FORMATION OF THE BUDGET OF INCOMES AND EXPENSES FROM DEPOSIT AND CREDIT OPERATIONS IN COMMERCIAL BANK BUDGETING

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Keywords: budgeting, the budget of incomes and expenses, monetary resources, commercial bank, deposits, credits, the credit organization, the monetary market, model, reserve fund, interest rate.

Budgeting is the distributed control system of activity of divisions of bank in time. In article the model of one of the most important parts of budgeting - model of formation of the budget of incomes and expenses of commercial bank is presented at realization of deposit and credit operations which are one of the basic directions of work of commercial banks.

A commercial bank is a complex enough structure which performs a set of various operations. Serious changes in the Russian economy have made the budgeting problem transform from the technology of management to a pressing need of effective work of the credit organization. Budgeting represents the process of planning and the account of actual results of the activity of a bank for the accounting period (the budgeting period).

To solve this problem it is necessary to consider the structure of the budget of a commercial bank. In figure 1 the typical structure of the budget of a commercial bank is represented. Budgets should correspond to the bank structure.

There are a number of the mathematical models describing bank activity which can be used for budgeting. It is possible to allocate two basic groups of models - the private and the full bank models. Full models of budgeting use the complex approach, while private models allow analyzing separate budgets of the bank. In this work private models of forming the budget of incomes and expenses will be considered

The purpose of budgeting of any commercial bank is reception of a maximum of profit. In figure 2 the scheme of forming the budget of

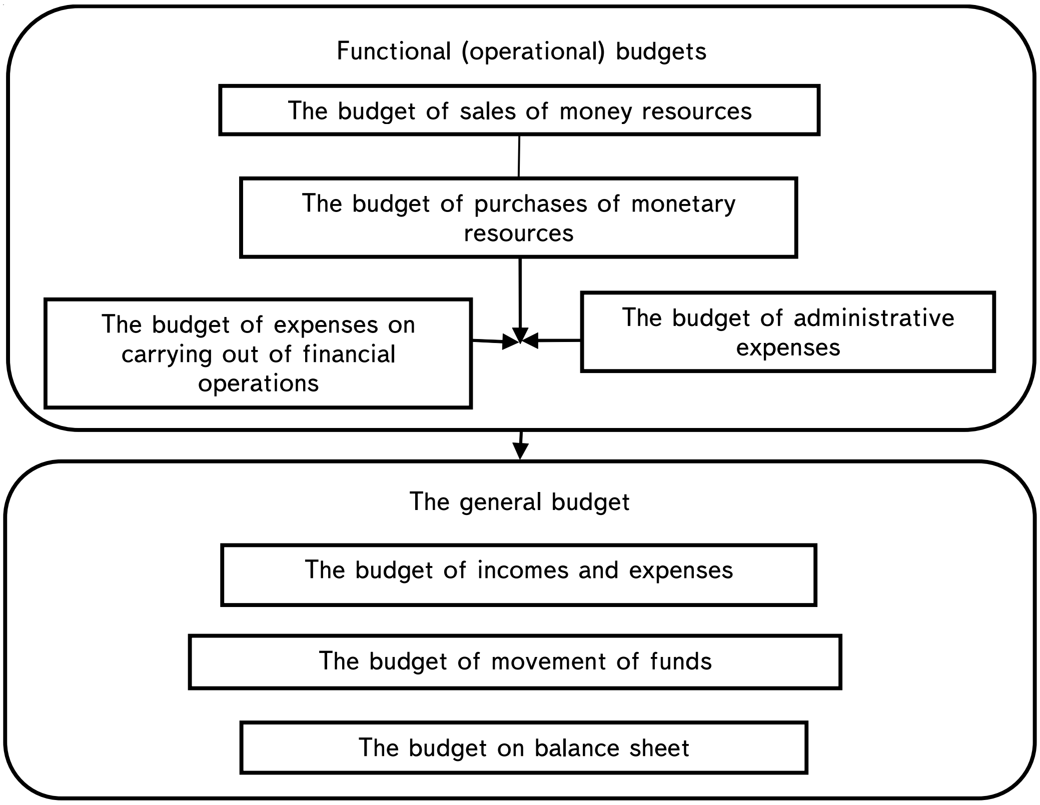

Fig. 1. **Typical structure of the budget of commercial bank**

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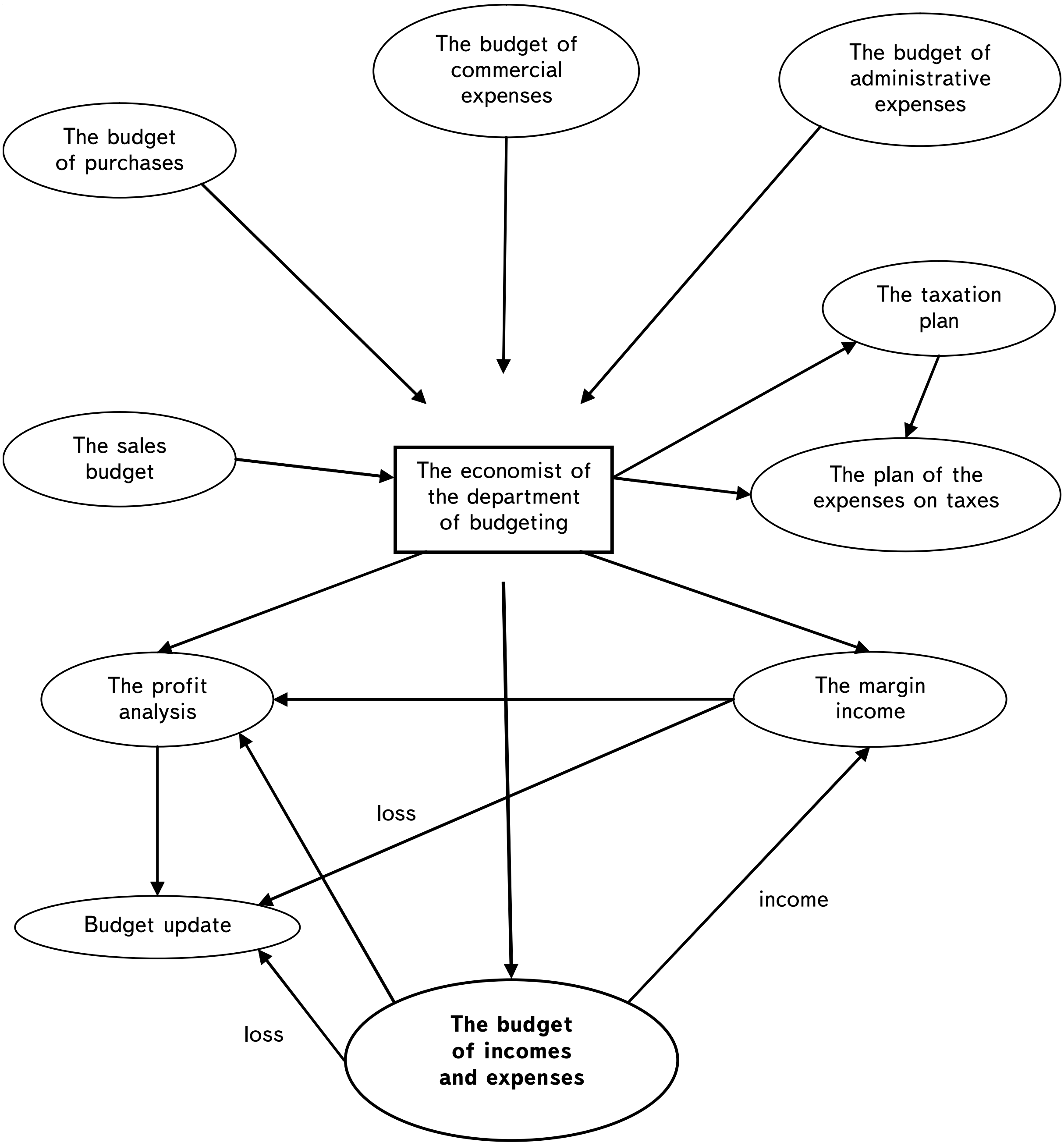

Fig. 2. **The scheme of forming the budget of incomes and expenses of commercial bank**

incomes and expenses of a commercial bank is presented.

Let's assume the basic designations:

x is the planned volume of deposits of a commercial bank;

is the planned volume of credits of a commercial bank;

is the interest rate;

- The deposits interest rate;

τ - Term on which money resources take places;

- Volume of demand for credits from outside borrowers in the credit market;

Π is the volume of investors of monetary resources from outside the depositary market.

The basic mathematical model can be presented as follows:

$$OD(y) = \tau(\alpha - \beta) y \xrightarrow[y \in X]{} \max,$$

where $X = \{(y, x) | y = x \le \min(A, \Pi)\}$ is the admissible set of the planned values of volumes of budgets of the resources.

The solution to problem (1) is reduced to a simple equation:

$$\overset{0}{x} = \overset{0}{y} = \min[A, \Pi] \cdot$$

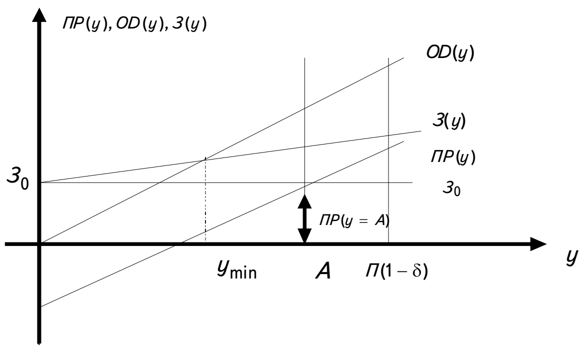

Fig. 3. **The dependence of the operational income and profit on credit volume for the linear function of expenses**

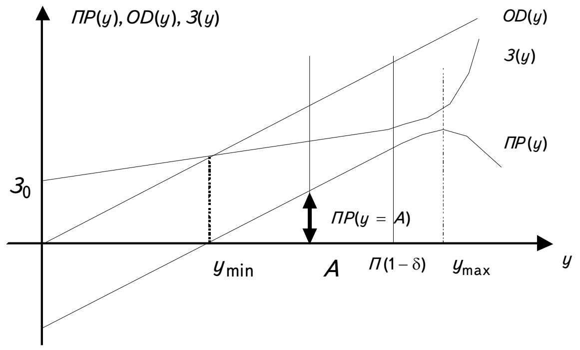

Fig. 4. **The dependence of the operational income and profit on credit volume for the nonlinear function of expenses**

Model (1) characterizes the behavior of the manager of a bank in his aspiration to receive the maximum operational income and provides the solution concerning the planned volumes of deposits and their use in credits.

However, while involving some kinds of deposits, for example the deposits of the clients, their part under specification δ distracts on the formation of the reserve fund in CBRF. Then the mathematical model can be as follows:

$$OD(y) = \tau\left(\alpha - \frac{1}{1-\delta}\beta\right) y \xrightarrow[y \in X]{} \max,$$

where $X = \{y \mid y \le \min(A, (1-\delta)\Pi)\}$ is the planned set of admissible values of the credit budget.

The solution to this model is to plan the optimum volume of the credit from the following simple equation:

$$y = \min\{A, (1-\delta)\Pi\}.$$

In the formalized kind the problem of optimum formation of the budget is described by the following model of the choice of optimum control:

$$\Pi P(y,x) = OD(y,x) - З(y,x) \xrightarrow[y,x \in X]{} \max,$$

where $X = \{(x,y) \mid y \le \min(A, (1-\delta)\Pi),\ y = (1-\delta)x\}$ is the planned volumes of the loans offered by a bank, and is the expenses.

For a case of linear expenses the gain of the operational income is higher than gain of expenses, i.e.

$$\frac{\partial OD(y)}{\partial y} > \frac{\partial З(y)}{\partial y}.$$

For a case of nonlinear expenses this inequality is observed to a point of $y = y_{max}$. In this point the profit reaches the maximum value, and the inequality (5) becomes equality, i.e:

$$\frac{\partial OD(y_{max})}{\partial y} = \frac{\partial З(y_{max})}{\partial y}.$$

Thus, with the fixed interest rates of the credit and the deposit the maximum profit corresponds to the credit volume y_{max} at which the gain of expenses with the increase in volume of the credit per unit is equal to the gain of the operational income (see fig. 3 and 4).

Let's complicate the models of decision-making and assume that the volume of the supply of credits depends on the credit interest rate, and the volume of the demand for credit resources is the function from the deposit interest rate. Such situation is characteristic for a bank working in the conditions of oligopolies or monopolies.

Then the model looks as follows:

$$\begin{cases} \Pi P = OD - \\ - З \xrightarrow[\alpha, \beta, x(\alpha), y(\beta) \in X]{} \max; \\ OD(\alpha, \beta, x(\alpha), y(\beta)) = \\ = \tau(\alpha y(\alpha) - \beta x(\beta)) \to \max; \\ З(\alpha, \beta, x(\alpha), y(\beta)) = \\ = З_0 + y_y(\underline{y} + b_\alpha(\alpha - \underline{\alpha})) + \\ + y_x(x - b_\beta(\beta - \underline{\beta})); \\ X = \{(x(\alpha), y(\alpha), \alpha, \beta) \mid y(\alpha) \le \\ \le A, x(\beta) \le \Pi, y(\alpha) = x(\beta), \\ \underline{\alpha} \le \alpha \le \overline{\alpha}, \underline{\beta} \le \beta \le \overline{\beta}\}, \end{cases}$$

where X is the admissible set of possible values of the volumes of deposits, credits and the interest rates planned by the manager of the bank; $\underline{\alpha}$, $\overline{\alpha}$, $\underline{\beta}$, $\overline{\beta}$ are the bottom and top margins of the values of interest rates.

Let's investigate properties of model (7) in the assumption that the volumes of the supply of credits $y(\alpha)$, the demand for credits $A(\alpha)$, the volumes of the demand for resources $x(\beta)$ and their supply $П(\beta)$ are linear functions from the corresponding interest rates:

$$y(\alpha) = \underline{y} + b_\alpha(\alpha - \underline{\alpha}); \quad A(\alpha) = \overline{A} - a_\alpha(\alpha - \underline{\alpha});$$
$$x(\beta) = \overline{x} - b_\beta(\beta - \underline{\beta}); \quad П(\beta) = \underline{П} + a_\beta(\beta - \underline{\beta}).$$

where b_α, a_α, b_β, $a_\beta > 0$ are the factors characterizing relative changes of volumes of the supply, the demand for credits and resources with minor changes of interest rates; $\underline{y}$, $\overline{A}$ are the supply and demand for credits at the bottom margin of the interest rate $\underline{\alpha}$; $\overline{x}$, $\underline{П}$ are the supply and demand of resources at the bottom margin of the interest rate $\underline{\beta}$.

Considering model (7) of a problem (8) it is possible to present it like this:

$$ПР(\Delta\alpha, \Delta\beta) = (\underline{y} + \beta_\alpha \Delta\alpha)\left[\tau(\Delta\alpha + \underline{\alpha}) - y_x\right] - (\overline{x} - b_b\Delta\beta)\left[\tau(\Delta\beta + \underline{\beta}) + y_y\right] - З_0 \xrightarrow[\Delta\alpha,\Delta\beta \in E]{} \max,$$

where $E = \left\{\Delta\alpha, \Delta\beta \middle| \Delta\alpha \le \frac{\overline{A} - y}{b_\alpha + a_\alpha}, \Delta\beta \ge \frac{\overline{x} - П}{b_\beta + a_\beta}, b_\alpha\Delta\alpha + b_\beta\Delta\beta = (\overline{x} - \underline{y}), \Delta\alpha = \alpha - \underline{\alpha}, \Delta\beta = \beta - \underline{\beta}, \Delta\alpha, \Delta\beta \ge 0\right\}$ -

Is the admissible set of changes of interest rates.

Let's transform model (9) - (10) to a simpler kind, where

$$OD(\Delta\alpha, \Delta\beta) = \tau[(\Delta\alpha + \underline{\alpha})(\underline{\gamma} + b_\alpha\Delta\alpha) - (\Delta\beta + \underline{\beta})(\overline{x} - b_\beta\Delta\beta)] \xrightarrow[\Delta\alpha,\Delta\beta \in E]{} \max,$$

$$E = \left\{\Delta\alpha, \Delta\beta) \middle| \Delta\alpha \le \frac{\overline{A_0} - \underline{y}}{b_\alpha + a_\alpha}, \Delta\beta \ge \frac{\overline{x} - П}{b_\beta + a_\beta}, b_\alpha\Delta\alpha + b_\beta\Delta\beta = (\overline{x} - \underline{y}) \Delta\alpha = \alpha - \underline{\alpha}, \Delta\beta = \beta - \underline{\beta}, \Delta\alpha, \Delta\beta \ge 0\right\}$$ -

is the admissible set.

In the model of restrictions the difference between the demand for credits and their offer is non-negative ($\overline{A} - \underline{y}$) > 0, as the demand for credits from outside investors at the bottom margin of the interest rate ($\alpha = \underline{\alpha}$) exceeds their supply from the outside banks. Model (11) - (12) is nonlinear concerning the variables $\Delta\alpha$ и $\Delta\beta$. The area of admissible solutions to the model (11) - (12) is presented in fig. 5 (it is painted in grey).

There are straight lines $\Delta\alpha = (\overline{A} - \underline{y} / (b_\alpha + a_\alpha)$, $\Delta\beta = (\overline{x} - \underline{П}) / (b_\beta + a_\beta) = \Delta\beta_0$, $b_\alpha\Delta\alpha + b_\beta\Delta\beta = \overline{x} - \underline{y}$ on the graph. The set of admissible decisions represents the piece of MS on the straight line $b_\alpha\Delta\alpha + b_\beta\Delta\beta = \overline{x} - \underline{y}$. Any point on this piece satisfies model (12) restrictions. The coordinates of M point are the optimum values providing the maximum size of operational income $OD(\Delta\alpha^0, \Delta\beta^0)$ = max. The M point is formed by crossing the vertical straight line from the inclined straight line, forming the following system:

$$\begin{cases} \Delta\beta = \dfrac{\overline{x_0} - П_0}{b_\beta + a_\beta} \\ b_\alpha\Delta\alpha^0 + b_\beta\Delta\beta^0 = \overline{x} - \underline{y}. \end{cases}$$

Solving this system concerning $\Delta\alpha_0$:

$$\Delta\alpha^0 = \frac{\overline{x} - \underline{y}}{b_\alpha} - \frac{b_\beta}{b_\alpha}\frac{\overline{x} - П}{b_\beta + a_\beta}.$$

Thus, the optimum value of changes in the interest rate changes $\Delta\alpha^1$, $\Delta\alpha^2$ corresponding the $M1$ and M points on the straight line, i.e.:

$$\Delta\alpha^0 = \min(\Delta\alpha^1 = \frac{\overline{A} - \underline{y}}{b_\alpha + a_\alpha},$$

$$\Delta\alpha^2 = \frac{\overline{x} - \underline{y}}{b_\alpha} - \frac{b_\beta(\overline{x} - \underline{П})}{b_\alpha(b_\beta + a_\beta)}.$$

In figure 5 the area of admissible decisions for the case when M point is formed by crossing a part of an ellipse from the inclined straight line, forming the system is also painted over

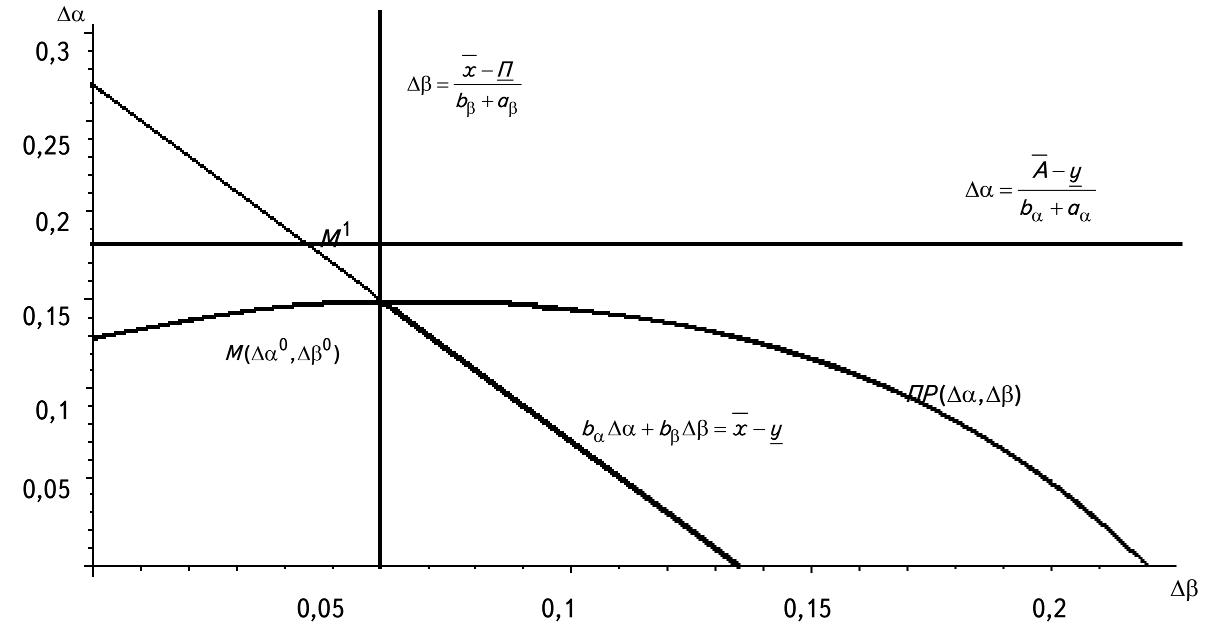

Fig. 5. **Graphical solution to the model**

$$\begin{cases} \Delta\alpha^0 = \dfrac{\bar{A} - \underline{y}}{b_\alpha + a_\alpha} \\ b_\alpha \Delta\alpha^0 + b_\beta \Delta\beta^0 = \bar{x} - \underline{y}. \end{cases}$$

Solving system (14) rather than changing $\Delta\beta$, we will receive

$$\Delta\beta^0 = \frac{\bar{x} - \underline{y}}{b_\beta} - \frac{b_\alpha(\bar{A} - \underline{y})}{b_\beta(b_\alpha + a_\alpha)}.$$

This value is simultaneously an optimum change of the interest rate of the deposit, forming one of the coordinates of M point .

Thus, a commercial bank adopts the following strategy in the course of purchase and sale of deposits and credits: to buy deposits under the price of $\beta^0 = \underline{\beta} + \Delta\beta^0$ in the volume of $x(\Delta\beta^0) = \bar{x} - b_\beta \Delta\beta^0$ and to involve them in credits under the price of $\alpha^0 = \underline{\alpha} + \Delta\alpha^0$ in the volume of $y(\Delta\alpha^0) = \underline{y} + b_\alpha \Delta\alpha^0$.

Thus the maximum value of the operational income equals

$$OD(\Delta\alpha^0, \beta^0) = \tau[(\Delta\alpha^0 + \underline{\alpha})(\underline{y}_0 + b_\alpha \Delta\alpha^0) - (\Delta\beta^0 + \underline{\beta})(\bar{x} - b_\beta \Delta\beta^0)].$$

This strategy allows to provide, on the one hand, the maximum value of the operational income, and on the other - to balance the depositary and credit markets. It means that the demand for credits and the supply of resources in the monetary market are satisfied to the full.

Thus, the mechanism of forming one of the most important budgets of a commercial bank - the budget of incomes and expenses - has been developed. On the basis of the developed mechanism it is possible to optimize the received operational income, to lower the expenses on financial operations, and on this basis to raise the overall performance and competitiveness of a commercial bank.

In summary, it is necessary to point out that the pressing character of this problem for Russia causes the necessity for commercial banks to adopt innovative methodic in this area.

The Dissertation "Increase of efficiency of functioning of commercial bank on the basis of introduction of system of budgeting" from a site of dissertations. URL: http://diss.rsl.ru.aspx? orig =/06/0217/060217045.pdf.

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