Economic and Mathematical Approaches to Researching the Banking System of Russia

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***Abstract*— The paper discusses the trends and specific features of the banking system developing in Russia. It evaluates how the economic sanctions, demand for money, taxes and other factors affect the banking system and the economy of the country as a whole. The authors use a formal logical approach and economic-mathematical approaches to identify and explain the conditions and processes occurring in the banking system, to characterize the laws of development of the banking system, and to substantiate the interrelation between the monetary policy of the central bank of Russia and the fiscal policy of the state. The paper is aimed at finding out ways to expand the possibilities of using economic-mathematical simulation in researching the trends and regularities in the Russian banking system and interrelation of the latter one with the budget system and the economy of the country.**

Keyords*— *banking system; regression analysis; correlation relationships; budget; economic development

I. INTRODUCTION

Many researchers in their papers present a diverse analysis of the development problems of the banking system, factors of its development and modern trends. Economic globalization and integration processes increase the impact of externalities on the national banking system, which causes unbalances, deficits and contradictions. Today it is very important not only to analyze qualitatively the state of the banking system, but also to assess quantitatively the factors which influence its state and economic growth as a whole. Special attention is paid to testing the efficiency of the Russian financial market, in particular, the banking services market, and to selecting the most acceptable methods of mathematical analysis of the banking sector [1, 2].

Despite achievements in the investigation of this problem, it remains topical. The national literature has not yet worked out a single approach to determining the number of information effectiveness levels of the financial market, including the banking market, and to constructing a hierarchical and multi-criteria categorization of economic-mathematical methods for researching this market [3, 4]. There are still discussions about the viability of using the methods of linear and nonlinear regression in application to researching the state of the national banking system and assessing its impact on economic growth. There is need for scientific research and substantiation of the theoretical and practical problems related to using the economic-mathematical methods in the analysis of the banking sector.

II. BODY OF PAPER

According to the judgments of some economists, the existing management system of the Russian economy can be characterized as nomenclature or red tape. The banking services market is recognized as being regulated excessively on the part of the central bank. Despite a high level of savings, banks do not use a mechanism for transferring them into investments to a sufficient extent. It is caused by a number of factors, primarily by the following ones:

- low capitalization level of the banking system (less than 2% to assets), which does not allow it to create "investment" money;
- a growing level of regulation in the banking system, which, in turn, is related to bank "cleaning" on the part of the central bank and a rise in the number of banks being subject to a restructuring procedure;
- decline in banking business attractiveness due to its low profitability.

In order to solve the problem of capitalization, some banks get reorganized through merging and affiliation, but these processes do not make a substantial impact on the investment-related situation. According to RIA Ranking experts, the profitability of the national banking system must increase by 1.5 times at least and reach 15–17%, to make investments grow in the banking sector and in the economy as a whole [5].

In addition, banks experience considerable difficulties due to a low monetization level of the economy. Inflation targeting, accompanied by a decline in the growth rates of money supply causes a "money famine", which, in turn, neither stimulates investments nor GDP growth.

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TABLE I. DYNAMICS OF MONEY SUPPLY AND GDP INDICATORS IN RUSSIA [a]

N	Indiators	2008	2010	2012	2014	2016	2017
1	GDP growth rates (in current prices), %	5.2	4.5	3.7	0.7	0.2	1.5
2	Increment rates M2, %	43.5	17.7	22.3	14.6	11.2	9.2
3	Money supply to GDP, %	31.4	43.2	44.1	45.0	44.7	43.5
4	Annual inflation rates (based on the consumer price index), %	13.3	8.8	6.6	11.4	5.4	2.4

a. Source: Compiled base on the data from Goskomstat of Russia / URL: http://http://www.gks.ru/ и Банка России/ URL: http://www.cbr.ru/analytics/?PrtId=analytics_nfo

The indicator of money multiplication is at a low level (3.3), which is several times lower than in the countries with a well-developed market economy and even in some developing countries. However, according to some experts, in the modern conditions such an indicator as money multiplier is becoming less informative, due to a narrow lending channel, unifying money supply and base money. Even if reserve requirements are mitigated, the central bank will not be able to stimulate lending and investing on the part of commercial banks, unless the latter ones change their different risk preferences [6].

With the above trends remaining, depreciation of the ruble and growth of taxes and tariffs can become a necessary tool to fix the balance of payments and the budget. The budget and tax channels will have priorities in ensuring investment and innovative processes in the economy, which needs dynamic structural transformations. The economic sanctions of the USA and western countries reduce the efficiency of traditional tools for macroeconomic regulation since the microeconomic system and the existing economic relations are becoming less stable.

It should be noted that standard approaches lack mathematical description of the banking sector. Research studies are mostly dedicated to the problems of network planning and management, mass service, inventory management [7, 8, 9]; and in the banking sphere - to the problems of interaction between banks and customers during lending and borrowing, and to crisis phenomena in an individual bank. Using the models of regression and correlation analysis in investigating the state and dynamics of the banking system, as well as its impact on the economic development of the country, allows us to:

- identify linkages and parameters which are essential and non-essential for the economic system;
- identify relations between various components of the system, and describe how different parameters affect each other;
- describe the process under investigation on the basis of mathematics.

However, it is clear that mathematical methods can solve neither macroeconomic problems nor microeconomic ones [10, 11]. Moreover, the mathematical model cannot fully embrace all relations between the elements of the economic system, in particular, the banking system. It is caused by the fact that individual motives and linkages are irrational and may be not covered in the model. So it is important to choose the most acceptable approach, which both describes consistently the quantitative and qualitative information on the subject of research and uses value judgments when determining the effect of uncertainty factors, synergy effects and other factors, increasing the reliability of the conclusions made and decisions taken.

This research study considers the profits of credit organizations as a resulting indicator of operations of the banking system, because, in the conditions of market and private property, profit is a driving force for development of business and stimulation of economic growth. We have grouped credit organizations by the size of their assets and selected 730 credit organizations and 6 groups, depending on the size of assets. The first group includes credit organizations whose total assets accounts for over 44 trillion rubles, the six group comprises organizations with the total amount of assets not exceeding 300 billion rubles. The data of monthly reports over the period from 01.01.2016 to 01.01.2018 were used, i.e. the sample size was 24.

Having studies the statistics on each group and on the entire banking system, we selected some factors to describe how profits of a credit organization depend on them. They are: x_1– own capital of banks; x_2 – deposits of legal entities; x_3 – deposits of individuals; x_4 – net assets of banks.

The research was concentrated mainly on the first two groups of credit organizations (with the largest amount of assets), since the organizations in the other four groups demonstrated instable amounts of profits and did not lead to logical conclusions. Relying the most important presuppositions of correlation-regression analysis, each of the selected samples was checked for belonging to a totality with a standard distribution. The calculations were made using MathCAD 14.0 and STATISTICA software.

Bar charts and functions have shown that the factor x_4 (net assets of banks) almost ideally correspond to the normal probability plot, while the factor x_3 (deposits of individuals) mostly reminds of a row with a trend. So, we found it reasonable to remove this factor indicator from our research. The correlation coefficients, characterizing the presence, degree and direction of the linear relationship between profit and factors x_1, x_2, x_4 turned out to be quite high, but after they had been verified for significance by Student's t-test, only the important coefficients were reserved r_{yx_1} , r_{yx_2} .

In order to assess the linkage between the result and the other set of variables, we have calculated the sample multiplex correlation coefficient Ry, which turned out to be equal to

0.846. The calculations allowed us to suggest that there is a linkage and it is quite strong. In other words, the balance profit of banks depends by 85.62% on these two factors together (a bank's own capital and deposits of legal entities). Checking for significance by Fisher's ratio test proved this assumption.

Then we constructed a regression equation using STATISTICA package.

For credit organizations of the first group the two-factor linear regression equation can be represented in the following form:

$$Y1 = -0.071 + 0.079x_1 + 0.040x_2.$$

For credit organizations of the second group the two-factor linear regression equation can be represented in the following form:

$$Y2 = -0.040 + 0.044x_1 + 0.010x_2.$$

The interrelations identified in the analysis and assessment of their level have shown that in case equity capital changes by 1 million rubles with the unchanged indicator of deposits of legal entities, profit will change, on average, by 79 thousand rubles and 44 thousand rubles for the first and second group of credit organizations respectively. In case deposits of legal entities change by 1 million rubles with a permanent value of equity capital, profit will change, on average, by 40 thousand rubles and 10 thousand rubles for the first and second group of credit organizations respectively. Comparing the obtained values, we have come to a conclusion that the biggest relative impact on profit is made by a change of equity capital in both groups.

It should be noted that the two factors (a bank's own capital and deposits of legal entities) selected from the initial four were not mutually correlated. Inclusion of both of these two factors in the model resulted in a substantial increase in the share of the explained part in the total variation of the dependent variable. The importance of contribution of each factor to the model was formally verified through assessing the significance of the relevant specific correlation coefficient.

At the same time, we understand that the analytical dependence we have worked out has, as any regression model, a number of drawbacks. An important component in the process of creating an econometric model is selection of factors which affect considerably the indicator under study and which should be included in the designed model. The factors we selected are not comprehensive in terms of the identified significance of their impact on the financial result of a bank (profit). We used them only with a bigger certainty in their influence.

According to some researchers, the banking services market is characterized with information inefficiency [12]. It can be assumed that in order to tackle the above problem, a non-linear multiplex regression model could be used, for example, a power one, where the parameters must be transformed in a linear form for their further evaluation (by substituting the variables).

III. CONCLUSION

The analysis of the state of the banking system and its effect on the economic development in Russia has revealed that the system is not efficient enough, which is predetermined by a number of external and internal factors. Using an uncomplicated description of regression-correlation interrelation between the financial result of credit organizations, ranked by groups given the asset size indicator, and such factors as a bank's own capital and deposits, has allowed us to to give quantitative assessment of the impact these factors make on the bank's profit. It has been found out that the banking system is segmented significantly; in each group different values of correlation are formed between the factors and the resulting indicator. The gained experience makes it possible to continue research and create a non-linear multiplex regression model for analyzing the condition of the national banking system.

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