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FRAMING A REGIONAL SPATIAL DEVELOPMENT PERSPECTIVE: THE RELATION BETWEEN HEALTH AND REGIONAL PERFORMANCE

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Abstract. The article describes the step-by-step process of testing the hypothesis about the importance of the health factor in the regions' economic growth, which determines their competitive positions. Calculations of the health development level in 22 regions of Ukraine were carried out, according to which those regions were divided into four clusters. The regions' integrated index of competitiveness was evaluated. The obtained taxonomic indicator allowed dividing the analysed regions into four groups according to their integral values of competitiveness. At the next stage, there were used several criteria for checking the data by groups for normality of distribution using the Shapiro-Wilk test and the Levin method, which made it possible to confirm the presence of the heteroscedasticity phenomenon of the variances of the compared groups of regions. To confirm a connection between the level of regions' health development and their competitiveness, a one-factor parametric ANOVA analysis, supported by Tukey's post hoc test, was carried out, which revealed a dependence between almost all groups of the regions compared. The Granger test made it possible to confirm the hypothesis of a unidirectional causal relationship between the health factor and the competitive positions of a region based on the integrated level of competitiveness. The obtained results prove the need for an active work in the direction of strengthening the regional health care system and the maximum involvement of stakeholders of various levels in the strategy issues of improving the territories and supporting the system of medical and social care of the population at the level of cities and regions. The authors emphasize that for implementing an effective regional health policy, it is important to take into account the influence of factors that can restrain health development, as well as those groups of determinants capable of stimulating this development: financial and budgetary mechanisms, involvement of marketing and information tools, taking into account behavioural and institutional factors.

Keywords: a level of health development, regional competitiveness, public health risk, quality of life, regional growth, causality
JEL Classification: C12, I15, R11

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1. Introduction

Given the spread of the COVID-19 pandemic around the world in 2020, over the years the issue of a health factor has not lost its relevance. The determinants of health are complex and linked to factors that operate both at the individual level and at the level of countries and regions (Smiianov et al., 2020). It is clear that individual health characteristics are determined by genetics, but the community lifestyle determines the inclination to care for a person's health. The main functions at the regional government level are health promotion, including the influence on social determinants and information and outreach work in the interests of health (Pimonenko et al., 2021). These components are the main ones when calculating regions' health development levels. It is appropriate to note that the relevance of the issue of health promotion in the regions of Ukraine today is due not only to the importance of preventing infectious diseases but also to the fact that Ukrainians continue to suffer from preventable diseases and premature death. Thus, according to statistical information, the leading cause of death from 2007 to 2017 were cardiovascular diseases, cancer, chronic respiratory diseases and type 2 diabetes. In 2019, 84% of deaths were related to a progressive state of non-communicable diseases which could be prevented if concomitant risks, such as the frequency of infectious diseases, prevention, following the principles of the concept of holistic health, were prevented in time (On the way, 2020).

The population's health is undoubtedly one of the leading indicators of national, regional and local well-being. This parameter is a fundamental component of human capital – an important indicator of a country's global competitiveness. This is a property without preserving and reproducing which each individual cannot realize his potential in various spheres of socio-economic life. Naturally, a high level of health ensures a corresponding quality of life. Along with the concepts of "public health" and "community health", the term "population health" is directly related to the condition and characteristics of individual persons or small groups of people. This term is a starting point for further generalization and comprehensive analysis of a regional level of health. Effective population health interventions require comprehensive attention to social, environmental, and medical determinants of health. Undoubtedly, an important role is played by promoting a healthy lifestyle, social cohesion and interaction to solve common problems.

Health can be called the factor that stimulates growth of the quality of life: only physically and mentally healthy people can make a positive contribution to their region with their professional contribution. It is a healthy personality that forms human capital and guarantees high productivity in regional development. A higher indicator of working capacity increases economic indicators at the level of regions and the entire country. For example, a one-unit increase in the multifactor health index in a country increases output by 2% (Bhargava et al., 2001). Dash et al. (2020) estimated that about a third of economic growth in developed countries over the past century was due to improvements in public health. In 2020, health problems prevented people from being economically active and fully realizing their production potential. This led to losses of up to 580 million person-years per year due to diseases of the working-age population. Health problems cost the world more than 12 trillion

US dollars. Health shocks such as global epidemics lead to additional economic losses (Prioritizing health, 2020). This article aims to confirm the authors' hypothesis that the high position of a region in terms of health parameters leads to a high probability that this region will receive a high rank in terms of spatial development prospects, which can be expressed through the competitiveness index.

2. Literature Review

Different approaches to regional growth and issues of ensuring competitiveness took place in the studies of many scientists in the 21st century (Kuzior et al., 2022; Arefieva et al., 2021; Trzeciak et al., 2022). Various factors stimulating regional growth are singled out in publications on this topic. In (Vyrostova et al., 2021; Pimonenko et al., 2021), this growth factor is called tourism and focuses on researching the relationship between tourism and economic growth. With this study, the authors confirm the hypothesis that tourism positively affects the growth of the territory's GDP. The subject of research by (Bondarenko et al., 2020) is the marketing and economic attractiveness of a territory and taking into account the parameters that determine it. It is noteworthy that the authors propose to determine the economic attractiveness of a territory according to five sub-indices: the development level of business structures, production indicators, the sphere of trade and investment, as well as issues of the environment and logistical support. Tielietov & Letunovska (2014) emphasize the importance of the social factor in ensuring a region's competitiveness, which can be realized by supporting social infrastructure objects subordinated to municipalities and local business entities. In (Zdražil & Kraftová, 2021), an attempt is made to evaluate the development of the multifactor productivity structure in a region and determinants affecting it. Theoretically, this study is based on the principles of accounting for the growing phenomenon. In the article (Roses & Wolf, 2021), the authors examine regional income growth and inequality based on the analysis of long-term panel data covering more than 170 European regions in almost 20 countries over a century. These data made it possible to compare the regions with each other and with the development level of other parts of the world. The analysis was carried out based on a comparison of such indicators as fluctuations in population density and economic activity, structural changes in the economy with a shift in the leading role of industries in the national economy, the rise and fall of industry, and the rise of the service sector. De Lucio, J. (2021) uses artificial intelligence techniques to analyse a regional situation. It combines the most common regional analysis tools (time series analysis, synthetic and dynamic parameters) with neural network tools that help reduce errors in evaluating a regional situation. Batzilis, D. (2020) studies cost sharing and the impact of political determinants on regional country growth using panel data.

It is the issues of politics and the current government that have a significant impact on regional development that are the focus of scientific research. Sleuwaegen & Ramboer (2020) think that economic efficiency of regions depends on a small number of companies that are the most productive, and their performance influences regional growth rates and indicators of competitiveness at the local level. Such companies, for example, account for most jobs in the region. Data studied by the authors indicate the stimulating role in the regional growth of such

parameters as the quality of market support institutions, agglomeration and infrastructure. Basboga (2020) analyses the impact of the factor of opening the country's borders and the intensity of cross-border cooperation on the regional growth, focusing his research, to a greater extent, on the border regions of Europe. In his opinion, opening national borders with free movement of people results in an increase in regional gross value added per capita of almost 3%. Kuzmenko et al. (2020), as well as Smiianov et al. (2020), concentrate their scientific research on determining the differentiated position of regions in terms of their ability to counter the impact of epidemic threats. They consider the health factor in the region as fundamental to determining the territories' sustainability and long-term competitiveness, since the lower impact of risk factors for public health determines the relative future stability of their economic indicators. Even in work (Zukin, 1971), it is emphasized that non-economic factors are decisive and significantly influence the outcomes of economic development programs. He makes a case for cases where healthcare factors significantly undermined the target values of economic development indicators under successful economic planning. Based on research results he concludes that economic development is directly and indirectly related to health and depends on this factor. A carefully planned and implemented regional healthcare program can help optimize economic development in a country. Rivera & Currais (2004) examine the impact of public health spending and its variations on economic growth. The authors proposed a modified Solow model that includes a health factor to explain the impact of several determinants on regional productivity. An empirical study based on panel data is carried out on the example of the regions of Spain. The results show that current government spending on health care has a stable positive effect while public investment in health care does not affect productivity measures.

Bousquat & de Paula (2017) analyse the coordination relationships between the primary health care unit and the established network of a regional medical sphere in a country. They chose stroke as a factor for tracking therapeutic routes and, thus, assessed the quality of medical care in a region. An analysis of the scientific literature on health care shows that many studies are devoted to comparing health indicators between different regions, in which attention is also paid to analysing the determinants of existing differences among them. Thus, health differences are reflected through indicators such as infant and maternal mortality, life expectancy, mortality rates from various causes, and indicators of mental well-being. Considerable attention in scientific research is paid to the social determinants of health. In addition, the differences among regions, according to the author, are due to the complex diet and other factors: economic conditions, lack of food security, environmental influences, psychological injuries and stress, and availability of medical services. Fronlich et al. (2006) explore patterns of health disparities and propose theoretical mechanisms that generate these patterns. They pay attention to the analysis of such indicators as life expectancy and mortality in the population. The article focuses on three social determinants of health: social status, income, and place of residence. The authors argue that health inequalities can be reduced by redressing inequity in the distribution of these determinants. Franzini & Giannoni (2010) found that residents of lower-income regions of Italy with higher unemployment and greater inequality were more likely to report poor health and adverse living conditions which they believed to be the main determinants level of health. Gusmano et al. (2014) examine

differences between access to health care in central and peripheral regions of France. They conclude that residents of low-income areas and those treated in public health facilities have poorer access to primary care. That is, income inequality and an access to a medical institution (public or private) are called by the authors the main determinants of the health services availability. Henriksen et al. (2015) revealed the homogeneity of the five regions of Denmark regarding socio-demographic characteristics and the level of health development. Conclusions are drawn based on descriptive characteristics for all five regions. Such parameters as the use of medical services and the use of medicines for 2008-2013 were also taken into account. In connection with the COVID-19 pandemic, in recent years, more and more studies have been devoted to analysing health issues through the prism of achieving resilience of the medical system and a region as a whole through the impact of epidemic threats. This issue is addressed in a paper (Perone, 2021), which examines the effectiveness of the Italian regions' response to the emergency related to COVID-19. The article aims at investigating the causes of differences in mortality rates in 20 Italian regions and 107 provinces using OLS multivariate regression and to construct a "taxonomy" of provinces at risk of mortality from COVID-19 using Ward's hierarchical agglomerative clustering method. As determining indicators, the author chose indicators of the development level of the health care system, the level of environmental pollution, climatic conditions, demographic characteristics, and indicators of the medical system saturation.

3. Methods

The object of the study is the regions of Ukraine. Data for calculations are taken from open sources of the State Statistics Service of Ukraine. The authors proposed that the high value of health parameters in a region is determined by its leading position in terms of overall competitiveness. To check it, several stages were performed:

- at the first stage, 22 regions were evaluated according to the level of health development using Kohonen's self-organized map toolkit, which made it possible to form clusters with the appropriate weighting coefficients based on the distance criterion of the values of each region from the winning neuron. The calculation results made it possible to identify four clusters of regions according to the level of health development. The leading regions are Kharkiv, Odesa, Vinnytsia; regions with a high level of health development – Zaporizhia, Kyiv, Khmelnytskyi, Mykolaiv, Volyn, Lviv, Dnipropetrovsk, Zakarpattia, Zhytomyr; regions with an average level of health development – Ivano-Frankivsk, Cherkasy, Poltava, Sumy; outsider regions – Kirovohrad, Chernihiv, Chernivtsi, Kherson, Rivne, Ternopil;
- at the second stage, integral indicators of the competitiveness of the regions of Ukraine were calculated. An analysis of the most common methods of determining competitiveness (European Regional Competitiveness Index, Regional Innovation Scoreboard, Porter Diamond Model, Regional Competitiveness Hat, Pyramid model of Regional Competitiveness, Index of European Competitiveness (Robert Huggins Associates), Regional Competitiveness Atlas (Eurochambers), OECD Regional Well-Being) made it possible to form the basis for specifying the parameters and single out the most informative of them, which are structurally grouped into four subgroups: economic (Gross regional product per person, Export of goods, Export of services, Number of enterprises, Number of employees per person),

social (Number of births per person, Total marriage rate, Enrolment of children in preschool education institutions, Provision of strawberries by institutions, Crime rate), environmental (Volumes of emissions into atmospheric air per person, Waste generation per person, Volumes of wastewater pollution, Volumes of forest loss, Installed capacity of renewable energy sources) and innovative (Number of employees involved in the implementation of scientific research works, Number of applications for useful models, Costs of scientific research and development, Propensity for innovation of the administrative apparatus of the regional government , Uniformity of innovative activity in the region). Statistical data are taken quarterly from 2010 to 2019 when the COVID-19 pandemic had not yet time to transform these indicators. The selection of parameters for calculating the regional competitiveness index was carried out according to the criterion of an absence of multicollinearity:

$$r_{ij} = \frac{\sum_1^n x_i - \bar{x}_i) \cdot \sum_1^n x_j - \overline{x_j})}{\sqrt{\sum_1^{118}(x_i - \bar{x}_i)^2 \cdot \sum_1^{118}(x_j - \bar{x}_j)^2}} \quad (1)$$

where r_{ij} is a Spearman's linear correlation coefficient (critical value 0.8); x_j, x_i are input data indicators; $\bar{x}_j$, $\bar{x}_i$ are average values of time series.

A distinctive feature of the approach is the use of quantitative and qualitative parameters to calculate these components. At the same time, Cronbach's alpha criterion was used to check the consistency of expert assessments. According to this criterion the analysis results make it possible to assess the acceptability of the selected indicators for describing the phenomenon under study. Standardization of indicators is proposed to be carried out by the z-scores method, and the calculation of the integral value of competitiveness is done by the taxonomy method when the extremes of indicators are first found for each of the sets of parameters (economic, social, ecological and innovative), and then the distances to the predominant indicator are calculated according to the formula:

$$d_{io} = \sqrt{\sum_{k=1}^{n}(y_{ik} - y_{0k})^2}, i = 1, \ldots, m \quad (2)$$

where y_{ik} is the values of indicators of the components of the index of regional competitiveness; *k* is the feature number; *n* is the number of features of each statistical unit; *m* is the number of regions.

It is advisable to calculate the integral index of regions' competitiveness according to the formula:

$$TP = 1 - \frac{d_{i0}}{\frac{1}{m}\sum_{i=1}^{m} d_{i0} + 4\sqrt{\frac{1}{m}\sum_{i=1}^{m}(d_{i0} - d_{0\text{cep}})^2};} \quad (3)$$

where d_{ocep} is mathematical expectation.

According to calculations, Kharkiv, Lviv, and Odesa regions are the leading regions in terms of competitiveness. Zaporizhzhia, Kyiv, Vinnytsia and Mykolaiv are regions with high

competitiveness. Khmelnytskyi, Zakarpattia, Zhytomyr, Cherkasy, Ternopil, Ivano-Frankivsk, Poltava, Volyn, Kherson, Rivne, Sumy are regions with an average level of competitiveness. Other regions belong to outsider regions;

– at the third stage, there was checked the normality of the distribution of regions' clusters by competitiveness using the Shapiro-Wilk test (Razali & Wah, 2011):

$$SW = \frac{(\sum_{i=1}^{n} a_i x_{(i)})^2}{\sum_{i=1}^{n}(x_i - \bar{x})^2} \quad (2)$$

where a_i is constant; $x(i)$ is the smallest indicator value in the sample.

– at the fourth stage, there was checked the grouping of regions for the presence of heteroscedasticity of disparities in individual clusters using the Levine method (Shymon et al., 2020):

$$L_t = \frac{(N-k)}{k-1} \cdot \frac{\sum_{i=1}^{k} N_i (Z_i - Z_{ij})^2}{\sum_{i=1}^{k} \sum_{j=1}^{N_i} (Z_{ij} - Z_i)^2} \quad (3)$$

where *Z* is a sample mean; *k* is the number of groups; N_i is the number of values in the i-th group.

– at the fifth stage, analysis tools were selected to analyse the regions' groups and confirm the research hypothesis.

4. Results and Discussion

At the initial stage, using the available values of regional competitiveness indices by a group, there was checked their normality of distribution according to the Shapiro-Wilk test (Table 1).

Table 1. Shapiro-Wilk test results

Variable	W	V	Z	p-value
Index of the region's competitiveness	0.881	3.023	2.234	0.012

Source: calculated by the authors using the Stata software.

According to the calculations, the value of the Shapiro-Wilk index is below one, and the asymptotic value is less than 0.05, which indicates that the distribution does not meet the criterion of normality and there are differences between the variables. In the next step, there is checked the homogeneity of the variances of the isolated groups of regions according to Levin's method (Table 2). The asymptotic significance value is less than 0.05 for W0 (mean), W50 (median), and W10 (for the top 5% and bottom 5% of values), indicating that the distribution does not meet the normality criterion and there are differences among the variables.

Table 2. The results of calculations using Levin's method

Level of health development	Mean	Student's deviation
Leaders	0.443	0.063
a high level of health development	0.356	0.072
the average level of health development	0.276	0.019
Outsiders	0.251	0.02
Total	0.324	0.083
W0 = 5.213	Pr > F = 0.009	
W50 = 4.145	Pr > F = 0.021	
W10 = 5.214	Pr > F = 0.009	

Source: calculated by the authors.

One-factor parametric ANOVA analysis was chosen to check the relationship between the competitiveness of regions and their level of health development. The results of the calculations are presented in Table 3.

Table 3. The results of the ANOVA analysis

Comparison	SS	MS	F	p-value
Between groups	0.093	0.031	10.7	0,0003
Within groups	0.052	0.003	Bartlett's criteria for equality of variances:	
In general	0.145	0.007	Chi^2 = 9.745, p-value = 0.021	

Note: SS is a sum of squared deviations; $_{MS}$ is the ratio of the sum of squared deviations to the number of their degrees of freedom; *F* is quantile of the Fisher distribution.
Source: calculated by the authors.

The analysis showed the presence of a statistically significant difference between at least two groups (F(3, 18) = 10.7, p-value < 0.05; since Bartlett's test > 9.488, p-value < 0.05, the conclusion was made about the presence of a statistically significant result. A further empirical analysis with the help of Tukey's post hoc test confirmed the proposed hypothesis regarding the presence of a statistically significant difference between the region's competitiveness and its level of health development, which was most significantly manifested in the intergroup comparison of the leader regions and outsider regions with other groups (22, 5±0.041, p-value = 0.000), and the leader regions and regions with an average level of health development (19.9±0.044, p-value = 0.001). There is no statistically significant difference in only one pair of groups: regions with an average level of health development and outsiders (2.5±0.033, p-value = 0.863) (Table 4).

Table 4. Tukey's post hoc test results

Comparison groups	Divergence	Standard error	t	p-value
Leaders and a high level of health development	-0.117	0.039	-3.00	0.035
Leaders and the average level of health development	-0.199	0.044	-4.56	0.001
Leaders and outsiders	-0.225	0.041	-5.45	0.000
High and medium levels of health development	-0.081	0.029	-2.12	0.049
High level of health development and outsiders	-0.107	0.026	-4.11	0.003
The average level of health development and outsiders	-0.025	0.033	-0.78	0.863

Source: calculated by the authors.

The Granger test will help assess the cause-and-effect relationships between the analysed indicators of the regions. The results of the causality assessment are given in Table 5.

Table 5. Cause-and-effect relationships between the regions' competitiveness and their level of health development using the Granger causality test

Hypothesis	W-statistics	Probability	Connection type
The level of health development of the region → Competitiveness of the region	0.422	0.025	One-way
Competitiveness of the region → The level of health development of the region	5.977	0.524	

Source: calculated by the authors.

The analysis showed a unidirectional relationship between the level of health development of the region and its competitiveness.

5. Conclusions

According to the obtained results, the hypothesis that there is a connection between the region's competitiveness level and its level of health development is confirmed. This makes it possible to conclude that the growth of the level of health in the region forms the prerequisite for improving its competitive position among other regions. This indicates that the health factor is an attractor of the region's attractiveness in terms of competitiveness indicators. The obtained results confirm the need to intensify work in the direction of strengthening the regional health care system, increasing the level of involvement of the territory's stakeholders in the development of health development strategies and in the sphere of managing the public system of medical and social care, which will ensure a full modernization of the health system in the regions, an approach to preventing common diseases, obtaining additional positive effects for the country. To implement an effective policy in the field of improving the region, it is advisable to analyse the factors that restrain this process, namely, mostly the economic

orientation of regional development, socio-economic inequality among the population, incomplete consideration of risk factors, the unpopularity of the culture of preventing a disease, etc. Improving the level of health care can be realized by considering such groups of determinants as financial-budgetary, marketing-informational, social-behavioural and institutional. Markers of effectiveness will be an increase in medical and demographic indicators of the population, an increase in the number of people covered by immunization, an increase in the number of entrepreneurs working in the field of health product manufacturing, etc. Then the ranking positions of a region according to the level of health development will also increase, which will make it possible to follow the trend of changes in the position according to the competitiveness index of the analysed object in their relationship, which is the subject of further scientific research.

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