

Definition of the bank operating income in estimating of the cost of commercial bank, taking into account amendments on bank risks

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Abstract. Definition of the bank operating income is discussed in the article, in making an assessment of its cost, and also the risks arising during its operating activities. We will consider types of risks and criteria of their classification. Bank risks are more socially responsible processes. Risking is not only own but mainly loan resources. In case of bank crisis the consequences can be much more notable, than manufacturer's crisis.

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Introduction

Finance, monetary circulation and credit

Bank risks are more socially responsible processes. Under the conditions when banks risk not only its own, but, mainly, loan resources, consequences become sharper. In case of failure not only the bank has losses but also his clients – the natural and legal entities who have placed in it its finances. Bank crises appear thus more painful than manufacturer's crisis as they involve numerous financial losses of the participants connected with each other by a chain of monetary and credit obligations [1].

Bank confidence of success is based not only on existence at the subject of the corresponding material, monetary, professional and intellectual prerequisites [2]. The risk becomes justified when activity of the bank possessing the corresponding prerequisites, brings good results exceeding expenses for their achievement.

Risk is the activity calculated on success with the uncertainty demanding from a business unit the ability and knowledge how to overcome negative events [3].

From the above follows that classification of the most essential risks arising in operating activities of commercial bank, is reduced to risk of liquidity and risk of solvency.

We will call a bank solvency the ability of bank to carry out its primary activity during an indefinitely great (in the limit of infinite) period, fulfilling all the obligations.

We will call a bank liquidity the ability of bank in due time to fulfill all the obligations shown to it for execution during a certain period of time [4].

In practice bank liquidity is estimated on the basis of liquidity coefficients, and solvency – on the basis of sufficiency coefficients of the capital.

Table 1. Classification of bank risks

Criteria of Classification	Types of bank risks
Risk level	Risks at macro level of the relations Risks at micro level of the relations
Character of a banking product, services and operations	Risk on off-balance operations Credit risk Settlement risk Operational risk and others
Extent of providing the foundations of other bank development	Risk of unbalanced liquidity Percentage risk Risk of profitability loss Risk of loss of competitiveness Risk of capital base Management risk
Forming risk factors	External risks (political, economic, demographic, social, geographical and other) Internal risks (and the primary and auxiliary activity, connected with assets or bank liabilities, with quality of management and realization of financial services)
Sphere and scale of risk activity	Risk proceeding from the country Risk connected with activity of a certain type of bank Risk connected with activity of the centers of financial responsibility Risk proceeding from bank operations, including: - from group of operations of a certain type (overall risk); - from separate operations with a certain client (individual risk)
Emergence time	Retrospective risks Current risks Perspective risks
The degree of risk dependence from bank	Risk dependent on activity of bank Risk not dependent on activity of bank
Type of bank	Risk of specialize bank Risk of branch bank
Size of risk	Low risk Moderate risk Full risk
Structure of client base	The risk proceeding from big, average and small customers The risk proceeding from branch structure of clients
The character of transaction accounting	Risk on balance operations Risk on off-balance operations

Risk of liquidity is the possibility that in some period of time a bank will be illiquid. That is the bank won't be able to execute in due time all the obligations shown to it in this period of time.

Risk of solvency is the possibility of bank to become insolvent. That is there will be sufficient bases to consider that in the near future bank can be not able to fulfill the obligations that will entail impossibility of continuation of its activity in former conditions.

Considering the essence of solvency risk emergence, it is possible to tell that this risk includes an assessment of credit, percentage and currency risk [5].

At an assessment of bank solvency it is necessary to carry out estimation of cost in the current prices of its net assets. In this regard it is important to estimate precisely the quality of credits, to allocate among other the "spoiled" credits and possibilities of guarantee collecting, to establish compliance of the created reserves to credit risk, to estimate scales of internal and connected financing. Concerning obligations it is necessary to check correctness of their considered cost.

The motivation of bank to strengthen the solvency, to increase the capital due to highly profitable operations with the maximum use of the resources can lead to liquidity loss owing to discrepancy of maturity dates of assets and liabilities on terms, non-performance by contractors of the obligations to bank, changes of exchange rates, etc. And restoration of liquidity demands immediate receiving of funds [6]. It can be done, having obtained the inter-bank credits, raising funds on deposits, selling assets. The forcedness of these actions attracts a concession in interest rates and the prices of assets sale that has an adverse effect on profit and the capital that is on solvency.

We will consider calculation of amendments on the risk arising during violation of bank solvency. Thus we allocate the major factors influencing the change of bank solvency: they are credit risk, percentage risk.

The amendment on credit risk.

Credit risk represents a risk of non-performance of credit obligations to the credit organization by the third party. Danger of emergence of this type of risk exists when carrying out loan and other operations equated to them which are reflected in balance and could have off-balance character.

We investigate influence of debt arrears change on the operating income of commercial bank. For this purpose we will differentiate the equation of the operating income from systems of the equations:

$$\alpha^e = \frac{((1 + \tau_1 \alpha_1)(1 + \tau_2 \alpha_2) - 1)}{\tau};$$

$$OI = \tau (\alpha Y - \beta X);$$

$$\beta^e = \frac{((1 + \tau_1 \beta_1)(1 + \tau_2 \beta_2) \dots (1 + \tau_L \beta_L) - 1)}{\tau};$$

$$E_{OI}^Y = \frac{\partial OI}{\partial Y} = \left\{ \begin{array}{l} \tau(Y\alpha - X\beta), \tau_d = \tau_c \\ \tau(Y\alpha - \tau_1 X_1 \beta^e), \tau_d < \tau_c \\ \tau_1(Y_1 \alpha^e - \tau X \beta), \tau_d > \tau_c \end{array} \right\} \quad (1)$$

According to Y and X. As a result we will receive the following system of the equations for sensitivity coefficients:

$$E_{OI}^X = \frac{\partial OI}{\partial X} = \left\{ \begin{array}{l} \tau(Y\alpha - X\beta), \tau_d = \tau_c \\ \tau Y \alpha - \tau_1 X_1 \beta^e, \tau_d < \tau_c \\ \tau_1(Y_1 \alpha^e - \tau X \beta), \tau_d > \tau_c \end{array} \right\} \quad (2)$$

τ – the term of a deposit (credit) portfolio;
 α – an interest rate of the credit of i-client;
 β – an interest rate of the deposit of i-client;
 Y – credit volume;
 X – deposit volume;
 OI – the operating income.

The equation for E_{OI}^Y characterizes income gained by bank during on one monetary unit of the credit, and size E_{OI}^Y is the income received by bank during –time on one monetary unit of the attracted resource.

Arrears can be reflected in financial statements of commercial bank on the corresponding accounts of balance, and also can be in the implicit hidden form in the way of prolongation of credit agreements, loaning up of the borrower, etc. In this regard the appraiser is faced with a problem of definition of the hidden forms of debt [7].

One of the methods of the hidden arrears definition is the GAP model.

Gap is the concept accepted in banking practice and characterizing a difference between sizes of assets and liabilities, sensitive to change a percentage rate. Division into rates of percent sensitive and tolerant to change assets and liabilities is rather conditional. Usually the given-out credits, the state securities of different types, the income of future periods belong to sensitive assets; to tolerant assets – the means which are in cash calculations, buildings, constructions, economic stock.

Sensitive liabilities represent the means received as a result of calculations with other banks,

deposits and the remains on accounts of natural and legal entities. Tolerant liabilities are mainly various funds of bank. The ratio of these types of assets and liabilities plays an essential role in formation of the bank income at change of percentage rate [8]. The equation for a gap calculation is reduced to a difference of sensitive assets and sensitive liabilities:

$G = \text{sensitive assets} - \text{sensitive liabilities}$, and possible versions of the provision of a gap: $G = 0$; $G > 0$; $G < 0$.

However in banking practice not all sensitive liabilities are involved into the credits: the remains on settlement accounts of clients; on-demand deposits; derivation in fund of obligatory reserves, etc. Considering these specifics it is possible to receive the provision of a gap $G = 0$, or $G > 0$ or when forming portfolio by long-term resources and the short-term credits, or having on balance the overdue credits. In this regard the problem of liabilities' structure management and assets (gap) has to be reduced to the analysis of volume ratios of an effective credit resource and credit investments in the conditions of percentage risk. Under an effective credit resource we will understand amount of money which the bank can place in the credits, having provided thus necessary settlement and cash operations. We will define an effective credit resource, using structure of a deposit portfolio.

$$CR_{ef} = \sum_{i=1}^m \sum_{h \in H} (1-\gamma)X_{ih} + X_{sh} + X_{rh} + \delta \cdot X_{\mu} + X_{cnet} - 0.05BShT, \quad (3)$$

where δ – the level of subsidence of money on on-demand accounts,

X_{μ} – the remains of money on on-demand accounts,

X_{cnet} – own net means of bank,

BShT – balance sheet total.

Credit investments of bank will be defined:

$$CI = \sum_{j=1}^n \sum_{l \in L} Y^{jl} \quad (4)$$

Then possible versions of a gap provision at the time of revaluation of assets and liabilities will have the following ratios:

$G_t = CI_t - CR_{ef} = 0$ (zero);

$G_t = CI_t - CR_{ef} > 0$ (positive);

$G_t = CI_t - CR_{ef} < 0$ (negative).

Considering gap G_t as an operating parameter of bank activity, we will consider its communication with the operating income [9].

Change of operating income OI gained at the set combination of assets and liabilities, as a result of α and β percentage rate change, is a differential size

and depends on the size of a gap which also is a differential variable:

$$\Delta OI_t = (\alpha - \beta)G_t \quad (5)$$

The equation (5), is received in the assumption of constancy of the sizes CI_t and CR_{ef} , and also spread invariance between credit α and deposit β percent rates. In case positive value of the Gap is received and average urgency of a deposit and credit portfolio isn't defined by a ratio $\tau_d > \tau_c$, it is necessary to consider change of the operating income calculated on formula (5), as reduction of the operating income at the expense of the hidden arrears.

Taking into account above told, the amendment on risk of borrowers' arrears of commercial bank will be defined:

$$OI_{ar} = OI - EY_{OI}Y_i - EX_{OI}Y_i - \Delta OI_t \quad (6)$$

The amendment on percentage risk.

According to Rouz [10], the author of the popular textbook on bank management, "among all types of risks which banks face, won't be another to which analysis and control so much attention is paid in recent years, as to risk of interest rates as the change of level of interest rates can negatively influence the income and cost of bank assets, liabilities and the capital». Within the last twenty-three years in world economy the increased instability of interest rates was observed. It was considerably caused by cancellation of the rules regulating interest rates. Thereby control of percentage risk became also actual, as well as control for credit and currency risks [11].

Bodies of bank supervision and regulation of many countries consider percentage risk in the normative documents.

In the fundamental principles of bank supervision the following definition of percentage risk is given:

The percentage risk is a potential susceptibility risk of financial position of bank to impact of adverse change of interest rates.

This risk influences the bank income, economic cost of assets, obligations and off-balance tools. The main forms of percentage risk which are the subject to banks are the following:

- ✓ The percentage risk is a potential susceptibility risk of financial position of bank, the risk of establishment of the new price arising in connection with a difference of terms (for the fixed interest rates) and establishment of the new price (for floating interest rates) bank assets, liabilities and off-balance positions;

- ✓ The risk of curve profitability arising in

connection with changes of an inclination and a form of curve profitability;

✓ The basic risk arising in connection with imperfect correlation of percent earned and paid on various tools;

✓ The alternativeness arising in connection with directly expressed or implied options, built in many bank assets and liabilities and off-balance portfolios.

The simplest method of measurement of percentage risk consists in gap definition between assets and obligations for terms (the GAP analysis). It was one of the first methods of such kind and continues to be used widely by banks [12].

All methods of an assessment of percentage risk assume forecasting of future dynamics of interest rates and its influence on cash flows.

The percentage risk of bank is defined by structure of its assets and obligations. For bank the situation is typical when long-term assets having a fixed rate, are financed by short-term obligations or obligations with a floating interest rate. As most often long-term rates exceed short-term, such situation allows banks to get necessary profit.

But if a short-term interest rate is increased, the cost of bank means will grow. If at the same time long-term rates don't change, the difference between interest income and expenses can become insufficient for a covering of overhead costs. As a last resort, this difference can become even negative. In such situation there are losses reducing the capital of bank [13].

We will define sensitivity of interest income to change of interest rates of the credit and deposits.

Differentiating the equation for interest income in parameter, we will receive:

$$\frac{\partial OI}{\partial \alpha} = \tau(y + \alpha \frac{\partial y}{\partial \alpha} - \beta \frac{\partial X}{\partial \alpha} - X \frac{\partial \beta}{\partial \alpha}) \quad (7)$$

Considering that $\frac{\partial y}{\partial \alpha} = \frac{\partial x}{\partial \alpha} = \frac{\partial \beta}{\partial \alpha} = 0$, we find

$$E_{OI}^{\alpha} \frac{\partial OI}{\partial \alpha} = \tau \quad (8)$$

From this equation follows that at increase in an interest rate of the credit at one point, the operating income will increase on τy .

Differentiating the equation for interest income on an interest rate of the deposit, we will receive:

$$\frac{\partial OI}{\partial \alpha} = \tau(y + \alpha \frac{\partial y}{\partial \alpha} - \beta \frac{\partial X}{\partial \alpha} - X \frac{\partial \beta}{\partial \alpha}) \quad (7)$$

Considering that $\frac{\partial y}{\partial \alpha} = \frac{\partial x}{\partial \alpha} = \frac{\partial \beta}{\partial \alpha} = 0$, we

$$\text{find } E_{OI}^{\alpha} \frac{\partial OI}{\partial \alpha} = \tau \quad (8)$$

As $\frac{\partial y}{\partial \beta} = \frac{\partial \alpha}{\partial \beta} = \frac{\partial \alpha}{\partial \beta} = 0$, from the last equation we find that

$$E_{OI}^{\beta} \frac{\partial OI}{\partial \beta} = -\tau x \quad (10)$$

This equality means that with increase in an interest rate of the deposit at one point, the size of interest income decreases by size τx .

In figure 1 the graphic solution of task analysis of the operating income size sensitivity to change of an interest rate of the credit is submitted. The inclination of the straight line corresponding to

optimum values of the operating income $OI(\alpha, \beta)$ to coordinate axes depends on values of interest rates of the deposits and the credits created in the monetary market. With change of an interest rate of the credit for size $\Delta \alpha$ a straight line tilt angle of equal values of the operating income to coordinate axes will change [14]. So with the growth of an interest rate of the credit the corner of crossing of a straight line with coordinate axes will decrease, with increase in an interest rate of the deposit the operating income will decrease, and the straight line tilt angle to coordinate axes will increase.

In the figure the straight line tilt angle $OI(\alpha + \Delta \alpha, \beta)$ is less, and the straight line

$OI(\alpha, \beta + \Delta \beta)$ has more than straight line

inclination $OI(\alpha, \beta)$ to a coordinate axis y. Thus, the size of sensitivity of the operating income to change of interest rates of and is graphically displayed by a straight line corner to coordinate axes.

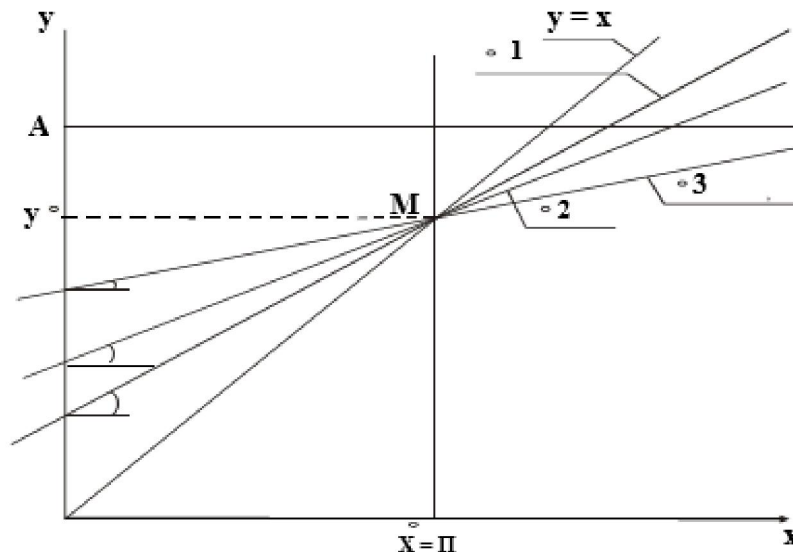


Figure 1. Graphic solution of task analysis of sensitivity size of the operating income to change of an interest rate

$$1 - \overset{0}{OI}(\alpha, \beta + \Delta\beta) ; 2 - \overset{0}{OI}(\alpha, \beta) ; 3 - \overset{0}{OI}(\alpha + \Delta\alpha, \beta).$$

At known coefficients of sensitivity of the income $\frac{\partial OI}{\partial \alpha}$, $\frac{\partial OI}{\partial \beta}$ and known sizes of change of market factors on change of profit is defined from the following equalities:

$$\Delta OI_{\alpha} = \frac{\partial OI}{\partial \alpha} \cdot \Delta \alpha ; \quad \Delta OI_{\beta} = \frac{\partial OI}{\partial \beta} \cdot \Delta \beta.$$

At simultaneous change of several factors, the size of change of profit will be defined as the sum of changes from each factor defined from the equation:

$$OI\% = \overset{0}{OI} + \overset{0}{OI}$$

The direction of change of the operating income depends not only on dynamics of the interest change rates in the market, but also on the provision of the Gap described earlier.

Influence of the gap on change of the operating income is presented in table 2 at various dynamics of an interest rate.

Table 2. Influence of the gap on change of the operating income

Gap	Interest rate change, (α,β)	ΔOI _t	Income change
negative	↑	< 0	↓
negative	↓	> 0	↑
positive	↑	> 0	↑
positive	↓	< 0	↓
zero	↑	0	0
zero	↓	0	0

It is obvious that in case of a negative gap ($G_t < 0$) at increase of interest rates the income decreases, at their decrease – increases. The concept of the gap is inseparably linked with periods of storage of deposits and repayments of the credits or revaluation of liabilities and assets. When these terms significantly differ, there is a so-called Stigum-Brench effect according to which if liabilities (or assets) are repeatedly overestimated before a gap provision

calculation, time difference is carried out and will define a position of the gap counted on the moment of revaluation. Thus, the negative provision of the gap is caused by formation of a bank portfolio by short-term deposit contracts placed in long-term credit contracts [15]. This model of a bank portfolio will lead to frequent revaluation of deposit contracts, and it can be in turn favorable to bank in a case of decrease in interest rates in the market.

At a positive gap ($G_t > 0$) the increase of an interest rate is accompanied by increase in the income, and its decrease by reduction. The positive provision of a gap in the absence of expired loans is caused by formation of a bank portfolio by short-term credit contracts and long-term resources. Such phenomenon is most typical for banks in conditions of "hot money" transition period when the super short credits for replenishment of current assets, the overdraft; inter-bank credits, etc. were given by banks. This model of formation of a bank portfolio is favorable to bank with a growth of interest rates in the monetary market.

We will notice that at a zero gap change of a percentage rate doesn't influence the gained income. In this case it is defined by the planned spread and size of an effective credit resource and credit investments. This provision of the gap arises when bank forms a portfolio by the deposit and credit contracts [16] coordinated in time. The coordinated structure of deposit and credit contracts is most favorable to bank at constants in time interest rates. In case of trend dynamics of interest rates such structure of a portfolio can lead to short-reception of the operating income. It should be noted that any model of formation of a deposit and credit portfolio allows carrying out hedging from percentage risk, in a case when dynamics of change of interest rates is badly predicted. In case of a nonzero gap the bank carries out game or on rate fall, or on its increase. If change of a rate of percent was opposite expected, at a nonzero Gap there are losses which reduce own capital of bank.

Thus, definition of the operating income of bank (OI), taking into account amendments on the risk, arising during operating activities of commercial bank is reduced to the following expression.

$$OI_r = OI + \Delta OI_{ar} + \Delta OI\%$$

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