

# MODELING OF REGIONAL SOCIO-ECONOMIC DEVELOPMENT OF BELARUS<sup>1</sup>

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## Abstract

This article presents the results of the analysis of regional socio-economic development of Belarus based on calculated integral criterion. The membership functions of fuzzy clusters of Belarus regions by this criterion were developed and compared. The Cobb-Douglas production functions of Belarus region were constructed and analyzed. The results of research can be used for regional socio-economic prediction.

## 1 Introduction

The problems of evaluation and analysis of regional development are actual both in Belarus and abroad. A lot of different valuation techniques of estimation were developed and proposed considering the complexity and diversity of the object. Among the topic of research should be noted methodology of international assessment agencies in Europe (for example, Eurostat [1]), Russian scholars O. Kuznetsova, A. Bakhtizin, domestic rating agency under the supervision of prof. M. Kovalev, regional assessments of V. Lyalikova and others. In this paper the evaluation and modeling is not made by time series because their stationary is subject of doubt. That's why it's made by variation. The purpose of this paper is modeling of regional socio-economic development of Belarus based on calculated integral criterion and fuzzy clusters of level of regional development.

## 2 The fuzzy clusters of regional development

The theoretical basis of the modeling and analysis is the author's technique of multi-agent situation analysis. It allows to determine main factors of regional socio-economic development and to develop a methodology for calculating the index, which characterizes the impact of the local area at the result of socio-economic development of the high region. Previous testing of this technique was carried out on the areas of Grodno Region for the years 2008-2014 [4]. In this study calculations of this indicator of all areas (118 cases) and the cities of regional subordination (10 cases) of the Republic of Belarus in 2014 were carried out. The necessity of integral criterions calculating by the author's methodology is defined by the absence of a formal comprehensive index

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of regional socio-economic development at local level. At the high level of regions this indicator is gross regional product. The presence of an integrated indicator allowing to assess the impact of various factors on the level of social and economic development [2]. The value of budget of the administrative-territorial unit, investments in fixed capital, retail turnover of trade and net exports of goods and services in current prices were summed for calculating the value of the integral criterion.

A lot of attention in regional economics research is given to inter-regional comparisons. In this regard, all local areas and cities of regional subordination of each region were divided into 4 fuzzy clusters: very high, high, medium and low level of development. Graphical representation of membership functions built on the example of Brest region are given on the figure.

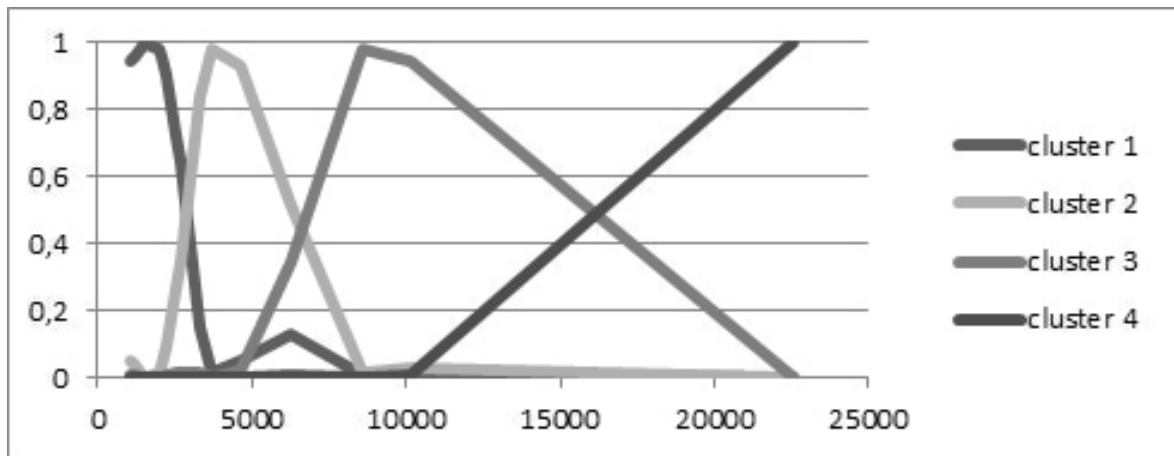


Figure 1: Graphical representation of the membership functions of local regions (of Brest region) of fuzzy clusters of socio-economic development

The Construction of membership functions provides its mathematical representation in the form of a piecewise-linear functions. For example, Brest regions membership functions get following formula:

$$F_1(x) = \begin{cases} 1, x \in (0; 2200) \\ -0,0006x + 2,213, x \in (2200; 3500) \\ 0, x \in (3500; \infty) \end{cases} \quad F_2(x) = \begin{cases} 0, x \in (0; 2200) \\ 0,0007x - 1,396, x \in (2200; 3200) \\ 1, x \in (3200; 4400) \\ -0,0002x + 2,001, x \in (4400; 8500) \\ 0, x \in (8500; \infty) \end{cases}$$

$$F_3(x) = \begin{cases} 0, x \in (0; 4700) \\ 0,0003x - 1,157, x \in (4700; 8550) \\ 1, x \in (8550; 9450) \\ -0,00008x + 1,719, x \in (9450; 22550) \\ 0, x \in (22550; \infty) \end{cases} \quad F_4(x) = \begin{cases} 0, x \in (0; 10000) \\ 0,00008x - 0,833, x \in (10000; 22550) \\ 0, x \in (22550; \infty) \end{cases}$$

where  $F_i(x)$  - the value of membership functions of cluster  $i$ ,  $x$  - calculated value of gross regional product of local area.

Assuming stability of the economy it will be possible to determine the membership of the administrative-territorial unit to the particular cluster depending on the value of the estimated gross regional product in the future.

### 3 The production functions of regional development

The factor analysis revealed that the main factors affected to the level of socio-economic development are population (or the number of employed in the economy, among which the correlation coefficient is 0.99) and the value of investments. These factors may be taken as the base of economic developments modeling with the Cobb-Douglas production function. In general it can be represented by the formula:

$$Q = a_0 L^\alpha K^\beta$$

where Q - gross regional product;  $a_0$  - factor which declare the level of technology development; L and K - numerical expression of labor and capital resources;  $\alpha$  and  $\beta$  - characteristics of efficiency of resources using.

The model was linearized by taking the logarithm for assess the value of the regression coefficients. The method of least squares was used for models constructing. As a result, we obtained the production functions for each area. The table below shows the production functions coefficients.

Table 1: Coefficients of production functions of regions of Belarus.

Region	$a_0$	$\alpha$	$\beta$
Brest region	23,4022	0,7158	0,3754
Vitebsk region	39,9304	0,7377	0,2954
Gomel region	42,8437	0,8984	0,2329
Grodno region	31,0446	0,8724	0,2736
Minsk region	45,0027	0,9978	0,1625
Mogilev region	30,3998	0,5682	0,4237
Source: author's own development.			

The determination coefficient for all constructed models is above 0.9, and p-value less than 0.001, the model is adequate. The free factor in all areas is quite close. In this article the simplest model of the Cobb-Douglas was used. The free factor of the model in the developed economic theory includes the level of technological development. Thus, theres no significant difference in the level of technological development in regions of the Republic of Belarus.

However the use of labor and capital factors in the production of gross regional product has noticeable difference. The analysis showed that Minsk regions capital flexibility is the lowest in the country, its much lower than the rate of labor flexibility.

This means that most of the cash resources of the region is spent on salaries, rather than to finance investment. This conclusion partly correspondes to the findings obtained by K. Rudyj [3].

Theoretically the values of the coefficients are stable over time if there is not major changes in the economy. In this case the models can be used for predicting social and economic development of regions.

## 4 Conclusion

In the research the integral criterion that takes into account the costs of households and the state, the value of businesss investments and net exports was proposed based on the technique of multi-agent situational analysis of regional development. The values of this criterion of all local areas and cities of regional subordination of the Republic of Belarus in 2014 were calculated.

All areas of each region were divided into 4 fuzzy cluster: very high, high, medium and low levels of development. In all regions, except Minsk, a cluster of very high development represented by only one object - the regional center. Comparing of membership functions of low development cluster in all regions allowed determining that Minsk and Brest regions are characterized by the development of higher and Vitebsk and Mogilev significantly lower than republican level.

Identification of key factors of socio-economic development was taken into account in the model of production functions of the gross regional product. We got that functioning of the economy in the regions of Belarus is mostly laboriousness. This is expressed by the fact that more than half of financial funds spent on salaries, rather than on investments. Thus the higher level of the regional development leads to the greater flexibleness of labor factor. This can be explained that the less developed areas have lower level of innovation and investments can significantly increase the impact of production and productivity. Highly developed areas need for this purpose the breakthrough technologies, which have higher cost and complexity of implementation.

## References

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