EUROPEAN JOURNAL OF LIFE SAFETY AND STABILITY (EJLSS)
ISSN 2660-9630
www.ejlss.indexedresearch.org Volume 11, 2021 ||

Ways of Economic-Mathematical Modeling of Commercial Banks

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Abstract: *This article considers about ways of economic-mathematical modeling of commercial banks. It analyzes the main stages of the process of mathematical modeling. To date, a large number of banking models have been developed that have one or more of the disadvantages listed below.*

Keywords: *economic-mathematical modeling, commercial banks, banking models, mathematical modeling, model building*

Date of Submission: 15-10-2021 ***Date of Acceptance: 29-11-2021***

One of the types of formalized sign modeling is mathematical modeling carried out by means of the language of mathematics and logic. To study any class of phenomena of the external world, its mathematical model is built, i.e. an approximate description of this class of phenomena, expressed using mathematical symbols.

The process of mathematical modeling itself can be divided into four main stages:

Stage I: Formulation of laws connecting the main objects of the model, i.e. recording in the form of mathematical terms formulated qualitative ideas about the connections between the objects of the model.

Stage II: Study of mathematical problems to which mathematical models lead. The main question is the solution of the direct problem, i.e. obtaining, as a result of the analysis of the model, the output data (theoretical consequences) for their further comparison with the results of observations of the studied phenomena.

Stage III: Correction of the adopted hypothetical model according to the criterion of practice, i.e. clarification of the question of whether the results of observations agree with the theoretical consequences of the model within the limits of observation accuracy. If the model was completely defined - all its parameters were given - then the determination of the deviations of the theoretical consequences from observations gives the solution of the direct problem with a subsequent estimate of the deviations. If the deviations go beyond the accuracy of the observations, then the model cannot be accepted. Often, when building a model, some of its characteristics remain undefined. The application of the practice criterion to the evaluation of a mathematical model allows one to draw a conclusion about the correctness of the provisions underlying the (hypothetical) model to be studied.

Stage IV: Subsequent analysis of the model in connection with the accumulation of data on the studied phenomena and modernization of the model. With the advent of computers, the method of

mathematical modeling took a leading place among other research methods. This method plays an especially important role in modern economic science.

The stage of building a model presupposes the presence of some knowledge about the object - the original. The cognitive capabilities of the model are due to the fact that the model reflects any essential features of the object - the original. The question of the necessary and sufficient degree of similarity between the original and the model requires a specific analysis. Obviously, the model loses its meaning both in the case of identity with the original (then it ceases to be the original), and in the case of an excessive difference from the original in all essential respects.

Thus, the study of some sides of the modeled object is carried out at the cost of refusing to reflect the other sides. Therefore, any model replaces the original only in a strictly limited sense. From this it follows that for one object, several “specialized” models can be built that focus on certain aspects of the object under study or characterize the object with varying degrees of detail.

At the second stage of the modeling process, the model acts as an independent object of research. One of the forms of such research is the conduct of "model" experiments, in which the conditions for the functioning of the model are deliberately changed and the data on its "behavior" are systematized. The end result of this stage is a lot of knowledge about the model.

At the third stage, knowledge is transferred from the model to the original, the formation of a set of knowledge S about the object is carried out. This process of transferring knowledge is carried out according to certain rules. The knowledge about the model should be adjusted taking into account those properties of the original object that were not reflected or were changed during the construction of the model. We can with sufficient reason to transfer any result from the model to the original, if this result is necessarily associated with signs of similarity between the original and the model. If a certain result of the model research is associated with the difference between the model and the original, then this result cannot be transferred.

The fourth stage is the practical verification of the knowledge obtained with the help of models and their use to build a generalizing theory of an object, its transformation or control.

In a market economy, a commercial bank requires a high level of management to ensure efficient operation and high competitiveness. In the banking sector, management can be divided into financial management and personnel management. The most important goal of strategic management of a commercial bank is considered to be the provision of maximum profit [3].

Usually, the maximization of the bank's profit is understood as - earn more with the lowest costs. But this goal is not long-term oriented. In the pursuit of maximum profit, the quality of customer service, the working conditions of the bank's employees, its financial stability may suffer, because the desire to maximize current profits does not imply investments in the repair and improvement of technical equipment, the accumulation of reserves to cover future losses, the establishment of relations with promising enterprises that are still unprofitable.

Consequently, the goal of planning a bank's activities should be focused on maximizing the value of the bank, for which it is necessary to strive to maximize profit in the medium and long term and stable dividends, an increase in the volume of banking operations, and an increase in the value of bank shares on the stock market. It follows from this that the following questions are of utmost importance for the owners of the bank.

1. Organize the bank management system in such a way as to extract the greatest amount of dividends and, if the need arises, to profitably sell the enterprise or a part of it.
2. It is necessary that all employees of the bank were interested in maximizing the profit of a commercial bank.

3. Make sure that the funds withdrawn by the owner in the form of dividends do not interfere with the work of the bank in the long term.

Banking management must ensure the safety of the attracted funds, timely and full refund of money to its depositors and creditors. To achieve this goal, the bank needs to create a system for managing liquidity, financial stability, accounts receivable and payable, ensuring a high quality loan portfolio and deposits. It is important for the effective operation of the bank to best meet the needs of the bank's clients in the quantity and quality of services provided, the speed of order fulfillment, and a high level of service. In addition, the activities of a commercial bank should contribute to the development of the economy by investing resources in the production sector, in promising industries, as well as in the regional economy.

The main tasks that need to be solved when managing the activities of a commercial bank follow from the above listed economic and social goals of the bank. The entire bank management system can be divided into two areas: financial management and personnel management. Financial management deals with planning, performance analysis, regulation and control of the bank's activities. The first and one of the most important tasks of bank management is planning its activities.

Planning determines the directions of the bank's future development, as well as its local goals and objectives. At the planning stage, forecast plans are drawn up, which set tasks for the bank for the next period, and strategies for their implementation are determined. Planning denotes the conditions and boundaries in which the team will work. Fulfillment or over fulfillment of the plan should financially stimulate the bank's employees, that is, be in the interests of the collective. As a result of planning, the following are developed: - long-term plans, which consider the formation and placement of resources in the long term; - current business plans focusing on the parameters of the bank's activities in the short term.

To date, a large number of banking models have been developed that have one or more of the following disadvantages:

1) limited applicability (suitable only for a specific bank or its division);

2) narrow focus (they consider only one problem facing the bank (for example, increasing profits, the task of managing liquidity));

3) problems with practical implementation, due to the complexity of the model;

4) the possibility of application depends on the economic situation (for example, in conditions of inflation not exceeding 10% per annum, etc.).

The work uses a model of the bank's branch activity, which will contribute to improving the functioning of a commercial bank as a whole. On its basis, in the future, it is possible to develop a computer program that will automate the search for the optimal variant of the ratio of the bank's assets and liabilities, taking into account the established restrictions. A complete model of the banking system developed by N.Ye. Egorova and A.M. Smulov was taken as the basis for developing a management model for a branch of a commercial bank [2].

As the initial data of the model, the data of the asset and liability of the balance sheet, the performance indicators of a branch of a commercial bank are used. The main limitations of the model arise due to the fact that the Central Bank of the Russian Federation imposes certain limits on the financial activities of the bank and the head bank, in turn, also restricts the activities of the bank's branch, then any solutions proposed by the model and associated with changes in the structure of the balance sheet must correspond to those specified on different levels of control constraints. The proposed optimization model for managing the assets and liabilities of a branch of

a commercial bank, taking into account the initial data and the existing system of restrictions, will facilitate the search for the best balance sheet structure from the point of view of the person making decisions on managing the bank's assets and liabilities. The intervals for changing the value of each of the indicators considered in the model (the system of restrictions) are established by expert advice, depending on the existing interest rates, the prevailing market conditions and the current legislation.

This model considers the relationships that arise in the process of forming the structure of the bank's assets and liabilities, as well as changes in the bank's equity capital. This model is designed for a large bank. In addition to attracting deposits and issuing loans, the bank is engaged in the purchase of securities from other issuers and provides interbank loans. For a branch of a commercial bank, the model in this formulation is not suitable. For the possibility of its practical implementation to the conditions of a branch of a bank, it must be simplified, which is presented below. Using a model that combines data on balances on balance sheets, interest rates on loans and deposits and interest income, using simulation modeling,it is possible to calculate various options for the structure of assets and liabilities and the corresponding values of the planned interest income and other financial indicators.

Conclusion

A model is a material or mentally imagined object that, in the process of research, replaces the object - the original, so that its direct study gives new knowledge about the object - the original.

Modeling refers to the process of building, learning, and applying models. It is closely related to such categories as abstraction, analogy, hypothesis, etc. The modeling process necessarily includes the construction of abstractions, and inferences by analogy, and the construction of scientific hypotheses.

The main feature of modeling is that it is a method of indirect cognition using objects - substitutes. The model acts as a kind of cognitive tool that the researcher puts between himself and the object and with the help of which he studies the object of interest. It is this feature of the modeling method that determines the specific forms of using abstractions, analogies, hypotheses, other categories and methods of cognition.

To understand the essence of modeling, it is important to keep in mind that modeling is not the only source of titles about an object. The modeling process is "immersed" in a more general cognition process. This circumstance is taken into account not only at the stage of building a model, but also at the final stage, when there is a combination and generalization of research results obtained on the basis of diverse means of cognition.

Modeling is a cyclical process. This means that the first four-stage cycle can be followed by a second, third, etc. In this case, knowledge about the object under study is expanded and refined, and the original model is gradually improved. The shortcomings found after the first cycle of modeling, due to a little knowledge of the object and errors in building the model, can be corrected in subsequent cycles.

A multicriteria problem can be represented in the form of several single-criterion problems, in which optimization is carried out according to one of the criteria, while the rest are specified in constraints. Based on the proposed model, one can proceed to three single-criterion optimization problems:

1) maximizing interest income;

2) maximizing the amount of funds raised by the branch independently;

3) maximization of the instant liquidity ratio. After finding a solution for each of the optimization criteria, the solutions obtained are analyzed, and the choice of the final version is carried out by the person making the decision, taking into account the additional non-formalized information available to him, the degree of his inclination to risk, etc.

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