MATHEMATICAL APPROACHES TO RESEARCH OF BRANCH SCIENTIFIC MAINTENANCE: REGIONAL ASPECT

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In this article the role of branch scientific maintenance for development of economy exclave region in Russia is considered by the example of the Kaliningrad region. With the help of econometric model and calculations scientific - practical recommendations are formulated. These recommendations are connected to financing a branch science in modern conditions.

The development of mathematical analysis, probability theory and statistics has created base for formation of various research tools in the field of economy.

One of such tools is economic-mathematical modeling. The models of economic processes are various by the form of mathematical dependences that create conditions for their wide application. For example, econometric model is based on the system of regression equations. This model is one of effective research tools of regional economy and allows to make complex analysis, forecasting of economic system.

That's why for modeling the processes of branch scientific maintenance of the region the econometric model has also been applied.

It is necessary to note, that scientific maintenance of branch development was always under steadfast attention in theory and practice.

By 1990 in Kaliningrad region the powerful scientific and technical potential has been generated. By the end of 1980th years the charges on science in the USSR made over 4,5 % from total internal product. The value of this parameter was one of the highest in the world.

Expenses for scientific maintenance of Kaliningrad region in total amount of charges of budget on branch development made 7-10%, that was also high enough parameter.

After disintegration of the USSR Kaliningrad region became isolated from the other part of the Russian Federation and has got the status of exclave region.

The break of traditional economic communications of the enterprises of real sector economy, boundary barriers, the problems of transit cargoes have led to the situation that Kaliningrad area has come across the problems in the manufacture of competitive production on the territory.

The research of rates development economy in Kaliningrad region for the period 1990-2000 shows that practically by all kinds of production branches the volume of manufacture before reforms has not been achieved.

There was a reduction of state orders and there were no investments for the release of new kinds of popular production.

Many research institutions of Kaliningrad area became private and reoriented the work to international projects and programs of northwest federal district.

In the beginning of 2000 the growth of economy could be observed in Kaliningrad region.

There was no fast development of innovative system in Russia and in many regions of the country. Kaliningrad area was not the exception.

Today charges on a science in the country exceed by 1 % from a total internal product. In 2007 the expenses for scientific research made 0,5 % from gross regional product in Kaliningrad region (fig. 1).

The experience of advanced countries is interesting for our research. So, the highest density of expenses for science in the world in gross domestic product has Israel. In 2007 it was 5,3 %. In Sweden a similar parameter was 3,7 %, in Finland and in Japan - 3,5 %. Russia allocates for science approximately a 42 time's smaller sum, than, for example, the USA.

By comparing the expenses for science in country regions it is possible to notice that the data varies greatly. For example, in Germany in West-

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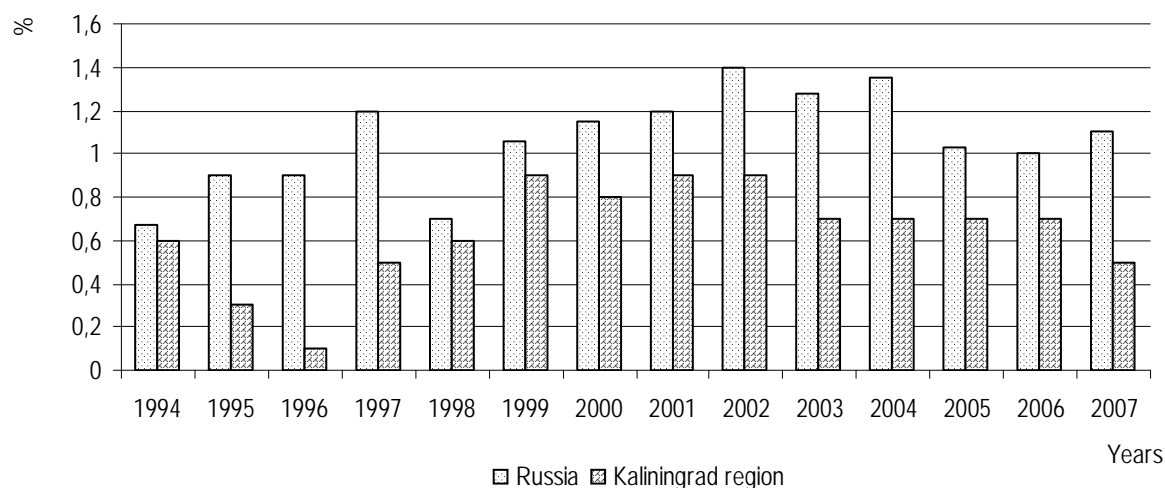
Fig. 1. **Dynamics of densities of expenses for scientific research and development in gross regional product (for the Russian Federation) and in gross regional product (for Kaliningrad region)**
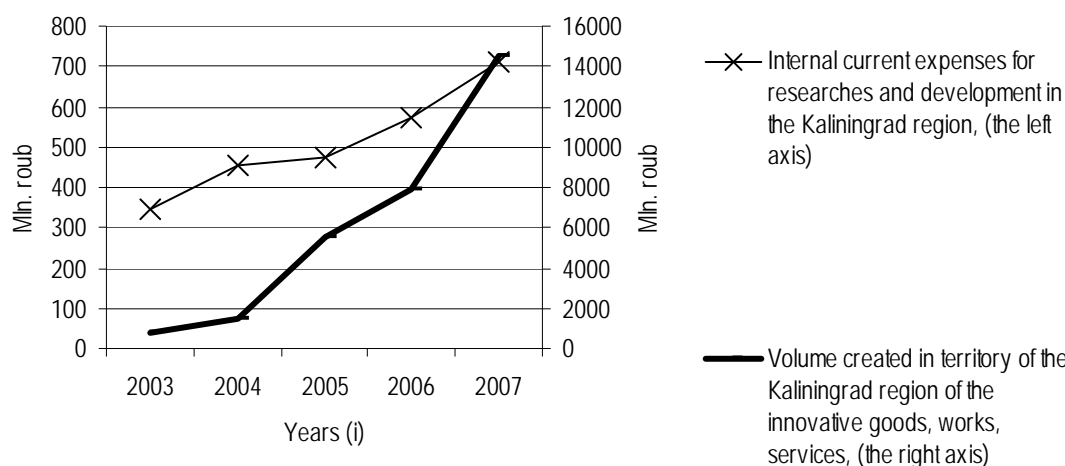

Fig. 2. **Expenses for scientific research, development and volume of innovative production that was made in territory of Kaliningrad region**

German district Braunshvajg the charges for scientific researches were 5,8 % from gross regional product in 2007, and in North-East Brandenburg the value of this parameter was 0,6%. In Poland a similar parameter in Swentoshikskiy district was 0,08 and 0,6%. in Katowizkjy district.

It is necessary to note that the expenses of regions for scientific maintenance have strong dependence on the structure of gross regional product and on the quantity and size of research institutions that are located on the territory of the region.

In the advanced countries the charges on science make not less than 2-3 % from gross regional product.

Therefore the author of the article pays attention to analyzing the role of branch scientific maintenance for the development of economy in Kaliningrad region in modern situation.

Let's assume, that significant influence on the volume of innovative products that have been made on the territory of the region is rendered with expenses for science. Expenses for a science are among the important characteristics of the development of branch scientific maintenance of the region (fig. 2).

For definition of this influence in article it has been constructed econometric model. The model describes interrelation of volume of the innovative goods, which have been made in territory of region and expenses for branch scientific maintenance.

The suggested model was based on the use of the method of least squares. Further para-

bolic approximation was made. It allowed to calculate the parameters of econometric models. Thus the condition was satisfied:

$$\sum_{i=1}^{5}(Yi - y*)^2 = S \Rightarrow MIN ,$$

where Yi - actual values of the volume of innovative goods which have been made on territory of Kaliningrad area, million rubles;

\- settlement values

of the volume of innovative goods which have been made on territory of Kaliningrad region, million rubles; xi — settlement expenses for scientific researches and development in Kaliningrad region, million roubles; a, b, c - the parameters of econometric models; S - the function describing the deviation of actual values from settlement.

Function will be a minimum when all private derivatives are equal to zero:

$$\begin{cases} \dfrac{dS}{da} = 0 \\ \dfrac{dS}{db} = 0 \\ \dfrac{dS}{dc} = 0 \end{cases} \text{or} \begin{cases} \sum\limits_{i=1}^{5}2(Yi - axi^2 - bxi - c)xi^2 = 0 \\ \sum\limits_{i=1}^{5}2(Yi - axi^2 - bxi - c)xi = 0 \\ \sum\limits_{i=1}^{5}2(Yi - axi^2 - bxi - c) = 0 \end{cases}$$

After the transformations we shall receive the following system of equations concerning the parameters of econometric models *a, b, c*:

$$\begin{cases} a\sum\limits_{i=1}^{5}xi^4 + b\sum\limits_{i=1}^{5}xi^3 + c\sum\limits_{i=1}^{5}xi^2 = \sum\limits_{i=1}^{5}(Yixi^2) \\ a\sum\limits_{i=1}^{5}xi^3 + b\sum\limits_{i=1}^{5}xi^2 + c\sum\limits_{i=1}^{5}xi = \sum\limits_{i=1}^{5}(Yixi) \\ a\sum\limits_{i=1}^{5}xi^2 + b\sum\limits_{i=1}^{5}xi + N \cdot c = \sum\limits_{i=1}^{5}Yi \end{cases}$$

Thus, in quantitative expression the system of equations looks like:

$$\begin{cases} 471840700941,73 \cdot a + 790700421,8 \cdot b + \\ +1386476,21 \cdot c = 11615387132 \\ 790700421,8 \cdot a + 1386476,21 \cdot b + \\ +2560,1 \cdot c = 18479711 \\ 1386476,21 \cdot a + 2560,1 \cdot b + 5 \cdot c = 30324,4 \end{cases}$$

The decision of the given system by the Gauss method has allowed to define the values of econometric models parameters:

$$\begin{cases} a = 0,0485467 \\ b = -12,813817774 \\ c = -835,9 \end{cases}$$

Thus, $Y_{тренд}(xi) = 0,0485467 \cdot xi^2 -$

With the help of the parabolic approximation of the decision the forecast values of the volume of innovative production in the region have been received, (fig. 3).
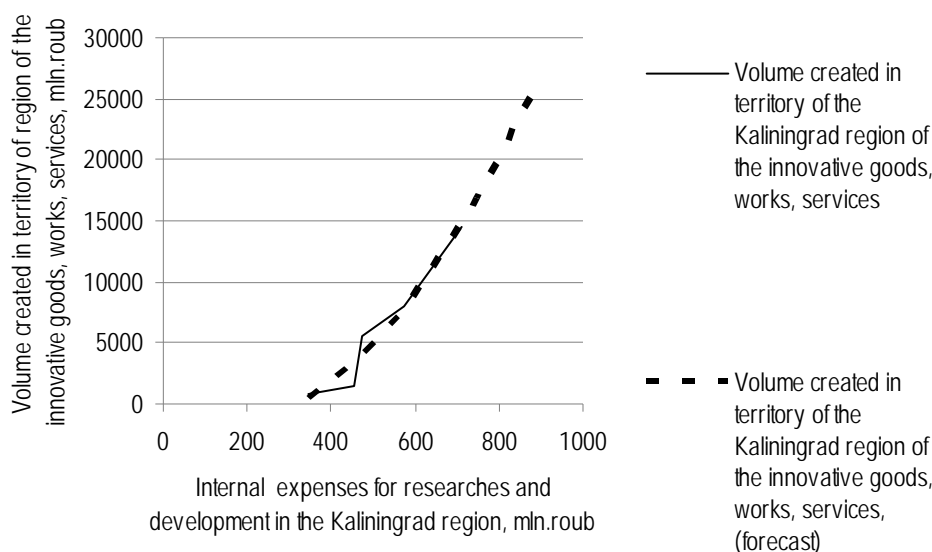

Fig. 3. **The forecast of the volume of innovative production, which is made on the territory of the region depending on the expenses for scientific research and development in Kaliningrad region**

According to the forecast, there is an increase by 26,5 % in expenses at scientific research and development in Kaliningrad area, the volume of innovative goods which are made on the territory of the region will grow in 1,8 times and will make 26954,463 million rubles.

In this case the economic growth will have an intensive character and promotes the increase in the incomes of the budget of the region. As a result there will be an economic and social effect.

The further increase in financing the scientific institution of the branches of the region depends on many factors. Among such factors are the economic growth, specialization of the region.

This problem is extremely important in the situation of economic crisis as the way of changing the volumes of financing regional programs and revealing priority directions of investment money are now of key importance.

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