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HEALTH CAPITAL AND POPULATION AGEING: FINANCIAL AND ECONOMIC CONSEQUENCES FOR THE LABOUR MARKET

ABSTRACT

The process of population ageing is one of the significant demographic risks that affects the state of the labour market and long-term economic sustainability. Accordingly, it is relevant to study the concept of Health Capital in the context of the impact of population ageing on financial and economic processes in the country. The purpose of the article is to substantiate the essence of the concept of Health Capital in the context of population ageing and assess its economic impact on the development of the labour market. The hypothesis of the study is that the development of the concept of Health Capital at the national level affects the reduction of macroeconomic risks, in particular, population ageing, by improving the quality of human capital, strengthening the labour supply, and enhancing labour market resilience. To test this hypothesis, economic and statistical analyses and multiple linear regression modeling were conducted. Based on the results obtained, a relationship between the concept of Health Capital and labour market indicators was confirmed. The developed econometric model explains 73.9% of changes in the employment rate. In particular, life expectancy and per capita healthcare spending have a statistically significant positive impact on employment. Healthcare spending as a share of GDP has a negative relationship with the employment rate. This relationship is explained by the fact that an increase in the share of healthcare spending does not always have a positive effect on the labour market. According to the current state of development of the healthcare system, such an increase is associated with macroeconomic imbalances and the military-political situation. Among the analyzed indicators, per capita healthcare spending has the most significant impact on employment outcomes. The findings confirm that Health Capital represents a strategic component of human capital and a significant determinant of labour market resilience and sustainable socio-economic development. Under conditions of martial law and post-war recovery, strengthening investment in healthcare, rehabilitation services, and preventive healthcare, alongside the improvement of financial mechanisms for supporting population health, can contribute to preserving labour potential, sustaining economic activity, mitigating the consequences of demographic ageing, and enhancing the long-term economic resilience of Ukraine.

Keywords: Health Capital, population ageing, labour market, employment, human capital, healthcare, economic resilience

JEL Classification: I15, J11, J21, O15

INTRODUCTION

At present, demographic transformation driven by population ageing has emerged as one of the most significant socio-economic challenges affecting sustainable economic development. Changes in the age structure of the population exert profound effects on the macroeconomic environment by reducing labour supply, increasing pressure on public finance and social protection systems, and altering the functioning of labour markets. As a consequence, demographic ageing contributes to declining economic activity, labour shortages, and slower long-term economic growth, thereby necessitating the revision of traditional approaches to human resource management and the development of effective mechanisms for strengthening human capital.

Within this context, the concept of Health Capital has gained increasing scholarly and practical significance. Health Capital represents a specific form of human capital that is accumulated and reproduced through investments in healthcare, disease prevention, rehabilitation, healthy lifestyles, and the creation of a safe living environment. As an economic asset, it determines individuals' physical and mental capacity to participate in productive economic activity, influences the duration of working life, labour productivity, and workforce competitiveness. At the macroeconomic level, the accumulation of Health Capital enhances the quality of human capital, reduces productivity losses associated with morbidity, strengthens labour market resilience, and supports sustainable economic development.

Under conditions of demographic ageing, Health Capital performs an important stabilizing function by extending healthy working life, increasing labour force participation, and mitigating the adverse effects of a shrinking working-age population. However, insufficient healthcare financing, the inefficient allocation of medical expenditures, and unequal access to healthcare services constrain the accumulation of Health Capital and intensify structural imbalances in the labour market. Accordingly, substantiation of the influence of the mechanisms of Health Capital on labour market indicators is an important scientific task.

The relevant research is of great importance for substantiating the current state of development of healthcare in Ukraine. The processes of demographic decline in the country are associated with a high level of external migration caused by a full-scale invasion. The consequence of such processes is a decrease in the efficiency of the functioning of the labour market. As a result, the stability of the national economy depends on the state's ability to preserve, restore and effectively develop the Health Capital of the working population. Accordingly, strengthening healthcare financing, expanding rehabilitation infrastructure and increasing investments in human capital are priorities for increasing the efficiency of the labour market and ensuring sustainable socio-economic development of Ukraine.

LITERATURE REVIEW

The issue of the impact of Health Capital on the labour market is quite widespread among the scientific community. In particular, in the scientific discourse, there are directions for studying the impact of the demographic consequences of ageing and the qualitative characteristics of human capital. The concept of Health Capital is widely studied. The scientific gap in existing research lies in the lack of qualitative substantiation of the impact of Health Capital mechanisms on reducing macroeconomic risks, in particular, population ageing, through improving the quality of human capital, increasing labour supply, and enhancing labour market resilience.

Health as Capital

The theoretical foundations of the concept of Health Capital are defined within the framework of human capital theory. According to Grossman's model (1972), human health is a consumable and investment resource. Sufficient financial provision of the healthcare system has a positive effect on labour productivity, the duration of work, and the development of the labour market. This scientific approach is substantiated in the work of Howitt (2005), where it is determined that investments in healthcare increase innovative potential and economic growth by enhancing the quality of human capital.

Accordingly, Health Capital is a set of human resources that influence the socio-economic development of the country (Schneider-Kamp, 2021). Health Capital should also be considered as a set of assets that are aimed at their economic reproduction (Davies & Schramme, 2025). Therefore, Health Capital is a broad social and economic indicator that, in its synergy, determines the main macroeconomic indicators (Schramme, 2019). Health Capital, through mechanisms of investment in healthcare, generates long-term economic and social returns (Fisher et al., 2021).

Health Capital mechanisms are in synergy with the country's economic growth and labour market indicators. Empirical evidence demonstrates that investments in healthcare and health capital contribute to economic recovery following crises, stimulate labour productivity, and strengthen economic resilience (Richards et al., 2025; Guo et al., 2025). Other studies confirm that public investment in healthcare and education represents one of the principal mechanisms for strengthening human capital and supporting sustainable economic growth (Kousar et al., 2023; Adenike & Sherifdeen, 2017). Existing empirical research primarily examines either the relationship between healthcare expenditure and economic growth (Eze, 2023) or the effects of health improvements on life expectancy and human capital accumulation (Vu, 2023). Comparative studies further indicate that effective public healthcare financing contributes to improved health outcomes and creates favourable conditions for long-term socio-economic development (Onofrei et al., 2021). Nevertheless, relatively limited attention has been devoted to the integrated assessment of Health Capital as a determinant of labour market resilience.

Population Ageing within the Health Capital Framework

Population ageing has become one of the major demographic challenges affecting the functioning of contemporary socio-economic systems. Demographic transformation reduces the proportion of the working-age population, increases dependency ratios, and places additional financial pressure on healthcare and pension systems (Ludwig et al., 2012; Watanabe et al., 2025). These processes contribute to labour shortages, declining economic activity, and slower long-term economic growth (Rosa et al., 2013).

The relationship between demographic ageing and economic development is multidimensional. Changes in the age structure influence both the accumulation of physical capital and the quality of human capital (Mason et al., 2016). Increasing life expectancy has a direct positive impact on labour productivity. Declining fertility rates reduce labour supply and slow economic growth (Castagna et al., 2013). Due to the intensification of the demographic ageing process, there is an increase in financing of the healthcare system, which requires a more efficient distribution of state budget expenditures (Aisa & Pueyo, 2013). Accordingly, Health Capital is an important mechanism for ensuring labour market stability and socio-economic growth in the country.

Thus, the literature examined identifies a positive relationship between population ageing indicators, health, labour productivity, and economic growth. Most researchers recognise Health Capital as an effective instrument for extending working life, maintaining labour productivity, and mitigating the adverse consequences of demographic ageing. At the same time, existing studies mainly analyse demographic processes, healthcare expenditure, or economic growth separately, whereas the mechanisms linking Health Capital, labour market performance, and economic resilience remain insufficiently explored.

Ukrainian Studies on Health Capital

Ukrainian researchers also devote considerable attention to the theoretical and practical aspects of Health Capital formation. In particular, Kunderova (2020) and Pashchenko (2024) consider Health Capital to be a fundamental component of human capital that determines labour productivity, human development, and national competitiveness. Contemporary Ukrainian studies further examine healthcare financing mechanisms, emphasising the importance of efficient allocation of public resources and institutional reforms for improving the performance of the healthcare system (Sheliomina, 2023; Kuzheliev & Nechyporenko, 2024). Considerable attention is also devoted to healthcare reform under current socio-economic conditions (Prymak, 2025), investment in human capital during wartime (Sakun et al., 2025), and the modernization of healthcare institutions as an essential prerequisite for post-war recovery (Todurov, 2025).

Despite the growing body of international and Ukrainian research, an important scientific gap remains. Existing studies primarily investigate healthcare financing, demographic ageing, or economic growth independently. However, comprehensive econometric evidence explaining how Health Capital influences employment, labour supply, labour productivity, and labour market resilience under conditions of demographic transformation remains limited.

AIMS AND OBJECTIVES

The purpose of the article is to substantiate the essence of the concept of Health Capital in the context of an ageing population and assess its economic impact on the development of the labour market.

To achieve this objective, the following research tasks are defined:

1. To investigate the relationship between demographic characteristics, Health Capital development indicators, and population employment rates.
2. To develop an econometric model for assessing the impact of Health Capital components on labour market functioning and to formalize the mechanisms of interaction between Health Capital and labour supply.
3. To substantiate practical directions for advancing the Health Capital concept as an instrument for enhancing economic and demographic resilience of the labour market under conditions of martial law and post-war recovery.

The hypothesis of the study is that the development of Health Capital mechanisms at the national level affects the reduction of macroeconomic risks, in particular, population ageing, by improving the quality of human capital, strengthening the labour supply, and enhancing labour market resilience.

METHODS

The study used a number of general scientific and special research methods. In particular, the methods of analysis and synthesis, comparative and economic and statistical analysis, as well as multiple linear regression modeling were used. The methods of analysis and synthesis were used to substantiate theoretical approaches to the essence of Health Capital and its significance in the demographic policy system. Comparative, economic, and statistical analyses were used to analyze the relationships between indicators of Health Capital development, demographic characteristics, and labour market indicators.

Using multiple linear regression analysis, a quantitative assessment of the impact of Health Capital indicators on the employment rate was investigated. The adequacy and statistical reliability of the model were checked using the Multiple correlation coefficient (R), the Coefficient of determination (R^2), Fisher's F-test, t-tests for individual coefficients, and the standard error of regression.

The dependent variable of the model is the employment rate of the population aged 20–64 (%). The corresponding indicator is an indicator of the efficiency of the labour market and the level of population involvement in economic activity. The independent variables are demographic and healthcare indicators, namely life expectancy at birth (years), current healthcare spending as a share of GDP (%), and current healthcare expenditure per capita (USD).

The choice of indicators is justified by the need for a comprehensive assessment of demographic characteristics, the health status of the population, and the level of financial support for the healthcare system. The selected variables are aimed at studying the relationship between the quality of human capital, investments in the health of the population, and economic activity in the context of demographic ageing.

The study has certain limitations. The time series of the empirical analysis covers the period 2002–2021, which limits the number of observations available for econometric modeling. The chosen period of the study is justified by the availability of statistical information and the lack of statistical data after the start of the full-scale invasion of Ukraine. The applied methodological approach is aimed at identifying the main patterns of interaction between health capital, demographic processes, and the functioning of the labour market. This approach provides the basis for further research in this area.

The analysis of the years 2002–2021 is justified by the presence of a full sample of statistical data required for all variables of the econometric model. The beginning of a full-scale invasion in 2022 significantly affected the formation of analytical information on demographic, social, and financial indicators, and the general state of healthcare. Indicators published after 2021 do not provide a complete comparative set of data for all indicators in the regression analysis.

It is also worth noting that the beginning of the full-scale invasion intensified significant changes in the country's demographic processes, employment, and healthcare spending. Accordingly, the inclusion of indicators after 2022 in the developed model may affect the formation of a structural gap in the time series. As a result, the choice of the study period 2002–2021 was determined as the most optimal for empirical assessment.

RESULTS

The implementation of the concept of Health Capital in the system of demographic system transformation requires the formation of a new paradigm in which the health of each person is a long-term economic resource (World Health Organization, 2026). The use of Health Capital mechanisms is an effective tool for increasing the economic and demographic sustainability of the labour market. The dominance of the dynamics of population ageing over the growth of the birth rate, together with the reduction of the economically active population, emphasises the need to integrate older age groups into production processes.

In the study of the economic consequences of demographic ageing, Health Capital is the main endogenous factor. The implementation of Health Capital mechanisms is aimed at reducing labour productivity losses and stimulating labour productivity growth in conditions of labour shortage. The rational application of Health Capital mechanisms has a positive effect on the adaptability of the national financial and economic system to new demographic transformations.

By its economic essence, Health Capital is an element of human capital that ensures working capacity, labour productivity and life expectancy. Investments in Health Capital form the quantitative and qualitative basis of the labour supply. Accordingly, the level of development of Health Capital affects the economic sustainability of the country. In particular, productive human resources are more adaptive to socio-economic and demographic changes in the country. As a result, an increase in life expectancy contributes to an increase in the level of economic activity in the regional and national context. Also, the

effective implementation of the mechanisms of Health Capital affects the reduction of labour productivity losses caused by diseases. Health capital has a direct impact on the indicators of demographic ageing of the population. To test the corresponding hypothesis, mathematical modeling methods were used, in particular, the method of multiple linear regression.

The objectivity of the assessment of the impact of Health Capital on labour market indicators is ensured by the presence of three independent variables:

1. Life expectancy at birth (years). The corresponding indicator is an integrated indicator of the quality of life, the health status of the population and the effectiveness of the healthcare system.
2. Current healthcare expenditures (% of GDP). A macroeconomic indicator that determines the level of healthcare provision within the general distribution of state financial resources. The corresponding indicator analyzes the macroeconomic burden of healthcare expenditures according to the functional distribution of state budget expenditures.
3. Current healthcare expenditures per capita (USD). The indicator characterizes the amount of financial resources involved in financing healthcare, determining the financial efficiency of providing medical care per capita.

The dependent variable (Y) in the model is the employment rate of the population aged 20–64 years. The selection of this age group is justified by its relevance for analyzing the economically active population and assessing the dynamics of demographic ageing. The time series is limited to the year 2021 due to the absence of a comprehensive statistical database following the onset of the full-scale invasion in 2022.

Table 1. Initial data for modeling the impact of Health Capital components on labour market performance. (Source: compiled by the authors based on the State Budget of Ukraine (2002–2021) and data from the Ministry of Health of Ukraine and the Ministry of Finance of Ukraine)

Years	Employment rate of the population aged 20–64 years, %	Life expectancy at birth, years	Current healthcare expenditure, % of GDP	Current healthcare expenditure per capita, USD
	Y	X ₁	X ₂	X ₃
2002	64.1	68.1	5.67	47
2003	64.4	68	6.07	60
2004	64.6	68	5.92	78
2005	64.4	68	6.15	109
2006	65.4	68	6.27	132
2007	66.6	67.9	6.2	174
2008	67.3	68.1	6.24	211
2009	64.7	69.1	6.95	173
2010	65.6	70.3	7.18	213
2011	66.5	71	6.78	243
2012	67.1	71.1	7.13	274
2013	67.4	71.2	7.22	291
2014	64.2	71.2	7.1	215
2015	64.4	71.3	7.09	161
2016	64.2	71.6	7.21	173
2017	64.2	71.9	7.44	187
2018	65.6	71.7	7.52	221
2019	66.9	72	7.09	247
2020	65.2	71.3	7.56	270
2021	64.8	69.7	8.01	368

As part of the empirical analysis, a multiple linear regression model was developed to assess the relationship between the employment rate of the population aged 20–64 and a set of demographic and Health Capital indicators. The model evaluates the impact of life expectancy at birth, Current healthcare expenditure as a share of GDP, and Current healthcare expenditure per capita on employment as a key indicator of labour market performance. The results obtained determine a statistically significant relationship between the variables and the level of employment. Therefore, it is worth determining that Health Capital is a significant factor in the functioning of the labour market and economic sustainability.

The estimated multiple linear regression equation is as follows:

$$Y = 56.022 + 0.360X_1 - 2.941X_2 + 0.022X_3,$$

where: Y – employment rate of the population aged 20–64 (%); X_1 – life expectancy at birth (years); X_2 – Current healthcare expenditure (% of GDP); X_3 – Current healthcare expenditure per capita (USD).

Table 2. Statistical characteristics of the econometric model assessing the impact of Health Capital on the employment rate. (Source: compiled by the authors using Microsoft Excel)

Regression Statistics	Value
Multiple R	0.8594
R Square	0.7386
Adjusted R Square	0.6896
Standard Error	0.6519
Observations	20

The regression statistics indicate a satisfactory level of model fit and explanatory power. The multiple correlation coefficient (Multiple R = 0.8594) demonstrates a strong linear relationship between the explanatory variables and the employment rate. The coefficient of determination ($R^2 = 0.7386$) indicates that 73.86% of the variation in the employment rate is explained by changes in life expectancy, Current healthcare expenditure as a share of GDP, and Current healthcare expenditure per capita, while the remaining 26.14% is attributable to other factors not included in the model. The adjusted coefficient of determination (Adjusted $R^2 = 0.6896$) remains relatively high after accounting for the number of explanatory variables, confirming the robustness and satisfactory explanatory capacity of the estimated model. Overall, the obtained results indicate that the developed econometric model provides an adequate framework for assessing the impact of Health Capital indicators on labour market performance, as measured by the employment rate.

Table 3. Results of the analysis of variance (ANOVA) and statistical significance testing of the regression model. (Source: compiled by the authors using Microsoft Excel)

Source of Variation	Df	SS	MS	F	Significance F
Regression	3	19.212441	6.404147	15.069559	0.000064
Residual	16	6.799559	0.424972	–	–
Total	19	26.012000	–	–	–

The analysis of variance (ANOVA) demonstrates that the estimated regression model is statistically significant. The Fisher statistic is $F = 15.070$, and the corresponding significance level is 0.000064. Since the p-value is well below the conventional significance threshold ($p < 0.001$), the null hypothesis that all regression coefficients are jointly equal to zero is rejected. This confirms the overall statistical significance of the model and indicates that the selected explanatory variables jointly provide a statistically significant explanation of the variation in the employment rate.

The obtained results further confirm the adequacy and reliability of the estimated econometric model, supporting its application for assessing the impact of Health Capital indicators on labour market performance, as measured by the employment rate.

Table 4. Estimated regression coefficients and statistical significance of the Health Capital determinants. (Source: compiled by the authors using Microsoft Excel)

Variable	Coefficient	Standard Error	t-Statistic	p-value
Constant (Intercept)	56.0221	8.8705	6.3156	0.000010
X_1	0.3603	0.1594	2.2601	0.0381
X_2	–2.9414	0.5756	–5.1099	0.000105
X_3	0.0222	0.0033	6.6458	0.000006

The estimated regression coefficients indicate that all explanatory variables included in the model are statistically significant at the 5% significance level ($p < 0.05$). Among the analysed determinants, Current healthcare expenditure per capita (X_3)

exhibits the strongest positive and most statistically significant effect on the employment rate ($p = 0.000006$). The estimated coefficients provide a basis for the economic interpretation of the relationship between Health Capital indicators and labour market performance.

1. **Factor X_1** – Life expectancy at birth (coefficient = +0.360). The obtained coefficient shows that an increase in life expectancy at birth by one year affects the average increase in the employment rate of the population aged 20–64 by 0.360 percentage points. Also, the p-value ($p = 0.038$) determines the statistical significance of this relationship. The obtained result confirms the theoretical foundations of the concept of "Health Capital" in that improving the health of the population contributes to the accumulation of human capital and reduces the negative impact of demographic ageing on labour market indicators. The development of Health Capital increases the efficiency of labour supply.
2. **Factor X_2** – Current healthcare expenditure (% of GDP) (coefficient = –2.941). Thus, a 1 percentage point increase in current healthcare spending as a share of GDP is associated with an average decrease in employment of 2.941 percentage points. The negative coefficient reflects the macroeconomic context in which healthcare spending tends to increase during periods of economic downturn. This trend was observed during the COVID-19 pandemic, martial law, and structural reforms of the healthcare system. The relative share of healthcare spending in GDP can increase while labour market performance deteriorates. The statistical significance of this relationship is determined by the p-value ($p = 0.000105$).
3. **Factor X_3** – Current healthcare expenditure per capita (coefficient = +0.022). The obtained indicator indicates that an increase in current healthcare expenditure per capita by USD 100 is associated with an average increase in the employment rate by 2.22 percentage points. The corresponding indicator has the highest level of statistical significance ($p = 0.000006$). As a result, it is worth stating that an increase in the amount of financing in the healthcare system contributes to improving the quality of human capital, reducing labour productivity losses, and strengthening the stability of the labour market. Increasing the attraction of investments in healthcare creates additional employment opportunities and develops the labour market.

Thus, the estimated three-factor multiple regression model provides a quantitative assessment of the relationship between the employment rate in Ukraine and the selected indicators of Health Capital development over the period 2002–2021. The empirical results demonstrate that all explanatory variables included in the model are statistically significant, while Current healthcare expenditure per capita exerts the strongest positive influence on the employment rate. In particular, the estimated coefficient indicates that an increase in life expectancy at birth by one year is associated with an average increase of 0.360 percentage points in the employment rate, highlighting the important role of demographic factors and population health in preserving labour potential and supporting labour market performance.

The obtained negative coefficient is associated with the share of Current healthcare expenditures in GDP and is not an indicator of the negative impact of healthcare financing on employment. This result indicates the impact of negative factors, in particular, financial and economic volatility, the COVID-19 pandemic, and structural reforms of the healthcare system, under which the amount of healthcare financing was increased. Under such conditions, the increase in expenditures is a consequence of changing the priorities of public finances.

The obtained results of the regression model have a high level of statistical reliability. In particular, $F = 15.070$; $p < 0.001$. The coefficient of determination ($R^2 = 0.739$) indicates that approximately 73.9% of the variation in the employment rate is explained by the studied indicators of Health Capital. Such empirical data confirm the adequacy of the proposed econometric model.

The synergistic relationship between Health Capital, healthcare system financing, and labour market indicators is formalized as follows:

$$Y_t = f(H_t(X_1), I_t(X_2, X_3)),$$

$H_t(X_1)$ – the existing stock of Health Capital in society, for which life expectancy at birth (X_1) serves as the integral indicator; $I_t(X_2, X_3)$ – the current investment in the reproduction and development of Health Capital through the healthcare financing system, represented by Current healthcare expenditure as a share of GDP (X_2) and Current healthcare expenditure per capita (X_3).

Taking into account the structure of the estimated regression model, changes in the employment rate resulting from variations in Health Capital are expressed by the following total differential equation:

$$dY = \frac{\partial Y}{\partial X_1} \partial X_1 + \frac{\partial Y}{\partial X_2} \partial X_2 + \frac{\partial Y}{\partial X_3} \partial X_3.$$

The presented formula takes into account the level of influence of each indicator of Health Capital on the employment rate of the population. The result is the expected indicator of the employment rate obtained by changing each individual variable indicator. For example, the change in the coefficient X_1 analyzes the expected increase in the employment rate due to an increase in life expectancy at birth by one year. The coefficient X_3 determines the expected change in the employment rate due to a change in current healthcare expenditure per capita by USD 1.

The proposed approach is aimed at quantifying the multiplicative effect of healthcare financing on the state of labour market development. The synergy is that the deterioration of the demographic situation in the country is accompanied by a decrease in life expectancy and a deterioration in labour market dynamics. The corresponding indicator determines that the increase in the volume of healthcare financing contributes to the accumulation of Health Capital due to an improvement in the general health of the population. The corresponding process occurs through a reduction in the population's productivity losses, in particular due to diseases. The result is a steady return of people to economic activity and increased labour productivity.

When calculating the formula, the assumption was made that the remaining variables are constant and the employment rate is constant. Accordingly, the presented formula should be used to calculate the amount of financing for the health sector in order to reduce the negative impact of reduced life expectancy on labour market indicators.

The calculation of the amount of financing for the health sector was carried out using the following formula.

$$\Delta Y = 0,360 \Delta X_1 - 2,941 \Delta X_2 + 0,022 \Delta X_3.$$

The resulting mathematical relationship provides a basis for predictive modelling and scenario analysis. In particular, assuming that the macroeconomic burden associated with healthcare expenditure as a share of GDP remains unchanged ($\Delta X_2 = 0$), it is possible to derive the equation of the compensatory financial effect. This expression determines the additional amount of healthcare financing required to offset the adverse effects of demographic deterioration, reflected in a decline in life expectancy (ΔX_1), while maintaining a stable employment rate.

$$\Delta X_3 = \frac{0,360}{0,022} \Delta X_1 \approx -16,36 \Delta X_1.$$

Therefore, the estimated model suggests that a one-year decline in life expectancy at birth would require an approximately USD 16.36 increase in Current healthcare expenditure per capita to compensate for the adverse demographic effect and maintain a stable employment rate, assuming that all other explanatory variables remain constant. This finding highlights the important role of healthcare financing as a mechanism for strengthening Health Capital and mitigating the labour market consequences of demographic ageing. Increased investment in the healthcare system contributes to improving population health, preserving labour potential, enhancing the psychophysiological capacity of the workforce, and reducing productivity losses associated with illness and premature withdrawal from economic activity.

From a macroeconomic perspective, the developed regression model enables the assessment of the economic implications of Health Capital for labour market functioning through its impact on employment. The employment rate is treated as an integrated indicator reflecting the ability of the working-age population to participate in economic activity and, therefore, captures the combined effects of demographic processes, population health, and healthcare investment on labour market performance. Consequently, the estimated coefficients provide a quantitative measure of the economic returns generated by improvements in Health Capital in the form of higher labour force participation, preservation of labour potential, and enhanced labour market resilience under conditions of demographic ageing.

The state of development of Health Capital in Ukraine is significantly affected by the effects of martial law. Military operations in the country affect demographic indicators and the labour market. Among the demographic indicators, an increase in the mortality rate, the number of injured people, and the deterioration of mental health are observed. Such factors negatively affect the overall national state of healthcare. Structural changes were noted in the healthcare financing system. The priority of redistribution of financial resources is aimed at providing first emergency medical care and rehabilitation of injuries of the population, in particular war veterans, received as a result of military operations. These structural changes determine the need to adapt the proposed analytical approaches to the socio-economic situation in the country.

In accordance with the demographic, economic, and social changes in Ukraine caused by the beginning of a full-scale invasion, it is important to adapt the proposed approaches to martial law and post-war recovery. Such an approach is

important for improving the practical applicability of the model and the possibility of using prospective forecasting. The result will be increased labour market stability and sustainable development of human capital in conditions of volatility.

Analysis of current macroeconomic and demographic indicators in the specified calculation model is included in order to be able to form a prospective forecast. This approach allows analysis of the effectiveness of attracting investments in the healthcare system. As a result, an assessment is made of the volume of investments necessary to financially cover demographic losses, strengthen labour potential, and promote the recovery of war veterans and the civilian population affected by military actions. Accordingly, the developed model is a quantitative basis for assessing the volume of financial investments necessary to improve the state of the labour market in conditions of socio-economic instability.

Based on the research conducted, it is worth noting that for the sustainable development of the concept of Health Capital in Ukraine, rational distribution of financial resources within the industry is important. In particular, investments should be directed to improving the system of service provision within the framework of physical and psychological rehabilitation of war veterans and civilians. The development of integration of veterans and persons with disabilities into the labour market is especially relevant. Such an approach will positively affect the labour market supply in conditions of demographic decline.

Digital development of the healthcare management system is an important direction for improving medical services. In particular, digital technologies can be applied during the distribution of financial resources. In this context, digital solutions are effective tools for monitoring and forecasting the need for financial resources in the industry. As a result of the application of digital tools, they will positively affect the rational distribution of financial resources in the healthcare sector. The use of public-private partnership mechanisms is promising. Synergistic interaction between the state and the private sector will provide significant opportunities for the development of the industry. Such processes will positively influence the development of the concept of Health Capital by strengthening the financial component of the medical industry. The use of digital technologies and mechanisms of public-private partnership will make it possible to strengthen the quality of medical services.

The development of the concept of Health Capital is important in the context of demographic ageing and the reduction of the working-age population. Sustainable economic development is directly dependent on the quality of human capital. In this context, investments in healthcare will help improve preventive medicine and the rehabilitation system. Attracting additional financial resources to the development of Health Capital is a factor in the formation of economic and demographic resilience. The result of such investment is a reduction in the negative consequences of population ageing and ensuring long-term stability of the labour market.

Attracting investments in the Health Capital development system is a component of state social spending. Such spending is of particular importance in the war and post-war period. In particular, through sustainable financing of the Health Capital system, it is important to achieve favorable conditions for restoring labour potential, strengthening competitiveness and ensuring sustainable socio-economic development of the country.

Thus, the results of the study determine that Health Capital is a social category of state policy and an economic factor that has a direct impact on the stability of the labour market in the context of demographic ageing. The proposed analytical model is aimed at quantitatively assessing the synergy between the level of development of Health Capital, the volume of investment in the healthcare system, and the state of the functioning of the labour market. The results of the study show that life expectancy and healthcare expenditure per capita have a statistically significant positive impact on the employment rate, while the share of healthcare spending in GDP demonstrates a statistically significant negative relationship. This result reflects the impact of macroeconomic constraints and the adaptive response of the health financing system in periods of instability, rather than a negative effect of health investments themselves. Among the determinants studied, per capita health spending has the strongest positive impact on employment rates.

DISCUSSION

The results of the study confirm the hypothesis put forward regarding the impact of the mechanisms of the Health Capital concept at the national level on reducing macroeconomic risks, in particular, population ageing, through improving the quality of human capital, strengthening the labour supply and enhancing labour market resilience. In particular, this approach is consistent with the conceptual conclusions of Grossman's research (1972), where Health Capital is defined as an investment resource that positively affects labour productivity and, accordingly, economic activity.

The empirical results obtained are relevant to the scientific conclusions of Vu (2023). The scientist emphasizes that increasing life expectancy is a driver of human capital accumulation. In this statement, Health Capital plays an important

role as the basis for ensuring a high life expectancy rate. Similar conclusions are presented in Mason's et al.'s research (2016), which indicates that demographic changes directly affect the labour market through employment indicators.

Similar scientific conclusions are drawn by the studies of Guo et al. (2025) and Onofrei et al. (2021). The aforementioned studies indicate that public spending on healthcare determines the level of economic resilience of the country. In continuation, it is worth noting that the scientific approach of Howitt (2005) determines that Health Capital is a factor of economic growth, which directly correlates with the results of the study. The scientific conclusions of Eze (2023) and Adenike and Sherifdeen (2017) substantiate the positive impact of investments in human capital on economic growth. The empirical studies in the conducted study confirmed the corresponding definition.

The results obtained expand the existing scientific approaches. In particular, in continuation of the studies of Aisa and Pueyo (2013) and Ludwig et al. (2012), the obtained empirical studies strengthen the justification for the impact of the demographic consequences of population ageing on macroeconomic indicators. Accordingly, the obtained results determine a quantitative assessment of the role of Health Capital in the development of the labour market. This approach is aimed at defining Health Capital as a socio-economic category aimed at regulating the level of employment under conditions of demographic transformation.

Unlike studies that consider separately defined aspects of investment support for the healthcare system and demographic changes (Fisher et al., 2021; Davies & Schramme, 2025), the obtained results systematize the synergy between the relevant categories. This approach allows for an assessment of the impact of Health Capital on demographic and financial indicators of the labour market. The developed analytical model has a predictive function aimed at the development of the healthcare system.

The results obtained are also consistent with the research of Saunders (1995), which substantiates that the volume and efficiency of financing the healthcare system significantly affect the quality of medical care, labour productivity, and socio-economic development in general. It is worth paying attention to the research of Pomeroy et al. (2020) and Shelemina (2023), which indicate that the development of human capital has a positive impact on the stability of the national economic system. Similar conclusions are indicated in the research of Wang et al. (2024). In particular, the author determined that socio-economic efficiency depends on the ability to form a qualitative level of human productivity through financial mechanisms. In this context, the developed model should be considered as an instrument for labour market development and a mechanism for strengthening national economic resilience.

It is worth noting that, unlike the analyzed studies, the obtained conclusions substantiate an integrated econometric model aimed at assessing the impact of Health Capital indicators and demographic indicators on the functioning of the labour market. This approach expands the existing interpretations of Health Capital through the prism of an effective mechanism of influence on the main macroeconomic indicators.

In general, the obtained results confirm the hypothesis put forward regarding the impact of the mechanisms of the Health Capital concept on reducing macroeconomic risks, in particular, population ageing, through improving the quality of human capital, increasing the labour supply and enhancing labour market resilience. It is substantiated that attracting investments in the development of Health Capital is an important economic tool that increases the stability of the labour market and strengthens national economic sustainability.

The limitation of the study to the period 2002-2021 is due to the availability of all methodologically consistent data for regression analysis. Analytical indicators after 2021 are limited, which is due to the beginning of a full-scale invasion and structural changes in the country's demographic and socio-economic processes. Thus, the results obtained primarily determine the synergistic relationship between Health Capital and labor market indicators in the pre-war period. Conducting a harmonized analysis of data after 2021 and assessing the impact of martial law on demographic and social indicators is an important direction for future research.

CONCLUSIONS

Thus, based on the conducted research, the role of the concept of Health Capital in the system of demographic ageing and the functioning of the labour market was determined. The results of the study substantiated that Health Capital is a structural component of human capital, which forms labour productivity indicators and labour market stability in conditions of socio-economic volatility.

The obtained results of the relationship between demographic indicators, Health Capital indicators, and the state of the labour market indicate that the health of the population shapes the dynamics of employment. Accordingly, an increase in

life expectancy and the accumulation of Health Capital contribute to the development of labour supply and increasing labour productivity. The development of Health Capital reduces the negative consequences of the reduction of the working-age population. In this context, demographic ageing is a process that requires strengthening human capital by attracting investments related to healthcare.

The developed econometric model enabled a quantitative assessment of the impact of Health Capital components on labour market functioning. The obtained results confirmed the statistically significant relationship between Health Capital indicators and the employment rate. In particular, healthcare expenditure per capita demonstrated the strongest positive effect on employment, confirming the importance of financial investment in healthcare as a mechanism for improving workforce quality and preserving labour potential. At the same time, the negative relationship between healthcare expenditure as a share of GDP and employment reflects the influence of external shocks and macroeconomic instability rather than the negative effect of healthcare investment itself. These findings support the hypothesis that strengthening Health Capital formation mechanisms contributes to reducing the economic risks associated with demographic ageing and enhancing labour market resilience.

The study substantiated practical directions for the development of the Health Capital concept as an instrument for ensuring economic and demographic resilience under conditions of martial law and post-war recovery. In the Ukrainian context, the preservation and restoration of labour potential require the transition toward a comprehensive healthcare model focused on prevention, rehabilitation, and reintegration of vulnerable population groups into economic activity. The developed analytical framework can be used to justify the scale of healthcare financing required to compensate for demographic losses, maintain labour supply, and support workforce recovery during the post-war period.

The findings confirm that Health Capital should be considered not merely as an element of social expenditure but as a long-term productive investment in human capital and economic resilience. Further research should focus on expanding the empirical database through longer time series, incorporating additional indicators of human capital quality, and applying advanced econometric approaches, including dynamic models, panel data techniques, and nonlinear methods. Promising research directions also include assessing the impact of healthcare digitalization and innovative medical technologies on the formation and accumulation of Health Capital.

ADDITIONAL INFORMATION

AUTHOR CONTRIBUTIONS

All authors have contributed equally.

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CONFLICT OF INTEREST

The Authors declare that there is no conflict of interest.

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КАПІТАЛ ЗДОРОВ'Я ТА ДЕМОГРАФІЧНЕ СТАРІННЯ: ЕКОНОМІЧНІ НАСЛІДКИ ДЛЯ РИНКУ ПРАЦІ

Демографічне старіння населення стало одним із ключових викликів сучасності, що впливає на функціонування ринку праці та довгострокову економічну стійкість. У цьому контексті метою дослідження є обґрунтування сутності концепції Капіталу здоров'я в умовах старіння населення та оцінка її економічного впливу на розвиток ринку праці. Гіпотеза дослідження полягає в тому, що розвиток механізмів концепції Капіталу здоров'я на національному рівні впливає на зниження макроекономічних ризиків, зокрема старіння населення через підвищення якості людського капіталу, посилення пропозиції робочої сили та підвищення стійкості ринку праці.

Для перевірки висунутої гіпотези використано методи економіко-статистичного аналізу та множинного лінійного регресійного моделювання. Отримані емпіричні результати підтверджують наявність статистично значущого взаємозв'язку між показниками капіталу здоров'я та результатами функціонування ринку праці. Розроблена економетрична модель характеризується високою пояснювальною здатністю та пояснює 73,9% варіації рівня зайнятості населення. Результати дослідження свідчать, що тривалість життя та витрати на охорону здоров'я на душу населення мають статистично значущий позитивний вплив на рівень зайнятості, водночас частка витрат на охорону здоров'я у ВВП демонструє статистично значущий негативний зв'язок. Такий результат відображає вплив макроекономічних обмежень та адаптивну реакцію системи фінансування охорони здоров'я в періоди нестабільності, а не негативний ефект самих інвестицій у галузь охорони здоров'я. Серед досліджуваних детермінант саме витрати на охорону здоров'я на душу населення мають найсильніший позитивний вплив на показники зайнятості.

Результати дослідження підтверджують, що капітал здоров'я є стратегічною складовою людського капіталу та важливим чинником стійкості ринку праці й сталого соціально-економічного розвитку. В умовах воєнного стану та післявоєнного відновлення посилення інвестицій у систему охорони здоров'я, розвиток реабілітаційних послуг і профілактичної медицини, а також удосконалення фінансових механізмів підтримки здоров'я населення можуть сприяти збереженню трудового потенціалу, підтримці економічної активності, пом'якшенню наслідків демографічного старіння та зміцненню довгострокової економічної стійкості України.

Ключові слова: капітал здоров'я, демографічне старіння, ринок праці, зайнятість, людський капітал, охорона здоров'я, економічна стійкість

JEL Класифікація: I15, J11, J21, O15