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Impact of banking sector development and environment on population health: evidence from EU transition countries

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ABSTRACT

This study explores the short and long-run effects of banking sector development and the environment on population health in EU member transition states through second-generation panel cointegration and causality analyses. The causality analysis revealed a significant causality between banking sector development and population health, but the causality direction varied depending on the indicator of banking sector development. Also, a one-way causality from greenhouse gas emissions per capita to population health was revealed. Furthermore, the cointegration analysis revealed that banking sector development had a very weak positive influence on population health in Bulgaria, Croatia, Estonia, Romania, Slovakia, and Slovenia, but had a very weak negative influence on population health in Hungary, Latvia, Lithuania, Poland. On the other hand, greenhouse gas emissions per capita had a negative effect on population health in Bulgaria, Croatia, Lithuania, and Romania. Lastly, real GDP per capita had a very weak positive influence on population health in Czech Republic, Hungary, Latvia, Lithuania, and Slovenia. Measures against environmental degradation need to be adopted to improve population health. Since the consumption of fossil fuels is the primary source of CO2 emissions, policymakers should find proper policy tools for reducing emissions by finding the right balance between costs and benefits.

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1. Introduction

One of the major social objectives today is to improve population health, with direct payoffs in people's lives and with indirect payoffs such as economic growth

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(Acemoglu & Johnson, 2007). In the last decade, many scholars have studied the relationship between financial-sector development and economic growth (Fink et al., 2009; Petkovski & Kjosevski, 2014; Pradhan et al., 2014), income inequality and population health (Judge et al., 1998; Wagstaff & van Doorslaer, 2000; Ram, 2006; Babones, 2008; Flegg, 1982, Rogers, 1979; van Deurzen et al., 2014), health and economic growth (Brenner, 2005; Acemoglu & Johnson, 2007; Lange & Vollmer, 2017; Bloom et al., 2019) and between environmental issues and population health (Anenberg et al., 2019; Balakrishnan et al., 2019; Nelson et al., 2019).

The results of the mentioned studies are mixed, for example in what concerns the relationship between health and economic growth while Bloom et al. (2019) found health as a determinant of economic growth, the research of Acemoglu and Johnson (2007) revealed no correlation between these two variables. Babones (2008) found a significant correlation between income inequality and population health and Wagstaff and van Doorslaer (2000) explained the strong association between the two variables with the absolute-income hypothesis.

Besides multiple benefits, global economic growth is considered a major driver of global environmental changes that in turn will affect human health. As we already mentioned, different studies were conducted to assess the impact of economic growth on human health but unanimous consent wasn't reached (Lange & Vollmer, 2017). Causes are multiple: firstly increases in average income can contribute to poverty reduction and health improvement (OECD, 2003), secondly, economic growth will increase government spending on public health services (Lange & Vollmer, 2017).

Hitiris and Posnett (1992), Dhrifi et al. (2021) found unidirectional or bidirectional relations of causality running from economic growth to health, according to the level of development for analyzed countries. There is also extensive research on the opposite side of this relationship. Bloom et al. (2019) found that good health has a significantly positive effect on aggregate output at both the micro and macro levels and provided an overview of works that include health as a determinant of economic growth. On the other hand, Acemoglu and Johnson (2007) found that economic growth, as measured by per capita income, was unaffected by population health.

Financial development and particularly banking sector development can play an important role in fostering economic growth (Bayar et al., 2021). It is imposed to raise the following question: can the banking sector impact directly human health system or indirectly through economic growth? At a first glance, these two sectors don't seem to influence each other, but a closer analysis reveals that they are related. Investments in global health don't support only economic growth but are also linked to potential financial returns.

The banking sector from analyzed countries underwent significant changes after the global financial crisis. Overall, the banking sector was characterized by an increased concentration trend, adjustments in business volumes (activity reduction in some countries, expansion especially in large emerging market economies), changes in business models generated by regulatory reforms. Technology changed the way in which financial products or services are accessed, improved customer protection, and increased efficiency and traceability of customers' transactions/investments. The COVID-19 pandemic has created unprecedented health crises and severely impacted

all economies, but the European banking sector absorbed the economic shock well mainly based on regulatory reforms launched by EU countries after the financial crises and also due to the existence of the Single Supervisory Mechanism for the Eurozone banks.

The looming threat of overpopulation and associated negative effects raise many concerns and force governments and companies to rethink their policies, their business models. More people require more resources causing environmental degradation with negative consequences on human health. Effects of global warming, renewable and non-renewable exploitation for human purposes (deforestation, intensive irrigation, air, water, soil pollution, and biodiversity losses) are only a few examples of global environmental changes associated with negative health impacts. Interconnections between human health and the environment must be carefully examined (Seymour, 2016) to capture the negative effects they exert on each other and to find solutions to limit these effects.

There is an intensified interest in the last period to identify and analyze the most significant factors that impact people's health, to identify and explore the linkages and causal directions among human health and other variables.

Our study attempts to answer the following questions:

Is there any relationship between banking sector development and population health? If so, what is the causality direction between these variables?

Is there any relationship between environment and population health? If so, what is the causality direction between them?

Is there any relationship between economic growth and population health? If so, what is the causality direction between these 2 variables?

In other words, we would like to investigate the causal effect of banking sector development, economic development and environment on population health. To achieve these goals and to find the right answers we employed the Westerlund and Edgerton (2008) cointegration test with structural breaks and the causality test of Dumitrescu and Hurlin (2012).

Growth can increase income levels that can improve nutrition, can increase the level of expenditure on preventive health activities or on preventive and curative health care goods. Also, economic growth can provide governments the opportunity to raise health expenditure.

On the other side economic growth can cause serious environmental damages by increasing greenhouse gas emissions. Environmental degradation can be associated with outcomes that can have a negative influence on human health. Environmental pollution can exert a significant negative effect on our personal health, being considered a major source of health risk (Briggs, 2003).

While the relationship between economic growth, environment and population health has been investigated by researchers like Cole and Neumayer (2006), McMichael et al. (2008), Mboera et al. (2012), Jorgenson (2014), Knight and Schor (2014), Bloom et al. (2019), Wang et al. (2019), further research is needed taking into account the importance of this subject.

Furthermore, our research focuses on the causal relationship between banking sector development and human health since no studies have been conducted in this direction. A more detailed analysis indicates that the banking sector can play an important role in improving human health and well-being. Firstly, this sector can support healthcare innovation and can direct capital to activities that support health. Companies that adopt eco-friendly behavior, eco-friendly practices and technologies, that develop environmentally sustainable products can benefit from easier access to finance, lower interest rates or other benefits from banks, the largest business lending institutions, in this way this sector plays a pivotal role in financing the transition to a sustainable society. If we need healthier societies, there are more actions required beyond the health sector, governments need to take proper measures to help all other sectors that can contribute to people's health and to the development of the health care system.

Secondly, governments dispose of limited public spending capacities, the budgetary deficit and public debts are increasing, and they are forced to find private funding. The COVID-19 pandemic sounded the alarm about the fact that in many countries, the health systems are on the brink of collapse and more funds are necessary to support this sector. Countries become more frequently affected by economic, health crises, with major negative consequences especially in developing countries therefore health systems must be consolidated to develop resilience to future crises and shocks. Loans and grants offered by development banks, directed specifically to the health sector can be one of the solutions that can help this system, especially in countries where governments rank lowest in healthcare spending. Weak governmental actions in issues associated with public health (environmental conservation, sustainable development) can be compensated by financial markets, especially by the banking sector.

Thirdly, especially in the case of commercial banks, the available financial capital is predominantly generated through households' savings, therefore knowing that health is an instrument for increasing income levels, a healthy population is more productive and has more money to increase savings. In turn, banks can mobilize the necessary capital for health investments, but the stability of this sector can be significantly affected by health issues such as outbreaks of infectious diseases. Considering recent challenges such as climate change, infectious disease epidemics, etc., central banks, financial system regulators need to employ prudential toolkits to assess the extent to which commercial banks can act as a supporting factor for different sectors and businesses.

In practice, the problem is more complicated, banks are constrained by different obstacles to finance different sectors and businesses, so even in the case of the health sector, they need to focus not only on risk issues but also on how they can improve health access and outcomes.

Our paper aims to contribute to the relevant literature in two ways: firstly, it is one of the early studies that investigate the impact of banking sector development and environment on population health in the sample of EU member states; secondly, our research uses a second-generation of econometric tests which allowed us to obtain more robust and reliable findings.

In this context, the next section summarizes the relevant literature and the data and method are explained in Section 3. Then the empirical analysis is conducted, the

findings are discussed in Section 4 and the main conclusions are presented in Section 5.

2. Literature review

According to World Health Organisation (WHO) (1984), health is considered 'A state of complete physical, mental and social well-being and not merely the absence of disease or infirmity'. Health is a fundamental right of each person and ensuring healthy lives is one of the main goals of sustainable development.

Public health is a major problem worldwide and governments have a difficult mission to ensure basic access to health services to all citizens. The burden of financing health services costs is not associated only with poor countries, in recent year's developing countries and even developed countries faced major constraints in raising sufficient resources for financing this sector. To improve health outcomes it is necessary to have an interdisciplinary approach, to create a partnership between academics, government entities, voluntary organizations, and the public health sector. Identifying factors that affect the population health or health services is a major challenge for population health research and studying the connections between health and other economic sectors can help us to identify proper tools and solutions to support this sector.

2.1. Health and economic growth

There is clear evidence that human health influences economic prosperity through several mechanisms: poor health reduce productivity (Cole & Neumayer, 2006), efficient preventions programs can allow governments, health authorities to use financial treatment resources for other destinations (WHO, 2001) high-income people can invest more in human capital, including health (Thomas & Frankenberg, 2002), etc.

Bloom et al. (2019) found that good health has a significantly positive effect on aggregate output at both the micro and macro levels and provided an overview of works that include health as a determinant of economic growth. A study carried out by Raji (2020) identified a bidirectional causality between economic growth and health in the long run and a unidirectional causal relation between these two variables in the short run.

Mixed results were reported by Wang et al. (2019) that analyzed the relationship between health expenditure, CO_2 emissions, and GDP growth for 18 OECD countries. The presence of unidirectional causality from GDP to health expenditure was revealed for seven countries and a bidirectional causality for two countries. On the other hand, Acemoglu and Johnson (2007) found that economic growth, as measured by per capita income, was unaffected by population health.

The problem is more complex and discussions about economic growth and human health and its determinants have intensified in the last period with relevant arguments.

2.2. Health and banking sector

Most of the previous studies focused on the causal relationship between economic growth, health, and mortality and found a significant correlation between them. We intend to focus mainly on the causal relationship between the banking sector, environment, and human health, this sector being in generally excluded from previous studies.

We sought research papers on banking sector development, environment, life expectancy, GDP, and health. Most of the literature focuses on narrow impacts by the banking sector on energy, trade balance, tourism, and investment. These limitations were not suitable for our paper as we sought to test the relationship between the health of the population and banking sector development.

Few studies explore the impact of income inequity on general population health as measured by life expectancy. Babones (2008) conducted a study on a very broad panel of countries (134 countries) using Gini coefficients of national income inequity that were correlated with life expectancy and controlling national income per capita for the period 1970 – 1995. The findings of his cross-sectional analyses reflected a strongly significant correlation of national income inequity with population health measured by life expectancy.

In Judge at al. (1998), the results of the selected OLS regression model show that for the 16 OECD, rich, industrialized countries (using data from the 1980s) included in the study, income inequality measured through different indicators such as GDP per capita is not a significant determinant of population health, measured by life expectancy. On the other hand, van Deurzen et al. (2014) conducted a similar study in 52 low and middle-income countries between 2000 and 2011 using different measures (household wealth inequity, health outcomes such as anemia status and women's experience with child mortality) and found that an improvement in health parameters at the country level can be achieved by increasing the wealth among the poor.

The findings of Rogers (1979) and Flegg (1982) regarding negative cross-country correlation between income inequity and population health are supported by more recent data such as Ram (2006), which used a panel of 108 countries with data from late 1990 and 2000, using, among different measures, real GDP per capita and life expectancy.

Wagstaff and van Doorslaer (2000) did a review of the literature regarding the negative effects of income inequity on population health, and they found that their absolute income hypothesis is likely to support the association between different levels of income and population health, considering that individual-level studies are much more relevant than population or community studies.

Life expectancy was selected also as representative of population health in our study because that expectancy lengthens as health improves. This was developed in a paper in the British Medical Journal by Robine and Ritchie (1991) and by Parrish (2010) in the Journal of Preventing Chronic Diseases. Most related papers are primarily about health outcomes as they relate to the utilization of medical facilities or treatments. Those papers that do focus on population health tend to focus on the effect on the public's health through increasing incomes, the demand for goods, and the impact on economic growth. While there are many such papers, they include a

limited focus such as social groups (Robine & Ritchie, 1991) or limit the exploration to individuals with a healthy lifestyle (Mehta & Myrskylä, 2017) or diabetes (Manuel & Schultz, 2004). A paper in the British Medical Bulletin by Lange and Vollmer (2017) suggests that the empirical evidence of economic growth on health is mixed and inconclusive. Our study was more narrowly focused which may account for the difference in findings.

In exploring banking sector development, we sought to determine the relationship between this development, key for economic growth, and its contribution to population health through increasing economic growth and the corresponding economic opportunities for the population. Many papers arise from studies by the World Bank on this relationship but include stock market performance or fixed capital formation (Zafar et al., 2019), or limit the focus on the World Bank's impact on the health sector (Ruger, 2007) or its relationship to that sector. We sought to expand the review to economic growth and its impact on the life expectancy of the population to measure the health impact. A paper by Petkovski and Kjosevski (2014) explored the influence of the banking sector on economic growth in central and southeastern Europe. They used bank credit, interest rates and quasi money as a measure of banking sector development, and found that only quasi money had a positive impact on economic growth. While there appears to be a correlation between the development of the banking sector and economic growth (Beck et al., 2019; Fink et al., 2009; Petkovski & Kjosevski, 2014), studies that tie the sector to economic growth abound, but there are few that then further correlate this effect on population health.

More reasons motivated us to investigate this relationship: Firstly, the global health burden is increasing constantly (Bokhari & Khan, 2009 (Eastern Mediterranean Region); Akande & Akande, 2020 (Nigeria) therefore to cover healthcare costs governments need to find proper solutions to finance this sector (Kai, 2017; Pourtaleb et al., 2020). Secondly, ensure healthy lives is explicitly included in the Sustainable Development Goals (UN General Assembly, 2015) therefore to fulfill this goal, major investment at the country level is required. Since public budgets are limited, the banking sector can be part of the solution that ensures the health sector's financial viability (Krech et al., 2018). Thirdly, the banking sector makes a contribution to population health through raising economic development (Bloom & Canning, 2008; Cylus et al., 2018). Fourthly, different crises (economic, financial, environmental, social, etc) can have direct and indirect health consequences (Checchi et al., 2007). Actual global pandemic showed us how interconnected and interdependent the global economy and our societies have become (European Environment Agency, 2021) therefore a crisis can shortly spread worldwide and can affect all economic sectors and people's lives. Fiscal policy measures used to protect the real economy can have potentially negative consequences on countries' financial stability, so banks and non-bank financial institutions need to be prepared to cope with rising risks and vulnerabilities. Fifthly, all over the world health sector is an important sector of the economy that offers new investment opportunities (Franklin, 2018 (United States); Omilola & Sanogo, 2020 (Africa)) and banks can contribute to population health by financing healthcare providers and suppliers (Krech et al., 2018).

A well-functional healthcare system must involve more actors that may contribute to finance this system. Even there are voices that are against the involvement of the private sector in health care system (Omilola & Sanogo, 2020), combining funding from different sources can have real benefits on this system, helping it to face actual challenges (European Commission Directorate-General for Health & Food Safety, 2017). Governments don't have the capacity to respond to growing health needs of the people and to increasing costs of health care goods and services therefore private-sector financing is required. Investments in this sector are critical to keep people safe and financing partnerships with the private sector can be the solution to improve the efficiency of health systems.

After the fall of communism, countries from Central and Eastern Europe have gone through a transition process and experienced different economic, financial and political changes. Financial systems from our sample countries have been shaped differently due to the influence of economic, political, legal, factors (Fohlin, 2000; Caporale et al., 2015; Anton, 2019). Caporale et al. (2015) found that the financial sector from countries like Czech Republic, Hungary, Poland, Slovakia and Slovenia is more developed compared to the one from countries like Bulgaria, Romania, Estonia, Latvia and Lithuania. The traditional monobank system has been replaced and gradually new banks have been allowed to enter. Nowadays central and commercial banks are sharing their responsibilities. Even there are specific features of the bank system in each analyzed countries, there are also many common characteristics.

2.3. Environment and health

There is growing evidence that global environmental changes affect negatively human health (McMichael et al., 2008; Mboera et al., 2012). The major concern is related to the fact that human activity is mostly responsible for environmental degradation. Greenhouse gas emissions have a negative effect on population health but are often a by-product of economic growth.

We used greenhouse gas emissions per capita to measure what would be any negative side effect of any economic growth.

The relationship between economic growth and the environment is very complex. The environment provides natural resources necessary for achieving economic goals and also absorbs waste and emissions (Everett, 2010). On the other side economic growth provides resources for new technology development that will have an important contribution in managing environmental assets.

Previous researches indicate mixed results: Holtz-Eakin and Selden (1992) suggested that CO_2 emissions are not highly correlated to economic growth, Knight and Schor (2014) indicated that is a positive correlation between these variables, while others suggested that the degree of greenhouse gas emissions, vary according to the degree of initial development, showing minimal impact in the beginning but impacting by varying factors as nations develop (Jorgenson, 2014).

Jorgenson (2014) examined this relationship for 106 countries from 1970 to 2009, using multi-regional samples throughout the world, like Africa, North America,

Europe, and Oceania, and his results emphasized that future economic growth may improve human well–being but at the cost of increased carbon emissions.

Nkalu and Edeme (2019) conducted a study linking environmental hazards to life expectancy in Africa, namely, Nigeria, with data from 1960 to 2017, using the autoregressive conditional heteroscedasticity (GARCH) model. The results of the study show that environmental hazards measured by carbon dioxide emissions decrease life expectancy, while income measured by GDP extends the life expectancy.

Environmental issues cannot be ignored when talking about economic growth. Zafar et al. (2019) connected in their study two of our variables, banking sector development and carbon emissions, and conducted a study on data from G-7 and N-11 countries from 1990 to 2016 using second-generation unit roots tests. Their results pointed out the fact that banking sector development negatively affects environmental quality by increasing carbon emissions in the N-11countries and positively in the G-7 countries.

The matter of economic growth and the environment is one of the challenges of our time. Knight and Schor (2014) approach this issue with a balanced data set of 29 high-income countries over the period 1991- 2008 and found that 'economic growth has a consistent, positive and significant relationship with both territorial and consumption-based carbon dioxide emissions'.

Clearly, the various studies show that there is a correlation between economic development and greenhouse gas emissions and emphasize their negative impact on public health. Also, equally clear is that the degree of that effect is mixed, varying on the developmental level of the country(s) under study. Nonetheless, we felt that greenhouse gas emissions were a reliable measure of the negative impact of economic growth.

Any clear causal effect of the banking sector development, environment, and real GDP per capita on population health is difficult to find.

As in previous studies, our findings show that economic development continues to reflect a mixed result on population health. The scope of this study did not include the effect of income per capita on population health, as this has already been explored extensively with results showing that changes in income induce significant effects on population health. We study the impact of greenhouse gas emissions, a product of economic growth, on population health and determined, as have virtually all studies, that this effect is negative (Anenberg et al., 2019; Balakrishnan et al., 2019; Nkalu & Edeme, 2019).

3. Data and econometric methodology

3.1. Data

This study explores the effect of banking sector development, environment, and economic development on population health in EU transition states through panel cointegration and causality analyses.

In the empirical analysis, population health was represented by the life expectancy index of UNDP. (2020) and the share of people with good or very good perceived health (Eurostat, 2020a).

Table 1. Dataset description.

Variables	Description	Source
HEALTH1	Life expectancy index	UNDP. (2020)
HEALTH2	Share of people with good or very good perceived health (% of the population aged 16 or over)	Eurostat (2020a)
PCREDIT	Private credit by deposit money banks to GDP (%)	Beck et al. (2019)
GHG	Greenhouse gas emissions per capita (tonnes of CO_2 equivalent per capita)	Eurostat (2020b)
RGDP	GDP per capita (constant 2010 US$)	World Bank (2020)

Source: own calculations.

The life expectancy index indicates the life expectancy at birth. In this context, minimum and maximum values of life expectancy at birth are determined to transform the indicators in different units into indices between 0 and 1. Then life expectancy index is calculated employing the following equation (see UNDP. (2020) for detailed information about technical issues)

$$Life\ \ expectancy\ \ index = \frac{actual\ \ value - minimum\ \ value}{maximum\ \ values - minimum\ \ value} \tag{1}$$

The second variable representing health is the share of people with good or very good perceived health. This variable is based on how persons evaluate their health on a scale from 'very good' to 'very bad' and calculated as the share of the persons aged 16 or over feeling itself in very good or good health (see Eurostat (2020a) for detailed information about the technical issues.)

On the other side, banking sector development was proxied by private credit by deposit money banks and deposit money bank assets as a percent of GDP, the environment was represented by greenhouse gas emissions per capita, and the control variable of economic development was represented by real GDP per capita. The private credit by deposit money banks indicates the financial resources provided to the private sector by domestic money banks (commercial banks and other financial institutions accepting transferable deposits) as a share of GDP. The deposit money bank assets indicate total assets which consist of claims on the domestic real nonfinancial sector including central, state and local governments, nonfinancial public enterprises and private sector) held by deposit money banks (see Beck et al., 2019) for detailed information about the technical issues). The variable of greenhouse gas emissions per capita in terms of tonnes of CO_2 equivalent per capita measures total national emissions of greenhouse gases consisting of CO_2, methane (CH4), nitrous oxide (N2O), and the F-gases (hydrofluorocarbons, perfluorocarbons, nitrogen triflouride (NF3) and sulphur hexafluoride (SF6)). The aforementioned emissions are transformed to a single indicator in units of CO2 equivalents through each gas' individual global warming potential (see Eurostat (2020b) for detailed information about the technical issues). Lastly, real GDP per capita is gross domestic product in constant 2010 U.S. dollars divided by midyear population.

However, we did not include the findings of the model including deposit money bank assets, because the results were found to be too similar and there is a very high correlation between two variables. All statistical data were annual and extracted from the databases indicated in Table 1.

Table 2. Dataset main characteristics summary (Model-1).

	HEALTH1	PCREDIT	GHG	RGDP
Mean	0.844879	46.54389	8.879798	13533.59
Std. Dev.	0.037841	18.49476	2.991323	4919.460
Min	0.765	6.3921	4.5	3955.276
Max	0.939	102.5376	16.8	25721.86

Source: own calculations.

3.2. Research methodology

The following econometric model was formed to investigate the influence of banking sector development, environment, and real GDP per capita on population health. Two models were estimated due to the employment of two indicators of population health. The study period was specified as 2000-2017 for the first model and 2005-2017 for the second model regarding data availability. Furthermore, the sample of the first model consisted of Bulgaria, Croatia, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, Slovakia, and Slovenia, but the second model excluded Croatia due to data non-availability. We expected the improvements in the banking sector and real GDP per capita to positively affect the population health, but environmental degradation to negatively affect the population health, regarding the relevant theoretical considerations and empirical literature.

$$HEALTH1_{it} = \beta_0 + \beta_1 PCREDIT_{it} + \beta_2 GHG_{it} + \beta_3 RGDP_{it} + e_{it} \quad (2)$$

$$HEALTH2_{it} = \beta_0 + \beta_1 PCREDIT_{it} + \beta_2 GHG_{it} + \beta_3 RGDP_{it} + e_{it} \quad (3)$$

The main characteristics of the dataset for the first model were reported in Table 2. The average life expectancy index was about 0.84 in the sample and exhibited no significant variations among the countries. The average greenhouse gas emissions per capita was 8.79 tons of CO_2 equivalent per capita and showed relatively small variation among the countries. However, the average private credit by deposit money banks to GDP was about 46.54% and the average real GDP per capita was about USD 13533, but both variables exhibited considerable variations among the countries.

The main characteristics of the dataset for the second model were reported in Table 3. The average share of people with good or very good perceived health was about 57.16 in the sample and indicated significant variations among the countries. The average greenhouse gas emissions per capita was 9.13 tons of CO_2 equivalent per capita and showed relatively small variation among the countries. However, the average private credit by deposit money banks to GDP was about 52.28% and the average real GDP per capita was about USD 14683, but both variables indicated considerable variations among the countries.

To test the impact of banking sector development, environment, and economic development on population health the panel data technique was employed. We have analyzed the presence of cross-sectional dependence using the Breusch and Pagan (1980) LM test, CD test of Pesaran (2004) and LM adj. test of Pesaran et al. (2008). Further, we used the adjusted delta tilde test of Pesaran and Yamagata (2008) to question the homogeneity of cointegrating coefficients. Also, using the Pesaran (2007)

Table 3. Dataset main characteristics summary (Model-2).

	HEALTH2	PCREDIT	GHG	RGDP
Mean	57.16923	52.2854	9.139231	14683.2
Std. Dev.	8.174178	16.4241	3.04566	4934.212
Min	35	16.69505	5.2	5561.164
Max	70.9	102.5376	16.8	25721.86

Source: own calculations.

CIPS test, we have examined the integration levels of the series, considering the presence of cross-sectional dependence.

At the next stage, the long-run relationship among population health, banking sector development, environment, and real GDP per capita was performed through the Westerlund and Edgerton (2008) cointegration test with structural breaks. It was considered necessary, because we found a structural break in the study duration, together with cross-sectional dependence and heterogeneity. Based on Eberhardt and Teal (2010) AMG estimator, we estimated the cointegration coefficients. The last step was the examination of causality interaction among the series based on the causality test of Dumitrescu and Hurlin (2012).

The Westerlund and Edgerton (2008) cointegration test take into consideration both cross-sectional dependence and heterogeneity together with the structural break, heteroscedasticity, and autocorrelation. Based on the following two equations we have shown the statistic of the cointegration test:

$$y_{it} = \propto_i + \psi_i t + \delta_i D_{it} + \beta_i x_{it} + (D_{it} x_{it})\gamma_i + \upsilon_{it} \tag{4}$$

$$x_{it} = x_{it-1} + w_{it} \tag{5}$$

Using the Augmented Mean Group (noted as AMG) estimator of Eberhardt and Teal (2010) we estimated the cointegration coefficients, because of the existence of cross-sectional dependence and heterogeneity

When all variables are integrated of the first order, we can use the AMG estimator to determine each cross-section's coefficient and the panel cointegrating coefficients. Also, the panel AMG estimator takes into consideration the common factors and dynamic effects of the series, producing efficient results for an unbalanced panel. Based on Eberhardt and Teal (2010), this estimator can be used in the case of an endogeneity problem resulting from the error terms. This AMG estimator split the variables, as in the following equations:

$$y_{it} = \beta_i^{\mathrm{l}} x_{it} + u_{it} \tag{6}$$

$$u_{it} = \alpha_i + \lambda_i^{\mathrm{l}} f_t + \varepsilon_{it} \ \ (i = 1 \ldots N, \ \ t = 1 \ldots T, \ \ m = 1 \ldots k) \tag{7}$$

$$x_{mit} = \pi_{mi} + \delta_{mi}^{\mathrm{l}} g_{mt} + \rho_{1mi} f_{1mt} + \ldots . + \rho_{nmi} f_{nmt} + \nu_{it} \tag{8}$$

$$f_t = \tau^{\mathrm{l}} f_{t-1} + \varepsilon_{it} \ \ ve \ \ g_t = \Psi^{\mathrm{l}} g_{t-1} + \Omega_{it}, \tag{9}$$

Table 4. Cross-sectional dependence tests' results.

	Model-1	
Test	Test statistic	Prob.
LM	142.7	0.0000
$LM_{adj.}$ *	14.25	0.0000
CD*	9.523	0.0000
	Model-2	
LM	54.51	0.1567
$LM_{adj.}$ *	−0.7	0.4839
CD*	-.5692	0.5693

Note: *two-sided test.
Source: own calculations.

where x_{it} represents the vector of observable covariates in the above equations, f_t and g_t are the unobserved common factors, and the λ_i are the country-specific factor loadings.

Lastly, the causality interaction among the series was analyzed by the Dumitrescu and Hurlin (2012) causality test, which is a developed version of the traditional Granger causality test for heterogeneous panels and can be used in case of $T > N$ and $N > T$.

4. Empirical results

The pre-tests of cross-sectional dependence and heterogeneity exhibit importance for the employment of the relatively more robust econometric tests for the unit root and cointegration. Therefore, the existence of any cross-sectional dependence was examined through the Breusch and Pagan (1980) LM test, CD test of Pesaran (2004) and LM adj. test of Pesaran et al. (2008) and the test results of both models are reported in Table 4. Following these tests, cross-section dependence among the series was revealed for the first model, but cross-section independence was discovered for the second model. Therefore, the second-generation unit root and cointegration tests should be employed for the first model to obtain more robust results.

Homogeneity of the cointegration coefficients for both models was analyzed through the homogeneity tests of Pesaran and Yamagata (2008) and results are displayed in Table 5. The null hypothesis in favour of homogeneity was rejected for the two models, and in turn, the cointegration coefficients were found to be heterogeneous.

Taking into consideration the presence of cross-sectional dependence, Pesaran's (2007) CIPS panel unit root test was run to test the presence of a unit root and findings are noted in Table 6. The results showed that all of the variables in Model-1 were integrated of the first order I(1). However, all the series except HEALTH2 were I(1) and HEALTH2 was stationary at the level in the Model-2.

The long-run relationship among population health proxied by life expectancy index, banking sector development, environment, and real GDP per capita was investigated through the Westerlund and Edgerton (2008) cointegration test with structural breaks, and the test consequences with structural breaks were reported in Table 7. The findings revealed a significant cointegration relationship among the variables because the null hypothesis of no significant cointegration relationship among the

Table 5. Homogeneity tests' results.

Test	Test statistic	Prob.
	Model-1	
$\tilde{\Delta}$	12.885	0.000
$\tilde{\Delta}_{adj.}$	15.011	0.000
	Model-2	
$\tilde{\Delta}$	7.461	0.000
$\tilde{\Delta}_{adj.}$	9.306	0.000

Source: own calculations.

Table 6. Unit root test results.

	Model-1		Model-2	
Variables	Constant	Constant + Trend	Constant	Constant + Trend
Zt-bar	Zt-bar	Zt-bar	Zt-bar	
HEALTH	−1.330	−1.646		
d(HEALTH)	−2.341**	−3.920***		
HEALTH2			−2.608**	−3.003*
d(HEALTH2)			−3.416***	−3.458**
PCREDIT	−1.837	−1.650	−1.785	−3.682***
d(PCREDIT)	−2.536***	−3.378***	−3.890***	−3.471**
GHG	−0.791	−2.922**	−2.188	−2.252
d(GHG)	−4.706***	−4.557	−3.587***	−3.778***
RGDP	−2.237**	−2.238	−2.268	−1.371
d(RGDP)	−2.377**	−2.282**	−2.45**	−3.35**

Note: ***, **, and * indicates it is respectively significant at 1%, 5%, and 10% significance level.
Source: own calculations.

series was denied at three versions of the cointegration tests. Furthermore, the structural breaks disclosed the structural breaks that are mainly suitable for the global financial crisis and Eurozone sovereign debt crisis. The cointegration analysis could not be conducted for Model-2, because the dependent variable was found to be I(0).

The cointegration coefficients were forecast by the panel AMG estimator of Eberhardt and Teal (2010) while taking notice of the cross-sectional dependence and heterogeneity. The results of the test are presented in Table 8. The panel cointegration coefficients revealed that only real GDP per capita had a significant, but very weak positive impact on population health in the long-run. However, the individual cointegration coefficients disclosed that banking sector development had a very weak positive influence on population health in countries like Bulgaria, Croatia, Estonia, Romania, Slovakia, and Slovenia, and a very weak negative influence in Hungary, Latvia, Lithuania, and Poland.

Furthermore, our results indicated that greenhouse gas emissions per capita had a negative effect on population health in several countries (Bulgaria, Croatia, Lithuania, and Romania) and real GDP per capita had a very weak positive influence on population health in Czech Republic, Hungary, Latvia, Lithuania, and Slovenia.

The study revealed a very weak negative but statistically insignificant impact of banking sector development on population health in the sample. The finding can be attributed to the claim that the banking sectors in the EU transition countries have fallen behind the ones in the developed countries due to the recent crises. Furthermore, the share of the banking sector in financing health investments has stayed relatively low.

Since no studies were conducted to determine the relationship between bank sector development and population health we investigated some studies carried out to

Table 7. Estimation of the cointegration coefficients.

Model	$Z_{\varphi}(N)$	P value	$Z_{\tau}(N)$	P value
No shift	−7.731	0.000	−8.426	0.000
Level shift	−5.691	0.000	−6.413	0.000
Regime shift	−7.835	0.000	−7.463	0.000
Country	Structural breaks (level shift)		Structural breaks (regime shift)	
Bulgaria	2014		2014	
Croatia	2008		2008	
Czech Republic	2004		2007	
Estonia	2010		2014	
Hungary	2006		2006	
Latvia	2010		2010	
Lithuania	2003		2003	
Poland	2003		2003	
Romania	2014		2014	
Slovakia	2009		2009	
Slovenia	2013		2014	

Source: own calculations.

Table 8. Cointegrating coefficients estimation (Model-1).

Country	PCREDIT	GHG	RGDP
Bulgaria	0.0000942***	−0.0015591***	3.33e-07
Croatia	0.0000931**	−0.0048212***	1.40e-06
Czech Republic	−0.0000148	−0.00132	2.07e-06***
Estonia	0.0000422***	0.0002163	1.37e-07
Hungary	−0.0000241**	0.0010739	1.07e-06***
Latvia	−0.0000454***	0.000867	7.14e-07***
Lithuania	−0.0003739***	−0.0039552**	2.44e-06**
Poland	−0.0003602***	−0.0004984	1.50e-06
Romania	0.0002648***	−0.0030674***	−4.05e-07
Slovakia	0.0000773***	0.0007474	−3.09e-07
Slovenia	0.0001278***	−0.0001719	1.21e-06***
Panel	−0.0000108	−0.0002942	7.94e-07**

Note: ***, **, and * indicates it is respectively significant at 1%, 5%, and 10% significance level.
Source: own calculations.

explore the relationship between the financial sector and population health. Claessens and Feijen (2007), Alam et al. (2016) found a positive association between these two variables. Most studies focused on the relationship between income inequality and population health and various results have been reported. Babones (2008) found a strongly significant correlation of national income inequity with population health measured by life expectancy, Judge at al. (1998) indicated that income inequality measured through different indicators such as GDP per capita is not a significant determinant of population health, measured by life expectancy, van Deurzen et al. (2014) suggested that an improvement in health parameters at the country level can be achieved by increasing the wealth among the poor and the findings of Ram (2006), Rogers (1979) and Flegg (1982) pointed out that a negative cross-country correlation exists between income inequity and population health.

One of the limits of our study is the sample dimension (11 countries), because, as it can be seen in large cross-country samples from other studies, there is a consistent negative relationship between income inequality and population health, while others such as Lange and Vollmer (2017) concluded that economic growth doesn't automatically determine improvement in population health, after studying different relevant literature on this matter.

Table 9. Results of Dumitrescu and Hurlin (2012) causality test (Model 1).

Null Hypothesis	W-Stat.	Zbar-Stat.	Prob.
DPCREDIT↛DHEALTH	**10.0706**	**3.47686**	**0.0005**
DHEALTH ↛ DPCREDIT	5.97097	1.04886	0.2942
DGHG↛DHEALTH	3.89490	−0.18070	0.8566
DHEALTH ↛DGHG	6.05321	1.09757	0.2724
DRGDP ↛ DHEALTH	5.29098	0.64614	0.5182
DHEALTH ↛ DRGDP	6.38867	1.29625	0.1949

Source: own calculations.

Regarding the relationship between greenhouse gas emissions and population health, this is just one of the dimensions of public health research's foundational empirical questions, namely, the relationship between economic development and human well-being. Jorgenson (2014) emphasized that economic growth improves human well–being, at the cost of increased carbon emissions, Nkalu and Edeme (2019) showed that environmental hazards decrease life expectancy, while income extends the life expectancy.

The majority of the studies suggest that greenhouse gas emissions are closely correlated with economic growth and fast economic growth can also help countries to spend more on health care. Developed nations are generally focused on the tertiary sector that registers lower carbon emissions than primary and secondary sectors. Economic development is a fundamental driver of technological transformations. More resources imply rising demand for innovative technology that in turn will contribute to greenhouse gas emissions reduction with lower influence on population health.

Our results can be explained by the sample structure and EU's stringent environmental issues, being obvious as it results from different studies, that in developed countries there is a need for green growth, meaning both an increase in GDP and a decrease in greenhouse gas emissions.

Nowadays, we cannot ignore the importance of financial markets, including the banking sector and its development but the causal interaction between this sector and human health was not investigated to date.

The causal interaction among population health proxied by life expectancy, banking sector development, greenhouse gas emissions, and real GDP per capita was analysed through the Dumitrescu and Hurlin (2012) causality test. The results are reported in Table 9 and reveal that banking sector development had a significant effect on population health.

The causal interaction among population health proxied by share of people with good or very good perceived health, banking sector development, greenhouse gas emissions, and real GDP per capita was also investigated through the Dumitrescu and Hurlin (2012) causality test and results are presented in Table 10.

The results revealed that one-way causality runs from health to banking sector development and also from the environment proxied by greenhouse gas emissions per capita to health when population health was represented by the share of people with good or very good perceived health. Similar results were reported by Chaabouni et al. (2016), Ullah et al. (2019) that revealed a one-way causal relationship from CO_2 emissions to health expenditures.

Table 10. Results of Dumitrescu and Hurlin (2012) causality test (Model-2).

Null Hypothesis	W-Stat.	Zbar-Stat.	Prob.
DPCREDIT↛HEALTH2	4.28992	0.40585	0.6849
HEALTH2 ↛ DPCREDIT	**10.0745**	**2.86003**	**0.0042**
DGHG↛HEALTH2	**9.32006**	**2.53995**	**0.0111**
HEALTH2 ↛DGHG	2.48469	−0.36005	0.7188
DRGDP ↛ HEALTH2	5.55646	0.94319	0.3456
HEALTH2↛ DRGDP	6.75451	1.45148	0.1466

Source: own calculations.

The results concerning greenhouse gas emission can be explained by the importance of the environmental issues in selected countries. We should take into account the fact that, in this century, issues like population health and environmental challenges are principal issues that governments need to face. There is an urgent need to take action to combat the critical environmental problems and effective environmental policies must be designed, implemented and enforced.

No significant causality between economic growth and population health has been revealed. Different results were reported by Chaabouni et al. (2016), Piabuo and Tieguhong (2017) that indicated a two-way causal relationship between health expenditures and economic growth and by Ghorashi and Rad (2017) found a unidirectional causality is running from health expenditures to economic growth.

5. Conclusion

Public health is a major problem worldwide and governments have a difficult mission to ensure basic access to health services to all citizens. The challenges related to health system financing are not associated only with poor countries, in recent years, developing countries and even developed countries are facing major constraints in raising sufficient resources for financing this sector as well as improving the efficiency and effectiveness of resource utilization.

To improve health outcomes it is necessary to have an interdisciplinary approach, to create a partnership between academics, government entities, voluntary organizations, and the public health sector. Identifying factors that affect the population health or health services is a major challenge for population health research and studying the connections between health and other economic sectors can help us to identify proper tools and solutions to support this sector.

In the present study, we aimed to investigate the short and long-run effects of banking sector development and the environment on population health in 11 EU member transition states for the period of 2000-2017. The results of this study reveal two conclusions. The first conclusion is that, in the long run, only real GDP per capita has a significant, but very weak positive impact on population health, while in the short run we have different results depending on the approach to measure population health.

The second conclusion is that at the country level, the cointegration coefficients reveal different causal interactions among population health measured through life expectancy, banking sector development, greenhouse gas emissions, and real GDP per capita. Furthermore, banking sector development had a very weak positive influence

on population health in Bulgaria, Croatia, Estonia, Romania, Slovakia, and Slovenia, but had a very weak negative influence on population health in Hungary, Latvia, Lithuania, and Poland. On the other hand, greenhouse gas emissions per capita had a negative effect on population health in Bulgaria, Croatia, Lithuania, and Romania. Lastly, real GDP per capita had a very weak positive influence on population health in the Czech Republic, Hungary, Latvia, Lithuania, and Slovenia.

The results obtained when compared to the presented literature studies can be explained by the fact that our study is more narrowly focused, both by the country panel (11 countries) and the measures used.

Analysing the causal relationship between variables, some remarks need to be added.

Using life expectancy as a measure of population health we found only one causal relationship running from banking sector development to population health. More jobs in this sector will reduce unemployment, people will be able to increase their income and improve their health status. A well-developed banking system will enable quick and easy access to investment funds for capital investment in the health infrastructure. Easy access to bank loans will stimulate economic development, governments will be able to raise funds for the health system.

Different results have been provided when population health was proxied by the share of people with good or very good perceived health. In this situation, a unidirectional causality running from population health to bank sector and from the environment to population health have been identified. A healthier population will be more productive, will have adequate jobs and earnings to access credits. But in turn, sick people can become poor by losing their jobs and become more vulnerable to infectious diseases, entering into a vicious downward spiral of lower incomes and high health care costs, being associated also with a fall in household savings. The relationship between countries' greenhouse gas emissions must be determined empirically whether countries are developing or developed. This can help us to understand better the complexity of this relationship and to allow policymakers to find proper solutions to mitigate the effects of greenhouse gases on population health. All analyzed countries pledged to reduce emissions and efforts have been made in this direction but the situation is not under control. Maybe different policies implemented by countries' government bodies or imposed by EU legislation are not efficient or are not adopted properly to reduce emissions and studies conducted in this area can help authorities to take proper actions.

The evidence of a causal relationship between banking sector development, environment and real GDP on population health is weak, however, studies show that any clear causal effect is difficult to find. This highlights some challenges for our future research, like the importance of a wide panel of countries used in the analyses and sophisticated statistical models. Future research can focus on the relationship between banking sector development and planetary health.

If our research used a single proxy variable to measure banking sector development (private credit by deposit money banks), economic growth (GDP per capita) and environment (greenhouse gas emissions per capita) to GDP we intend to continue this study and to conduct more complex analyses, including more measures for each variable.

With all the above limitations of our research, we believe that we used objective measures for both population health (life expectancy and share of people with good or very good perceived health) and the economic component of our study. To sum up, our contribution shows that, in transitional European economies, population health is influenced to a small extent by GDP per capita and development of the banking sector, this being justified by the specifics of the economies considered in our study.

The world has changed fundamentally, and people are exposed to unprecedented health risk factors. Healthcare systems are under extreme pressure and the coronavirus pandemic revealed vulnerabilities and underlined problems in this system. Governments are under pressure to reduce costs and to provide quality services, and at the same time, healthcare systems face depleting resources and increasing demands for health services. Health systems need a financing system that ensures essential health services even when facing major disruptive changes. Besides other financial sector actors, banks can play a key role in financing long-term investments. Many countries have set ambitious health policies agendas to achieve the Sustainable Development Goals (SDGs) that require higher investments but in a situation of constrained budgets. Banks can be part of the solution, playing different roles as investors, intermediaries, or lenders. By providing credits for investments, ensuring liquidity for bridging the liquidity gap, banks can be proper partners in strengthening health systems.

The findings of this research have some policy implications, especially on issues related to the link between banking sector development and human health.

Adequate governments' policies can influence savings and investments in health systems. More funds at banks' disposal can have a positive influence on health investments. Also, governments, banks, and other financial institutions can cooperate to give support to small businesses so people can become more flexible to generate their own revenues and invest more in health insurance plans, or to adopt a healthy lifestyle. These can provide positive health effects and will put less pressure on public sector healthcare.

Countries can also implement climate-related policies at their central bank level, by introducing brown penalizing factors and supporting green assets and activities that in the medium and long term will improve the quality of population health.

It can take several years to observe the effects of different policies on the health system, but more studies that include more countries in the sample, from different regions and at the different stages of development, that adopted different policies that may have a direct or indirect impact on the health system, are required.

Even many countries have included health sector reforms in their policy agenda to achieve positive outcomes in this sector, there are more steps necessary to improve overall health and quality of life.

Author contributions

All authors have contributed significantly for this research in all phases and sections.

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