ANALYSIS OF THE SUSTAINABILITY INDICATORS OF SOCIO-ECONOMIC DEVELOPMENT IN AZERBAIJAN BY MULTI-DIMENSIONAL STATISTICAL METHODS

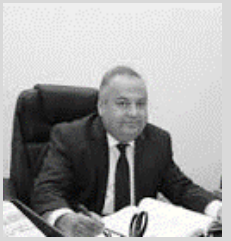
R.K. Isgənderov,
Professor, Azerbaijan National Academy of Sciences,
Institute of Economics, Baku,
Azerbaijan

Sh.A. Abbasova,
Assoc. prof. Baku State University, Baku,
Azerbaijan

R.M. Guliyev,
Assoc. prof. Baku State University, Baku,
Azerbaijan

F.A. Mirzeyev,
Assoc. prof. Baku State University, Baku,
Azerbaijan

R.Z. Huseyn
Assoc.prof. Institute of Agricultural Economics, Baku,
Azerbaijan



Abstract. *In article the analysis of sustainability of the socio-economic development of the Republic of Azerbaijan by the method of the main component is carried out. The method of the main component is one of the most commonly used factor analysis methods. Application of this method has allowed to decrease of number of indicators and to reveal the major factors influencing economic growth and socio-economic development of the country for period 2000-2013. The current situation of socio-economic development in Azerbaijan is analysed and recommendations for improvements put forward in this article.*

Key words: *socio-economic development, sustainable development, economic, social and ecological factors, multivariate statistical methods, factor analysis method.*

1.Introduction

The main goal of socio-economic development of the country is to provide the increase of welfare of the population based on sustainable economic growth. Realization of this goal is only possible by complex approach to the problem. Because, the realities of the modern life requires to research the sustainable economic growth and increase of welfare of the population together. It should be noted that, sustainable development includes ecological aspects as well as economic and social aspects. The indicators of sustainable development mean the quantities of changes in economy, enviroment and social life over time [2]. These indicators allow to evaluate the current situation of the problem in line with reflecting the quantitative and qualitative characteristics of the problem.

Though, sustainable socio-economic development should be refered taking into account economic, social and environmental factors[3]. That's why to research the numerous indicators of socio-economic development systematically, these indicators have been groupped and analysed[6].

The necessity for assessment of sustainability of soci-economic development of the country shows the actuality of the research. Research of multi-dimensional statistical methods allows to decrease the number of numerous indicators mentioned above to few most important factors and this make the process of assessment easier.

The main objective of research is to replace the numerous indicators of socio-economic development with several factors using multi-dimensional statistical methods.

2.The necessaty of application of multi-dimensional statistical methods in analysis of sustainable economic growth

Multi-dimensional statistical methods first were investigated by an english scientist C.Pirson and developed by american researchers L.Gudman, Q.Hotelling, L.Terstown, K.Holzinger, Q.Kauzer later [4]. In this research, the multi-dimensional statistical methods have been classified, division of these methods into several groups was substantiated depending on the method of detecting factors.

Application of the multi-dimensional statistical methods allowed to replace the indicators sustainable socio-economic development with few factors making the process of assessment easier which can later be used in the process of forecasting of strategy of socio-economic development of the country. We should also note that, application of the multi-dimensional statistical methods for analysis of sustainable economic growth is a wide sphere of research possibilities and the results of research carry important scientific and practical interest.

3.Analysis of indicators of sustainability of socio-economic development in Azerbaijan by multi-dimensional statistical methods

To promote the sustainable development in the country "The state program on poverty reduction and sustainable development in Azerbaijan Republic in 2008-2015" has been adopted as it happens in all of developed countries. Development of the country is a multilateral and multifaceted process and it has been researched from social, economic and environmental points of view. The indicators of sustainability of socio-economic development of Azerbaijan Republic for the period of 2000-2013 have been found and analysed under three groups[6]. These indicators reflect the changes of economic, social and environmental spheres over time. The indicators are given in the follwing table [6]. The indicators are:

Economic:

X1- the volume of GDP (mln.man);
X2- the volume of industrial production (mln. manat);
X3- the volume of agricultural production (mln. manat);
X4- the volume of domestic investments (mln. manat);
X5- the volume of foreign investments (mln. manat);
X6- government income(mln. manat);
X7-government expenditures (mln. manat);
X8- retail turnover (mln.manat);
X9- the average nominal wages (manat);
X10- external trade turnover (mln. US$);
X11- income of the population (mln.man);
X12- expenditures of the population (mln.man);
X13- consumer price index (CPI, inflation, %);
X14-rate of manat to 1 US dollar (manat);

Socal:

X15- number of population (thsd. person);
X16- natural increase of population (person);
X17- life expectancy at birth (number of years);
X18-infant mortality under 1 year;
X19- unemployment rate (%);
X20 - the average level of pensions (man);
X21-saving attracted from population (mln.manat)

Ecological:

X22- air pollutant emissions (thsd. tonnes);
X23-discharge of sewage water (mln m^3).

Table 1

The indicators of sustainability of socio-economic development of Azerbaijan Republic for the period of 2000-2013

years	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Macro-economic indicators														
X!	4718.1	5315.6	6062.5	7146.5	8530.2	11875.6	17135.8	25228.1	40137.2	35601.5	42465	52082	54743.7	58182
X2	3639	3769	4019	4982.1	5961.4	9308.8	15544	22495.6	29773.3	22563.6	27978.2	35026.9	34565	33898.1
X3	1060.7	1179.9	1300.0	1408.0	1547.9	1844.5	2068.2	2319.7	2916.5	3347.3	3877.7	4525.2	4844.6	5244.6
X4	460.3	437.7	546	938.3	1324	2104.9	2901.4	4626.7	7702.2	6079.9	7499.2	10199	12148.4	13704.9
X5	829.5	1016.8	2172.8	3311	496.3	4628.5	4514.2	5727.2	5625.8	395.1	6619.7	6849.8	8102.7	8269.3
X6	714.6	784.8	910.2	1220.9	1509.5	2055.2	3868.7	6006.6	10762.6	10325.9	11403	15700.7	17281.5	19496.3
X7	764	807.5	931.8	1234.5	1502.1	2140.6	3790.1	6086.2	10774.2	10503.8	11765.9	15397.5	17416.5	19143.5
X8	2101.5	2355	2663.7	3028.3	3677	4548.2	5654.1	7423.9	10585.4	11493.4	13261.7	15880.3	17559.1	19655.9
X9	44.3	52.0	63.1	77.4	96.7	123.6	141.3	214.0	274.4	298	331.5	364.2	398.4	425.1
X10	2917.3	3745.3	3832.9	5216.6	7131.4	8558.4	11638.9	11771.7	54626	20824.5	33160.7	44161.7	43813.5	43551.2
X11	4047.3	3802.0	5018.6	5738.1	6595.1	8063.6	10198.5	14558.2	20735.4	22601.1	25607	30524.6	34769.5	37562
X12	3272.2	3130.0	4171.2	4793.8	5549.9	6508.7	8208.1	11249.7	15891.9	17417.6	19251.5	22184	24564	28021.2
X13	101.8	101.5	102.8	102.2	106.7	109.6	108.3	116.7	123.4	99.9	106.1	108.7	100.9	101.9
X14	0.8948	0.9313	0.9722	0.9822	0.9827	0.959	0.8934	0.8581	0.8216	0.8037	0.8026	0.7897	0.7856	0.7845
Macro social indicators														
X15	8032.8	8114.3	8191.4	8269.2	8349.1	8447.4	8553.1	8666.1	8779.9	8922.4	8997.6	9111.1	9235.1	9356.5
X16	70293	65072	64193	64466	82041	89939	96698	98308	99376	99625	112063	122310	119452	118288
X17	71.8	71.9	72.2	72.3	72.4	72.4	72.4	73.0	73.4	73.5	73.6	73.8	73.9	74.2
X18	16.4	16.6	16.7	15.5	14.4	12.7	11.9	12.1	11.4	11.3	11.2	11.0	10.8	10.8
X19	11.7	11.2	10.7	9.1	8.6	7.7	7.3	6.5	5.8	5.7	5.6	5.4	5.1	4.9
X20	13	14.4	14.7	17.7	23.8	24.0	28.5	41.1	62.9	95.8	100.4	112.9	145.1	152
X21	79.3	117.0	153.4	251.9	403.1	495	820	1468.4	1905.3	2334.9	3029.8	4119.8	5113.4	6395.8
Ecological indicators														
X22	908	979	620	838	975	1054	875	970	937	997	957	1003	1076	1119
X23	4106	3966	4596	4749	4817	4878	5164	5237	5325	4802	6005	5068	5419	5173

And now, we will try to apply multi-dimensional statistical methods to assess the relations among the indicators of sustainability of socio-economic development. First of all, we will try to apply the factor analysis method, which belongs to multi-dimensional statistical methods. The main goal of the factor analysis method is to decrease the number of analysed indicators to few generalized factors and to show them as the linear combination of these factors.For this purpose, primary data about the indicators is given as the matrix: $\{X_{ij}\}$, *i,=1,...,m, j= 1,...,n,* where X_{ij} – is the price of *i* at the year of *j*, *m*- is the number of indicators, *n*- is the number of years. So, we've got a matrix of 23*14. The matrix includes 23 macroeconimic, social and ecological indicators for 14 years.

First of all, the matrix X is transformed into the standardized form of Z: $z_{ij} = \frac{x_{ij} - \bar{x}}{\sigma_j}$.

Later, R correlation matrix is calculated by using of standardized estimation: $R = \frac{1}{n} ZZ'$.

Eigenvalues and eigenvectors of the correlation matrix are calculated from the equation below: $|R - \lambda E| = 0$.

The diagonal matrix Λ is formed by calculated characteristict values $|\lambda|$. Based on the matrix Λ and normalized characteristic vectors *V* factor loading matrix *A* is defined.

Generalized factors are given as the following:

$F = A^{-1}Z'$ və ya $F = \Lambda^{-1}A'Z'$,

where: *A*- factor loading matrix;

F- vector of factors;

Λ – the diagonal matrix of characteristic values.

The method of the main component is one of the most commonly used factor analysis methods. During the selection of the main components at the first step the component with the highest dispersion is choosen, at the next stage the component with the lower dispersion is choosen and so on. Though, the number of initial set of indicators decreases and identification of the key factors having the impact on socio-economic development of the country for the given period becomes possible, which is actual by itself.

Application of the main components method is carry out by SPSS software [5]. The result of the application of main components is the decrease of 23 indicators into 3 factors. Thus, one of the goal of analysis – shortening the sign space (8 times) has been solved by expression of the large amount of elemental traits with the least amount of internal characteristics of cases**.** These factors explain 94% of selected general despersion, the first factor 70%, the second – 15%, and the third – 9%.

As the result of orthogonal rotation of factors by "verimax" method, we've got a new factor loading matrix (Table 2). The table includes indicators with higher than 300 factor loadings.

The first factor includes with high loadings the following indicators connected to sphere of production: GDP (0,981), volume of industrial production (0,929), volume of agricultural production (0,857); in financial sector: external trade turnover (0,919), domestic investments (0,970), consumption expenditures (0,924), consumer price index (0,887), rate of manat to 1 US dollar (-0,827); in social sphere: natural increase (0,854), the unemployment rate (-0,819), infant mortality (-0,767). This can be explained as the following: the growth of the basic economic indicators increase the expenditures of the population and domestic investments, decrease the unemployment, stimulate the population growth, decrease infant mortality. On the other side this stimulate the inflation, that is explained pozitive connection this factor with consumer price index. In generally, we can called this factor as "economic growth and social welfare".

The second factor includes with the highest factors loadings the following indicators: foreign investments (0,924), life expectancy at birth (0,911), discharge of sewage water (-0,878) and infant mortality rate (-0,545). Foreign investments in national economy are mainly connected with oil industry and the activities implemented in Caspean See. Application of high level waste water treatment technologies by oil companies, resulted in the decrease of the "discharge of sewage

water" indicator. On the other side, this factor resuluts in creation of new jobs, decrease in unemployment, increase of welfare, decrease of infant mortality rate.

Table 2

Factor loading matrix

	Factors		
	1	2	3
GDP	0,981	0,504	
Life expectancy at birth	0,376	0,911	
Natural increase	0,854	0,388	
Infant mortality	-0,767	-0,545	-0,304
Air pollutant emissions			0,810
Discharge of sewage water		-0,878	
Volume of industrial production	0,929		
Volume of agricultural production	0,857	0,514	
Retail turnover	0,919	0,386	
Consumer price index	0,887	0,397	
Rate of manat to 1 US dollar	-0,827	0,523	
Consumer expenditures	0,924	0,358	
Domestic investments	0,970	0,355	
Foreign investments		0,924	0,315
External trade turnover	-0,391		0,839
The unemployment rate	-0,819		

In the third factor, foreign trade turnover (0,839) and air pollutant emissions emissions of pollutants into the air (0,810) take the highest factor loading. As Azerbaijan is an oil producing country, environmental pollution is mainly connected to the energy sector. Also, the key product in foreign trade turnover is oil. The relationship between given indicators is explained with this. This factor can be called "foreign trade and environmental factor".

4.Conclusions

As the result of research of economic, social and environmental indicators of Azerbaijan by multi-dimensional statistical analysis for the period of 2000-2013, three factors have been indentified. On the bases of selected factors, the directions of possible progress of these factors can be forecasted by application of econometric modelling.

Acknowledgements

Research for this paper was supported by the Science Development Foundation under the President of the Republic of Azerbaijan – Grant № EİF-2013-9(15)-46/44/5

References

[1].Indicators of Sustainable Development, UN Department for Policy Coordination and Sustainable Development, December, 1994.

[2]. Rennings K., Wiggering H. (1997) Steps towards Indications of Sustainable Development Linking Economic and Ecological Concepts //Ecological Economics, pp. 25─36.

[3]. Tamashevich V.N. (2002) Problems of statistical mapping of economic growth and economic development // Questions of Statistics, № 5, p. 15-23

[4]. Soshnikova L.A. Tamashevich V. N. Uebe G., Schaeffer M. (1999) Multivariate statistical analysis of the economy, M .

[5]. Byuyul A.Tsefel P. (2002) SPSS: iskusstvoobrabotki information. Statistical analysis and restore hidden patterns. (Per.s it.) St. Petersburg., Diasoft, 680 p.

[6].Isgenderov Ramiz (2015) The analysis of the indicators characterizing the sustainability of socio-economic development in the Republic of Azerbaijan. Scientific works of the Azerbaijan Scientific Research Institute of Economy and Organization of Agriculture.. Number 2. Baku, pp.13-20.

[7]. State Statistical Committee of the Republic of Azerbaijan. Azerbaijan in figures 2015. Baku 2015. 136 p.

[8]. Statistical Yearbook of Azerbaijan 2015, Baku, 2015. 814 p.

[9]. İndustry of Azerbaijan. Baku, 2015. 344 p.

[10]. www.stat.gov.az (25.02.2016)

Information about authors

R.K.Isgənderov, Professor, Azerbaijan National Academy of Sciences, Institute of Economics, Baku, Azerbaijan, e-mail for correspondence: isgenderov_ramiz@box.az
Sh.A.Abbasova, Assoc. prof. Baku State University, Baku, Azerbaijan
R.M.Guliyev, Assoc. prof. Baku State University, Baku, Azerbaijan
F.A.Mirzeyev,Assoc. prof. Baku State University, Baku, Azerbaijan
R.Z.Huseyn Assoc.prof. Institute of Agricultural Economics, Baku, Azerbaijan