



## Research Article

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# Optimization of Credit Activity of a Commercial Bank Based on a Parametric Model

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## Abstract

*In the past few decades, a line of research focusing on the financial portfolios of banking structures has been actively developed in the world's economic science. The interest in deposit-and-loan portfolios is caused by the rapid growth of both the banking sector and the entire capital market in the world. This paper presents empirical research in the field of analysis of the credit and investment activities of a commercial bank with an extended set of criteria. The team of authors considered a certain approach to parametric modelling of the optimal banking portfolio taking into account unregulated exogenous (macroeconomic) and endogenous (set by the bank) parameters that affect its structure and composition. As part of the proposed method, a list of monitored parameters of the banking portfolio, which was developed due to financial stability and reliability indicators, was compiled. Accordingly, based on calculations with a modified parametric model and assessment of the level of their financial stability and reliability, shortcomings in the structure and composition of the portfolios of the banking organizations under research were identified with respect to the rationality of resource allocation and the adequacy of equity capital. Thus, it was concluded that taking into account the criteria for managing the banking portfolio, measures of profitability and risk, as well as the reliability of the financial and economic base and financial stability of the bank contributes to the growth of its rating and client base, which is especially important for universal commercial banks.*

**Keywords:** financial stability of a bank, reliability criteria, liquidity standards, reserve rate, CAMELS methodology, parametric model of a bank portfolio, portfolio of loan deposits

## 1. Introduction

Managing the efficiency of the banking sector is of particular interest to all players in the financial market; the relevance of this issue has increased after the 2007-2008 crisis. (Fayman *et al.*, 2019). A lot of studies have shown that after the mortgage bond crisis, banking structures have become more conservative in the allocation of financial resources and risk assessments. The management of liquidity, capital, and risks has become more responsible (Khalikov *et al.*, 2018). Systemic risks of the banking sector in the period of strong market instability have increased many times, which has become a threat to the sustainable and dynamic development of the economy as a whole.

It is quite very complex to create a deposit-and-loan portfolio. In the contemporary financial market context, they are obliged to take into account the volatile nature of either external or internal environments. This is the concept within the framework of the author's approach to modeling banking portfolios, where those volatile parameters are reproduced in both the values of the criteria and restrictions. These parameters are the regulatory standards (Bank of Russia standards) for profitability, total risk, liquidity, as well as the international banking standards (Basel II, Basel III) and banks' internal standards developed according to the deposit-and-loan portfolio strategy, taking into account the consent of the Board of Directors. An advantage of this parametric method is the possibility of taking into account new criteria and restrictions in the face of permanent changes in the context of the bank's lending and investment activities; in other words, the changed parameters can be taken into account on an accrual basis. In this regard, a parametric feature is a need for an entity to choose a numerical procedure for selecting an optimal financial portfolio. Below, the team of authors examines in more detail the concept, terminology, problem statement, model, and methods of a parametric approach to optimal management and control of a banking financial portfolio.

## 2. Literature Review

The main task of managing the efficiency of a bank is the task of optimising the banking portfolio, which is widely known in the banking practice starting with the papers of P. Rose, J. Sinka, A. Bush, M. Kleene, N. Murphy, K. Seeley, and other scientists and credit analysts. Those works can be characterised by the conclusions as follows. First, they study a banking institution as a commercial undertaking that transfers temporarily idle funds of households, corporations, individuals, and municipal entities into loans and investments in financial assets to increase the profitability and stability of activities in the capital markets (Baret *et al.*, 2020). Due to this, it can be argued that profitability, risk, and liquidity indicators can assess the banking portfolio. Secondly, the papers consider the so-called "complete" models of a banking firm, which take into account the maximum number of parameters that influence banking. Third, analysts usually investigate deterministic models, in which changes in the internal and external environment of the bank occur sporadically, or initiate a revision of the model previously used. However, contemporary banking practice can be characterised by frequent changes in these parameters, which cannot be implemented within the framework of the "classical" theory and requires new approaches.

For the purposes of this work, it is important to distinguish the concepts of 'financial reliability' and 'financial stability' of a banking organization (Zavyalova *et al.*, 2017).

In the authors' opinion, "financial reliability" characterises the bank's ability to cover all current liabilities to customers (individuals and legal entities) at the expense of its own funds and reserves, without violating liquid liabilities.

In turn, the 'financial stability' of a credit institution is understood as preserving the structure of the bank portfolio and the profitability of the credit and investment activity in the context of predicted changes in the parameters of the bank's external and internal environment.

Understanding financial stability as a sign of maintaining a stable trajectory of developing the subject of economic relations as a whole reflects the position of the authors and, in particular, in relation to the credit and investment activity of a commercial bank, which is fully sovereign both in

terms of income and risks, as well as losses (Gorskiy and Fomintseva, 2020; Gorskiy *et al.*, 2020; Gorskiy, 2019; Gorskiy and Reshulskaya, 2018).

### 3. Data and Methodology

The large-scale revocation of licenses and the critical state of many Russian private banks pose the question to their management regarding maintaining the same profitability of banking resources while maintaining a certain level of financial risk. For this purpose, analysts traditionally identify the principle of correct management of the bank portfolio as the basic one, taking into account the regulated and unregulated parameters of the external and internal environment (Zhivaikina and Peresetsky, 2017). It can be stated that parametric modeling of the banking activity is not an end in itself, but a tool for solving problematic issues, including in the banking sector (Gadzhiagaev and Khalikov, 2016; Khalikov and Antikol, 2011).

Therefore, a rational toolkit for the analysis of credit and investment activities of a separately taken reporting credit institution is relevant and necessary. Parametric approaches have great potential in this area of research. The study of the financial stability of the credit and investment activity of a commercial bank is proposed to be organized using the parametric model of the optimal bank portfolio, first introduced into consideration by Gorskiy and Khalikov (Gadzhiagaev and Khalikov, 2016; Gorskiy and Fomintseva, 2020) and modified by Gorskiy, Vyshinskaya, Gasanova, Reshulskaya, and Rudakov (Gorskiy *et al.*, 2020; Gorskiy, 2019).

This model uses the following designations for exogenous (uncontrolled) and endogenous (controlled) parameters of the external and internal environment of a commercial bank, which significantly affect the structure and composition of the portfolio of deposits and loans (Table 1).

**Table 1:** Parametric model variables and their description

Parameter	Description
$T$	time horizon for planning the bank's activities
$t$	planning period
$D_i^{(t)}$	$i$ -th deposit, valid in the time period $t$
$K_j^{(t)}$	loans and other investments of the bank in the period $t$
$I^{(t)}$	number of deposits opened by the beginning of the period $t$
$J^{(t)}$	number of loans and other investments by the beginning of the period $t$
$p_i^{(t)}$	deposit interest rate on the deposit for the period $t$
$\gamma_i^{(t)}$	lending interest rate
$\delta_i^{(t)}$	share of non-repayable loans
$r_1^{(t)}$	1 <sup>st</sup> reserve ratio
$r_2^{(t)}$	2 <sup>nd</sup> reserve ratio
$DP^{(t)}$	limit value of savings for the period $t$ , which can be placed into deposits
$EC^{(t)}$	bank's equity capital in liquid form (for the period $t$ )
$DI^{(t)}$	potential investment market capacity for the period
$S^{(t)}$	limit value for the time period $t$ of the imbalance of the credit and deposit structure of the bank
$\epsilon$	limit value of profitability of earning assets

Further, a parametric model is presented in two main versions: static one and dynamic one.

The description of the parametric model is presented in three blocks (designated by Roman numerals): clarification of the constraints on variables and balance equations; description of the key variables of the static model; description of the dynamic option.

Static (for a selected time interval) version of the model given in an earlier work by the authors (Gorskiy and Reshulskaya, 2018):

Bank deposits for the time interval  $t$ :  $D_i^{(t)} = D_i^{(t)} (\rho_i^{(t)})$ . (1)

Credits at the time  $t$ :  $K_j^{(t)} = K_j^{(t)} (\gamma_j^{(t)})$ . (2)

Balances of liabilities and assets:  $\sum_{i=1}^{I^{(t)}} D_i^{(t)} \leq DP^{(t)}$  (3),  $\sum_{j=1}^{J^{(t)}} K_j^{(t)} + EC^{(t)} \leq DI^{(t)}$ . (4)

Bank balance for the planning period  $t$ :  $\sum_{i=1}^{I^{(t)}} (1 - r_{1,i}^{(t)}) \cdot D_i^{(t)} + EC^{(t)} \geq \sum_{j=1}^{J^{(t)}} (1 - r_{2,j}^{(t)}) \cdot K_j^{(t)}$ . (5)

Control of the gap boundary of assets and liabilities subject to revaluation by a certain date:

$$\left| \sum_{i=1}^{I^{(t)}} D_i^{(t)} - \sum_{j=1}^{J^{(t)}} K_j^{(t)} \right| \leq S^{(t)}. \quad (6)$$

Taking into account the active position in the field of investment policy, the authors apply the following inequation:  $\sum_{j=1}^{J^{(t)}} K_j^{(t)} - \sum_{i=1}^{I^{(t)}} D_i^{(t)} \leq S^{(t)}$ . (7)

The model also takes into account the limit on the bank's liquidity:  $\sum_{j=1}^{J^{(t)}} (\gamma_j^{(t)} - l^{(t)}) \cdot K_j^{(t)} \geq \sum_{i=1}^{I^{(t)}} \rho_i^{(t)} \cdot D_i^{(t)}$ . (8)

It is proposed to consider the possible criteria for the credit and investment activity of a commercial bank.

The first is to maximise the interest margin without taking into account the risk of non-repayment of part of the loan obligations (Gorskiy and Fomintseva, 2020; Gorskiy *et al.*, 2020):  $F_1 = \max \left\{ \sum_{j=1}^{J^{(t)}} \gamma_j^{(t)} \cdot K_j^{(t)} - \sum_{i=1}^{I^{(t)}} \rho_i^{(t)} \cdot D_i^{(t)} \right\}$  (9), the second one – taking into account:

$$F_1 = \max \left\{ \sum_{j=1}^{J^{(t)}} \delta_j^{(t)} \cdot \gamma_j^{(t)} \cdot K_j^{(t)} - \sum_{i=1}^{I^{(t)}} \rho_i^{(t)} \cdot D_i^{(t)} \right\}. \quad (10)$$

In addition, the authors proposed to use the criterion for the maximum weighted sum of the interest margin and bank reserves (Gorskiy and Reshulskaya, 2018):  $F_2 = \max \left\{ \lambda_1 \cdot \left[ \sum_{j=1}^{J^{(t)}} \gamma_j^{(t)} \cdot K_j^{(t)} - \sum_{i=1}^{I^{(t)}} \rho_i^{(t)} \cdot D_i^{(t)} \right] + \lambda_2 \cdot \sum_{j=1}^{J^{(t)}} r_{2,j}^{(t)} \cdot K_j^{(t)} \right\}$ , (11) where:  $0 \leq \lambda_1, \lambda_2 \leq 1$ ;  $\lambda_1 + \lambda_2 = 1$ .

The specific criterion for the maximum interest margin can also be considered (with or without taking into account the risk of unliquidated obligations) per rouble of earning assets (Maximov and

$$\text{Khalikov, 2008): } F_3 = \max \left\{ \frac{\sum_{j=1}^{J^{(t)}} \gamma_j^{(t)} \cdot K_j^{(t)} - \sum_{i=1}^{I^{(t)}} \rho_i^{(t)} \cdot D_i^{(t)}}{\sum_{j=1}^{J^{(t)}} K_j^{(t)}} \right\} \quad (12)$$

Criteria (9) – (12) do not fully reflect the priorities and features of the credit and investment activity of a commercial bank, since they are focused on the selected time period and do not take into account the long-term strategy of bank portfolio management. An analysis of long-term planning is required, based on the estimates of the bank's cash flows (Rose, 2001).

The paper proposes an alternative criterion, which is the integral indicator of the present value of the accumulated interest margin (Gadzhiagaev and Khalikov, 2016; Gorskiy, 2019):  $F_4 =$

$$\sum_{t=1}^T \frac{\sum_{j=1}^{J^{(t)}} \delta_j^{(t)} \cdot \gamma_j^{(t)} \cdot K_j^{(t)} - \sum_{i=1}^{I^{(t)}} \rho_i^{(t)} \cdot D_i^{(t)}}{(1+e)^t}, \quad (13)$$

where:  $T$  is the strategic horizon;  $e$  – discount rate, taken as equal to the alternative (market) cost of the capital, allocated to loans and investments.

In case of exceeding the established strategic horizon of the number of planning periods, a restriction is added on the minimum profitability of operating assets:  $\sum_{j=1}^{J^{(t)}} (e_j^t - \varepsilon) \cdot K_j^{(t)} \geq \sum_{i=1}^{I^{(t)}} \rho_i^{(t)} \cdot D_i^{(t)}$ . (14)

In addition, it is recommended to split the sets of raised funds and loans ( $I^{(t)}$  and  $J^{(t)}$ ) into groups:  $I^{(t)} = I_1^{(t)} + I_2^{(t)}$  and  $J^{(t)} = J_1^{(t)} + J_2^{(t)}$ , where  $I_1^{(t)}$  – active deposits, in  $J_1^{(t)}$  – active loans and investments of previous periods. This separation corresponds to inequations (3) – (7), (14) and is correct (Khalikov and Maximov, 2015; Maximov and Khalikov, 2016).

III. It is proposed to move on to formalizing the dynamic version of the parametric model. The planning horizon includes several time intervals. To describe the uncertainty of future development in these periods, a number of alternative economic scenarios are used that describe the possible

states of the internal and external financial markets (Korhonen, 1987).

The authors emphasise the composition of deposits and highlight: urgent demand obligations (DS); interbank loans and promissory notes (DV) and other types of deposit funds (DP) (Khalikov and Antikol, 2011; Gorskiy, 2019).

It is suggested that  $\Delta EC^{(t)}$  is the change in the bank's equity capital on the planned interval  $t$ . It is proposed to write down the restrictions on the volume of the bank's liabilities:

$DS^{(t+1)} = DS^{(t)} + \alpha_1 \cdot \Delta EC^{(t)}$ ;  $DV^{(t+1)} = DV^{(t)} + \alpha_2 \cdot \Delta EC^{(t)}$ ;  
 $DP^{(t+1)} = DP^{(t)} + \alpha_3 \cdot \Delta EC^{(t)}$ ;  $\alpha_1, \alpha_2, \alpha_3 \geq 0, \alpha_1 + \alpha_2 + \alpha_3 = 1$ , (15) where:  $\alpha_1, \alpha_2, \alpha_3$  – the shares of profit on liabilities.

Liquid assets  $AL$  (rate of  $r_{AL}$  interest), medium and low liquid assets  $AS$  (rate of  $r_{AS}$  interest), are distinguished.

Inter-period constraints are written down:  $AL^{(t+1)} = AL^{(t)} + \alpha_1 \cdot \Delta EC^{(t)}$ ;  $AS^{(t+1)} = AS^{(t)} + (\alpha_2 + \alpha_3) \cdot \Delta EC^{(t)}$ , (16) where:  $\alpha_1, \alpha_2, \alpha_3$  – the shares of the distribution of the bank's own funds between assets, which coincide with the ones given in correlations (15).

The balance of the bank portfolio, linking the current and next time intervals, is set by the formula:  $DS^{(t+1)} + DV^{(t+1)} + DP^{(t+1)} = AL^{(t+1)} + AS^{(t+1)}$ . (17)

The dynamic model of a commercial bank includes the criterion  $F_4$  (at maximum), inter-stage (3) – (7), (14) and inter-period (15) – (17) constraints. Endogenous parameters are represented by the same list and expanded by variables of the  $\alpha_i$  group.

The indicator of financial stability of the credit and investment activity of a commercial bank, previously introduced into consideration by Gorskiy *et al.* (2020), is a linear convolution of the return on equity capital and accumulated liquidity ratios:

$$FU = \beta_1 \cdot \frac{T}{\sum_{t=1}^T EC^{(t)}} \cdot \frac{\sum_{t=1}^T \lambda_0^{(t)}}{(1+e)^t} + \beta_2 \cdot \frac{\sum_{t=1}^T \lambda_0^{(t)}}{T \cdot \max_{T=1, T} \{DS^{(t)} + DV^{(t)} + DP^{(t)}\}}, \quad (18) \text{ where: } \beta_1 \text{ and } \beta_2 - \text{convolution}$$

weights,  $\beta_1, \beta_2 \geq 0, \beta_1 + \beta_2 = 1$ .

The formula (18) includes two summands. The first one is the discounted value of the accumulated interest margin per unit of average equity capital. The second one is the quotient of accumulated liquidity and the amount of attracted investments for the considered time horizon (Khalikov and Maximov, 2017).

It is also necessary to take into account an additional limitation on the maximum liquidity gaps for the period of portfolio management:  $\lambda_0^{(t)} = \sum_{j=1}^J \delta_j^{(t)} \cdot \gamma_j^{(t)} \cdot K_j^{(t)} - \sum_{i=1}^I \rho_i^{(t)} \cdot D_i^{(t)}$ . (19)

As part of the exogenous (external) parameters of the model, the reserve ratio  $r_1^{(t)}$  and the norms of banks' liquidity, established by the Central Bank of the Russian Federation in the regulations, which will be used further, are of particular interest (On the Central Bank of the Russian Federation (Bank of Russia): Federal Law No. 86, 2002).

In addition, the model takes into account mandatory liquidity criteria, which also characterise the assessment of solvency risk, quality of assets, adequacy of equity capital, for the quality of the bank's resource base and assets (Maximov and Khalikov, 2016):

- norms of instant liquidity (N2), not less than 10%;
- norms of current liquidity (N3), not less than 50%;
- norms of long-term liquidity (N4), should not exceed 120%;

CAMELS uses the following indicators of rating assessments of the bank's reliability for individual components (Rostami, 2015; Salhuteru and Wattimena, 2015; Misra and Aspal, 2013):

Coefficients of capital adequacy ('C' – Capital adequacy) to protect the financial interests of clients.

Coefficients of asset quality ('A' – Asset quality) in terms of the degree of 'repayment' of off-balance sheet items and assets.

Coefficients of business activity ('M' – Management) for assessing the level of financial management, the efficiency of the company's management, and the potential for quality management (Gadzhiagaev and Khalikov, 2016).

Coefficients of financial stability ('E' – Earnings) to assess the adequacy of the bank's income in the context of prospective development.

Coefficients of liquidity ('L' – Liquidity) to assess the bank's ability to ensure full and timely fulfillment of its obligations.

Coefficient of sensitivity to risk ('S' – Sensitivity to risk), characterizing the degree of the bank's response to market volatility.

For this purpose, in the parametric model designed to assess and manage the financial stability of the bank's credit and investment activity, the factor of reliability of this activity, it is proposed to use the coefficients from two key sections of the CAMELS standard – capital analysis ('C') and the level of return on assets ('A') of a credit company (Rostami, 2015; Salhuteru and Wattimena, 2015; Yakimova, 2009; Takalo, 2019):

Coefficient of capital adequacy:  $K_2 = \frac{SOF}{RF}$ , where: SOF – sources of own funds; AF – the amount of attracted funds. Normative value of the coefficient: 20-30%.

The parameter is relevant for use within the parametric model, since the credit institution's own funds determine the level of protection of the funds of the company itself, counterparties, and clients cooperating with it. In the event of bankruptcy, the amount of equity capital determines the amount distributed among the owners at the time of liquidation (Bluhm *et al.*, 2010). Own funds are represented by a limited list of items in form 1 in section III of the balance sheet in line 1300 (article 13 in the Russian Accounting Standards). At the same time, the significance of the coefficient is due to its denominator, which determines the amount of funds attracted by the bank. Their number affects the level of the bank's presence in the credit market and the amount of its cash flows.

The level of return on assets (LRA) is the ratio of the overdue debt of assets that generate direct income (AI) and the total value of all assets (A):  $LRA = \frac{AI}{A}$ . Normative value: 70-90%.

The indicator is designed to assess assets in terms of profitability and efficiency. Correct redistribution of assets helps a commercial bank to generate more income with a proportional risk (Rožanova, 2017). In addition, the current criterion of financial reliability assesses the work of top management, allowing to control the balance of profitability and liquidity of own assets (Salhuteru and Wattimena, 2015).

In order to confirm the adequacy of the parametric model for assessing the financial stability of a credit enterprise, it is necessary to select the objects of research. The team of authors performed calculations of financial portfolios for three Russian commercial banks from different echelons: JSC Alfa-Bank; AKB Absolut Bank (PJSC); LLC CB Ring of the Urals (Yakimova, 2009).

JSC Alfa-Bank is owned by the Alfa-Group consortium. The key sources of funds are funds of individuals and corporate clients (LLC Information Agency 'Banki.ru', 2021). As of January 1, 2021, the volume of net assets amounted to 4.8 trillion rubles. In 2020, assets increased by 25.41%. The bank has high ratings from the leading rating agencies: S&P has given the organization a BB+ rating, and Moody's Bai confirms that the bank has the highest rating in the category of speculative transactions.

PJSC AKB Absolut Bank is a bank of the second echelon of the Russian banking sector. PJSC AKB Absolut Bank is a large bank in terms of assets; the priority areas of its activity are operations with corporate clients and medium-sized businesses (LLC Information Agency 'Banki.ru', 2021). The main sources of investment: deposits of legal entities and individuals. As of October 1, 2020, the amount of net assets of Absolut Bank amounted to 287.19 billion rubles, for the year the assets showed an increase of 3.94%. According to the information provided by Moody's agency, the bank was assigned a B2 rating, and its Russian counterpart Expert RA assigned it a ruBBB-rating, which indicates a moderate level of its creditworthiness.

LLC CB Ring of the Urals is a large regional bank controlled by the majority shareholders of the Ural Mining and Metallurgical Company (UMMC) (Korhonen, 1987). Target sources of income are deposits of the local population and corporate clients' accounts. At the beginning of 2021, the bank's net assets amounted to 42.06 billion rubles. Between 2020 and 2021, total assets increased by 4.93%. The bank has been assigned a rating of ruBBB-, which indicates acceptable credit risk.

Over the past decade, the Bank of Russia revoked the licenses of more than 300 Russian banks, which confirms the trend towards a reduction in the number of credit institutions and indicates the growing influence of exogenous factors on their activities (Perevyshina and Perevyshin, 2015). Based on the results of previous studies conducted by Gorskiy *et al.* (2020), it was found that the most 'sensitive' norms to changes in banking indicators regulated by the Bank of Russia, as well as international and domestic regulations and guidance materials, were considered to be the reserve ratio (the share of liabilities of a commercial bank on attracted deposits, which it must keep either in cash on accounts or in a deposit in the Central Bank). In the Russian Federation, the policy of mandatory reserves is regulated by two normative acts: Federal Law No. 86-FZ dated July 10, 2002 'On the Central Bank of the Russian Federation (Bank of Russia) ' and Regulation of the Bank of Russia dated December 1, 2015 No. 507-P 'On mandatory reserves of credit organizations'. The authors have determined the optimal value of the rate  $r_1^{(t)} = 4.75\%$  in order to achieve the maximum profitability of financial portfolios of commercial banks. This value will be used in further calculations.

The initial data on the structure of the portfolios of the banks, selected for calculations, and the main indicators of their financial activities as of December 1, 2020, are presented in Tables II-V.

**Table 2:** Parameters of the portfolios of JSC Alfa-Bank, AKB Absolut Bank, and LLC Ring of the Urals (Central Bank of the Russian Federation, 2021; Banking Analyst Portal, 2021)

	JSC Alfa-Bank	AKB Absolut Bank	LLC Ring of the Urals
Customer loans, thousand rubles	3,178,088,635	185,879,336	20,276,637
The amount of attracted funds, thousand rubles	3,715,123,714	208,522,774	34,166,406
Loan rate, pi (in %)	8.5	12.5	13.5
Deposit rate, yj (in %)	4	5.5	6
1 <sup>st</sup> reserve ratio, r1 (in %)	4.75	4.75	4.75
2 <sup>nd</sup> reserve ratio, r2 (in %)	from 0 to 100	from 0 to 100	from 0 to 100

**Table 3:** Structure of loan portfolios (principal amount of debt) of JSC Alfa-Bank, AKB Absolut Bank, and LLC Ring of the Urals, in million rubles (Central Bank of the Russian Federation, 2021)

Account	Group of accounts	Account name	Principal amount of debt		
			Alfa-Bank	Absolut Bank	Ring of the Urals
45107	Loans provided to non-governmental financial institutions	for a period from 1 to 3 years	44,132.663	985.912	302.959
45201		Loan provided in case of insufficient funds on the settlement (current) account ("overdraft")	20,170.831	335.131	22.977
45204		for a period from 31 to 90 days	14,222.475	2244.146	116.91
45205		for a period from 91 to 180 days	72,950.866	6812.871	1550.806
45206		for a period from 181 days to 1 year	205,969.054	6422.93	3494.986
45207		for a period from 1 to 3 years	333,691.443	1554.237	217.05
45208		for a period over 3 years	802,491.288	4836.989	801.83
45401		Loans and other funds provided to individual entrepreneurs	Loan provided in case of insufficient funds on the settlement (current) account ("overdraft")	1161.281	4.622
45406	Loans for a period from 181 days to 1 year		1736.672	0	5.5
45407	Loans for a period from 1 to 3 years		1892.131	0	0
45504	Loans and other funds provided to individuals	Loans for a period from 91 to 180 days	568	0	0
45505		Loans for a period from 181 days to 1 year	972.89	2.613	459.218
45506		Loans for a period from 1 to 3 years	24,704.762	69.695	115.802
45507		Loans for the period over 3 years	597,793.637	85,643.655	6003.04
45509		Loan provided in case of insufficient funds on the deposit account ("overdraft")	8133.59	56.069	26.932
47101		on demand	178,264.407	1.217	0
47801	Investments in the acquired rights of claim	Rights of claim under contracts for the provision (placement) of funds, the fulfillment of obligations under which is secured by a mortgage	1351.752	3377.877	0

**Table 4:** The structure of loan portfolios (overdue debt) of JSC Alfa-Bank, AKB Absolut Bank, and LLC Ring of the Urals, in million rubles (Central Bank of the Russian Federation, 2021)

Account	Group of accounts	Account name	Overdue debt		
			Alfa-Bank	Absolut Bank	Ring of the Urals
45107	Loans provided to non-governmental financial institutions	for a period from 1 to 3 years	24,258.691	1554.237	290.908
45201		Loan provided in case of insufficient funds on the settlement (current) account ("overdraft")	128.947	4.622	28.225
45204		for a period from 31 to 90 days	419.537	126.2	4
45205		for a period from 91 to 180 days	9426.768	1978.458	98.65
45206		for a period from 181 days to 1 year	3702.257	468.418	212.31
45207		for a period from 1 to 3 years	4736.62	11.524	265.585
45208		for a period over 3 years	36,316.855	4836.989	852.972
45401	Loans and other funds provided to individual entrepreneurs	Loan provided in case of insufficient funds on the settlement (current) account ("overdraft")	460	30	18.826
45406		Loans for a period from 181 days to 1 year	422.135	8.372	5.15
45407		Loans for a period from 1 to 3 years	188.446	0	0
45815	Loans and other funds provided to individuals	Provided to individuals	53,193.625	874.535	87.627
45817		Provided to non-resident individuals	141.339	0.006	0.007
47801	Investments in acquired rights of claim	Rights of claim under contracts for the provision (placement) of funds, the fulfillment of obligations under which is secured by a mortgage	0.699	0.446	0

**Table 5:** Structure of deposit portfolios of JSC Alfa-Bank, AKB Absolut Bank, and LLC Ring of the Urals, million rubles (LLC Information Agency 'Banki.ru')

Account	Group of accounts	Account name	Account balance		
			Alfa-Bank	Absolut Bank	Ring of the Urals
42301	Deposits and other funds raised from individuals	Demand deposits	8258.104	291.592	250.953
42304		Deposits for a period from 91 to 180 days	12738.82	3483.37	0
42305		Deposits for a period from 181 days to 1 year	186,095.703	15,735.318	0
42306		Deposits for a period from 1 to 3 years	84,166.525	85,627.613	0
42307		Deposits for a period over 3 years	0	257.333	16,783.587
42601	Deposits and other funds raised from non-resident individuals	Demand deposits	167.082	3.321	0.368
42604		Deposits for a period from 91 to 180 days	427.397	11.638	0
42605		Deposits for a period from 181 days to 1 year	1777.588	25.536	0
42606		Deposits for a period from 1 to 3 years	1171.519	262.635	0
42607		Deposits over 3 years	0	0.252	9.954

It is noted that loan portfolios have a different structure. Alfa-Bank qualitatively diversifies its own loans and advances, has a secured credit and investment portfolio. At Absolut Bank, the main share of loans falls on loans to legal entities and long-term advances to individuals. LLC CB Ring of the Urals expects a return on medium-term loans and credits to individuals with a period of 3 years or more.

With regard to deposits, the following trends were noted. Banks of the third echelon are trying to attract funds for the long term in order to maintain the planned level of cash flows, while taking on increased risk. Larger banking structures are trying to pay more attention to the deep diversification of the portfolio of attracted funds in order to minimise credit risk (Derevyanko *et al.*, 2017, Shim, 2019). In addition, deposits of individuals from all three credit institutions account for about half of

the total volume of deposits.

#### 4. Results

A sequential analysis of the portfolios of the selected banks is conducted for the reporting year 2020 for various lending and deposit rates.

The values of the target criteria (10) – (12) are calculated for the static version of the parametric model at the same rate of mandatory reserve and the discount rate equal to 5% (Table VI).

**Table 6:** Values of optimality criteria for the credit and investment activity of JSC Alfa-Bank, AKB Absolut Bank (PJSC), and LLC Ring of the Urals

	Alfa-Bank	Absolut Bank	Ring of the Urals
$F_1$ , in thousand rubles	63,613,340.7	4,186,835.5	198,233.7
$F_2$ , in thousand rubles	60,848,220.6	3,102,116.7	277,578.9
$F_3$ , in %	0.026	0.034	0.028
$F_4$ , in thousand rubles	60,584,134.0	3,797,583.2	171,241.7

Conclusion: credit institutions have a sufficient interest margin, since there is the coefficient  $F_3 > 0.2\%$  for each of them. The calculations also confirm the high level of interest margin per rub. of profitable assets, which indicates the stable functioning of banks.

The next step is to analyze the key parameters of banks' credit activity:  $V^{(t)}$ ,  $Y^{(t)}$ ,  $P^{(t)}$ ,  $k2^{(t)}$  (loan portfolio volume, repayment volume for previously placed loans, the amount of overdue debt, the ratio of overdue debt (Table VII).

**Table 7:** Estimated values  $V^{(t)}$ ,  $Y^{(t)}$ ,  $P^{(t)}$  for JSC Alfa-Bank, AKB Absolut Bank, and LLC Ring of the Urals in 2020

	Alfa-Bank	Absolut	Ring of the Urals
$V^{(t)}$ , in million rubles	2,434,803.66	122,241.77	17,978.877
$Y^{(t)}$ , in million rubles	348,633.97	18,493.46	1557.02
$P^{(t)}$ , in million rubles	133,395.91	9893.81	1859.0
$k2^{(t)}$ , %	5.48%	8.09%	10.34%

Despite the high volatility of financial markets and multidirectional credit and investment activity, banks have demonstrated high asset manageability and an acceptable level of bankruptcy risk. The share of overdue debt for the crisis year 2020 is insignificant, although it needs to be adjusted, since a value less than 10% of the total debt is desirable.

It is suggested to analyze the values of banks' liquidity indicators in 2020 (in comparison with the Central Bank standards), which will allow assessing the levels of their solvency (Table VIII).

**Table 8:** Values of mandatory liquidity norms for JSC Alfa-Bank, AKB Absolut Bank (PJSC), and LLC Ring of the Urals, in % (Banking Analyst Portal, 2021)

	Alfa-Bank	Absolut	Ring of the Urals
$N_2$	91.42	96.29	52.95
$N_3$	104.28	150.72	126.18
$N_4$	54.40	46.38	23.38

Using the methodology for analyzing the financial condition of the bank, approved by the Central Bank of Russia and Bank Directives dated January 16, 2004 No. 1379 (On the Central Bank of the

Russian Federation (Bank of Russia): Federal Law No. 86 (2002), it was revealed that the studied commercial banks were financially stable as part of the procedure for participating in the deposit insurance system.

At the final stage, the financial reliability of banks will be assessed using the coefficients selected above for the analysis from the CAMELS standard (Table IX).

**Table 9:** Values of CAMELS criteria for the reliability of financial activities of JSC Alfa-Bank, AKB Absolut Bank (PJSC), and LLC Ring of the Urals, in % (Banking Analyst Portal, 2021)

	Alfa-Bank	Absolut Bank	Ring of the Urals
$K_2$	15.44	15.4	15.95
LRA	85.28	84.61	80.36

Diversifying the credit and investment portfolio has a positive effect on the financial stability of a banking organization. According to Shim (2019), deep diversification of the loan portfolio, other things being equal, ensures the priority of a commercial bank in terms of financial stability.

Taking into account the values of the calculated reliability indicators from the CAMELS standard, the following can be stated: the structures of financial portfolios do not meet the capital adequacy norms. Thus, all the studied banks have a high level of earning assets, but it is possible to adjust the LRA parameter when the amount of cash of organizations that fall under the conditions of mandatory bank reserves at the rate  $r_1^{(t)} = 4.75\%$  changes. This is ensured by the diversification of banks' deposit resources.

In addition, it is necessary to reduce overdue debt based on the reallocation of funds in the portfolio, taking into account the average rates of credits and deposits.

The improved structures of the credit and investment portfolios of commercial banks are presented in Tables X, XI.

**Table 10:** Modified structure of loan portfolios (principal amount of debt) of JSC Alfa-Bank, AKB Absolut Bank (PJSC), and LLC Ring of the Urals, in million rubles

Account	Group of accounts	Account name	Principal amount of debt		
			Alfa-Bank	Absolut Bank	Ring of the Urals
45107	Loans provided to non-governmental financial institutions	for a period from 1 to 3 years	44,132.66	985.912	302.959
45201		Loan provided in case of insufficient funds on the settlement (current) account ("overdraft")	20,170.831	1335.131	272.977
45204		for a period from 31 to 90 days	14,222.475	2244.146	616.91
45205		for a period from 91 to 180 days	72,950.866	6812.871	1550.806
45206		for a period from 181 days to 1 year	205,969.054	6422.93	3494.986
45207		for a period from 1 to 3 years	333,691.443	2554.237	717.05
45208		for a period over 3 years	802,491.288	4836.989	891.83
45401		Loans and other funds provided to individual entrepreneurs	Loan provided in case of insufficient funds on the settlement (current) account ("overdraft")	6161.281	254.622
45406	Loans for a period from 181 days to 1 year		6736.672	250	30.5
45407	Loans for a period from 1 to 3 years		6892.131	250	25.00
45504	Loans and other funds provided to individuals	Loans for a period from 91 to 180 days	50568	2500	250.00
45505		Loans for a period from 181 days to 1 year	50,972.89	5002.613	959.218
45506		Loans for a period from 1 to 3 years	74,704.76	5069.695	1615.802
45507		Loans for a period over 3 years	447,793.64	73,143.655	4753.04
45509		Loan provided in case of insufficient funds in the deposit account ("overdraft")	8133.59	306.069	276.932
47101		on demand	178,264.407	1.217	0
47801	Investments in the acquired rights of claim	Rights of claim under contracts for the provision (placement) of funds, the fulfillment of obligations under which is secured by a mortgage	1351.752	3377.877	0

**Table 11:** Modified structure of loan portfolios (overdue debt) of JSC Alfa-Bank, AKB Absolut Bank, and LLC Ring of the Urals, in million rubles

Account	Group of accounts	Account name	Overdue debt		
			Alfa-Bank	Absolut	Ring of the Urals
45107	Loans provided to non-governmental financial institutions	for a period from 1 to 3 years	24,258.691	1554.237	290.908
45201		Loan provided in case of insufficient funds on the settlement (current) account ("overdraft")	128.947	254.622	28.225
45204		for a period from 31 to 90 days	419.537	376.2	4
45205		for a period from 91 to 180 days	9426.768	1228.458	83.65
45206		for a period from 181 days to 1 year	3702.257	718.418	112.31
45207		for a period from 1 to 3 years	4736.62	1011.524	265.585
45208		for a period over 3 years	26,316.855	3836.989	702.972
45401	Loans and other funds provided to individual entrepreneurs	Loan provided in case of insufficient funds on the settlement (current) account ("overdraft")	460	30	18.826
45406		Loans for a period from 181 days to 1 year	422.135	8.372	5.15
45407		Loans for a period from 1 to 3 years	188.446	0	0
45815	Loans and other funds provided to individuals	Provided to individuals	48,193.625	624.535	72.627
45817		Provided to non-resident individuals	141.339	250.006	15.007
47801	Investments in the acquired rights of claim	Rights of claim under contracts for the provision (placement) of funds, the fulfillment of obligations under which is secured by a mortgage	0.699	0.446	0

In portfolios of loans and advances of commercial banks, it is necessary to increase the overall level of assets that make a profit. As an option, the following portfolio modification strategies were proposed, taking into account the increase in the total number of short-term and medium-term debt obligations in order to minimise the credit risks of commercial banks (Fayman *et al.*, 2019).

For Alfa-Bank, in the section of loans provided to legal entities, a high diversification of assets is observed, which makes it possible to assert that it is inexpedient to change the items. In the section of loans intended for individual entrepreneurs, it is proposed to increase lending by 5 billion rubles. In the group of accounts 'Loans and other funds provided to individuals', the following reallocation of funds is possible: a decrease in long-term loans by 150 billion rubles and a uniform increase in loans up to 3 years evenly in three items by 50 billion rubles. In terms of overdue debt, it is recommended to reduce loans in the items numbered 45208 and 45817 by 10 and 5 billion rubles, respectively.

The commercial bank Absolut Bank may have amendments in terms of lending to non-governmental enterprises, where each of the following accounts is increased by 1 billion rubles: overdraft loans; loans for a period of 1 to 3 years. In the section for loans to individuals, it is recommended to add a total of 750 million rubles. With regard to loans to individuals, a certain diversification is required: it is possible to reduce the issuance of loans for a period of more than 3 years by 12.5 billion rubles, while transferring these funds to neighboring items by the same amount. With regard to the volumes related to overdue debt, the following steps can be taken: reduction of item 45206 by 1.5 billion rubles and an increase in items 45201, 45204, and 45206 by 250 million rubles each. Then it is required to apply a similar action to the items relating to loans of 1 year or more, in the amount of 1 billion rubles. The last stage in improving the loan portfolio is the reallocation of funds in the amount of 250 million rubles, between the accounts 45815 and 45817.

A different strategy is proposed for the loan portfolio of the CB Ring of the Urals. With regard to loans provided to financial institutions in the private sector, it is necessary to increase the accounts by a total of 1.25 billion rubles. In addition, the items should be increased by 25 million rubles, related to lending to individual entrepreneurship. In the group of accounts 'Loans and other funds provided to individuals', it is recommended to diversify resources: a decrease in long-term loans by 1.25 billion rubles and an increase in short-term and medium-term loans by the same amount. Additionally, it is planned to increase loans in this section ('overdraft') in the amount of 250 million rubles. As for the items of the loan portfolio related to the bank's overdue debt, it is required to reduce loans to private

companies by 265 million rubles. The second step is to reduce lending to resident individuals by 15 million rubles, while allocating the same money to non-resident individuals.

To improve the CAMELS criterion – the LRA ratio, it is proposed to reduce the amount of cash at each of the credit institutions so that these amounts would meet the regulator's norms reflected in the mandatory reserve rate equal to 4.75%. The following corrections were proposed in the form of reductions: for JSC Alfa-Bank by 75 billion rubles; for AKB Absolut Bank by 1.5 billion rubles; for LLC Ring of the Urals by 500 million rubles.

Due to these actions, the commercial banks will significantly improve their lending positions, which is confirmed by updated financial indicators (Table XII).

**Table 12:** Updated financial indicators of the credit and investment activity of commercial banks

	Alfa-Bank	Absolut	Ring of the Urals
$V^{(t)}$ , in million rubles	2,440,603.65	125,241.77	19,553.877
$Y^{(t)}$ , in million rubles	349,464.458	18,947.318	2696.417
$P^{(t)}$ , in million rubles	118,395.919	9143.807	1594.0
$k2^{(t)}$ , %	4.85%	7.34%	8.26%
Assets that generate direct income, thousand rubles	4,014,019,654	238,743,325	33,636,293
Cash, thousand rubles	366,908,239	16,425,039	3,763,056
Total volume of assets, thousand rubles	4,624,808,616	278,014,897	39,726,104
The level of the bank's reserves in national currency, in %	7.93%	5.91%	9.47%
CAMELS criterion (LRA)	86.79%	85.87%	84.67%

It is also required to correct bank portfolios in terms of deposits of individuals. All commercial banks have a coefficient  $K_2 < 20\%$ , which indicates the urgency of such a correction. The proposed changes are taken into account in the improved structure of banks' deposit portfolios (Table XIII).

**Table 13:** Improved structure of deposit portfolios of JSC Alfa-Bank, AKB Absolut Bank, and LLC Ring of the Urals, million rubles

Account	Group of accounts	Account name	Account balance		
			Alfa-Bank	Absolut	Ring of the Urals
42301	Deposits and other funds raised from individuals	Demand deposits	8258.104	291.592	250.953
42304		Deposits for the period from 91 to 180 days	17,738.82	3983.37	850
42305		Deposits for a period from 181 days to 1 year	151,095.703	13,235.318	850
42306		Deposits for a period from 1 to 3 years	69,166.525	70,127.613	850
42307		Deposits for the period over 3 years	2500	1757.333	8283.587
42601	Deposits and other funds raised from non-resident individuals	Demand deposits	167.082	3.321	0.368
42604		Deposits for the period from 91 to 180 days	427.397	11.638	50
42605		Deposits for a period from 181 days to 1 year	1277.588	75.536	50
42606		Deposits for a period from 1 to 3 years	1171.519	162.635	50
42607		Deposits for the period over 3 years	250	0.252	9.954

For Alfa-Bank, it is proposed to increase the volume of deposits by 5 billion rubles in account 42304

and a decrease in the amount of 35 billion rubles in account 42305. In the section of attracted funds related to residents, deposits for a period of 1 to 3 years were reduced by 15 billion rubles and the volume of long-term deposits was increased by 2.5 billion rubles. At the same time, short-term deposits for the period up to 1 year from residents were adjusted downward by 500 million rubles and long-term deposits were increased by the amount of 250 million rubles.

As for the commercial bank Absolut, it was proposed to increase item 42304 by 0.5 billion rubles, to reduce deposits with the duration from 181 days to 1 year by 2.5 billion rubles. It is suggested to reduce medium-term deposits by 15.5 billion rubles, while adding evenly 500 million rubles to short-term and long-term deposits for residents. For non-residents, it was proposed to reduce deposits for a period from 181 days to 1 year by 100 million rubles and add 50 million rubles to deposits from 1 to 3 years.

For CB Ring of the Urals in the section 'Deposits and other funds raised from individuals', it was proposed to increase the funds for accounts 42304, 42305, and 42306 in the amount of 850 million rubles. In addition, in this section, it is necessary to reduce long-term deposits by 8.5 billion rubles. It is recommended to evenly increase the deposit portfolio of non-resident individuals by 50 million rubles, except for the items 'Demand deposits' and 'Deposits for the period over 3 years'.

To improve the capital adequacy criterion, a strategy for increasing the sources of own funds is proposed by increasing the reserve funds and authorised capital at the expense of additional proportional contributions of the co-founders. Thus, the following increases are required: for JSC Alfa-Bank – by 136 billion rubles; for PJSC Absolut Bank – by 4.35 billion rubles; for LLC CB Ring of the Urals – by 350 million rubles. With regard to the reserve accumulations of banks: 25 billion rubles – for JSC Alfa-Bank; 1.4 billion rubles – for PJSC Absolut Bank; 77 million rubles – for LLC Ring of the Urals (Table XIV).

**Table 14:** Updated financial indicators of attracted funds for the considered commercial banks

	Alfa-Bank	Absolut Bank	Ring of the Urals
All attracted funds, thousand rubles	3,672,463,714	192,472,774	28,366,406
Sources of own funds, thousand rubles	734,480,661	38,497,112	5,673,457
Authorized capital, thousand rubles	195,587,623	13,742,407	2,350,000
Reserve fund, thousand rubles	27,979,381	1,869,620	197,866

As a result of the proposed adjustments, the capital adequacy ratio of all analyzed banks increased and became equal to 20%.

The obtained financial results make it possible to predict the sustainable development of the credit and investment activity of the examined commercial banks in the medium-term perspective.

## 5. Conclusion

Parametric modeling of the credit and investment activity of commercial banks is aimed at choosing its optimal options according to the criteria of financial stability and reliability and taking into account restrictions on the amount of equity capital, reserves, the quality of working assets that meet the requirements of the regulator, international and internal standards, as well as the bank's strategy in the areas of corporate and retail lending and investing in real and financial assets. The advantage of the parametric approach to modeling a banking enterprise is the possibility of a quick assessment and subsequent correction of the bank portfolio based on the analysis of the impact on its structure and composition of unregulated parameters of the external environment, which initiates a significant part of the uncertainty and risks of banking activities, as well as in the mentioned areas, which play a key role in ensuring the profitability and investment attractiveness of the bank.

The work also shows other positive aspects of parametric modeling of the banking activity. In particular, an example is given of expanding the functionality of the model, originally proposed for

use in managing the financial stability of a bank, by the task of choosing the optimal portfolio of deposits and loans, taking into account the restrictions on the bank's reliability, determined within the framework of the CAMELS standard.

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