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RESEARCH OF HEALTH AS A COMPONENT OF LABOR POTENTIAL OF THE COUNTRY BY METHODS OF ECONOMETRIC ANALYSIS

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ABSTRACT

The population health indicator, which has an impact on the development of labor potential and its demographic component, has been studied. A correlation analysis of the factors influencing the state of health of the population was performed. It has been proven that there is a strong relationship between life expectancy as an indicator of health and the factors that characterize the health care system, economic development of the state, quality of food and lifestyle. Spatial econometric models of the relationship between effective variable life expectancy and factor characteristics of different nature based on statistical material from 38 European countries were created. The obtained models have high values of adequacy and accuracy criteria, as well as satisfactory predictive quality.

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Introduction. The gradual movement of the country on the path of social progress depends on the development of its productive forces, the central element of which is labor potential. Under the labor potential of scientists understand the set of labor resources and reserves of living labor, able to achieve the set goals. The labor potential of Ukraine, like any other country, is a complex socio-economic category, so its structure depends on many characteristics. Factors that affect the state of labor potential of society, region, or individual enterprise include demographic, ecological-geographical, socio-economic, socio-psychological, legal, information and communication, technical and organizational and industry. Thus, emphasizing the most important of the factors influencing the labor potential, labor potential can be defined as the total number of citizens of working age who, according to certain characteristics (health, psychophysiological characteristics, educational, professional and intellectual level, socio-ethnic mentality) are able and intend to work" [1]. That is, the quantitative composition of the labor potential is best reflected in demographic indicators (number and growth of the existing population, quantitative characteristics of the economically active population, birth and death rates, migration, etc.). Unfortunately, the current period of development of Ukraine's labor potential is accompanied by a long demographic crisis. Over the last 12-14 years, the population of Ukraine has decreased by almost 4 million people. Accordingly, the size of labor potential and the available labor force decreased. Most researchers agree that the quantitative reduction of the labor force is accompanied by a deterioration in the qualitative characteristics of the working population: negative changes relate to the health of the population, its intellectual level, the degradation of the gene pool [2].

Actually, it turns out that the health of the population affects both the quantitative and qualitative characteristics of labor potential, as the deterioration of public health weakens the immune system, reduces the endurance and strength of workers and employees, as well as their creative abilities. Ultimately, this leads to premature death, ie to a quantitative reduction in the country's labor potential. Careful analysis of undesirable trends in the state and dynamics of labor resources involves the study of factors that affect the labor potential of the country, including econometric methods. However, despite the large number of bibliographic sources devoted to this topic, the factors influencing the state and development of labor potential, in particular the factor of health, remain insufficiently covered in the literature.

Thus, **the purpose of this article** is to build and analyze spatial regression models of the dependence of the health indicator on the factors influencing it on the statistical material of European countries.

Review of literature and data sources. In this study, health is considered as a component of the labor potential of society (country), but in general it is a socio-economic category, which is the subject of research by scientists in many fields of knowledge, including philosophy, sociology, political economy, medicine, demography.

From the many approaches to the definition of health, we consider the philosophical - normative, in which health is the state of normal functioning of the organism at all levels of its organization, the normal course of biological processes, which determines individual survival and reproduction. The definition of health proposed by the eminent Ukrainian physician and writer Mykola Amosov is also similar to this approach. From his point of view, "health is the maximum productivity of organs while maintaining the qualitative limits of their functions" [3].

The World Health Organization (WHO) in its documents defines health within the socio-valued approach as a state of complete physical and social well-being. Well-being is a dynamic state of mind, which is characterized by a certain mental harmony between the abilities and expectations of the employee and the requirements and opportunities represented by the environment [4].

It has only been a subject of research in the field of health economics since the last third of the twentieth century, despite the fact that prominent economists of the past have taken into account the component of health in their work. For example, Alfred Marshall wrote in [5]: "… The health and strength of the population include three components - physical, mental and moral. They form the basis for productivity and the creation of material goods. In turn, material wealth increases health".

Thus, in the socio-economic sphere of health creates the conditions for active creative work of the individual in society. It gives a person the ability and desire to consume material goods, as well as the ability to learn, develop, reproduce such economic entities.

In research in social medicine, it is common to distinguish several levels at which health-related processes are considered and modeled:

– individual - the health of the individual;
– group - health of social and ethnic groups;
– regional - health of the population of administrative territories;
– public - the health of society as a whole, the health of the nation, population.

Public health is understood as a conditional statistical concept due to the complex influence of social and biological environmental factors, which is assessed by demographic indicators, indicators of physical development, morbidity, disability and the prevalence of prenosological (ie borderline before the disease) conditions [6].

Public health as a whole guarantees economic growth and the country's competitiveness in global markets.

To analyze what factors affect public health, it is important to determine its indicators, ie quantitative indicators that to some extent reflect the state of public health.

According to WHO documents, the following indicators should be taken into account for public health assessment [4]:

- GNP deductions for health care;
- Availability of first aid;
- The level of immunization of the population;
- Level of examination of pregnant women by qualified personnel;
- Nutritional status of children;
- Infant mortality rate;
- Average life expectancy;
- Hygienic literacy of the population.

From the point of view of researchers, life expectancy and mortality are chosen as the best and most frequently used health indicator in cross-country studies [7–10]. These indicators are most often used because they are available in all countries where there are systems for collecting and processing demographic statistics and civil registration. Therefore, such data must be reliable. Some researchers choose these indicators in gender. Life expectancy is sometimes chosen at the age of 65. Infant mortality indicators are also selected in surveys and cross-country comparisons in developing countries [11]. In this study, I chose healthy life expectancy (HALE) as the indicator for the health of the country's population.

Health state, and therefore life expectancy as an important indicator, depends on a large number of socio-economic factors, the study of which is sometimes contradictory. With regard to public health, such factors have been carefully analyzed in a WHO review [12]. These indicators and their groups can be characterized as follows: educational factors, income characteristics and indicators of income inequality (Gini coefficients), factors of urbanization, indicators that reflect the functioning of the health care system, factors of quality of life and impact (negative) environment.

Let's briefly discuss each group of factors. Most researchers claim that the level of education has a positive effect on the health of the population. First, the level of education and culture depends on the hygienic literacy of the population. Second, educated individuals are aware of, generate and promote models of healthy living. The influence of education on life expectancy was studied, for example, in the article by TL Kharkova, S. Yu. Nikitina and E.M. Andreeva [10], who showed that in most age groups in Russia the level of education reduces the age of mortality.

The influence of purely economic determinants on life expectancy is also not disputed by experts. Most often, at the level of intercountries` comparisons, the GDP per capita is chosen at current prices or converted into international dollars at purchasing power parity, and sometimes the average per capita income is added to it. Some researchers also evaluate the relationship between life expectancy and indicators of property inequality - the Gini coefficient. Such a dependence, for example, was found in the work of Andreev and Shkolnikov [9]. Unemployment is also linked to economic development, which has a negative impact on life expectancy.

Factors such as urban population share and population density are also taken into account in some studies. These parameters for countries with a large area correlate with the availability of health services.

The results of studies on the impact of the characteristics of the health care system on the health of the population are quite controversial. Usually, such parameters are selected funds that are reimbursed for these purposes, often in relative terms as a percentage of GDP. In addition to financial indicators, quantitative indicators are also considered: the density of hospital beds and the number of doctors and nurses per 10,000 population.

The relationship between health indicators and health care costs is quite complex, and it is very difficult for a researcher to understand what is primary and what is secondary. On the one hand, increasing health care benefits means increasing those who have improved their health. On the other hand, an increase in life expectancy leads to a deterioration in health with each passing year, and therefore to the cost of additional funds for the treatment of diseases of old age.

These discrepancies are reflected, for example, in [13], where 31 European countries were analyzed and it is shown that despite the fact that health care costs are related to life expectancy, the number of hospital beds per capita correlates with the above indicator.

Many factor models of health effects use groups of indicators that describe a healthy lifestyle. Such factors include per capita alcohol consumption, the number of smokers per 100 females and males, the percentage of the overweight adult population, the consumption of animal protein in grams per day per person, and others. In all studies where they were included, these factors were significant, and their impact was consistent with the hypotheses.

On the last we will consider factors of influence of environment. These include such indicators as emissions of harmful substances into the atmosphere (in kg per capita): concentration of fine suspended particles, CO_2 emissions per dollar of GDP, pesticides. The influence of some of these indicators was discussed in [14] and [12]. It is not as significant as the influence of other factors, but in [12] it is noted that "Factors that determine health and social justice are in a relationship of interdependence with factors that determine environmental and economic sustainability".

Thus, summarizing the numerous studies on the factors that affect public health, we can conclude that they are closely related and it is difficult to separate them from each other. Actually, the economic development of the state has an impact on the environment, on the way of life of the population, and on the health care system in the country. On the other hand, the state of health of the population generates the demand for medical services, and thus affects the development of the health care system, the amount of savings on it and others.

Thus, the task of modeling the relationship between the life expectancy indicator and the factors that affect it is methodologically quite complex. Data for modeling were selected mainly from statistical databases of the World Bank and WHO.

Analysis/study/results. The easiest way to measure the impact of various factor traits is not a productive variable using a linear econometric model. In this paper several spatial econometric models will be build/ The calculations are based on OECD and WHO statistics for 2016 for 38 European countries, namely, Armenia, Azerbaijan, Belarus, Belgium, Bosnia and Herzegovina, Bulgaria, Croatia, Cyprus, Czechia, Denmark, France, Georgia, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, North Macedonia, Norway, Poland, Portugal, the Republic of Moldova, Romania, the Russian Federation, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Ukraine, the United Kingdom of Great Britain and Northern Ireland.

The resultant variable was the healthy life expectancy of HALE, and the factor variables had to be selected from a set of available traits found in WHO documents and other literature. The list includes the following factors:

- GDP per capita;
- Average salary per month;
- Curent health expenditure;
- Hospital beds (per 10,000 population);
- Population living in urban areas (%);
- Overweight in both sexes, and separately for men and women;
- Insufficient weight in both sexes, and separately for men and women;
- Alcohol consumption for both sexes, and separately for men and women;
- Smoking for both sexes, and separately for men and women;
- Consumption of protein;
- Concentration of fine solid particles for the country, and separately for settlements and cities;
- Concentration of CO2 in the air.
- Application of pesticides
- Gini coefficient;
- Unemployment;
- Public expenditure on education (% of GDP).

From the correlation analysis conducted for these factors, it became clear that the most important for life expectancy are GDP per capita, health care costs, and average wages. It should be mentioned that the natural logarithms of these values were used instead of GDP per capita and health expenditure. Next in importance are factors such as protein intake, the proportion of overweight men and smoking in men. In some cases, these factors may be added by the proportion of underweight men and the concentration of particulate matter in the air.

Other factors during the analysis were not so significant. And for the factors of alcohol consumption, unemployment, the share of overweight and underweight women, it turned out that they do not affect life expectancy in Europe. The insignificance of alcohol for life expectancy draws attention. This can be explained by the fact that in Europe, they consume high-quality alcohol and rather moderately, not so that drinking was the cause of death.

Therefore, after the construction of the correlation matrix were selected those factors that showed a close correlation of factors X_j, $j = 1,\dots,$m with Y ($0,6 \le r_{yj} \le 1$). All of them are given in table. 1.

On the basis of Table 1, an economometric model has been established, in which all the named factors were presented, however, GDP and health Expenditure were logarithmized.

Table 1. Factors influencing the health of the population by country

	Names of factors in the database of the World Bank, WHO	Abbreviations for simulation and the name of the independent variable	Links to data sources
Group of economic factors	– GDP per Capita; – Average Salary	– GDP, X2; – AvSal, X3	[15]
Indicators that characterize the health care system	– Current Health Expenditure per capita; – Hospital beds (per 10000 population)	– Exp, X1; – Hosp, X9	[16] [17]
Indicators that characterize the ecological state	– CO2 emissions (kg per 2011 PPP $ of GDP); – Conc, Of PM2,5 Rural (concentration of solid particles)	– CO2, X10; – PM2,5, X7	[18] [19]
Indicators of unhealthy lifestyle	– Smoking prevalence, males (% of adults); – Prevalence of overweight among adults, BMI ≥ 25 (crude estimate) (%)	– Smokm, X5; – Overw, X6	[20] [21]
Indicators of food quality	– Average supply of protein of animal origin (g/capita/day) (3-year average); – Prevalence of underweight among adults, BMI < 18 (crude estimate) (%)	– Protein, X4; – Underw, X8	[22] [23]

This econometric model depends on 10 factors and has the form (1)

$$Y=\alpha_0+ \alpha_1 X_1+\alpha_2 X_2+\ldots+\alpha_{10} X_{10}+\varepsilon. \quad (1)$$

In (1) Y - life expectancy from birth;

X_1 - X_{10} have the same value as in table 1, except that X_1 = ln (GDP), and X_3 = ln (Exp); ε is a random residual component.

Obviously, the constructed model is not perfect, because for 10 factor features we have a rather small sample length. But on its basis by the method of exclusion it is possible to receive other models.

Simultaneously with the exclusion of one of the factors, the normalized coefficient of determination R^2norm was calculated, which, unlike the usual coefficient of determination R^2, does not increase from the addition of factors to the model, if the added factor is not significant. To conduct experiments with R^2norm factors were added to the model in the following order: $Y = f(X_1) \rightarrow Y = f(X_1,X_2) \rightarrow Y=f(X_1,X_2,X_3) \rightarrow \ldots \rightarrow Y = f(X_1,\ldots,X_{10})$. Table 2 shows the values of R^2 and R^2norm corresponding to the number of factors in the model. The R^2norm was calculated by the formula (2):

$$R^2_{норм}=1-(1-R^2)\frac{n-1}{n-m-1}, \quad (2)$$

where n is the sample length;

m is the number of model factors.

Table 2. Changing criteria R^2norm and R^2 depending on the number of factors

The number of factors	1	2	3	4	5	6	7	8	9	10
R^2	0,846	0,852	0,856	0,857	0,858	0,881	0,884	0,886	0,917	0,917
R^2 norm	0,842	0,843	0,844	0,840	0,836	0,858	0,858	0,855	0,891	0,887

Initially, a 6-factor model was constructed that included the factors that most strongly correlated with LE (Life Expectancy). The names of the factors remained as they were in model (1). The number of factors was chosen for reasons of sufficient sample length and the ability to take into account factors of different nature.

The equation of the six-factor model with the estimated coefficients has the form (3):

$$Y = 62{,}99 + 4{,}18X_1 – 2{,}59X_2 + 0{,}00068X_3 + 0{,}009X_4 - 0{,}003X_5 + 0{,}136X_6. \quad (3)$$

Carrying out rapid diagnostics of this model, it can be noted that it has high values of the coefficient of determination (R^2 = 0,88) and Fisher's criterion (F = 38,43), as well as a low value of the standard error s_e, which indicates its adequacy. On the other hand, the values of the *t*-statistics of the coefficients (t_0=8,52; t_1=3,67; t_2=-1,86; t_3=1,15; t_4=0,348; t_5=-0,101; t_6=2,43) show that only the coefficients α_0, α_1 and α_6 are significant.

The low value of *t*-statistics with a simultaneously high coefficient of determination is often a manifestation of the multicollinearity of the model factors. Therefore, the model was tested for multicollinearity using χ^2-criterion and *F*-criterion. This test showed that there is multicollinearity in the data. The principal component method was used to get rid of it.

When applying this method, we usually move from the initial factor features to some new vectors, which are called principal components, each of which is some linear combination of the original features. On the one hand, these main components have the property of orthogonality to each other, ie there will be no multicollinearity between them. On the other hand, the main components constructed by the method are not always easy to interpret.

The principal components method allows to calculate the matrix of factor loadings *W*, the elements of which are essentially the correlation coefficients between the main components and the original factor characteristics. This allows you to interpret the main components in terms of the subject area of the model. The factor loadings matrix can be obtained by finding the eigenvalues and eigenvectors of the correlation matrix by the formula:

$$W = V \cdot \Lambda^{\frac{1}{2}} = \begin{bmatrix} w_{11} & w_{12} & \dots & w_{1n} \\ w_{21} & w_{22} & \dots & w_{2n} \\ \dots & \dots & \dots & \dots \\ w_{n1} & w_{n2} & \dots & w_{nn} \end{bmatrix}, \quad (4)$$

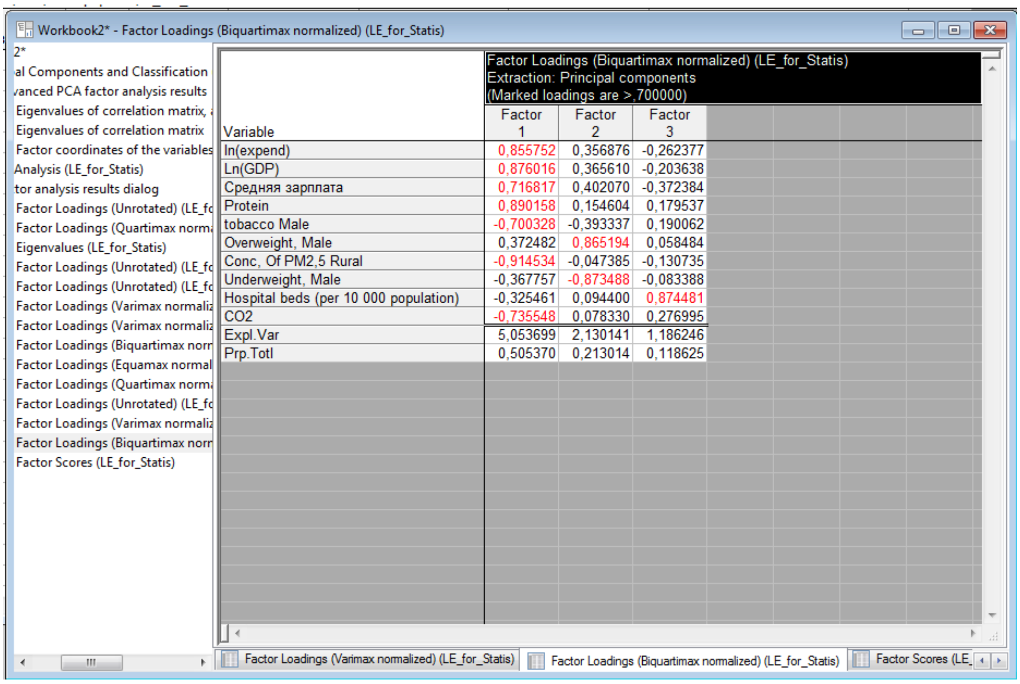
where V is a matrix composed of columns of normalized eigenvectors;

$\Lambda^{1/2}$ - diagonal matrix, where the diagonal contains the roots of the eigenvalues of the correlation matrix R.

All calculations for the principal components method were performed in the Statistica system. After rotation of the matrix *W* by the method of normalized biquartimax, such a matrix of factor loadings was obtained as shown in Fig. 1.

We will consider positive and large enough (more than 0.7) coefficients of the factor load matrix. In the first component, these conditions correspond to the correlation coefficients for the logarithm of GDP and monetary expenditures for the health care system, as well as for wages and protein consumption. That is, we can explain the first main component as a component of economic development of the state, because the consumption of protein along with monetary and income characteristics indicates the welfare of the country. The largest amount of protein is consumed in developed countries. I note that other coefficients of the first component, significant in absolute terms, but negative in sign, are also indicators of economic development, but of its shadow side - high concentration of fine particles in the air, CO2 emissions, smoking - all these are unattractive manifestations of our civilization.

The second component, if one takes the largest positive factor, is responsible for the number of overweight men. As the econometric analysis shows, this factor is included in all regression dependencies with a positive sign, and therefore causes a positive effect on HALE. At the same time, the only factor other than the one considered, which has a large absolute but negative correlation coefficient, is the percentage of men who are underweight. That is, we can say that the second main component is responsible for the percentage of men with excess or insufficient body weight. The only large ratio in the third component corresponds to the number of hospital beds in the country per 10,000 population.



Factor Loadings (Biquartimax normalized) (LE_for_Statis)
Extraction: Principal components
(Marked loadings are >,700000)

Variable	Factor 1	Factor 2	Factor 3
ln(expend)	0,855752	0,356876	-0,262377
Ln(GDP)	0,876016	0,365610	-0,203638
Средняя зарплата	0,716817	0,402070	-0,372384
Protein	0,890158	0,154604	0,179537
tobacco Male	-0,700328	-0,393337	0,190062
Overweight, Male	0,372482	0,865194	0,058484
Conc. Of PM2,5 Rural	-0,914534	-0,047385	-0,130735
Underweight, Male	-0,367757	-0,873488	-0,083388
Hospital beds (per 10 000 population)	-0,325461	0,094400	0,874481
CO2	-0,735548	0,078330	0,276995
Expl.Var	5,053699	2,130141	1,186246
Prp.Totl	0,505370	0,213014	0,118625

Fig. 1. Elements of the matrix of factor loads after rotation

After the interpretation of the principal components, it is possible to obtain their values by the formula $F = W^{-1}Z$ (Z is a matrix of standardized initial factors) and to use the regression model on these three components, so that multicollinearity will be eliminated.

With the help of Excel function LINEST the coefficients of the regression on the three principal components have been estimated. LINEST results can be shown in Table 3.

Let us write the equation for this model, instead of Y we write its designation LE.

In this way,

$$LE = 78{,}43 + 2{,}68F_1 + 1{,}72F_2 - 1{,}41F_3. \quad (5)$$

Table 3. Statistical criteria for regression on head components, insured by LINEST

	α_{F3}	α_{F2}	α_{F1}	α_0
Model coefficients	-1,41369	1,725555	2,6816	78,43684
Standard errors $s_{\alpha j}$	0,225357	0,225357	0,225357	0,222372
R^2 and s_e	0,87572	1,37079	#Н/Д	#Н/Д
F- criterion	79,85887	34	#Н/Д	#Н/Д
SS, MS	450,1802	63,88823	#Н/Д	#Н/Д
t-statistics of coefficients	-6,27312	7,657	11,89937	352,7288

As one can see from table 3, the regression model is built on the main components, has a high quality: a large coefficient of determination R^2 = 0,87; Fisher's criterion F = 79,85, which is several times greater than the critical value of F_{crit} = 2.88. And the t-statistics of the coefficients all turned out to be significant.

Model (5) has a remarkable predictive power. For the point retro-forecast calculated on the set sample values, the average error of approximation in this case does not exceed 1,5%. Thus, model (5) is both adequate and accurate.

The lasteconometric model to be considered in this study includes three factors: X_1 is the expenditure of the health care system, X_6 is the percentage of overweight men, and X_9 is the number of hospital beds. Estimating the coefficients of the model using the LINEST function, for which healthy life expectancy was chosen as the dependent variable Y, we obtain the following equation of the model.

$$Y = 53{,}14 + 2{,}13X_1 + 0{,}18X_6 - 0{,}045X_9 \quad (6)$$

Each of the coefficients of this model has the following meaningful interpretation.

α_0 = 53,14 obviously means the life expectancy that will be in the country if it is not affected by any factors. This value for different models will be different and varies in the range from 53.14 to 67.5 years. Indeed, this value is always lower than real life expectancy, because without the achievement of social progress, our lives would be reduced.

A factor of 2.13 for the factor variable X_1 shows that if the cost of maintaining a health care system per person increases by $ 1, life expectancy will increase by 2.13 years.

Similarly, the coefficient for the variable X_6 means that with an increase in the proportion of overweight men by 1%, life expectancy will increase by 0.18 years.

But with an increase in the number of hospital beds per unit per 10,000 population, life expectancy will decrease by 0.04 years. This paradoxical conclusion about the number of hospital beds is often found in the literature and shows that it is better not to be in the hospital if you are sick, because it reduces life expectancy in the case of unqualified interventions in your body.

Model (6) demonstrates high coefficients of determination and Fisher's criterion (R^2 = 0.9, F = 105), as well as significant t-statistics for all coefficients: t_0=20,46528, t_1=8,621056, t_6=3,694666, t_9=-3,65448. It also has good predictive power. Two countries were selected for testing - Finland and Austria, not included in the sample on which the model was built. The factors specific to these countries are listed in Table 4. There are more than three of them, as a forecast for the six-factor model will still be created. The values of the relevant factor variables were taken from WHO statistics.

Table 4. Significance of factors influencing life expectancy in Finland and Austria

	ln(expend)	Ln(GDP)	Average wages	Protein	Tobacco Male	Overweight, Male	Hospital beds (per 10000 population)
Austria	8,459331	10,78436	3122	61	19,2	58,1	74,2
Finland	8,317498	10,75257	2656	72	20,7	62,5	39,7

For Austria and Finland, point and interval forecasts were constructed using three-factor and six-factor models. These results are shown in Table 5. The relative approximation error was calculated in comparison with the real value of life expectancy observed in these countries in 2016. For Austria, this figure was 81.64 years, and for Finland - 81.43 years.

Table 5. Point and interval forecasts constructed using three-factor and six-factor models

	Point forecast according to the three-factor model	Interval forecast according to the three-factor model	Relative error of approximation of the point forecast	Point forecast according to the six-factor model	Interval forecast according to the six-factor model	Relative error of approximation
Austria	78,49767	[61,25; 95,73]	3,84%	80,991	[63,60;161,41]	0,8%
Finland	80,55133	[63,80; 97,30]	1,079%	80,86	[0,2;161,51]	0,7%

The average approximation error was calculated on the basis of retro forecast data, which was 1,27% for the six-factor model and 1,23% for the three-factor model.

Conclusions. Labor potential is a concept of macro level, which characterizes not only the existing but also the potential labor opportunities of the population, real and potential labor force. One of the most important qualitative indicators of labor potential is the health of the population. Not only the economic development of the state, but also its defense, competitiveness and economic security depend on the state of health of the population.

The relationship between the indicator of public health and the factors influencing it was studied by means of econometric analysis. Several regression models have been built, which have high values of adequacy and accuracy criteria, as well as satisfactory predictive quality. Based on the obtained models, it is possible to accurately predict the life expectancy of the population of a given country, to assess the degree of influence of factor variables on the health indicator, as well as the natural level of life expectancy (excluding the effects of favorable and unfavorable factors).

REFERENCES

1. Управління трудовим потенціалом: навч. посіб. [для студ. вищ. навч. закл.] / Васильченко В. С., Гриненко А. М., Грішнова О. А., Л. П. Керб Л. П. К.: КНЕУ, 2005. 403 с. Retrieved from https://buklib.net/books/30087/
2. Перебейнос О.М. Демографічна безпека та загрози демографічного розвитку: державно-управлінський аспект / О.М. Перебейнос. - Retrieved from http://www.kbuapa.kharkov.ua/e-book/db/2011-1/doc/7/03.pdf
3. Амосов Н.М. Раздумья о здоровье. М.: Молодая гвардия, 1979. 50 с. Retrieved from http://adminland.ru/crimea/books/70302116/index.htm.
4. Всемирная организация здравоохранения. URL: https://www.who.int/ru
5. Маршалл А. Принципы экономической науки. Retrieved from http://library.tneu.edu.ua/files/EVD/HTML/marshal/marshal.htm (дата обращения: 15.09.2020).
6. Oxford Textbook of Global Public Health, 6 edition. Edited by RogesDetels, Martin Gulliford, Quarraisha Abdool Karimand ChorhChuan Tan. – Oxford University Press, 2017.–1728 p.
7. Preston S. H. (1975). The Changing relation between mortality and level of economic development // Population Studies. 29: P. 231–248. Retrieved from https://www.ssc.wisc.edu/~walker/wp/wp-content/uploads/2012/01/preston1975.pdf
8. Андреев Е., Школьников В. Связь между уровнями смертности и экономического развития в России и ее регионах. Демографическое обозрение. 2018. Т. 5. С. 6-22. Retrieved from https://demreview.hse.ru/article/view/7707/8548
9. Колосницына М. Г., Коссова Т. В., Шелунцова М. А. Факторы роста ожидаемой продолжительности жизни: кластерный анализ по странам мира. Демографическое обозрение. 2019. Т.6. Вип. 1. С. 124–149. Retrieved from https://cyberleninka.ru/article/n/faktory-rosta-ozhidaemoy-prodolzhitelnosti-zhizni-klasternyy-analiz-po-stranam-mira
10. Зависимость продолжительности жизни от уровня образования в России /Т.Л. Харькова, С.Ю. Никитина, Е.М. Андреев / Вопросы статистики, 2017, Вип. № 8. С. 61–69. Retrieved from https://voprstat.elpub.ru/jour/article/view/546/499
11. Gupta S., Verhoeven M., Tiongson E. (1999). Does higher government spending buy better results in education and health care? IMF, Working Paper. 99/21, Washington, DC. Retrieved from https://papers.ssrn.com/sol3/papers.cfm?abstract_id=880548
12. ВОЗ (2014). Обзор социальных детерминант и разрыва по показателям здоровья в Европейском регионе ВОЗ: заключительный доклад. Всемирная организация здравоохранения. Европейское региональное бюро. Копенгаген. Retrieved from http://www.euro.who.int/__data/assets/pdf_file/0004/251959/Review-of-social-determinants-and-the-health-divide-in-the-WHO-European-Region-FINAL-REPORT-Rus.pdf?ua=1
13. Heuvel, van den W., Olaroiu M. (2017). How important are health care expenditures for life expectancy A comparative European analysis. Journal of the American Medical Directors Association, 18(3), 9–12. Retrieved from https://www.jamda.com/article/S1525-8610(16)30559-X/pdf
14. Bradley E.H., Sipsma H., Taylor L.A. American health care paradox—high spending on health care and poor health. QJM: An International Journal of Medicine. 2017. 1, P.61–65. Retrieved from https://academic.oup.com/qjmed/article/110/2/61/2681813
15. World Bank (2018). World Development Indicators, DataBank. Retrieved from http://databank.worldbank.org/data/reports.aspx?source=wdi-database-archives-%28beta%29
16. Retrieved from https://www.who.int/data/gho/indicator-metadata-registry/imr-details/4951
17. Retrieved from https://www.who.int/data/gho/indicator-metadata-registry/imr-details/97
18. Retrieved from https://data.worldbank.org/indicator/EN.ATM.CO2E.PP.GD.KD
19. Retrieved from https://www.who.int/data/gho/indicator-metadata-registry/imr-details/4674
20. Retrieved from https://www.who.int/data/gho/indicator-metadata-registry/imr-details/prevalence-of-current-tobacco-use-(crude-adjusted-rate)
21. Retrieved from https://www.who.int/data/gho/indicator-metadata-registry/imr-details/2390
22. Retrieved from http://www.fao.org/faostat/en/#data/FS
23. Retrieved from https://www.who.int/data/gho/indicator-metadata-registry/imr-details/4804