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COMPARATIVE ESTIMATE OF LIFE EXPECTANCY OF THE RUSSIA POPULATION

The quality of life is characterised by set of indicators. One of them is life expectancy at birth. *The life expectancy at birth* is an average quantity of years which will be presumably lived by the person with maintenant of death rate current for concrete age groups in the future. [2]

The economic reform in Russia has led to setback in production, unemployment growth and hyperinflation occurrence. As a result, the population quality of life has got worse. In dynamics of life expectancy of the country population there are four periods: sharp falling in 1990–1994, rise in 1995–1997, decrease in 1998–2003 and confident increase in 2004–2010. The maximum of an indicator was observed in 1990 – 68.9 years. All the next years this indicator was lower. The life expectancy of Russians was decreased with fast rates in 1990–1994, decreasing annually by 1.1 years.

The quality of the Russia population life is expedient to consider in comparison with similar indicators of other countries, for example, the developed ones. For this purpose the sample is formed. It includes four countries which are concerned as developed countries according to United Nations classification. The selection criterion for the countries in the sample is the level of GDP per capita. The sample includes two countries with average level of GDP per capita (Canada and Italy) and two countries with higher and lower value of the given indicator (Norway and Portugal accordingly). The data of the World Bank and World Health Organization is used as the initial information [2, 3].

The life expectancy in all countries of sample were constantly increasing since 1980: in Portugal – from 71.2 to 78.7 years, in Canada – from 75.1 to 80.7 years, in Norway – from 75.7 to 80.8 years, in Italy – from 73.9 to 81.4 years.

We will reveal the factors, which make the strongest impact on the life expectancy in the developed countries, and then we will compare with the Russian reality. A priori according to the available data such indicators as GDP per capita, disease incidence of a tuberculosis, infant mortality rate, alcohol consumption rate, are allocated.

Aiming to except false correlation the time factor is included. Last century there is observed the tendency to increase of life expectancy in the world. In countries of the sample the life expectancy increased on average from 75.7 years to 80.6 years. The dynamic equation for life expectancy of the population in the countries of the sample depending on time is the following:

$$\hat{y} = 75{,}68 + 0{,}26t, \qquad R = 0.76.$$

where t – years since 1990 ($t = 1, \ldots, 19$).

The equation explains 58% of the life expectancy variation from time. Annually on average in countries of the sample life expectancy is increasing by 0.26 years

GDP per capita reflects a standard of well-being of the country inhabitants. The growth of the population incomes promotes improvement of life conditions and life qualities and, as a consequence, increase in longevity. The pair regress equation of the life expectancy on GDP per capita is the following:

$$\hat{y} = 65{,}09x_1^{0{,}06} \qquad R = 0.89,$$

where x_1 – the size of the gross domestic product per capita at purchasing-power parity, thousand USA dollars.

The received equation explains 80% of the life expectancy variation. The growth of GDP per capita by 1% leads to the life expectancy increase on average 0.06% for the group of analyzed developed countries.

The sickness rate of tuberculosis. The close correlation between sickness rate of the tuberculosis and the life expectancy is observed in Portugal ($R = -0.98$). The dependence for set of countries in the sample is less close. It is expressed by linear regression:

$$\hat{y} = 79{,}45 - 0{,}07x_2 \qquad R = -0.77,$$

where x_2 – the disease incidence of tuberculosis, cases per 100ths. population.

The equation explains 59% of the life expectancy variation. The life expectancy decreases on average 0.07 years, when sickness rate of a tuberculosis increase by 1 case per 100ths. persons.

The infant mortality rate influences straightly the average life expectancy. Besides, this indicator reflects the general standard of the population well-being and medicine development. The life expectancy is reduced with infant mortality growth. The dependence between indicators is described by the linear equation:

$$\hat{y} = 82{,}75 - 0{,}83x_3 \qquad R = -0.79,$$

where x_3 – the infant mortality rate, cases per 1ths. live-born children.

The received equation explains 62% of an indication variation. The life expectancy is reduced on 0.83 years with increase in infant mortality rate by 1 case per 1 ths. live-born children.

The alcohol consumption rate. As the data shows, alcohol in small amounts influences positively the life expectancy. At the alcohol consumption rate above 7 litres of pure alcohol a year the correlation between factors becomes inverse. The high alcohol consumption rate reduces considerably the population life expectancy: influences destructively the person health, abnormalize a mental condition whict provokes

crimes, suicides and degradation of the human as personality. Therefore two separate regress equations are constructed: for a small consumption rate and for the raised one:

below 7 litres $\hat{y} = 67{,}77 + 2{,}05x_{41}$ $R = 0.95$;

more than 7 litres $\hat{y} = 86{,}31 - 0{,}78x_{42}$ $R = -0.95$,

where – alcohol consumption rate per capita a year, litres of pure alcohol.

These equations explain more than 90% of the life expectancy variation. The constructed equations allow to conclude that in the developed countries growth of the alcohol consumption rate by 1 litre of pure alcohol a year (within 7 litres) is accompanied on 2 years increase of the life expectancy. If the alcohol consumption rate exceeds 7 litres of pure alcohol a year, the growth of the alcohol consumption rate by 1 litre of pure alcohol leads to decrease in the life expectancy on 0.8 years.

All constructed models are statistically significant according to Fisher's criterion, the equation parameters differ significantly from zero according to *t*-criterion. The models standard errors do not exceed 1.5% from average.

Consequently all considered factors make significant impact on the life expectancy. It increases with the course of time, and also with increasing GDP per capita. The inverse linear correlation is observed between the life expectancy and the infant mortality rate, the sickness rate of tuberculosis, the high rate of alcohol consumption.

Results of the factor analysis underlie the construction of multiple-factor model of the life expectancy of population in the countries of the sample. The big number of relations of the life expectancy from the considered factors is described by linear regression, therefore the multiple-factor model is constructed expediently in the linear form too.

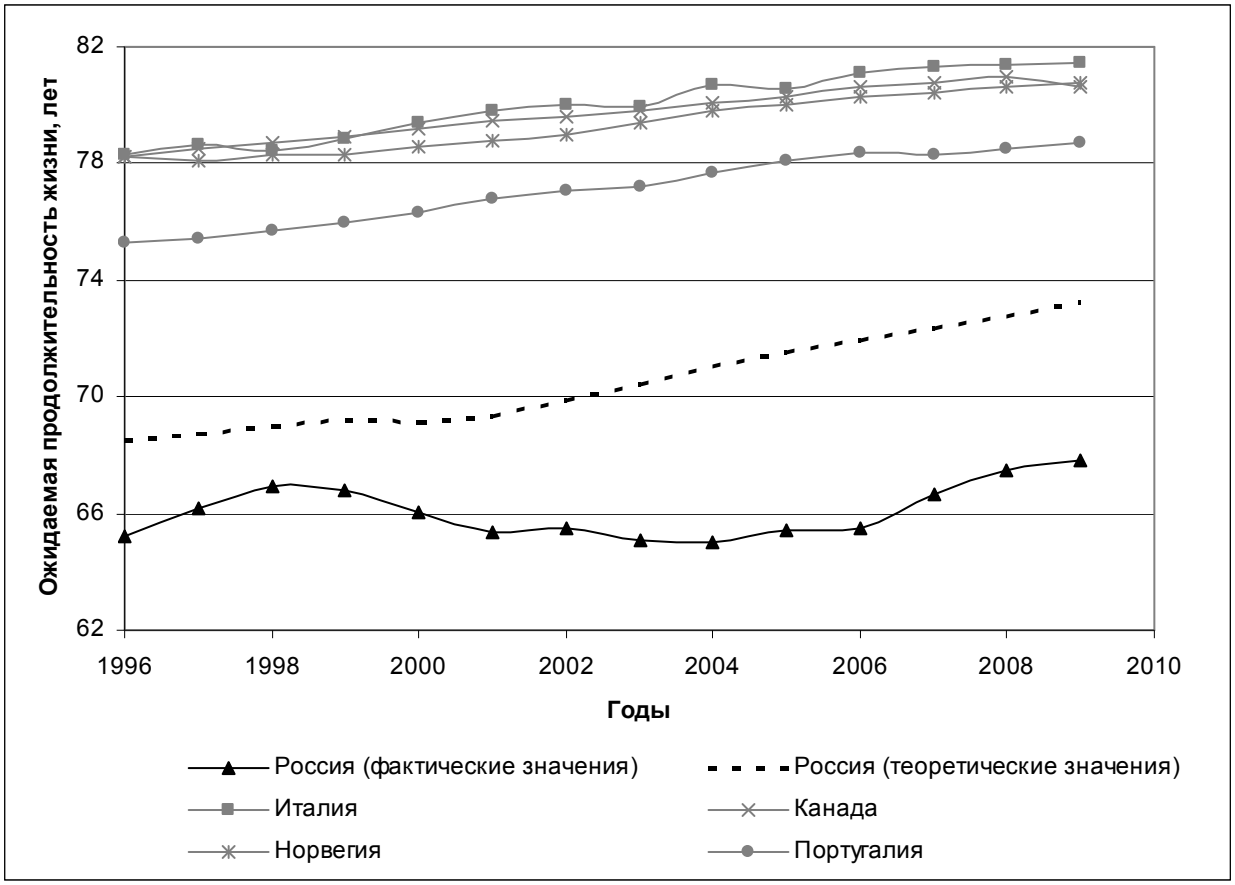
After of the equation parameters check on the significance three variables remained in the equation:

$$\hat{y} = 79{,}212 + 0{,}0578x_1 - 0{,}0351x_2 + 0{,}3494x_3 \qquad R = 0{,}910.$$

The equation explains 82.8% of the life expectancy variation. The theoretical values calculated by the equation differ from actual data on average 0.7 years. Variables in the model meet the requirements of check on absence of multicollinearity and heteroscedasticity. Adequacy of the model is checked up by the interval forecasting procedure of life expectancy. The approximation average error of model is equal to 0.2%. The indicator actual values are in a confidence interval with probability of 95%, so the constructed model is adequate and can be used for construction of the forecasts of the life expectancy of population in the developed countries. The increase of GDP per capita on 1thsd. USA dollars promotes increase in the population life expectancy on 0.06 years. With growth of sickness rate of tuberculosis by 1 case per 100ths. inhabitants average life expectancy decreases on 0.04 years and with growth of the infant mortality rate by 1 cases per 1ths. live-born children average life expectancy decreases on 0.34 years.

Let's substitute variables' values for Russia into the equation for the purpose of checking the application possibility of the constructed model for the description and forecasting of the Russians life expectancy.

The actual and predicted by the model curves of the life expectancy in Russia in comparison with curves of the life expectancy in countries of the sample are presented in graph 1. As it can be seen on the graph, potentially, the Russians life expectancy could be essentially longer, but even in this case Russia would concede to the developed countries in the life expectancy level.



Graph 1. The life expectancy in the developed countries of the sample, actual and theoretical values for Russia

The indicators of the countries being compared during the analyzed period indicate this (tab. 1). From the table data it can be see that GDP per capita (as at average and at the period end) in Russia is lower, than in the sample countries. Sickness rate of tuberculosis exceeds this indicator many times in comparison to developed countries indicators. Infant mortality rate in 20 years has decreased on 12.4 cases per 1ths. live-born children, or on 57.7%, decreasing annually on 4.2 %. Nevertheless, it remains considerably higher, than in the sample countries. It is reflected on the life expectancy.

Table 1

The indicators of compared countries

Indicators	Italy	Canada	Norway	Portugal	Russia
The life expectancy at birth, years					
Average value (1990–2009)	79.2	79.1	78.7	76.3	66.4
At the end of period	81.4	80.6	80.8	78.7	68.6
GDP per capita at purchasing-power parity, thousand USA dollars					
Average value (1990–2010)	25.2	28.7	35.9	17.8	9.4
At the end of period	31.6	39.0	56.7	25.6	19.8
The sickness rate of tuberculosis, cases per 100ths. Population					
Average value (1996–2009)	8.6	6.7	6.6	54.1	109.5
At the end of period	5.9	5.0	6.4	35.0	107.0
The infant mortality, cases per 1ths. live-born children					
Average value (1990-2010)	5.1	5.6	4.1	6.0	16.9
At the end of period	3.1	5.2	2.8	3.0	9.1

Besides, the Russians life expectancy is influenced by additional factors. In Russia the risk of loss of life because of the external reasons (accidents, road and transport incidents, violence, suicides) is 3 times higher than the similar indicator on the West [1]. First of all it can be explained by features of the Russian inhabitants mentality (they are more careless, than Europeans, do not fasten seat belts in the car, give less attention to the health and so forth). Also factors of decrease in the life expectancy are: a high crime rate, a considerable quantity of consumed alcohol, a bad road condition, lack of medical services availability for the population, especially in the remote areas, more severe climate and so forth.

Consequently, the models constructed for developed countries of the sample, cannot be used for the description and forecasting of this indicator in Russia. For forecasting of the life expectancy in Russia the exponential smoothing of the second order is used. The dynamic equation is like:

$$\hat{y} = 68{,}878 - 0{,}6945t + 0{,}0333t^2 \qquad R = 0{,}75$$

The standard error of the model is equal to 1.3% in relative expression from an average life expectancy. The share of forecasts' validity is equal to 100% with probability of 95%. The value of the forecast average absolute error is 0.21 years.

Thereby the constructed predictive model can be considered adequate to real values of the life expectancy in Russia and it can be used for construction of the forecast for next years. According to the received forecast, the life expectancy in Russia will increase and in 2013 it will reach the value of 71.4 years. Nevertheless, next

years Russia won't can reach the life expectancy level of the developed countries, but this indicator rates of rise are predicted above the one in Western countries.

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