \sum_{i=1}^n X_i$$

$$X_7 + X_8 + X_9 + X_{10} + X_{11} + X_{13} + X_{14} + X_{15} + X_{22} + X_{28} + X_{29} + X_{30} + X_{31}$$

$$\leq 0.33 \times \sum_{i=1}^n X_i$$

$$X_i \leq 0.25 \times 8\,621\,466$$

$$\sum_{i=1}^n X_i = 27\,797\,157$$

The results of calculating the optimal structure of the bank's loan portfolio are shown in table 6.

Thus, the most profitable for the bank are:

– product line «Cash loan for individuals» (1. «Prosto tak», 2. «All inside», 3. Express, 4. Express XXL, 5. Idea challenge, 6. Express 1000, 7. Big Cash), as well as loans cash for individual entrepreneurs (24. Cash PE loan, 26. Cash for 150, 27. Express Challenge).

The bank has already begun to change the structure of the loan portfolio. Thus, over the last three years, the growth rate of loans to legal entities was 1.22, while the growth rate of loans to individuals was 1.34.

The rest of the loans are not so attractive for the bank, as they are either too risky or low-profitable, so their share should be 1% of the total portfolio to ensure the appropriate level of diversification.

Table 6

The results of calculating the optimal structure of the bank's loan portfolio

Variable	The value of the variable (loan amount), thousand UAH	Loan share (in% of the total loan portfolio)
X1,X2,X3,X4,X5,X6,X7	2155366,5	0.077539
X8,X9,X10,X11	277971,57	0.01
X12	406089,03	0.01461
X13,X14,X15,X16,X17, X18,X19,X20,X21,X22,X23	277971,57	0.01
X24	2155366,5	0.077539
X25	277971,57	0.01
X26,X27	2155366,5	0.077539
X28,X29,X30,X31,X32	277971,57	0.01
TOTAL	27 797 157	1

All these measures will allow the bank to receive net interest income in the amount of 7,605,238 thousand UAH.

But the share of the loan portfolio in total assets is only 47.14%. The total amount of investments measured at fair value through other comprehensive income and investments measured at amortized cost is UAH 12,503,675 thousand, accounting for 21.21% of total assets. Therefore, the next step is to optimize the bank's investment and loan portfolio in accordance with the objective function (1), which takes into account interest income from investments in securities, subject to the necessary restrictions (2-14).

$$Z = 0.6X_1 + 0.45X_2 + 0.1X_3 + 0.36X_4 + 0.1X_5 + 0.39X_6 + 0.36X_7 +$$

$$0.288X_8 + 0.18X_9 + 0.27X_{10} + 0.299X_{11} + 0.39X_{12} + 0.29X_{13} + 0.27X_{14} + 0.299X_{15} + 0.01X_{16} + 0.01X_{17} + 0.01X_{18} + 0.01X_{19} + 0.01X_{20} + 0.01X_{21} + 0.299X_{22} + 0.299X_{23} + 0.36X_{24} + 0.36X_{25} + 0.36X_{26} + 0.1X_{27} + 0.149X_{28} + 0.159X_{29} + 0.155X_{30} + 0.12X_{31} + 0.13X_{32} + 0.0915 \times CS_{va1} + 0.0567 \times CS_{v1} - 4\,875\,909 \rightarrow \max$$

At the same time, the bank's loan and investment portfolio will account for 60% of total bank assets, and net interest income will amount to 11,421,138.09 thousand UAH.

The results of calculating the optimal structure of the bank's loan portfolio are shown in table 7.

Table 7

The results of calculating the optimal structure of the bank's loan and investment portfolio

Variable	The value of the variable (loan amount), thousand UAH	Portfolio structure (in% of the total loan and investment portfolio)
The amount of loans granted	27 797 157	69
The bank's investments in securities valued at amortized cost	12 503 675	31
Total	40 300 832	100

**Conclusions.** According to the results of the study, the following conclusions can be drawn. Regarding the formation of the optimal structure of the commercial bank loan portfolio at the time of excess demand for banking resources over their supply is determined:

The most profitable for the bank are:

– product line «Cash loan for individuals» (1. «Prosto tak», 2. «All inside», 3. Express, 4. Express XXL, 5. Idea challenge, 6. Express 1000, 7. Big Cash)

– loans cash for individual entrepreneurs (24. Cash PE loan, 26. Cash for 150, 27. Express Challenge).

Other loans are not so attractive to the bank, because they are either too risky or low-profitable.

Regarding the formation of the optimal structure of the credit and investment portfolio of a commercial bank at the time of free banking resources excess over their demand, it is determined that 69% of the total portfolio should be loans to bank customers and 31% – bank investments in securities valued at amortized cost. Net interest income in this case will amount to 11,421,138.09 thousand UAH. The bank's credit and investment policy may change depending on the market situation in accordance with the bank's strategic objectives.

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## ОПТИМІЗАЦІЯ СТРУКТУРИ КРЕДИТНО-ІНВЕСТИЦІЙНОГО ПОРТФЕЛЮ БАНКУ

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**Методологія дослідження.** Теоретико-методологічну базу дослідження склали наступні методи: аналізу та синтезу, теоретичного узагальнення – для дослідження процесу управління кредитно-інвестиційним портфелем банку; порівняльного аналізу – для встановлення більш ефективних напрямів використання фінансових ресурсів банку; формалізації (для постановки завдання математичного моделювання); узагальнення та синтезу – для обґрунтування наукового підходу при визначенні оптимальної структури кредитно-інвестиційного портфелю банку.

**Результати.** Виявлено, що на фоні суттєвого збільшення банківських депозитів кредитування економіки продовжує скорочуватись. Цьому сприяє поточна економічна ситуація, яка характеризується подальшим занепадом. Відновлення позитивної динаміки неможливе без структурних зрушень.

У банківській сфері зміни пов'язані з розвитком світових фондових ринків та інвестиційної діяльності банків. Вагомий потенціал комерційних банків в активізації інвестиційної діяльності це можливість діяти одночасно у двох важливих напрямках — на ринку цінних паперів і на кредитному ринку, які відповідають за перетворення заощаджень в інвестиції.

**Новизна.** Запропоновано стратегію управління кредитно-інвестиційним портфелем банку з метою максимізації прибутку за різних умов співвідношення попиту і пропозиції вільних банківських ресурсів. Розроблено економіко-математичну модель оптимізації структури кредитно-інвестиційного портфелю банку.

**Практична значущість.** Використання економіко-математичної моделі оптимізації структури кредитно-інвестиційного портфелю банку з метою максимізації прибутку за різних умов співвідношення попиту і пропозиції вільних банківських ресурсів дає можливість банку робити вибір: де в даний момент потрібно зосередити свою діяльність - на ринку цінних паперів чи на кредитному ринку .

**Ключові слова:** управління кредитно-інвестиційним портфелем, економіко-математична модель, цільова функція, оптимальна структура, нормативи НБУ.

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