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Econometric Modeling Of Life Length As A Factor Of The Quality Of Life Level In Uzbekistan.

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Abstract. Modeling the quality of life of the population of the Republic of Uzbekistan. On the basis of the regression model constructed, the elasticity coefficients were calculated, which reflected the degree of influence on life expectancy of factors such as the mortality rate, emissions of pollutants and GDP per capita. A forecast of the life expectancy of the country's population has been made.

Key words: model, factors, GDP, quality, life, forecast, population, regression, coefficient, elasticity.

1. INTRODUCTION

In recent years, the concept of "quality of life" has been widely used in the world. The most important task of the government of the Republic of Uzbekistan is the formation of a strong social policy oriented towards the interests of citizens, aimed at creating conditions that ensure a dignified life and intellectual development of a person, reducing social inequality, increasing the level of income of the population, ensuring universal accessibility and acceptable quality of basic social services, in particular health care.

Modern researchers of the quality of life think it necessary to consider this category as a systemic integrity, which is expressed through a complex structure of interrelationships of its components: the quality of the natural environment, the quality of population health, the quality of education, the quality of culture. [8]

All factors influencing the quality of life of citizens of Uzbekistan are directly or indirectly subdivided into economic, environmental, social, natural, geographic, ideological, historical, cultural and political.

"Quality of life" has not yet been unambiguously defined. According to the UN Development Program, the main indicators characterizing the quality of life are:

1) life expectancy;
2) education;
3) the level of GDP per capita. [9]

From our point of view, significant, in terms of importance, factors are: the demographic state of the population, education, health care, standard of living (well-being), housing conditions, social security (safety, communication, culture and recreation), as well as the ecological situation.

The quality of life of the population is a category that integrates all the conditions of life necessary for a person, the degree of satisfaction of all needs and interests. For Uzbekistan, the issue of assessing the quality of life is acquiring special relevance and is one of the priority tasks.

2. MATERIALS AND METHODS.

Reforming the economy of Uzbekistan, conditioned by the operation of the laws of market relations, is associated with fundamental changes in all sectors, which require new thinking and new knowledge from the specialists involved in these processes. According to economists-analysts, economic, historical successes of the nation are 80% determined not by natural resources and technologies, but by the efficiency of management. However, as the world experience shows, such a role of management can be realized only under favorable external and internal conditions. The defining internal condition is the orientation of society towards the quality of life.

Quality of life is a complex socio-economic category. The study of the quality of life of the population in the context of the development of a market economy remains one of the urgent tasks of economic analysis. The quality of life of the population can be judged by comprehensively assessing the standard of living, the material situation of the population, as well as the socio-economic aspects of the development of society over the studied period of time.

Market laws are not able to bring the economy out of the situation arising from a situation of declining living standards. For this, it is necessary, on the basis of an analysis of the real situation, an economic mechanism for changing the quality of life of the population.

The market system is imperfect in terms of regulating the quality of life, the components of which are: health and duration of labor resources, education, quality of resources, environmental and social security, etc.

3. RESEARCH RESULTS.

Based on the foregoing, the determining socio-economic indicators of the quality of life of the population are:

- average per capita monetary income per capita,
- GDP per capita,
- GRP per capita,
- average monthly nominal accrued wages per person,
- investments in the construction of housing stock,
- ratio of funds,
- Ginny coefficient,
- investment in fixed assets per capita in actual prices. [1]
- indicator of medical provision and the state of the health care system;
- social indicators (crime, unemployment, life expectancy at birth, general mortality rates, emissions of pollutants into the air), etc.;

The relevance of the study of the quality of life of the population is due to the fact that the processes currently taking place in the Republic of Uzbekistan and the regions indicate that insufficient attention to the development of the social sphere can lead to negative consequences. Competent management of social processes is impossible without knowledge of the situation in the field of the level and quality of life in the regions and the country as a whole.

Aivazyan S. A., Mitroshin A. A., Kozlov A. I., and others are devoted to the analysis of the quality of life of the population [2, 3, 4]. In particular, according to a number of authors, when studying the quality of life of the population, it is necessary to take into account the level of income of the population (GDP or GRP per capita), the level of education, the average life expectancy, the safety of the population, the quality and affordability of housing, the quality of infrastructure, water, food, ecology and other indicators of the population's vital activity.

Life expectancy at birth is one of the main indicators of the quality of life of the population. In the work of Faizova L.V. [5] carried out econometric modeling of life expectancy at birth. On the basis of the constructed model, the coefficients of elasticity were calculated, which reflected the degree of influence on the life expectancy of such factors as the mortality rate, emissions of pollutants and crime of the population.

Further, to conduct a multivariate statistical analysis of the quality of life of the population of the Republic of Uzbekistan, we will select the following indicators:

y - life expectancy at birth, years;

x1 - general mortality rates (number of deaths per 1000 people of the population);

x2 - the number of registered crimes (per 1000 population);

x3 - emissions of pollutants into the air from stationary sources (tons per 1000 population);

x4 - GDP or GRP per capita;

x5 - unemployment rate,%.

For the study, we used the data of the above indicators for 10 years (the period from 2010 to 2019), presented on the website of the State Committee of the Republic of Uzbekistan on Statistics [5].

The inclusion of a particular set of factors in the multiple regression equation is associated, first of all, with the researcher's idea of the nature of the relationship between the modeled indicator and other economic phenomena. The factors included in multiple regression should not be mutually correlated and, moreover, should not be in an exact functional relationship. If there is a high correlation between the factors, then it is impossible to determine their isolated influence on the effective indicator, and the parameters of the regression equation are not interpretable.

Intercorrelation coefficients (i.e. correlations between explanatory variables) allow duplicating factors to be eliminated from the model. It is believed that two variables are clearly collinear, i.e. are in a linear relationship with each other if the pair correlation coefficient $|r(x_i, x_j)| \geq 0.7$. In this case, one of the duplicate factors is excluded from the regression model. In this case, preference is given not to a factor more closely related to the result, but to the factor that, with a sufficiently close connection with the result, has the least closeness of connection with other factors.

Now, by the magnitude of the paired correlation coefficients, we will determine clearly collinear factors. Paired correlation coefficients were determined using Microsoft Excel (Data Analysis).

Table 1 Correlation matrix

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	x_1	x_2	x_3	x_4	x_5
x_1	1				
x_2	0,663	1			
x_3	0,211	0,170	1		
x_4	-0,587	-0,972	-0,021	1	
x_5	-0,793	-0,957	-0,247	0,877	1

Source: Author's calculations.

It can be seen from the correlation matrix that the absolute values of the correlation coefficients between x4 and x2, x5 and x1, x5 and x2, x4 and x5 are greater than 0.7. There are three options for excluding clearly collinear factors:

Option 1: exclude x4 and x5 from the model;

Option 2: exclude x2 and x5 from the model;

Option 3: exclude x2 and x4 from the model.

The greatest difficulties in using the apparatus of multiple regression arise in the presence of multicollinearity of factors, when more than two factors are interconnected by linear dependence, i.e., there is a cumulative effect of factors on each other. In our case, the factors x2, x4 and x5 are interconnected by a linear relationship. To assess the multicollinearity of factors, the determinant of the matrix of paired correlation coefficients r (xi, xj) between factors can be used. In the case of three factors, the determinant is:

$$Det|R| = \begin{vmatrix} r(x_1, x_1) & r(x_1, x_2) & r(x_1, x_3) \\ r(x_2, x_1) & r(x_2, x_2) & r(x_2, x_3) \\ r(x_3, x_1) & r(x_3\, x_2) & r(x_3, x_3) \end{vmatrix}$$

The closer to zero the determinant of the interfactor correlation matrix, the stronger the multicollinearity of the factors and the more unreliable the results of multiple regression. And, conversely, the closer to one the determinant of the interfactor correlation matrix, the lower the multicollinearity of the factors.

For variant 1, the determinant of the interfactor correlation matrix is:

$$Det|R| = \begin{vmatrix} r(x_1, x_1) & r(x_1, x_2) & r(x_1, x_3) \\ r(x_2, x_1) & r(x_2, x_2) & r(x_2, x_3) \\ r(x_3, x_1) & r(x_3\, x_2) & r(x_3, x_3) \end{vmatrix} = \begin{vmatrix} 1 & 0{,}663 & 0{,}211 \\ 0{,}633 & 1 & 0{,}170 \\ 0{,}211 & 0{,}170 & 1 \end{vmatrix} = 0{,}535$$

For variant 2, the determinant of the interfactor correlation matrix is:

$$Det|R| = \begin{vmatrix} r(x_1, x_1) & r(x_1, x_3) & r(x_1, x_4) \\ r(x_3, x_1) & r(x_3, x_3) & r(x_3, x_4) \\ r(x_4, x_1) & r(x_4\, x_3) & r(x_4, x_4) \end{vmatrix} = \begin{vmatrix} 1 & 0{,}221 & -0{,}587 \\ 0{,}211 & 1 & -0{,}021 \\ -0{,}587 & -0{,}021 & 1 \end{vmatrix} = 0{,}616$$

For variant 3, the determinant of the interfactor correlation matrix is:

$$Det|R| = \begin{vmatrix} r(x_1, x_1) & r(x_1, x_3) & r(x_1, x_5) \\ r(x_3, x_1) & r(x_3, x_3) & r(x_3, x_5) \\ r(x_5, x_1) & r(x_5\, x_3) & r(x_5, x_5) \end{vmatrix} = \begin{vmatrix} 1 & 0{,}221 & -0{,}793 \\ 0{,}211 & 1 & -0{,}247 \\ -0{,}793 & -0{,}247 & 1 \end{vmatrix} = 0{,}349$$

Consequently, the maximum determinant of interfactor correlation has a 2-variant, and therefore we will choose this variant of excluding clearly collinear factors. Thus, the multivariate regression equation is:

$$y = a + b_1 \cdot x_1 + b_3 \cdot x_3 + b_4 \cdot x_4$$

In linear multiple regression, the parameters b1, b3, and b4 at x are called the "pure" regression coefficients. They characterize the average change in the result with a change in the

corresponding factor by one, while the value of other factors remains unchanged, fixed at the average level.

The assessment of the closeness of the relationship and statistical significance in multiple regression is determined by the multiple correlation coefficient R and the multiple determination coefficient D = R2.

Using Microsoft Excel (Data Analysis), the coefficient of multiple correlation, determination, parameters of the regression equation and the values of the Fisher criterion were determined (see table 2).

Table 2 Results of estimating the regression parameters

Multiple R		0,9967
R-square		0,9934
Parameters (coefficients)	t-statistics	P-value
a=78,58753	65,070149	8,86E-10
b_1= -1,28937	-5,162523	0,00209
b_3= 0,00990	1,524531	0,178216
b_4=0,00014	20,602876	8,51E-07
	F_p	$F_{кр}$
Fischer's Criteria	298,8323	6,41E-07

Source: Calculated by the authors

Table 2 shows that R = 0.9967 and D = 0.9934. This means that 99.34% of the variation in life expectancy at birth is explained by the variation of factors x1 (the number of deaths per 1000 people), x2 (the number of registered crimes per 1000 people), x3 (emissions of pollutants into the air from stationary sources of tons per 1000 people) and x4 (GDP per capita). The p-values of the parameters of multiple linear regression are very small, therefore, all coefficients of the linear model are significant.

Using the t-statistic values or the P-value, we can determine which of the coefficients are significant at the significance level α = 0.05. Using Excel, we determine the critical value of t statistics:

t (1– α / 2; n - k– 1) = STUDENT.EDU (0.975; 6) = 2.446.

Let us compare the absolute value of the t-statistic with the critical value of the t-statistic. Table 2 shows that all the absolute values of the t-statistics of the coefficients of the regression equation with the exception of b3 (1.524531) are greater than the critical value of the t statistics (2.446). This means that the coefficient b3 with a factor x3 (emissions of pollutants into the air) is insignificant, and the rest of the coefficients are significant. This result also confirms the P-value. By virtue of Table 2, all P-values of the coefficients of the regression equation with the exception of b3 (0.178216) are less than the significance level of α (0.05). Therefore, all multivariate linear regression coefficients except b3 are significant.

The calculated value of the Fisher criterion is much higher than the critical Fisher value and therefore we conclude about the statistical significance of the linear regression equation with a significance level of 0.99.

Now let's determine the average approximation error of the regression model. Average approximation error (ε) is the average relative deviation of the predicted values (yp) from the actual (yi):

$$\varepsilon = \frac{1}{n}\sum\left|\frac{y_i - y_p}{y}\right| \cdot 100\%$$

The constructed regression equation is considered satisfactory if the value of ε does not exceed 10–12%.

The predicted values are determined using a regression equation

$$y = 78{,}58753 - 1{,}28937 \cdot x_1 + 0{,}0099 \cdot x_3 + 0{,}00014 \cdot x_4$$

Table 3 below defines the predicted life expectancy at birth (years) and the average approximation error.

Table 3 Average error of approximation of expected duration life at birth

Year	Life expectancy at birth (y)	Predictive life expectancy at birth (yp)	Remains	$\left\|\frac{y - y_p}{y}\right\|$
2010	73	73,02193	-0,02193	0,00030
2011	73	73,01237	-0,01237	0,00017
2012	73,1	73,12454	-0,02454	0,00034
2013	73,4	73,36863	0,03137	0,00043
2014	73,4	73,47491	-0,07491	0,00102
2015	73,6	73,54821	0,05179	0,00070
2016	73,8	73,68343	0,11657	0,00158
2017	73,7	73,75260	-0,05260	0,00071
2018	74,6	74,57809	0,02191	0,00029
2019	75,1	75,13529	-0,03529	0,00047
	Total			*0,00601*
	Average approximation error, %			***0,06014***

Source: Calculated by the authors

Table 3 shows that the average error in approximating life expectancy at birth is 0.06%. This means that the constructed regression equation is considered very good.

The coefficient of elasticity shows how many percent the result y will change when the factor x changes by 1% from its nominal value. For linear regression, the coefficient of elasticity is:

$$Э_i = b_i \cdot \frac{x_i}{y}$$

and depends on xi, therefore, calculate the average coefficient of elasticity

$$\overline{Э}_{yx_i} = b_i \cdot \frac{\overline{x_i}}{y}$$

The average coefficient of elasticity shows how many percent, on average, in the aggregate, the result y will change from its value when the factor xi changes by 1% from its value.

The calculation of the elasticity coefficients made it possible to determine the contribution of each factor to the change in life expectancy; the elasticity coefficients were calculated:

$$\overline{Э}_{yx_1} = b_1 \cdot \frac{\overline{x_1}}{\overline{y}} = -1{,}28937 \cdot \frac{4{,}84}{73{,}67} = -0{,}0847$$

$$\overline{Э}_{yx_3} = b_3 \cdot \frac{\overline{x_3}}{\overline{y}} = 0{,}0099 \cdot \frac{28{,}755}{73{,}67} = 0{,}0039$$

$$\overline{Э}_{yx_4} = b_4 \cdot \frac{\overline{x_4}}{\overline{y}} = 0{,}00014 \cdot \frac{7167{,}47}{73{,}67} = 0{,}0141$$

Thus, with an increase in mortality, life expectancy will decrease by 8.47%, an increase in pollutant emissions and GDP per capita will lead to an increase in life expectancy by 0.39% and 1.4%, respectively. The reason for the increase in life expectancy with an increase in pollutant emissions is the upward trend in pollutant emissions per capita in the periods 2010-2014 and 2016-2019. In fact, in developed countries, almost all pollutants (garbage, waste) are recycled, and due to this, emissions of pollutants tend to decline. Waste is also recycled in our country, but not in all regions.

Now let's make a forecast of life expectancy at birth. According to the State Statistics Committee of the Republic of Uzbekistan, in 2020 the mortality rate (x1) is 5.1 and GDP per capita (x1) is 16949.1 thousand soums. Due to the absence of the amount of pollutant emissions (x3), let us take the arithmetic average of this indicator for the period 2010 - 2019, i.e. 28,755 tons per thousand people. In 2020, the mortality rate increased by 10.9% compared to 2019. This is a consequence of the COVID-19 coronavirus pandemic. Since 2021 people also continue to get sick with this contagious virus, it is necessary to take into account the consequences of the coranavirus.

Let's say that in 2021, the mortality rate increases by an average of 8% to 5.5. Suppose that the growth rate of GDP per capita remains the same as it was in 2020, i.e. 11.6%. Then, in 2021, GDP per capita will be 18,910.8 thousand soums. Let's also assume that in 2021 the amount of pollutant emissions will be 4% more in relation to the arithmetic average of this indicator for the period 2010 - 2019, i.e. 29.905 tons per thousand people. Substituting these data into the regression equation, we get:

2020 г. $y = 78{,}58753 - 1{,}28937 \cdot 5{,}1 + 0{,}0099 \cdot 28{,}755 + 0{,}00014 \cdot 16949{,}1 = 74{,}8$

2021 г. $y = 78{,}58753 - 1{,}28937 \cdot 5{,}5 + 0{,}0099 \cdot 29{,}905 + 0{,}00014 \cdot 18910{,}8 = 74{,}3$

Thus, the life expectancy at birth in 2020 will be 74.8 years, and in 2021 - 74.3 years. These projected life expectancies at birth are lower by 0.3 and 0.6, respectively, compared to 2019.

4. CONCLUSION.

Quality of life is one of the main factors affecting life expectancy. It is for this component in the structure of the human development index that the Republic of Uzbekistan does not lag behind the value for some developed countries.

The main factors that make the greatest contribution to the change in life expectancy at birth, as one of the main indicators of the quality of life of the population, were the mortality rate, emissions of pollutants and GDP per capita.

According to the constructed model, with an increase in total mortality, life expectancy will decrease by 8.47%, and an increase in GDP per capita will lead to an increase in life expectancy by 1.4%. Life expectancy at birth in 2021 will be 74.3 years, down 0.6 points from 2019.

In our opinion, the development tactics of any country (region) should have two directions - social and economic. The goal of the first direction is to improve the standard of living and social well-being of the population, the goal of the second is to develop a competitive economy in the region. Ultimately, the two directions should ensure the development of human potential and, as a result, an improvement in the quality of life of the population of the regions, which will lead to an increase in the well-being of the country as a whole.

Thus, the use of the results of the study will allow us to more objectively assess the quality of life of the population, identify problem areas of social policy at all levels of government, and make timely informed management decisions to improve the quality of life of the population.

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