

Article

Health Expenditures, Human Capital, and Sustainable Development: Panel Evidence from the New EU Member Countries

Canan Şentürk ¹, Gamze Sart ^{2,*}, Mahmut Ünsal Şaşmaz ³  and Yılmaz Bayar ⁴ ¹ Department of Economics, Suleyman Demirel University, Isparta 32260, Türkiye² Department of Educational Sciences, Hasan Ali Yücel Faculty of Education, İstanbul University-Cerrahpaşa, İstanbul 34500, Türkiye³ Department of Public Finance, Usak University, Usak 64000, Türkiye⁴ Department of Public Finance, Bandırma Onyedi Eylül University, Balıkesir 10200, Türkiye

* Correspondence: gamze.sart@iuc.edu.tr

Abstract: Both health and human capital are simultaneously resources and indicators of sustainable development. Therefore, this research article studies the causal interaction among total health expenditures, out-of-pocket expenditures, human capital, and sustainable development in eleven EU member countries during 2000–2020 through the panel causality test. The result of the causality test indicates that indicators of health expenditures, human capital, and sustainable development are closely interrelated, but the causal interaction among indicators of health expenditures, human capital, and sustainable development differs among the new EU members. On the one hand, health expenditures and human capital are significant factors underlying sustainable development. On the other hand, sustainable development is a significant determinant of health expenditures and human capital. Considering the significant role of human capital for sustainable development, education and training programs should especially be revised in a way to improve the sustainability and healthy life awareness and qualifications of the individuals. Furthermore, the digital transformation of health systems from both supply and demand sides should be supported by public health policies.

Keywords: health expenditures; human capital; sustainable development; new EU member countries; panel causality analysis



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1. Introduction

The global gross domestic product, population, and urbanization have remarkably increased since the start of the Industrial Revolution. However, disastrous environmental problems, economic and social inequalities, and poverty on a global scale came along with significant economic expansion. The United Nations (UN) took the initiative to combat global economic, social, and environmental problems, and the term of sustainable development was first introduced in the Brundtland Report to overcome these economic, environmental, and social problems [1]. In this context, the first Millennium Development Goals (MDGs) in 2000 were accepted by the UN members, and then the MDGs were transformed to the Sustainable Development Goals (SDGs) in 2015 to achieve peace and prosperity for our world [2].

Sustainable development is a broad concept that encompasses environmental, economic, and sociodemographic elements. The most common definition of the concept is “meeting the needs of the current population in a way that does not prevent meeting the needs of future generations” [1]. Therefore, improving the quality of human life without harming the environment is very important in terms of health services and systems, and the term also includes future generations and long-term health [3]. Recently, it has been more clearly accepted that the relations between social, economic, health, and environmental

factors are mutual and affect each other in achieving SDGs [3]. The internal balance of each element must be sustainable and the relations between these main components must be balanced [4].

An extensive number of empirical studies have been conducted on factors behind sustainable development and many social, economic, and institutional factors, such as education, higher education, entrepreneurship, economic freedom, ICT (information and communication technologies) penetration, technological innovation, energy (renewable and non-renewable), urbanization, and gender equality/women employment. Considering the heterogeneity between sustainable development levels, these factors emerge as determinants of sustainable development [5–17]. In this study, the interaction among human capital, health expenditures, and sustainable development is studied considering the gap in the related empirical literature.

Health is also an important factor that activates and concerns other aspects of economic development. For example, healthy individuals are more economically productive, accelerating the overall economic development of a country [18,19]. In this regard, health expenditures are important for the achievement of SDG-3 (good health and well-being) and other multiple SDGs (for example, ending hunger and poverty; decent work and economic growth; industry, innovation, and infrastructure; sustainable cities and communities). However, sustainable development is expected to influence the health expenditures through better environmental, economic, and social sustainability. Furthermore, the negative effects of environmental impairment on human health can also negatively affect productivity, industrial production, and ultimately national output [20,21]. In conclusion, a mutual interplay between health expenditures and sustainable development seems possible on theoretical terms.

On the other hand, human capital is a vital component of economic, environmental, and social sustainability, because human capital is the main actor in all economic and social processes including production, consumption, technological progress, innovation, climate change, and income distribution [21–24]. Therefore, a significant influence of human capital on sustainable development is theoretically expected. On the other hand, improvements in sustainable development are also expected to remarkably impact human capital [25]. As a consequence, a mutual interplay between human capital and sustainable development seems possible on theoretical terms.

This study aims to investigate the interaction of human capital, health expenditures, and sustainable development in the new European Union (EU) members within the framework of causality. The new EU members have shown significant progress in the SDGs and human capital in recent years [26,27]. The EU membership process also has a significant role in the progress in sustainable development, because sustainable development is one of the main objectives of the EU policies and the articles of the Treaty of Amsterdam [28]. Furthermore, the new EU member countries, especially Romania, Estonia, Lithuania, and Latvia, have experienced significant increases in general and per-capita health expenditure levels [29]. The interaction among human capital, health expenditures, and sustainable development in the countries in deference to the noteworthy improvements in sustainable development, human capital, and health expenditures has been studied.

In this respect, it is expected that this research article will contribute to the relevant empirical literature in three aspects. First, there is very limited empirical literature on the link between health spending, human capital, and sustainable development as uncovered by the literature review section. Therefore, it is thought that this article will be one of the first studies to analyze the interaction between these variables in the new EU members. Furthermore, the use of the overall sustainable development index enables the net relationship among health expenditures and human capital sustainable development to be observed because the empirical studies have generally centered on the nexus between one dimension of sustainable development such as environmental sustainability, sustainable growth or social development, and health expenditures and human capital. Therefore, the second novelty of this research is to choose a more inclusive indicator of sustainable development.

Lastly, another important potential contribution can be noted in that this study is based on a multi-country analysis at a disaggregated (by country) level. In this way, causality tests with cross-sectional dependence and heterogeneity are used simultaneously to increase the robustness of the empirical results.

In this context, data from new EU member countries are used in this study and the following research questions are posed.

Do health expenditures have an impact on achieving sustainable development goals?

Is human capital development effective in achieving sustainable development goals?

How does sustainable development affect human capital development and health expenditures?

In this context, the subsequent stages of this study are organized as follows: Section 2 comprises the earlier studies and presents an extensive literature survey on health expenditure, human capital, and sustainable development. Section 3 includes data, econometric models, and tests. In Section 4, research findings are presented and this study concludes with the discussion and conclusion part.

2. Theoretical and Empirical Literature

2.1. Theoretical Literature

Both health expenditures and human capital are theoretically anticipated to influence sustainable development. In this context, two important points come to the fore in health programs designed for sustainable development. The first of these is that the improvements in health have a direct effect on welfare, and the other is that the improvements in health will have an indirect effect by reflecting on the welfare through the increase in production [30]. With this dimension, it is increasingly considered as a central component of sustainable development. It is not only an indicator of the success or failure of the development process, but also a fundamental social policy argument for sustainable development [31]. Increasing health expenditures is a way to stimulate growth for developed and developing countries [21,32]. In other words, health expenditures contribute to economic growth and development [33–40]. According to this view, increasing the funds allocated to health from both domestic and international sources will bring about economic development [41]. On the other hand, the opposite view can also be true, namely, that economic growth increases health expenditures. Economic growth brings with it an increase in the demand for services that will enable individuals to lead a more comfortable life. Guaranteeing minimum needs by the state or other institutions increases people's demands for goods and services other than basic needs [42]. One of the reasons for the increase in health expenditures with increasing income is the increase in the tendency toward private health services apart from public health services. With the increase in living standards, individuals seek higher-quality services.

Human capital is one of the main determinants of sustainability in terms of resource productivity [43]. Therefore, the focus of sustainable development lies not only in economic growth itself, but also in the qualitative improvement in human well-being and in unlocking human potential [44]. According to Lucas's [45] construction of a simple neoclassical growth model that expands the endogenous growth model that includes both human and physical capital to include environmental pollution, there will be a sufficiently strong positive external impact from human capital with constant returns to scale [46]. With the expanded version of Uzawa [47] and Lucas [45] (with an adaptation of the endogenous growth model that contains environmental degradation and preventatives), economic growth is considered to be sustainable in the long run. Emphasizing that it is consistent with the environmental Kuznets curve, it can be said that in the long run, it is optimal for human capital to increase more rapidly than physical capital, output, and consumption while pollution reduces. Therefore, it can be thought that human capital does not cause environmental degradation, and the substitution of physical capital with human capital in production is important for pollution control. In this way, a simple pollution reduction mechanism can be activated [48]. In summary, by evaluating both the economic and

environmental aspects of sustainable development, it is concluded that human capital is the main factor of economic growth, and environmental degradation is a by-product of the produced capital used in production [48–52].

2.2. Empirical Literature

In the empirical literature, there have been no studies analyzing the nexus between health expenditures and overall sustainable development. The studies have usually investigated the relationship between health expenditures and economic growth and development [33,35–38,40,53]. Therefore, this will be one of the first articles studying the linkage between health expenditures and overall sustainable development.

Odior [33] examines the direct/indirect effects of public policies on health and economic growth performance in Nigeria, concluding that investment in health expenditures and health services is important for stable economic growth. According to Naidu and Chand [35], empirical findings on public health expenditures and the impact of advances in medical technology on economic growth rates in Pacific Island countries prove that public expenditure on healthcare plays a key role in economic growth. Based on the idea that “a nation with healthy people will be considered a rich nation”, Oni [36] argues that gross capital formation, total health expenditures, and labor productivity are critical determinants of economic growth. Raghupathi and Raghupathi [40] argue that public health expenditures in the USA will strengthen human capital as health expenditures will create more health opportunities, and this will contribute to economic growth by increasing productivity.

Some researchers have investigated the nexus between health expenditures and the environment, and many of the available studies (Narayan and Narayan [54]; Yahaya et al. [55]; Yazdi and Khanalizadeh [56]; Alimi et al. [57]; Qudrat-Ullah and Nevo [58]) argue that environmental degradation generally causes growth in healthcare spendings.

Yahaya et al. [55] point to environmental quality as a strong determinant of health expenditures, especially in developing countries. CO₂ emission has a long-term impact on health expenditures. With the expansion of economic activities in developing countries, environmental degradation is increasing and this puts more pressure on the health budget. Alimi et al. [57], in their study examining the nexus between CO₂ emissions and health expenditures, argue that the increase in environmental degradation raises health expenditures. While the results are significant for the public, they are statistically insignificant for private health expenditures. Similar to these results, Khan et al. [59] conclude that the public health expenditures of countries increase because of the growing environmental degradation. According to Ibukun and Osinubi [60], the increase in health expenditures caused by the deterioration of environmental quality is caused by low air and water quality. And for inclusive and sustainable economic growth and development, policies that aim to reduce environmental degradation need to be supported.

According to Zaman and Moemen [61], the direction of the relationship is changing and there is an increase in environmental degradation as a result of the increase in health expenditures. Contrary to these studies, Yang [62] states that the increase in public expenditures for health and technological progress reduces carbon emissions. Zhong et al. [63] is a more comprehensive study that deals with sustainable development with an index obtained from the variables of life expectancy at birth, employment, labor force participation, education, energy intensity, FDI, and GDP. It is stated that sustainable development has a statistically significant negative effect on health expenditures. Pervaiz et al. [64] evaluate the impact of health expenditures and human development index on carbon emissions for sustainable development. According to the study covering Brazil, India, South Africa, and China, there is a long-term relationship with health expenditures and HDI. In addition, it is concluded that health expenditures increase CO₂, while HDI decreases it.

Some researchers have also concentrated on the linkage between health expenditures and social development, which is represented by human development and its sub-components. At this point, studies that take into account the relationship between the infant mortality rates/life expectancy of birth and health expenditures come to the fore. Nixon

and Ulmann [65] argue that rises in health expenditures are importantly related to infant mortality rate. Gupta et al. [66] conclude that health expenditures reduce child mortality rates in 50 developing countries. According to Owusu et al. [67], the increase in health expenditures in low- and middle-income countries reduces maternal and infant mortality. McGuire et al. [68], in their study investigating the nexus between health expenditures and national income in the United Kingdom, argue that there is only an important relationship between the potential loss of life and health expenditures. According to the study of Kiross et al. [69], which includes sub-Saharan African countries, health expenditures are an important component in reducing infant and newborn deaths. In addition, there are studies claiming that the effect of health expenditures on infant mortality is either small or statistically insignificant [70,71].

The mortality rate in countries is due to poverty and inadequate environmental conditions, and therefore, the average life expectancy increases as the income level of the countries increases. As economic growth increases, the share of many sectors such as education and health from the budget also increases and health expenditures increase, leading to the progress of health facilities and services. It is expected to be reflected in the economic development of the country [72,73].

Ekperiware et al. [74] focus on the key role of changes in human capital in terms of the three scopes of sustainable development (economic, social, and environmental). According to the analysis based on 1981–2014 data, environmental degradation negatively affects human capital, but increases in human capital reduce environmental degradation and increase economic growth. Therefore, the increase in human capital leads to economic growth and development by reducing environmental degradation. Oloookere et al. [75] argue that all components of human capital development play an important role in poverty reduction. The impact of human capital development on the path to sustainable development is emphasized and investments in education and health are considered to be a driving force for improving the quality of human resources. Khan [76] claims that the increase in human capital is necessary to assure the sustainability of economic development and decrease environmental degradation.

According to Sinha and Sen [77], a relationship is determined between carbon emissions and human development, and carbon emissions cause an increase in air pollution, negatively affecting hygienic conditions and labor productivity for the workforce. According to Lan et al. [52], Gorham et al. [78], and Lan and Munro [79], the increase in human capital raises awareness about environmental regulations and makes it easier to comply with regulations in society. Thus, human capital leads to a decrease in environmental degradation and an improvement in environmental quality. According to the results of the study by Asongu and Odhiambo [80] on 44 SSA countries for the period of 2000–2012, increases in CO₂ emissions have a negative effect on human capital development. This proves that emissions are potentially considerably harmful to human development.

Based on the associated literature research, the first hypothesis of this article is as follows:

Hypothesis 1. *There is a significant causal interaction between health expenditures and overall sustainable development.*

The empirical literature on effects of human capital has usually concentrated on the relationship between human capital and economic growth and development [81–86]. However, relatively few researchers have conducted studies on the nexus between human capital and life expectancy, education, and health [40,64,87–90]. Therefore, this paper studies the causal relationship between human capital and sustainable development unlike the extensive empirical studies on economic and social effects of human capital.

The emphasis on the role of human capital in economic growth and development in the theoretical framework leads to efforts to prove it with empirical findings in the literature [81–86]. According to Oladeji and Adebayo [81], human capital development has critical importance in the growth process. In addition, it is interpreted not only as a

tool, but also as a goal to be achieved for economic progress and is seen as an argument worth developing. Anyanwu et al. [85], in their analysis for Nigeria for the 1981–2010 periods, noted that although human capital development indicators had a positive effect on economic growth, they were statistically insignificant. Omar [86] examines the relationship between economic development and human development in the prominent Arab countries (Egypt, Jordan, and Bahrain, Kingdom of Saudi Arabia, and Bahrain) and reaches causality findings between variables, concluding that economic development has an impact on human capital.

Moreover, the studies examining the relationship between human capital and life expectancy, education, and health also find a place in the empirical literature [40,64,87–90]. For example, according to Raghupathi and Raghupathi [40], as higher education attainment increases, an improvement in health and life expectancy is expected. Similarly, Zhang and Zhang [87] support human capital by finding a positive link from health to education. Mirowsky and Ross [88] argue that education creates improvements in health in people and, as a result, enables them to develop skills and characteristics that contribute to human capital, such as cognitive development and problem-solving skills, learned effectiveness and personal control, etc. On the contrary, Acemoglu and Johnson [89] argue that there is no relationship between increases in human capital investments and improvements in life expectancy. Similarly, Lorentzen et al. [90] also reach conclusions that deaths and/or life expectancy have no effect on human capital.

Based on the associated literature research, the second hypothesis of this article is as follows:

Hypothesis 2. *There is a significant causal interaction between human capital and overall sustainable development.*

3. Data and Method

This research article studies the causal relationship among health expenditures, out-of-pocket expenditures, human capital, and sustainable development in eleven EU members during 2000–2020 through a panel causality test. In the empirical analyses, sustainable development (SUSTAINDEV) is represented by sustainable development index (SDI) calculated by Sachs et al. [26] for all countries as of 2000 taking notice of the 17 SDGs of the UN. Furthermore, Sachs et al. [26] also calculate the score of each SDG from 17 SDGs separately. The SDI scores 1 out of 100, indicating overall progress in the achievement of all SDGs. For example, a score of 70 means a country has achieved 70% of the 17 SDGs. On the other hand, health expenditures are represented by current health expenditure (% of GDP) (HEALTH) and out-of-pocket expenditures (% of current health expenditures) (POCKET) based on the World Health Organization Global Health Expenditure database, and both variables are elicited from World Bank [91,92].

Finally, human capital (HCAPITAL) is proxied by the human capital index of UNCTADSTAT [27], which includes the education, skills, and health conditions of a country's population, and the number of researchers and expenditures on research activities. The study contains the 2000–2020 periods, because SDI is present as of 2000 and the health variables are present up to 2020.

The econometric tests are performed through EViews 12.0 and Stata 17.0. The new EU members consist of Bulgaria, Croatia, Czechia, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, Slovakia, and Slovenia. The summary statistics of the SUSTAINDEV, HEALTH, POCKET, and HCAPITAL are reported in Table 1. The average value of SUSTAINDEV is 75.024, the mean of health variables (HEALTH and POCKET) is 6.609% of GDP and 190.456% of current health expenditures, and the average value of human capital index is 56.892. However, the variables of POCKET and HCAPITAL denote a remarkable variation during 2000–2020, but the variables of SUSTAINDEV and HEALTH indicate a moderate variation during 2000–2020.

Table 1. Summary statistics of the series.

Characteristics	N	Obs.	SUSTAINDEVHEALTH	POCKET	HCAPITAL
Mean	11	231	75.024	6.609	190.456
Maximum	11	231	80.628	9.454	442.096
Minimum	11	231	66.786	4.209	13.573
Std.Dev.	11	231	3.032	1.000	97.9463

The interrelation among health indicators, human capital, and sustainable development has led us to make a two-way analysis. Therefore, the relationship among health indicators, human capital, and sustainable development is investigated by Kónya [93] via a causality test, taking notice of heterogeneity and cross-sectional dependence.

The causal relationship among indicators of health expenditures, human capital, and sustainable development is analyzed by Kónya [93] via a causality test, an improved version of Granger's causality test, which conducts causality analysis at the country level. This test takes into account both cross-sectional dependence and heterogeneity. The Kónya bootstrap causality test rests upon the seemingly unrelated regression of Zellner [94], producing more robust results than those of ordinary least squares' estimators and generating bootstrap critical values for each cross-section. The heterogeneity of slope coefficients in the panel cointegration model is a critical pillar of this test. Thus, it is possible to test the Granger causality relationship separately for each horizontal section in the panel. Lastly, the bootstrap causality test does not require that the variables under consideration should be stationary or co-integrated. The causality test is based on the Equation sets of (1) and (2) [93]:

$$\begin{aligned}
 y_{i,t} &= \alpha_{1,1} + \sum_{i=1}^{ly_1} \beta_{1,1,i} y_{1,t-i} + \sum_{i=1}^{lx_1} \gamma_{1,1,i} x_{1,t-i} + \varepsilon_{1,1,t} \\
 y_{2,t} &= \alpha_{1,2} + \sum_{i=1}^{ly_1} \beta_{1,2,i} y_{2,t-i} + \sum_{i=1}^{lx_1} \gamma_{1,2,i} x_{2,t-i} + \varepsilon_{1,2,t} \\
 &\vdots \\
 y_{N,t} &= \alpha_{1,N} + \sum_{i=1}^{ly_1} \beta_{1,N,i} y_{N,t-i} + \sum_{i=1}^{lx_1} \gamma_{1,N,i} x_{N,t-i} + \varepsilon_{1,N,t}
 \end{aligned} \tag{1}$$

and

$$\begin{aligned}
 x_{1,t} &= \alpha_{2,1} + \sum_{i=1}^{ly_2} \beta_{2,1,i} y_{1,t-i} + \sum_{i=1}^{lx_2} \gamma_{2,1,i} x_{1,t-i} + \varepsilon_{2,1,t} \\
 x_{2,t} &= \alpha_{2,2} + \sum_{i=1}^{ly_2} \beta_{2,2,i} y_{2,t-i} + \sum_{i=1}^{lx_2} \gamma_{2,2,i} x_{2,t-i} + \varepsilon_{2,2,t} \\
 &\vdots \\
 x_{N,t} &= \alpha_{2,N} + \sum_{i=1}^{ly_2} \beta_{2,N,i} y_{N,t-i} + \sum_{i=1}^{lx_2} \gamma_{2,N,i} x_{N,t-i} + \varepsilon_{2,N,t}
 \end{aligned} \tag{2}$$

where y is sustainable development and x are health expenditures, out-of-pocket expenditures, and human capital index. l is the optimal length, identified by information criteria such as Akaike and Schwarz. A one-way causal relationship from x to y is uncovered if not all the $\gamma_{1,j,i}$ s are zero, but all $\beta_{2,j,i}$ s are zero. However, a one-way causal relationship from y to x is uncovered if all $\gamma_{1,j,i}$ s are zero, but not all $\beta_{2,j,i}$ s are zero. Lastly, a two-way causal relationship between two series is unveiled if neither $\gamma_{1,j,i}$ s nor $\beta_{2,j,i}$ s are zero.

4. Results

In the results section, tests of cross-sectional dependence (CD) and heterogeneity are applied as the first stage. The cross-sectional dependency is tested via LM, LM CD, and LM_{adj.} tests [95–97] and their results are indicated in Table 2. The probability values of the CD tests are lower than 5% and, hence, the null hypothesis proposing cross-sectional independence is rejected. Consequentially, the subsistence of cross-sectional dependence among health indicators, sustainable development, and human capital is concluded. Secondly, the subsistence of homogeneity is tested using delta tilde and adjusted delta tilde tests [98],

and their results are denoted in Table 2. In the same vein, probability values of both tests are lower than 1% and, hence, H_0 (presence of homogeneity) is rejected. Consequentially, the availability of heterogeneity is discovered. Therefore, panel estimates should consider the country-specific heterogeneity.

Table 2. Cross-sectional dependence and heterogeneity test results.

Cross-Sectional Dependency Test	Test Statistic	p Value
LM	181.7	0.0000
LM CD	4.651	0.0000
LM _{adj.}	25.26	0.0000
Heterogeneity Test	Test Statistic	p Value
$\tilde{\Delta}$	11.031	0.000
$\tilde{\Delta}_{adj.}$	12.638	0.000

In the causality test, the causal relationship between health expenditures (HEALTH) and sustainable development (SUSTAINDEV) is analyzed using the bootstrap Granger causality approach pursuant to the availability of cross-sectional dependence and heterogeneity, and the test results are introduced in Table 3. The results of the causality test indicate a significant causal relationship from HEALTH and SUSTAINDEV in Croatia, Czechia, Latvia, Romania, and Slovenia, and a causal relationship from SUSTAINDEV to HEALTH in Estonia, Hungary, Lithuania, Poland, and Slovakia.

Table 3. Bootstrap Granger causality test between HEALTH and SUSTAINDEV.

Countries	HEALTH $\rightarrow$ SUSTAINDEV				SUSTAINDEV $\rightarrow$ HEALTH			
	Wald. Stat.	Bootstrap Critical Values			Wald. Stat.	Bootstrap Critical Values		
		1%	5%	10%		1%	5%	10%
Bulgaria	0.674	38.02	17.69	11.85	0.773	32.63	17.21	11.72
Croatia	22.83 **	29.93	15.62	10.58	0.159	30.58	16.57	11.63
Czechia	13.04 *	41.51	20.17	12.77	12.89	41.83	21.58	15.01
Estonia	0.530	43.78	21.85	14.72	33.03 **	48.80	26.66	18.04
Hungary	0.134	40.06	17.79	11.75	23.03 **	28.43	15.99	10.57
Latvia	23.72 **	44.67	22.15	15.22	0.961	57.30	33.07	23.87
Lithuania	0.178	33.73	16.86	11.38	11.71 *	33.69	16.65	11.15
Poland	0.879	46.51	22.27	14.77	42.26 ***	25.94	13.84	9.444
Romania	14.43 *	36.62	18.44	11.96	0.140	22.75	11.87	8.063
Slovakia	1.571	36.39	18.24	12.07	27.77 **	38.46	20.88	14.15
Slovenia	24.20 **	41.08	19.95	12.91	0.122	47.10	25.85	17.76

Note: Optimal lag length is chosen considering the Schwarz information criterion and bootstrap probability values are obtained from 10,000 replications. ***, ** and * are respectively significant at 1%, 5% and 10%

The causal relationship between out-of-pocket expenditures (POCKET) and sustainable development (SUSTAINDEV) is analyzed using the bootstrap Granger causality approach pursuant to the availability of cross-sectional dependence and heterogeneity, and the test results are introduced in Table 4. The results of the causality test indicate a significant bidirectional causal relationship between POCKET and SUSTAINDEV in Latvia and Lithuania; a unidirectional causal relationship from POCKET to SUSTAINDEV in Bulgaria, Estonia, Poland, and Slovenia; and a causal relationship from SUSTAINDEV to POCKET in Croatia and Romania.

Table 4. Bootstrap Granger causality test between POCKET and SUSTAINDEV.

Countries	POCKET $\rightarrow$ SUSTAINDEV				SUSTAINDEV $\rightarrow$ POCKET			
	Wald. Stat.	Bootstrap Critical Values			Wald. Stat.	Bootstrap Critical Values		
		1%	5%	10%		1%	5%	10%
Bulgaria	29.48 **	44.65	21.52	14.14	0.398	56.70	31.93	22.49
Croatia	0.712	27.18	14.60	9.308	32.36 **	33.32	17.73	12.20
Czechia	0.469	26.80	13.09	8.783	0.294	57.24	33.23	23.45
Estonia	25.55 **	40.12	20.44	13.51	2.551	65.40	37.18	26.98
Hungary	0.106	31.69	15.52	10.28	0.721	32.28	18.35	13.00
Latvia	26.79 **	50.75	24.22	15.76	26.44 **	43.27	23.33	16.39
Lithuania	11.87 *	35.59	17.75	11.44	35.29 *	68.93	41.98	31.18
Poland	16.69 **	28.85	14.61	9.736	1.243	43.13	22.69	15.82
Romania	0.930	35.03	17.98	12.00	37.72 *	77.63	46.16	33.55
Slovakia	1.208	27.85	14.70	9.964	0.129	37.77	20.09	14.24
Slovenia	16.14 *	28.17	14.42	9.515	0.480	44.92	25.29	17.32

Note: Optimal lag length is chosen considering the Schwarz information criterion and bootstrap probability values are obtained from 10,000 replications. ** and * are respectively significant at 5% and 10%.

The causal relationship between human capital (HCAPITAL) and sustainable development (SUSTAINDEV) is analyzed using the bootstrap Granger causality approach pursuant to the availability of cross-sectional dependence and heterogeneity, and test results are introduced in Table 5. The results of the causality test indicate a significant bidirectional causal relationship between HCAPITAL and SUSTAINDEV in Bulgaria; a unidirectional causal relationship from HCAPITAL to SUSTAINDEV in Czechia, Lithuania, Romani, and Slovenia; and a causal relationship from SUSTAINDEV to HCAPITAL in Croatia, Hungary, Latvia, and Poland.

Table 5. Bootstrap Granger causality test between HCAPITAL and SUSTAINDEV.

Countries	HCAPITAL $\rightarrow$ SUSTAINDEV				SUSTAINDEV $\rightarrow$ HCAPITAL			
	Wald. Stat.	Bootstrap Critical Values			Wald. Stat.	Bootstrap Critical Values		
		1%	5%	10%		1%	5%	10%
Bulgaria	10.52 *	31.43	16.13	10.48	27.77 **	33.48	16.62	10.86
Croatia	0.859	38.51	19.77	13.18	35.06 **	60.97	32.33	23.30
Czechia	26.81 **	41.18	19.47	12.60	0.603	61.61	33.86	23.16
Estonia	0.567	50.18	25.06	16.36	1.404	46.83	23.68	16.50
Hungary	0.145	39.39	19.57	12.84	26.13 **	40.57	22.18	15.18
Latvia	0.367	41.23	21.81	14.60	25.66 **	38.94	21.30	14.39
Lithuania	27.76 *	42.47	21.65	13.95	0.115	44.1	22.73	14.77
Poland	2.287	29.93	15.25	10.17	32.65 **	53.48	28.08	19.63
Romania	19.79 **	26.13	13.71	9.067	1.599	38.49	18.70	12.21
Slovakia	1.454	34.33	17.62	11.57	1.090	45.88	24.43	17.03
Slovenia	22.12 **	38.18	18.56	12.04	0.386	54.86	29.35	20.52

Note: Optimal lag length is chosen considering the Schwarz information criterion and bootstrap probability values are obtained from 10,000 replications. ** and * are respectively significant at 5% and 10%.

5. Discussion

The value of each type of capital is shaped on the basis of people's mental awareness, creativity, and social innovation. This makes human capital one of the main determinants of sustainability in terms of resource efficiency. In addition, health plays an important role in determining the quality of human capital required for economic growth and, when evaluated together, supports sustainable development by contributing to social welfare. A reciprocal interaction among health expenditures, human capital, and sustainable development exists in theoretical terms, because both variables are vital to achieve economic growth, economic development, industry, R&D, innovation, technology and infrastructure, sustainable cities and communities, and the end of poverty. Furthermore, levels of health and human capital are significant indicators for the achievement of sustainable development. For these reasons, a feedback relationship among health expenditures, human capital, and sustainable development is expected a priori. However, this interaction can be changed considering specific characteristics of countries such as economic growth, economic development, human capital, and education level taking into account the relevant empirical literature.

The causality findings on the relationship between indicators of health expenditures and sustainable development uncover that both variables affect each other, but the interaction between health and sustainable development differs among the countries. Therefore, the first hypothesis of this study is confirmed. Accordingly, our results line up with theoretical expectations. Furthermore, the results are consistent with Suhrcke et al. [21], Over [30], von Schirnding [31], the WHO [32], Jacob and Abel [41], and Musgrave [42]. Although no studies have investigated the interaction between health expenditures and SDI, the related empirical studies have uncovered a nexus between health expenditures and economic growth and development. In this regard, the results of our study are consistent with the results of Odior [33], Swift [34], Naidu and Chand [35], Oni [36], Aboubacar and Xu [37], Piabuo and Tieguhong [38], Bloom et al. [39], and Raghupathi and Raghupathi [40] that claim that increasing the funds allocated to health and health expenditures from both national and international sources is a way to promote economic growth and development for developed and developing countries.

The results of the causality analysis reveal a close interrelation between human capital and sustainable development in line with the related theoretical consideration by Šlaus and Jacobs [43], Lucas [45], Stokely [46], Uzawa [47], and Gupta et al. [66]. Therefore, the second hypothesis of this study is confirmed. In terms of empirical studies, few studies have investigated the relationship between sustainable development and human development, but the findings of this study are consistent with the results by Ekperiware et al. [74], Oloookere et al. [75], Khan [76], Oladeji and Adebayo [81], Ranis et al. [82], Ranis, [83], Costantini and Monni [84], and Omar [86], which employ similar proxies.

6. Conclusions

Sustainable development has become a vital agent to overcome the global social and economic inequalities, combat environmental problems, and protect biodiversity during the past four decades. However, there has been a significant heterogeneity among the countries in terms of sustainable development. Therefore, this research article analyzes the interaction among indicators of health expenditures, human capital, and sustainable development in the new EU members through the bootstrap causality test in the face of cross-sectional dependency and heterogeneity. SDI is calculated as of 2000 and the indicators of health expenditures are present up to 2020. For this reason, the availability of these variables restricts us to perform the causality analysis for 2000–2020.

The results of the causality test unveil that health expenditures, human capital, and sustainable development are closely interrelated and are in accordance with the theoretical considerations and empirical findings to a great extent. However, countries' characteristics such as current educational attainment, infrastructure, and economic development have influence on the relationship among indicators of health expenditures, human capital, and

sustainable development. Therefore, we reveal different causality interactions for the new EU members.

Human capital is at the center of almost all SDGs. Therefore, human capital plays a key role in advancing overall sustainable development including economic and environmental sustainability and social development. On the other hand, sustainable development also creates an environment to improve human capital. In this regard, health itself is one of the SDGs and is a complementary factor with human capital in terms of sustainable development. In light of our findings and the associated literature, the sustainability and healthy life awareness and qualifications of the individuals can be improved through education and training programs to make advances in multiple SDGs. Furthermore, the acceleration of digital transformation of health systems from both supply and demand sides by public health policies can give support to sustainable development in terms of good health and wellbeing and, in turn, healthy individuals with high qualifications foster the sustainable development. In conclusion, instruments such as education and information and communication technologies (ICT) can be employed to foster sustainable development through health and human capital. Future studies can be conducted on the effect of ICT infrastructure and adoption on the nexus between health indicators and sustainable development.

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