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Calculation Method of Innovation Index of Azerbaijan

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Abstract. The article was updated taking into account the national and specific features of Azerbaijan, statistical indicators in this area, the collection and processing of information, the innovative potential of economic regions and sectors, were changed the system of indicators and assessments of the country's scientific and technological development. The used methodology is based on the experience of countries such as Russia, Belarus and Kazakhstan. The selected system of indicators allows us to assess the level of innovative development in different regions, to analyze the factors affecting the innovation index in economic regions. The results show that the formation of a national innovation system requires the development of economic regions.

***Keywords**:* innovation potential; innovative activity; innovation index; scientific and technological development; economic region; Azerbaijan.

Методика расчета инновационного индекса Азербайджана

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Аннотация. В данной статье описываются национальные, специфические и статистические показатели регионов Азербайджанской Республики. Дается информация о данных, которую можно аккумулировать и обрабатывать, учитывая инновационный потенциал экономических регионов и отраслей страны. Также, была изменена система показателей и рассчитана оценка научно-технологического развития регионов. В методике был использован опыт таких стран, как Россия, Беларусь и Казахстан. Таким образом, выбранная система показателей позволяет оценить уровень инновационного развития различных сфер, проанализировав факторы, влияющие на инновационный индекс в экономических регионах. Результаты показывают, что для формирования национальной инновационной системы необходимо развитие экономических регионов.

Ключевые слова: инновационный потенциал; инновационная деятельность; инновационный индекс; научно-технологическое развитие; экономический регион; Азербайджан.

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Introductıon

Typically, the methodology for assessing the potential for innovation in countries is based on the legislation of that country. Thus, there are significant differences that were not explained when applying standard valuation methods in EU countries. When developing international standards, it is impossible to take into account the specifics of all countries, therefore in the international approach was adopted a universal system of indicators. Political goals of states are not taken into account. Recently, in many countries, the demand for science policy and strategic and technological planning has increased. This leads to improved information support for the decision-making process in national and economic zones.

The system of guidelines and indicators developed by the UNESCO Institute for Statistics in Montreal does not reflect the characteristics of national innovation systems in different countries. The European Innovation Scoreboard (EIS) reports for Norway are examples of this. The adopted system of indicators and methods for analyzing innovation policy cannot be applied to the country [11]. That is why each country conducts research to create its own system of indicators of innovative development. The main criteria for creating a system of indicators are the ability to provide information on the collection and processing of data, solving development problems in the country.

Lıterature revıew

At the national level, the measurement of innovation is important. Because innovation is one of the key factors for sustainable economic growth. Innovation is a complex process and it is difficult to cover all relevant dimensions.

Modern economy does not give a clear definition of the concept of "innovative potential", and therefore there is no optimal approach to its measurement (Valitov, Khakimov, 2015).The concept of "innovative potential" was first proposed by C. Freeman in the 1970s and 1980s. He believed that innovation is a system of measures for the formation, development and exploitation of the social, economic and institutional potential of large innovations. The practical side of the concept of "innovative potential" is reflected in the works of P. Drucker, exploring the sources of development of modern industry (Drucker, 2009).

Maer Matei evaluated the effectiveness of innovations using EIS for Monica Romania to represent the time gaps between input and output. Results include performance estimates, bias corrections, and 95% confidence intervals for Data Envelopment Analysis evaluators (Maer Matei, 2010).

In the Volga Federal District for 2005-2010, Glebova I. and Kotenkova S. (Glebova, Kotenkova, 2014) calculated the integral indicators of innovative development of the three regions and proposed a regional system of indicators of innovative potential. In their opinion, a comparative analysis of the potential of regional innovations made it

possible to identify the main problems and possible solutions to them in this area.

Semenenko E. (Semenenko, 2017) analyzed the innovative activity of Ukrainian industry over the past seven years, examined development trends and methods for assessing the innovative activity of industrial enterprises. To this end, he used a systematic approach and the methodology of economic, statistical and economic-mathematical analysis to study innovative trends in the industrial sector of the national economy. He believes that sustainable growth and competitiveness of industrial enterprises is possible only through the effective use of innovative resources, economic knowledge, the use of modern high technologies, the development of high-quality new products and the creation of innovations. These cases require the development of scientifically based methodologies for assessing innovation. Monitoring the effectiveness of innovation is important not only to determine the position of the industry in specific markets and in the global economy, but also to optimize the resource potential in the innovation process.

Evaluation of innovative activity can reduce risks and regulate investment policy, both at the individual and at the state level.

M.N.Titov and others (Titov, M.N. et al. 2010) believe that the potential of innovation lies in the ability of the real sector to provide a sufficient degree of updating production factors, combinations of products, organizational and managerial structures, as well as corporate culture.

Research in this area in Azerbaijan has not yet been expanded. Some scientists have conducted a study evaluating some of the components of innovation potential. The works of Z.M.Najafov, F.A.Gasimov, T.M.Aliyev, S.Abasova, A.Muradova and others [4; 8; 10] are an example of this. Nevertheless, each of these scientists took an individual approach to the problem and did not conduct any research on the system of integrated indicators and its information.

This study was based on research by the Institute of Science Development Problems of the Russian Academy of Sciences, the Center for Scientific Research and Statistics, the Belarusian Institute of System Analysis and Information Support of Science and Technical Sphere (BELISA), and the Kazakhstan Scientific and Technical Information Center.

Assessment and analysis of the scientific and technical sphere in Azerbaijan is based on the assessment scheme and methodology "Russian regional scientific and technical complexes: assessment indicators and comparative analysis methods" taking into account Russian experience in this field [9]. This methodology was finalized taking into account the national and specific characteristics of Azerbaijan, statistical indicators in this area, information collection and processing, innovative potential of economic regions and sectors, the indicator system was changed and calculated for Azerbaijan.

Evaluatıon of innovatıve actıvıty

Based on the used methodology, the general structure of indicators for the assessment and comparative analysis of the changed scientific, technical and innovative activities is presented for Azerbaijan.

Not all data necessary for calculating the innovation index is yet reflected in the statistics of Azerbaijan. Since it is not recommended to use data from different sources when calculating the innovation index, only official data of the Azerbaijan Statistical Committee should be selected from the list of key indicators, and calculations should be made on their basis (Figure 1).

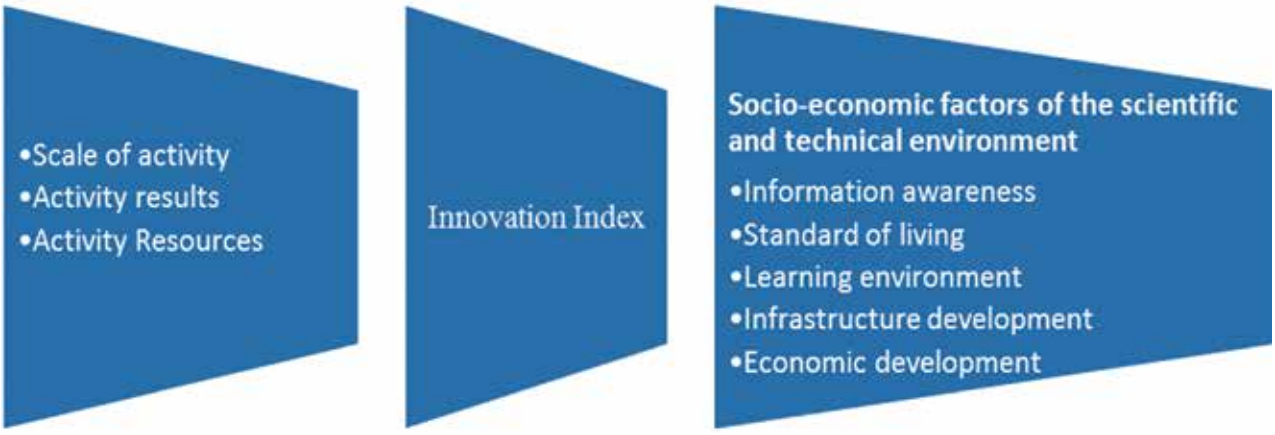

Figure 1. **The system of indicators of innovation activity**

The innovation index is calculated on the basis of indicators characterizing the organization's activities in the field of innovation. Indicators of the socio-economic environment are considered as external factors. External factors have a direct impact on the formation of the innovation index.

The used methodology "European Innovation Scoreboard" is based on the innovation index, which determines the source of information, the composition of the criteria and indicators, organizational procedures, general recommendations for the analysis and evaluation of the scientific and technical complex. This methodology consists of 4 steps (Figure 2).

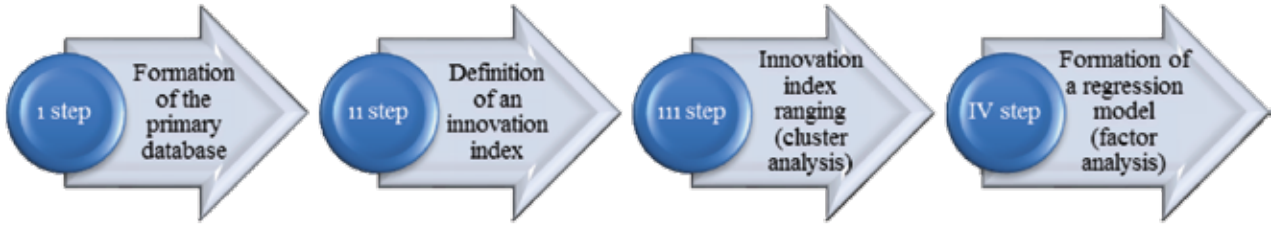

Figure 2. **Steps of methodology**

Let's explain each step individually.

In our case, economic regions were taken as objects. In fact, we can take as an object countries, ministries, organizations, research institutes, universities and so on. It depends on the question.

The system of indicators characterizes the scientific and technical complex and the socio-economic environment of the economic region. All indicators correspond to the statistical system. In the development of the methodology, indicators of scientific and technological development, socio-economic conditions, their relationship and comprehensive compatibility, assessment and analysis methods using the proposed system of indicators and indexes were taken into account.

The tool of this method is multidimensional statistics. As an economic modeling

tool, we used SPSS 17 statistical package and MS Excel spreadsheet. First of all, the used indicators are brought into a comparable form, that is, a single indicator scale is created.

Normalization of indicators is carried out according to the method of linear scaling.

Based on the reports on the normalization of indicators, an analysis of the distribution of objects according to the selected system of indicators is carried out.

The list of ranked economic regions is grouped into clusters.

The cluster method is a multidimensional statistical procedure. This method adjusts objects based on information available in groups for a relatively similar attribute.

The cluster analysis method consists of several stages:

1. The choice of algorithm.
2. The choice of the cluster method, which determines the strategy of the process of combining objects into clusters (signs of consolidation).
3. The choice of a method for calculating the distance between clusters, which determines the various features of objects in clusters.
4. Determining the number of clusters.

In our case, due to the small number of objects, the hierarchical algorithm is selected by the Vard method.

This analysis method also allows you to analyze factors. Here, indicators are first normalized and then checked.

Socio-economic factors can have both positive and negative effects on the environment. Therefore, they should be divided into two groups, respectively. Such preliminary data can be used to build a regression model. After that, a correlation model should be created to determine the influence of factor indicators on final values.

In the modeling process, indicators that are important for the final values are identified. The structure given for economic regions is divided into stages corresponding to the functional structure of the factor indicator.

The first stage is the influence of the level of education on the innovation index; the level of provision with elements of the information infrastructure of the region; standard of living; level of economic development, etc. are the parameters of the regression equation.

The next stage of modeling is the calculation of dispersion and determinant coefficients for each factor. Based on these coefficients, it was decided to integrate specific indicators into the regression model and build a double regression model for each cluster.

This model allows us to predict the value of the innovation index, which depends on changes in factor prices.

The calculations were performed using the SPSS 17.0 package. As we have shown, some indicators characterizing the economic activity of the region are not published (not processed) in the official statistics of the State Statistics Committee of Azerbaijan. Therefore, we had to compress the scorecard a little. Indicators are normalized by linear scaling.

As we have already noted, the normalized indicator is denoted by $\overline{G}_j$ ($\overline{G}_j$— j=1,2,3 is the average price for groups, *j*— valid pointer code). Let's build the algorithm we mentioned above. As shown in Table 1, the scorecard is divided into three groups: "Resources", "Scale", "Results". Each of these groups is further subclassified (Table 1).

As can be seen from Table 1, the third group will not participate in our calculations and algorithms, since there are no official statistics on indicators.

Having performed the calculations according to the indicated, we obtain Table 2. As a result, economic regions are ranked by the development of innovations.

Since we make calculations by economic region, their number is limited, so there is no need to divide them into clusters (Table 2).

Table 1.

Indicator distribution system

Groups	Resources		Scale		Results	
	Labor resources	Material and technical base	Scientific activity	Innovation activity	Scientific activity	Innovation activity
Number of indicators	4	2	6	1	0	0

Table 2.

Index of innovative development of economic regions

Indexes	Baku city	Absheron	Guba-Khachmaz	Ganja-Gazakh	Shaki-Zagatala	Aran	Lankaran	Nakhchivan	Dakhlik Shirvan
Innovation reserve index (I_1)	0.355	0.117	0.087	0.109	0.037	0.121	0.143	0.248	0.313
Innovation scale index (I_2)	0.405	0.235	0.174	0.225	0.145	0.105	0.130	0.229	0.049
Innovation index (I)	0.380	0.176	0.130	0.167	0.091	0.113	0.136	0.238	0.181

Calculations with normalized data take into account the initial distribution of economic regions for the selected system of indicators (Figure 3).

The cluster analysis in SPSS-17 once again confirms the above. Let's look at the rating of economic zones by region.

Let's look at the ranking of economic regions by classification.

The Table 3 shows the special index and the innovation index, as well as average estimates for each cluster, normalized for clusters and subgroups by economic region.

As you can see, Baku is ahead because the main scientific potential is concentrated in this city. The economic regions in the cluster occupy a special place in Azerbaijan because of their importance. In addition to accumulating scientific potential in these areas, Absheron created technology parks and free economic zones, and the Nakhchivan Autonomous Republic pays special attention to innovation in all areas and management. Two other zones: Ganja-Qazakh and Quba-Khachmaz, as well as economic areas located in cluster 3, are inversely proportional to the prices of special

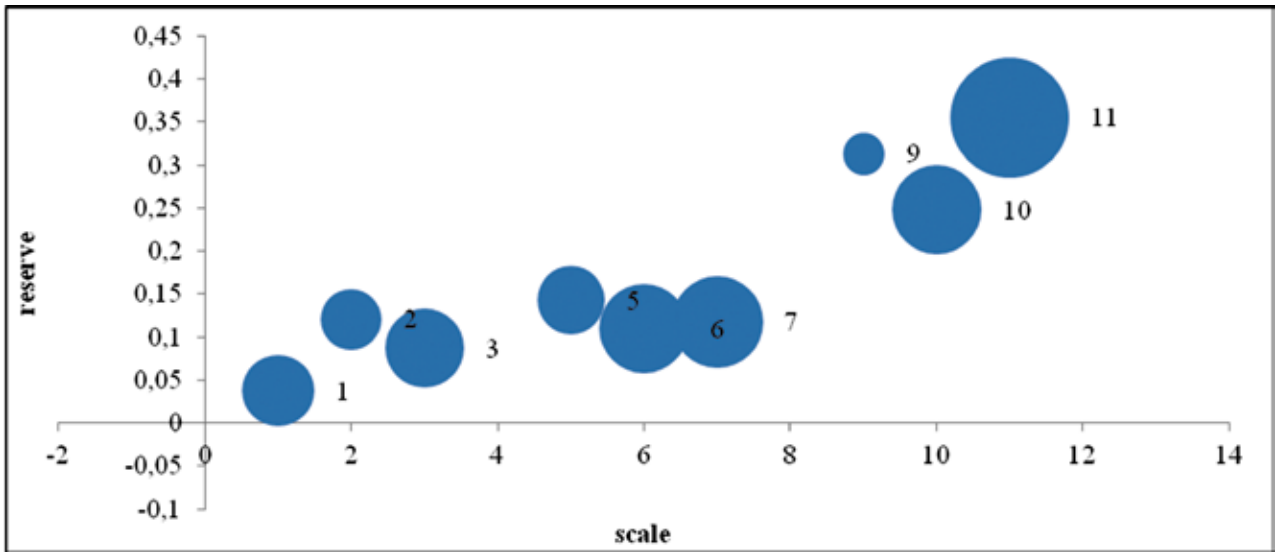

Figure 3. **Distribution of economic zones by components of the innovation index**

indicators. In other words, the regions that are most significant in human resources are the lowest in CIS. Added external factors allow us to analyze factors when assessing the level of innovative development of economic regions (Table 3).

Table 3.

Economic classification according to the level of innovative development

Clusters			Cluster 1	Cluster 2					Cluster 3				
Economic regions			Baku city	Nakhchivan	Absheron	Ganja-Gazakh	Guba-Khachmaz	Average rating	Dakhlik Shirvan	Lankaran	Aran	Shaki-Zaqatala	Average rating
Special indexes	Resources	Staff	0,48	0,27	0,11	0,19	0,07	0,16	0,13	0,3	0,21	0,04	0,16
		Material and technical base	0,24	0,23	0,13	0,03	0,11	0,13	0,5	0	0,03	0,03	0,15
		Index	0,36	0,25	0,12	0,11	0,09	0,14	0,31	0,1	0,12	0,04	0,15
	Scale	Science	0,81	0,46	0,47	0,45	0,35	0,43	0,1	0,3	0,21	0,29	0,21
		Index	0,81	0,46	0,47	0,45	0,35	0,43	0,1	0,3	0,21	0,29	0,21
Innovation index			0,58	0,35	0,29	0,28	0,22	0,29	0,21	0,2	0,17	0,16	0,18

Result

The distribution of scientific and technical potential in the country and the management of innovative development is one of the most important issues in the formation of NIS in the country.

Science and technology should be improved in Azerbaijan. The development of scientific and technological potential and innovation in economic regions is one of the key issues in the development of the national innovation system in the country. The formation of a national innovation system requires the development of economic regions. As a result of the study, the methodology was adapted to Azerbaijan and calculations were made. The methodology is based on a system of indicators characterizing the internal and external environment and factors of innovation. The proposed method uses tools that are widely used in international practice.

The assessment of the Innovation index is based on internationally recognized principles. For each economic region, was found a comparative assessment of the innovative potential of Azerbaijan, where regions were ranked and was conducted a cluster analysis.

The selected system of indicators allows us to assess the level of innovative development in different regions and analyze the factors affecting the innovation index in economic regions. We divided economic regions into clusters and analyzed factors.

The innovative activity of economic regions was measured on the basis of a system of sample indicators that allow for the territorial distribution of the country's scientific and technical potential and cluster analysis.

REFERENCES

1. Drucker P.F (2009). Business and Innovation. Moscow: «I.D.Vilyams».

2. Glebova I., Kotenkova S. (2014). Evaluation of Regional Innovation Potential in Russia. Procedia Economics and Finance, International Conference on Applied Economics. Vol. 14. pp. 230-235.

3. Maer Matei, Monica (2010). Innovation efficiency analysis for Romania. Economic computation and economic cybernetics studies and research / Academy of Economic Studies Vol.44.

4. Qasımov F.H., Nəcəfov Z.M., Hüseynova A.D. Elmi-tədqiqat işlərinin qiymətləndirilməsinin və idarə olunmasının informasiya təminatı sistemi. Bakı: Elm, 2005, 118 c.

5. Semenenko E.H. (2017). Estimation of innovation activities of the Ukraine industry. Ekonomichnij visnik universitetu. Vipusk № 35/1.

6. Titov M.N. et al. (2010). The methodology of new technologies and nanomaterials transfer management. SPb.: SPGUTD.

7. Valitov Sh., Khakimov A.(2015) Innovative Potential as a Framework of Innovative Strategy for Enterprise Development. Procedia Economics and Finance, Vol. 24. Pp. 716-721.

8. Huseynova A.D. (2012) Science of Azerbaijan in the context of globalization. Fundamental research, No. 6, pp. 711-715.

9. Kazantsev A.K. , Leora S.N., Nikitina I.A., Rubvalter D.A., Firsova S.A. (2009) Regional science and technology complexes of Russia: indicators of estimation and a technique of the comparative analysis. Information-analytical Bulletin of the CISN, No.1.

10. Kasumov, F.G. and Guseynova, A.D. (2011), "Role of science in economy development in conditions of globalization", Materials of the 3rd International Scientific and Practical Conference, Kiev, November 9–11, 2011, pp. 90–96.

11. Special Project, URL: www.expert.ru.

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