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Control, Diagnostics, Ordering Of Information About Regional Banks Activity And Planning In The Form Of The System Of Differential Equations.

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**Control, Diagnostics, Ordering Of Information About Regional Banks Activity And
Planning In The Form Of The System Of Differential Equations.**

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Abstract.

The analysis of banking, as a rule, has complex statistical property and claims significant time and efforts on collecting the information, its aggregation and comparison of data of the accounts for reception of the information, describing banks condition. In present work simple mathematical model, which have a decision, is offered. This model permits on available algorithm in the form of systems of simple algebraic and differential equations to conduct instant monetary diagnostics and control of conformity of real financial situation and planned, incorporated in the model. The offered methods permits not only to describe statistical data but also to plan the investments in regional enterprises through intermediary mechanism. The problem is especially urgent for foreign investors which are not aware with the features of financial parameters of the regions.

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In the post-crisis period of Russian economy, with deep economic problems in industrial sector of regions, it is especial important to develop the strategy of management by money funds and their redistribution by means of regional financial flows. Special interest, thus, acquire questions of choice by the investor of sphere of capital enclosure, establishing on the regional level mutual relations with regional financial structures in parameters of employment, incomes, costs and profits. In the works (Zaitsev 1999a; Zaitsev 1999b) in the general form the method of management by financial flows is offered. It is possible to name this method as an ordering of information about flows hereafter in the form of decision of the system of differential equations, which represents the problem of economic kinetics or numerical economic experiment over planning of the optimum reproduction structure on regional economy level (Pavlenko, F., Novitskiy, V., 1999). The opportunities of the method allow by use of modern informational technologies to reach dozens of variables y_1, y_2, y_n (\mathbf{n}), which specify reproduction components of the costs of regional enterprises. It is possible to say the same about managing parameters k_i, a, b, c etc., which describe the conditions of economical system.

In present researches, the case of interaction of financial intermediary, performing functions of crediting of the homogeneous enterprises of industry, agriculture and trade is considered. Regional commercial banks, on the one hand, participate by investments in process of reproduction, productive use of the saved money capital, replacing own means of the enterprise in the right part of Marx equation(Marx, 1969), on the other hand attends to reproduction of the bank capital, when on the entrance of system are the money in the form of accumulation, and on the exit are money of the special sort in the form of credit resources. Thus, the cost of bank capital is transferring on the banks products.

In fig. 1 statistical data, processed by method of sliding average (Obchaja teorija statistiki, 1997), about current incomes and costs of regional commercial bank, attending to crediting of real sector are submitted. The granting and the return of lended cost describes the process of extended reproduction of the bank and industrial capital, with yield, sufficient for payment of interest and of the main sum of the debt by the enterprise.

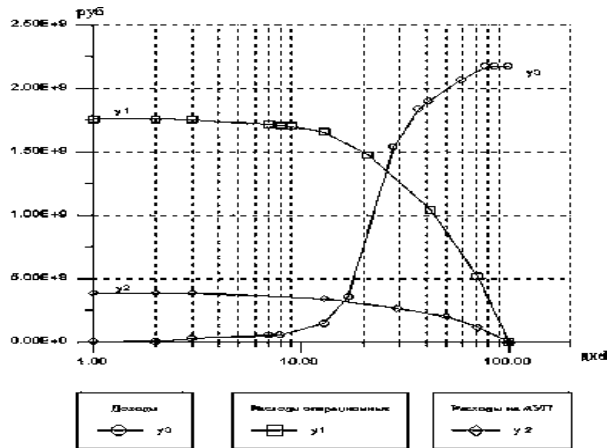


Figure 1. The incomes and costs spending of the bank in the 1st quarter, 1996 (roubles.): y_1 - operating costs; y_2 - costs for wages; y_3 - the incomes.

The character of curve appearance on Fig. 5 agrees with dynamics of growth of the sizes of compulsory reserves of credit organisations (Kugaev, Kaltirin, 2000) in conditions of relative stabilisation.

For model description of the results of regional bank activity (see fig. 1) the equations of kinetic type are written down in the form of reproduction system (1).

$$\begin{aligned}
 y_1 &\xrightarrow{k_1} y_3 \\
 y_2 &\xrightarrow{k_2} y_3 \\
 y_1 + y_2 &\xrightarrow{k_3} y_3 \\
 y_3 &\xrightarrow{k_4} y_1 + y_2
 \end{aligned} \tag{1},$$

where: y_1, y_2, y_3 - operating costs, costs for wages and incomes accordingly; k_1 and k_2 - correlation coefficients; k_3 and k_4 - restriction coefficients.

For decision of the problem on (1), the system of differential equations in the form of functions is written down: $f_1 = dy_1/dt$; $f_2 = dy_2/dt$ and $f_3 = dy_3/dt$.

$$\begin{aligned} F [1] &:= -k [1] * y [1] -k [3] * y [1] * y [2] + k [4] * y [3]; \\ F [2] &:= -k [2] * y [1] -k [3] * y [1] * y [2] + k [4] * y [3]; \\ F [3] &:= k [1] * y [1] + k [2] * y [2] + k [3] * y [1] * y [2] -k [4] * y [1] * y [2]. \end{aligned} \quad (2)$$

Unlike reproduction system of enterprises- banks clients (Zaitsev, 1999a) in system (1) two new equations with correlation coefficients k_1 and k_2 are entered, because it is impossible to define for certain the order of inclusion in reproduction of the bank capital the costs of the enterprises-clients as interactions costs units in money terms. Besides, Marx reproduction equation, inherent to specific character of banking, is written down with restrictive coefficients k_3 and k_4 , specifying by the ratio k_3/k_4 the restriction on spending of the advanced costs, considered as use of beforehand scheduled for a quarter fund of means and its reinvestment with synergetic effect.

In Fig. 2 the results of the decision of the system of differential equations (1) by use of method described in (Zaitsev V.V, 2000) are submitted.

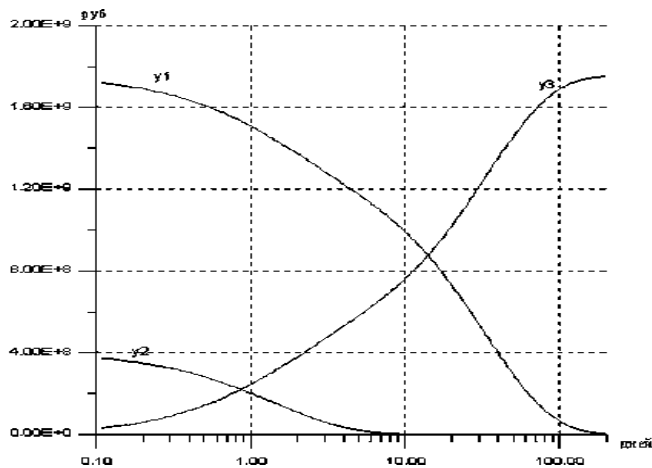


Figure 2. The decision of system of differential equations (2) at significances of managing parameters: $y_{10} = 1.75 \cdot 10^9$, $y_{20} = 3.9 \cdot 10^8$, $y_{30} = 0$; $k_1 = 30.14 \cdot 10^{-3}$, $k_2 = 12.6 \cdot 10^{-3}$, $k_3 = 4.2 \cdot 10^{-10}$, $k_4 = 4.2 \cdot 10^{-11}$; variables y_1, y_2, y_3 - operating costs, costs for wages, incomes in money terms, roubles.; t - time, days.

The decision of the system (2) assumed definition of coefficients k_1, k_2, k_3, k_4 , from deciding of simple algebraic system (2) for particular significances of first derivatives on plots of time t in days, and acceptance of appropriate significances y_1, y_2, y_3 . (fig. 1) In par-

ticular, for time $t=5$, $y_1=3.25 * 10^8$, $y_2=1.67 * 10^9$, $y_3=7 * 10^7$ (fig.1) graphic differentiation and the simple decision of system (2) as system of three equations with three unknown, gives the following significances: $k_1=30.14 * 10^{-3}$, $k_2=12.6 * 10^{-3}$, $k_3=4.2 * 10^{-10}$. Thus, there was entered three variables k_1 , k_2 , k_3 , and k_4 was found from restriction $k_3 / k_4 = 10$. The dimension of factors in system of equations is defined by the order of "reaction" in reproduction system (1). Thus, from the point of view of left and right parts, the system is authorised as well as in any kinetic model.

Absolute significances of y_1 , y_2 , y_3 and their dependencies on time with sufficient reliability repeat real statistical data in fig. 1, that testifies the reliability of the model (1,2).

The consent of offered model (fig. 2) with real statistics of activity of regional commercial bank (fig. 1) confirms reliability of the model and opportunity to use the offered method of ordering of the information about activity of the subjects of regional economy in the form of systems of simple and differential equations (1,2).

In model (1,2) we can find confirmation of the Leontief's theoretical work (Leontief, 1986) about uniformity and interaction of dynamic reproduction cycles in creation and realisation of cost by the enterprises of various branches of economy, in this case of the enterprises of traditional industries, agriculture and trade with regional financial intermediary. In fact, regional commercial bank with classical structure of activity and functions of means saving on accounts, crediting and cash service, executing own reproduction cycle, produces and sells bank services, provides wages and employment to the bank's staff, redistributes profits. For example credit, as one of the bank services, becomes the initial element of the costs of enterprise in "input-output" system, replacing its own means, and again created cost of the enterprises, included to bank account current, becomes the base element of the costs of the bank.

However, (Leontief, W.,1986) does not permit to reproduce the real activity of regional commercial bank as good, as model (1,2) does (see fig. 1-2). The uniformity of received laws for enterprises in work (Zaitsev 1999a; Zaitsev 1999b) and in present researches fig.2, characterises normal situation of reproduction in Marx model (Marx, 1969), i.e. real economic interaction of the financial intermediary and enterprises - clients.

Thus, model (1,2) permits to approach through factors k_i , and a , b , c , which specify the ratio of the costs and results, to significances of parameters, determining the proportions

of regional economy. If a, b, c etc., by analogy to Leontief's matrixes (Leontief, 1986) can be set from economic essence of considered objects, the factors k_1, k_2 and k_i can be defined by deciding the system of algebraic equations. Nevertheless, for particular economic situations the managing parameters k_i are possible to present in the form of analytical dependencies $k_i = A_i(M) * \exp(-m/M)$, where M is fixed capital, m - current periodic financing which can act as stabilising monetary factor, for example.

There are two situations, when $m/M \ll 1$, and \exp according to known rule $e^x = 1 + (m/M)^1/1! + (m/M)^2/2! + \dots \approx 1$ and empirical function $A(M)$ will be the managing parameter in system of differential equations. In all other cases the managing parameters k_i will be found as combination of empirical functions $A_i(M)$ and exponents, determined by the relation of current periodic financing and base financing. The dimensions of k_i will be defined by number of multipliers - variables y in the base system of equations and this dimension should be incorporated in empirical functions $A_i(M)$.

The character of interaction agrees with Kondratiev's theory (Kondratiev, 1991), outgoing from repeatability of cycles of economic conjuncture, however, with new significances of managing parameters, specifying the condition of economic system at new stages of development.

In fig. 3-4 the variants of planning by change of significances of managing parameters, rendering influence on condition of economic system of bank in parameters of the incomes, costs, employment and profit are shown. The situation on fig. 3 describes, modelled in future activity of regional commercial bank with the change reproduction parameters of the bank capital (fig. 1-2), consisting in increase of fund of means, allocated on wages (in 3,5 times) or increase of the number employed at preservation of constant relative size of wages on one bank worker.

Situation on fig. 2, where the contradiction of appropriation of profits is opened. In fact, the incorporated resources on payment of spent labour of the workers of bank are really spent in the first decade, thus being appropriated in the form of percent on enclosed money capital by the proprietor of the bank. Reproduction situation in fig. 3 illustrates an opportunity of redistribution for payment of labour of the banks workers without essential change of intensity and volume of return of enclosed means.

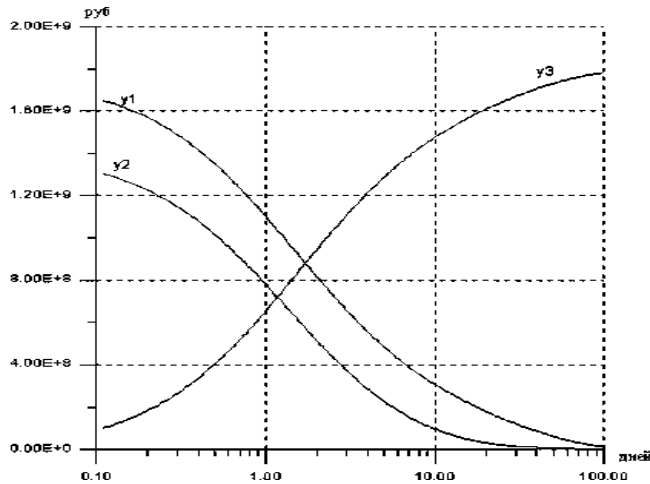


Figure 3. The decision of system of differential equations (2) with increase of money funds for wages at significances of managing parameters: $y_{10}=1.75 \cdot 10^9$, $y_{20}=13.9 \cdot 10^8$, $y_{30}=0$; $k_1=30.14 \cdot 10^{-3}$, $k_2=12.6 \cdot 10^{-3}$, $k_3=4.2 \cdot 10^{-10}$, $k_4=4.2 \cdot 10^{-11}$; variables y_1, y_2, y_3 - operating costs, costs for wages, incomes in money terms, roubles.; t - time, days.

Model situation in fig. 4, describes increase of effect from enclosed means as finding alternative source of profits and its appropriation, reflected by increase in 2 times of coefficient at first member of the third equation of system (2), thus, describing the efficiency of resources investments of bank in active operations (for example, crediting).

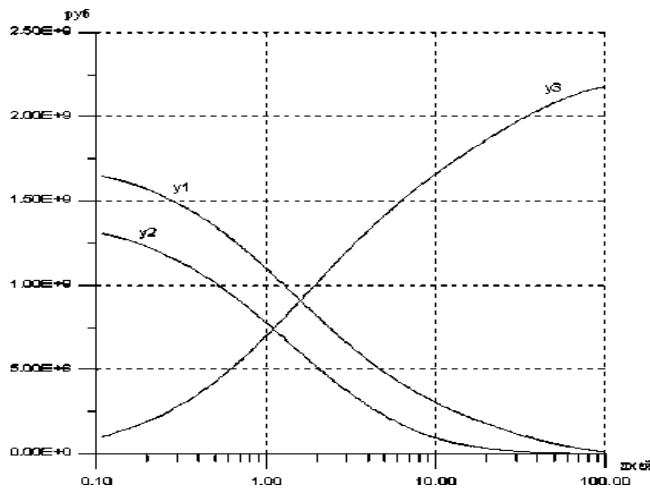


Figure 4. The decision of system of differential equations (2) with increase of investments efficiency at significances of managing parameters: $y_{10}=1.75 \cdot 10^9$, $y_{20}=13.9 \cdot 10^8$, $y_{30}=0$; $k_1=30.14 \cdot 10^{-3}$, $k_2=12.6 \cdot 10^{-3}$, $k_3=4.2 \cdot 10^{-10}$, $k_4=4.2 \cdot 10^{-11}$; variables y_1, y_2, y_3 - operating costs, costs for wages, incomes in money terms, roubles.; t - time, days.

For external investor the purchase of statistical data in the form of fig. 1, model (1,2) and fig. 2 will allow during time, determined only by speed of machines, to plan sharing of initial costs and participation in future profits

Above-stated permits to approve, that the system of economic kinetic equations (1) and its decision (2) can, on the one hand, act as an ordering of the information (fig.1) on financial flows of regional economy in metamorphose transformations of the money and valid industrial capital through institute of the financial intermediary(fig.2); on the other hand can be used for planning and control of investment activity and reception of profits (fig. 3-4) in microeconomic (inside banking), regional and interregional scales, especially for large investors, including foreign, entering in interaction with regional bank structures not having the sufficient information about facilities of the regional industry.

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