USE OF EXPERT ESTIMATIONS IN THE FORM OF INDISTINCT TRIANGULAR NUMBER FOR FORECASTING THE CONDITION OF LIQUIDITY OF COMMERCIAL BANK

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Abstract. Management of monetary streams in a commercial bank is carried out on conditions of uncertainty: the need of clients for the credit is unknown to a bank; actions of clients on purchase of deposits of bank are uncertain, on the preschedule termination of depositary contracts etc. Use by banks of traditional means of the technical analysis without taking into account uncertain factors will not allow a bank to construct the forecast of a condition of liquidity for the prevention of crises of liquidity. Use of expert estimations in the form of indistinct triangular number is represented by the best way of the account of the set of uncertain factors in the model of management of liquidity.

One of the methods of management of liquidity in commercial banks is the method of breaks of liquidity which is centered in the model of management of liquidity. Let's consider the stages of imitating model construction.

At the first stage time intervals within the limits of which the size of requirements and obligations to repayment will be estimated are allocated. Such intervals are called “time baskets” [1, p.46]. For operative management of liquidity it is useful to describe “time baskets” with a one-day term difference. Thus, the number of period will coincide with the quantity of days before the date of the forecast from a certain moment. On the basis of the established rule of the “time basket” formation we construct a model of passive evolution. Assets and liabilities with a definite term of removal are observed separately in accordance with the stipulated terms on loan funds. Emergence of new requirements and obligations which may occur in the future while signing new contracts has not been taken into account yet. The set of all the assets on terms of removal may be presented in the form of a rectangular matrix $A=(a_{ij})$ sized $m \times n$. The elements of matrix - a_{ij} – are the absolute quantities of assets repayment, where i - an ordinal number of the transaction of a commercial bank, $i=\overline{1,m}$, where m – a total number of transaction on assets of a bank, and j – the number of a “time basket”, $j=\overline{1,n}$, where n – the examined quantity of “time baskets” , which is defined by the horizon of the forecast. Similarly, the set of removal of liabilities of commercial bank may be described as a rectangular matrix $L = (l_{ij})$ sized $k \times n$. The elements of a matrix - l_{ij} are the absolute quantities of removal of liabilities, where i - an ordinal number of the transaction of a commercial bank, $i=\overline{1,k}$, where k – a total number of transactions on liabilities of a bank, and j – the number of a “time basket”, $j=\overline{1,n}$, where n – the examined quantity of “time baskets”, which is defined by the horizon of the forecast.

At the second stage the total quantity of assets is calculated with the repayment maturity, belonging to j – “time basket” at a certain moment of time t. According to the terms of removal the set of all the combined assets may be described as a matrix with a line of dimension $1 \times n$:

$$A_w=(a_j). \tag{1}$$

Each element of a matrix (1) - a_j – is equal to the sum of elements of one column of matrix $A=(a_{ij})$:

$$a_j = \sum_{i=1}^{m} a_{ij} , \tag{2}$$

where a_{ij} - elements of j – column of matrix $A=(a_{ij})$,

$j=\overline{1,n}$, n – the quantity of “time baskets”,

m – the quantity of operations with assets under the signed contracts.

The quantity of liabilities is calculated similarly with the repayment maturity belonging to j - "time basket" at a certain moment. By matrix we mean a line of dimension $1 \times n$ with division of liabilities according to repayment maturities $L_w=(l_j)$ consisting of elements, each element is equal to the sum of elements of one column of matrix $L=(l_{ij})$, $j = \overline{1,n}$ where n – the definite quantity of "time baskets":

$$L_w = \left(\sum_{i=1}^{k} l_{i1} \quad , \sum_{i=1}^{k} l_{i2} \quad ,... \quad , \sum_{i=1}^{k} l_{in} \right), \tag{3}$$

where k – the number of operations with liabilities under the signed contracts.

At the third stage breaks of liquidity are calculated for each of the marked "time baskets" according to the formula [1, p.46]:

$$G_w = A_w - L_w, \tag{4}$$

where $G_w=(g_{wj})_{1\times n}$ - a vector as a line of dimension $1 \times n$, elements of which are the quantities of breaks of liquidity at a certain period of time t for j - "time basket".

The positive meaning of this index means the surplus of liquidity while the negative one – the deficit of liquidity.

The fourth stage allows to move from the method of passive evolution, i.e. a model of attenuation of a flow of payments in a commercial bank to a complete discrete model of payment calendar management which takes into account not only new requirements and obligations but also the possible risk of the change of the urgency of requirements and obligations in case of unpredictable suspension of the contract. Forecast is received by expert estimations in the form of indistinct triangular number [2] on a short-term, intermediate term and long-term prospect taking into account the total quantity of risk (stochastic factors and factors of uncertainty are taken into consideration). An expert has got an opportunity to take advantage of the statistical information processing results received by all accessible traditional means of the technical analysis - the analysis of time lines, the correlation analysis etc. The strategy of bank development, the forecast of the situation in financial markets will be the additional bases in the preparation of expert estimation.

The processed results of interrogation are represented as two matrixes. The elements matrixes - lines (A_{new}) sized $1 \times n$ - will be the experts' generalized estimations of new obligations of a bank for examined set of "time baskets":

$$A_{new}=(a_{new\, j})_{1\times n} \tag{5}$$

The elements matrixes - lines (L_{new}) sized $1 \times n$ will be the experts' generalized estimations of new obligations of a bank for examined set of "time baskets":

$$L_{new}=(l_{new\, j})_{1\times n} \tag{6}$$

The feature of expert estimations consists in the fact that they are given in the form of indistinct triangular number (see fig.1).

The expert will name the minimal size of the requirement $a_{new\, j\, min}$, where j – the number of "time baskets", the most real size of examined parameter - $a_{new\, j\, real}$ and greatest possible - $a_{new\, j\, max}$ determined by the horizon of the forecast. The negative value of an expert estimation of requirements of a bank means an excess of emerge of the sum of new requirements over the sum of prescheduled repayment of requirements. Thus, each element of a matrix (5) will be submitted as:

$$a_{new\, j}=(a_{new\, j\, min}, a_{new\, j\, real}, a_{new\, j\, max}). \tag{7}$$

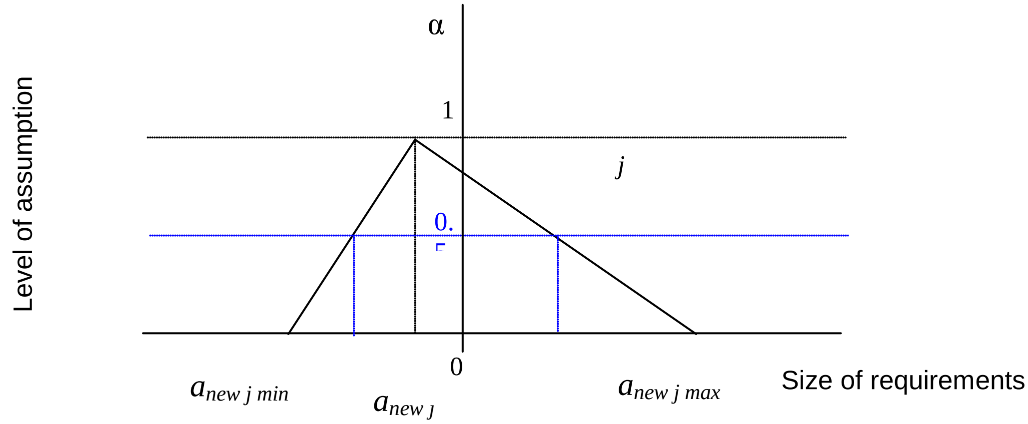

Fig.1. *An expert estimation of size of new requirements in the form of indistinct triangular number for "time basket" j.*

The negative value of an expert estimation of obligations of bank means an excess of the sum of returned means by a bank over the sum of emerge of new obligations. Each element of a matrix (6) is represented as:

$$l_{new\ j}=(l_{new\ j\ min}, l_{new\ j\ real}, l_{new\ j\ max}). \tag{8}$$

The new prospective breaks of liquidity received on the basis of expert estimations in the form of indistinct triangular number may be calculated according to the following formula:

$$G_{new} = A_{new} - L_{new} = \left(g_{newj}\right)_{1 \times n}. \tag{9}$$

Taking into account new predictable breaks of every liquidity, the forecast of breaks of liquidity in the form of indistinct triangular number for "time basket" may be calculated (9):

$$G = G_{\omega} + G_{new}. \tag{10}$$

Each element of matrix $G=(g_j)$ sized $1 \times n$ is an indistinct triangular number - $g_j = (g_{j\ min}, g_{j\ real}, g_{j\ max})$, $j=\overline{1,n}$, and n - examined quantity of "time baskets".

The received forecast of possible new breaks of liquidity precisely specifies to a manager responsible for the condition of liquidity, what steps to follow for a specific time interval: at negative breaks-find additional liquid means, at positive - variants of investment of predictable temporarily free resources into additional operations within a certain time interval. And the forecast may be made for a different level of assumption ($\alpha=\overline{0,1}$).

References

[1] Voloshin I.V. Data Preparation for Analyzing Breaks of Liquidity // Bank Technologies, 2002, May p. 46-48.
[2] A.-M. Gil Lafuente Financial Analysis under Uncertainty, 1998. – 150 P.