Open Peer Review on Qeios

Financial Repercussions of Carbon Emissions and Depletion of Natural Resources: The Role of Fiscal Policy in Determining Health Expenditures

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Funding: No specific funding was received for this work.

Potential competing interests: No potential competing interests to declare.

Abstract

This study examines the impacts of various environmental factors on public and private health expenditures. The significant and robust effects of carbon emissions, depletion of forest areas, depletion of natural resources, and access to clean fuel for cooking on health expenditures, communicable diseases, and average life expectancy highlight the importance of investing in improving environmental conditions. Empirical evidence shows that carbon emissions are a major contributor to the increase in public and private health expenditures. Additionally, the study reveals an interesting aspect of fiscal policy, where external outstanding debt has a significant positive effect on per capita private health expenditures but a negative effect on nationwide aggregate health expenditures. This finding underscores the need for cautious management of debt financing from external sources. The study's results suggest that governments should avoid heavy indirect taxation, while a higher proportion of direct taxes in government revenue can enhance public sector spending on health services. Furthermore, the effectiveness of government, political stability, and absence of violence in a country emerge as significant determinants of health expenditures and the spread and severity of communicable diseases. The study utilizes five equations estimated using 14 years of data from 187 countries, employing the panel least squares (PLS) technique.

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Keywords: Access to clean fuel, CO2 emissions, Depletion of natural resources, Health expenditures, Government effectiveness.

JEL Classification: H20, H51, I12, Q54.

1. Nexus of Environmental Conditions, Health Expenditures, and Green Financing

The impact of environmental conditions on sustainable economic development, human life, living standards, and health conditions is a crucial concern in contemporary economic literature and policy debates. This area has gained even more importance in the wake of the Covid-19 pandemic, as there have been immediate changes in financing patterns to offset economic losses. The global economic outlook and the measures to achieve the Sustainable Development Goals (SDGs) have been significantly affected by Covid-19 and its repercussions.

The economic policies implemented to address the Covid-19 crisis and its aftermath have raised several questions. One important question pertains to the impact of declining growth and limited fiscal space on spending for the improvement of environmental, social, and governance (ESG) indicators. The economic slowdown has had an impact on investments and policies related to environmental, social, and governance (ESG) factors. Sachs et al. (2020) predicted that Covid-19 will have a severe impact on most of the Sustainable Development Goals (SDGs). Nemoto and Morgan (2020) also emphasized the critical role of environmental, social, and governance (ESG) investments in achieving inclusive growth in Asia and reducing income inequality caused by the Covid-19 pandemic.

During periods of recession and economic crises, the diversion of funds for survival strategies may result in lower prioritization of environmental-related spending and green financing. This situation has two important implications: (1) Environmental-related investment and green (or sustainable) financing can play a crucial role in reducing the prevalence and severity of communicable diseases, pandemics, and health expenditures. Neglecting green (or sustainable) investment and spending on environment-related projects may contribute to an increase in the occurrence and severity of communicable diseases and health expenditures, which will ultimately further harm economic growth. (2) Lower spending on environmental-related investment in the short to medium term may erase past achievements and disconnect them from future plans. This implies that more green (or sustainable) investment than anticipated will be required in the future.

The links between environmental conditions and sustainable economic development have been established in various studies. The economic literature has discussed the impacts of carbon (CO2) emissions, depletion of forest areas, depletion of natural resources, methane emissions, and nitrous oxide emissions on various social and economic variables. The detrimental effects of a polluted environment and carbon emissions on public health are evident. The burning of fossil fuels, including coal, natural gas, and oil, releases carbon dioxide into the atmosphere, leading to its accumulation along with methane and nitrous oxide, which contribute to global warming and climate change. These emissions have significant effects on the planet as they are the greenhouse gases with the highest levels of emissions in the atmosphere. Exposure to CO2 can result in various health effects, such as headaches, dizziness, restlessness, a tingling or pins-and-needles sensation, difficulty breathing, sweating, tiredness, increased heart rate, elevated blood pressure, coma, asphyxia, and convulsions.

Unhealthy environmental conditions contribute to higher private expenditures on healthcare, which can also impact health insurance businesses. This impact can arise from a smaller number of policyholders due to high premium rates or higher payments due to an unexpectedly large number of claims against health insurance policies. Similarly, governments' higher

expenditures on health services are also a consequence of unhealthy environmental conditions. In some cases, increased public sector spending on health services may lead to a higher fiscal deficit. This situation becomes a crisis when a country relies on external fiscal sources, potentially resulting in debt distress.

Some studies have established the links between ESG standards and return on investment in the context of developed countries. However, investment decisions in developing countries still primarily consider return on investment in monetary terms only (Duffy and Eberts, 1991; Hideo et al., 2019). Furthermore, the impacts of environmental-related indicators on public and private spending and health conditions have not been extensively discussed in the present context. This study aims to fill this gap. The objective of this study is to test the impacts of environmental conditions on health expenditures by the public and private sectors. In summary, this study examines the effects of various environmental factors on public sector health expenditures, private healthcare expenditures, the number of deaths caused by communicable diseases, and life expectancy.

The decision-making process regarding investment in relation to environmental, social, and governance (ESG) responsibilities for global sustainable development is also important in policy research. The literature acknowledges that traditional measures and the wealth maximization approach are insufficient to assess the long-term sustainability of business ventures (Geory and Stewart, 2018; Mehar, 2010; Mehar, 2020a; United Nations Environment Program, 2018; United Nations Conference on Trade and Development, 2014; UNCTAD, 2015; Yoshino, Helble, and Abidhajaev, 2014). International agreements for economic cooperation and regulations related to local and foreign investments encompass environmental concerns, climate change, women's empowerment, rights of minorities and indigenous peoples, transparency, human rights, drug trafficking, good governance, and individual liberty. Addressing environmental, social, and governance (ESG) issues in accordance with global standards ensures sustainable competitiveness and efficient use of economic resources. Compliance with globally accepted ESG standards guarantees the long-term sustainability of investment returns. Global investors, therefore, need to consider ESG-related conventions when preparing feasibility studies for investments in developing countries (Mehar, 2020a).

The next section of this paper reviews the global patterns of health expenditures, environmental conditions, and communicable diseases. This section also depicts the global demography and economic conditions. The regulatory efforts and financial mechanisms to tackle environmental issues are also described in this section. A statistical model to explain the role of carbon emissions and depletion of natural resources has been established in Section 3, while the determinants of health expenditures, communicable diseases, and life expectancy have been empirically tested in Section 4. Based on estimated parameters and empirical evidence, some policy implications are mentioned in Section 5.

2. Global Patterns of Health Expenditures and Environmental Conditions

According to the United Nations Conference on Trade and Development (UNCTAD, 2022), global CO2 emissions from energy combustion and industrial processes rebounded in 2021, reaching their highest-ever annual level. This can create obstacles in achieving the Sustainable Development Goals (SDGs). This section presents a comparison of the trends in

health expenditures and environmental conditions. The trends in socioeconomic variables, environmental conditions, and health expenditures establish a justification to explore the causes and effects of health expenditures.

Table 1 shows the global picture of carbon (CO2) emissions and depletion of natural resources. It is evident that there has been no change in the depletion of forests as a percentage of gross national income. This ratio was 0.06 in 2008, and it remains the same in 2022. However, the depletion of natural resources has decreased from 2.5 in 2008 to 0.8 in 2022. A peculiar aspect of the picture is that the depletion of forests as a percentage of gross national income was 2.7 in East and South Africa, but it has decreased to 2.0 percent in 2022. In West and Central Africa, it was 1.1 percent in 2008, and it remains at 1.0 percent. The depletion of natural resources in East and South Africa was 12.5 percent of gross national income in 2008, but it has decreased to 4.4 percent in 2022. In West and Central Africa, it was 10.6 percent in 2008, and it is now 3.6 percent in 2022. The following sections of this study present empirical evidence that carbon emissions and the depletion of forests and natural resources adversely affect health conditions and life expectancy rates. The depletion of forests and natural resources in African countries will further exacerbate the economic and social challenges they face.

Interestingly, despite various efforts and awareness campaigns, there has been no improvement in carbon, methane, and nitrous oxide emissions. Global carbon emissions were 4.4 per capita metric ton in 2008, and it remains the same in 2019 (the latest estimate). Nitrous oxide and methane emissions were 0.4 per capita metric ton in 2008, and there has been no change in this ratio. Carbon emissions in North America were 18.1 per capita metric ton in 2008, and it has now decreased to 14.8 per capita metric ton. In high-income countries, it was 11.5 per capita metric ton, and now it is 9.8. The positive aspect is that North America, the European Union, and high-income countries have achieved 100 percent access to clean fuel and technologies for their population. However, in East and South Africa, the access is only 19.5 percent, and in East and Central Africa, it is 14.9 percent.

Table 2 depicts that the worldwide average of per capita health expenditures is $1,115. The per capita health expenditures are $10,317 in North America and $5,635 in high-income countries. In African countries, it is less than $100, and in South Asia, it is $60. The global average of per capita private health expenditures is $446, with less than $50 in South Asia and Africa, and $4,971 in North America.

Global health expenditures as a percentage of GDP are around 10 percent, while the global average of public sector expenditures as a percentage of GDP is around 6 percent. In South Asia, these ratios are 3 percent and 1 percent, respectively. The situation is similar in West and Central Africa. In high-income countries, total spending on health as a percentage of GDP is 12 percent, while government spending on health is 8 percent.

Communicable diseases and malnutrition account for 18.4 percent of global deaths. Unfortunately, this rate is 59 percent in West and Central Africa and 49 percent in East and South Africa. In South Asia, it is 25 percent, while in high-income countries, it is as low as 6.6 percent.

Sixteen percent of the world's population lives in high-income countries, with 10 percent in North America and the European Union. The remaining 84 percent of the population does not have access to the facilities available in high-income countries, which affects their living conditions and life expectancy. There is a significant variation in average life

expectancy, with 80 years in high-income countries and 57 years in West and Central Africa.

The worldwide average of tax revenue as a percentage of total government revenue is 58 percent. It is 52 percent in high-income countries and 50 percent in the European Union. However, it is more than 65 percent in Africa and South Asia. The share of indirect taxes is much lower in North America (only 8 percent). In other countries, particularly in South Asia, the share of indirect taxes is much higher than in North America. These statistics reveal the interconnection between economic prosperity, health conditions, and health expenditures.

The spending on health in low and middle-income countries is much lower than the world average. The lower per capita income and high inflation rates contribute to the reduced expenditure on healthcare. Table 1 highlights that African and Asian countries face a severe crisis with higher numbers of deaths due to communicable diseases and nutrition problems compared to high-income countries. Additionally, Table 1 indicates that high-income countries are responsible for significant carbon (CO2) emissions.

The accelerating effects of climate change are rapidly revealing the physical and transition risks associated with non-sustainable investments. Simultaneously, there has been an acceleration in regulatory responses to environmental issues. In 2018, the European Commission established a working group of technical experts on sustainable finance to define an economic activity classification that robustly determines whether an activity or company is sustainable. However, when the disclosure regime comes into effect in January 2022, several gaps in data, classification, and definitions have been identified. For instance, the classification of fossil gas and nuclear energy remains controversial (Sanchez Nicolas, Elena: 2021). Similarly, some countries argue that natural gas should be considered sustainable, with few exceptions (Morgan: 2021). According to experts in the working groups, the inclusion of natural gas contradicts climate science because methane emissions from natural gas are significant contributors to greenhouse gases (Sanchez: 2021 and Hall: 2021). Meanwhile, the United Kingdom (UK) is developing its own separate taxonomy (Government of the United Kingdom: 2021).

Table 1. Depletion of Natural Assets and Carbon Emission

Region/Group	Net forest depletion (% of GNI)	Natural resources depletion (% of GNI)	CO2 emissions (metric tons per capita)	Methane emissions (per capita metric tons of CO2 equivalent)	Nitrous oxide emissions (per capita metric tons of CO2 equivalent)	Access to clean fuels and technologies for cooking (% of population)
2008						
Africa Eastern and Southern	2.74	12.54	1.0	0.23	0.50	14.7
Africa Western and Central	1.14	10.63	0.4	0.30	0.52	6.6
South Asia	0.26	2.82	1.0	0.06	0.19	29.6
East Asia & Pacific*	0.17	5.72	4.3	0.33	0.33	46.4
European Union	0.01	0.20	7.7	0.14	0.55	98.9
North America	0.00	1.10	18.1	0.94	0.87	100.0
High income	0.00	1.16	11.5	0.50	0.62	99.6
World	0.06	2.49	4.4	0.41	0.39	54.8
2020						
Africa Eastern and Southern	2.00	4.41	0.9**	0.16**	0.40**	19.5
Africa Western and Central	0.99	3.62	0.5**	0.23**	0.46**	14.9
South Asia	0.18	0.83	1.5**	0.07**	0.20**	60.2
East Asia & Pacific*	0.05	0.83	5.9**	0.38**	0.37**	75.1
European Union	0.01	0.07	6.1**	0.12**	0.48**	99.5
North America	0.00	0.23	14.8**	1.30**	0.84**	100.0
High income	0.01	0.37	9.8**	0.63**	0.57**	99.8
World	0.06	0.79	4.4**	0.42**	0.39**	69.6

** Excluding high-income countries*

***' Data for 2019*

Source: World Bank: Environment, Social and Governance Indicators (2022)

Table 2. Health Expenditure and Causes of Death

Region/Group	Total health expenditure (% of GDP)	Government health expenditure (% of GDP)	Health expenditure per capita (USD)	Private health expenditure per capita (USD)	Cause of death, by communicable diseases, maternal/prenatal and nutrition conditions (% of total deaths)
2008					
Africa Eastern and Southern	6.3	2.6	88.9	39.1	
Africa Western and Central	3.7	0.8	64.0	44.7	
South Asia	3.5	0.8	35.0	26.0	
East Asia & Pacific*	3.7	1.7	115.4	63.1	
European Union	9.2	6.8	3418.3	892.3	
North America	14.7	7.2	7113.0	3636.2	
High income	10.7	6.6	4344.7	1657.5	
World	9.1	5.4	859.0	344.4	
2019					
Africa Eastern and Southern	6.3	3.0	91.1	36.2	49.0
Africa Western and Central	3.4	0.7	61.4	39.2	59.5
South Asia	3.1	1.0	60.5	40.0	25.3
East Asia & Pacific*	5.1	2.8	414.0	184.5	8.2
European Union	9.9	7.4	3476.6	872.4	5.6
North America	16.3	8.5	10317.6	4971.5	5.3
High income	12.5	7.7	5635.5	2151.4	6.6
World	9.8	5.9	1115.0	445.7	18.4

** Excluding high income countries*

Source: World Bank: World Development Indicators (2022) and Environment, Social and Governance Indicators (2022)

Table 3. Income and Demography

Region/Group	Population (Million)	Population density (people per sq. km of land area)	Life expectancy at birth (years)	GDP per capita (USD)
2008				
Africa Eastern and Southern	495.7	33.7	57	1428
Africa Western and Central	336.9	37.2	54	1681
South Asia	1612.4	338.0	66	947
East Asia & Pacific*	1940.8	121.1	73	3081
European Union	439.9	110.2	79	37050
North America	337.4	18.6	78	48398
High income	1163.6	33.0	79	40065
World	6801.4	52.4	70	9428
2020				
Africa Eastern and Southern	685.1	46.2	63	1354
Africa Western and Central	466.2	51.5	57	1683
South Asia	1882.5	394.7	70	1852
East Asia & Pacific*	2116.4	132.1	76	8262
European Union	447.7	112.0	80	34330
North America	369.6	20.4	78	61452
High income	1240.9	35.2	80	43416
World	7821.0	60.2	72	10882
*** Excluding high-income countries**				

Source: World Bank: World Development Indicators (2022)

Table 4. Public Debt and Revenue

Region/Group	External debt (Billion USD)	External debt: public and publicly guaranteed (Billion USD)	Taxes on income, profits and capital gains (% of revenue)	Taxes on goods and services (% of revenue)	Transparency, accountability, and corruption in the public sector rating (1=low to 6=high)
2008					
Africa Eastern and Southern					2.7
Africa Western and Central					2.8
South Asia	324.29	156.52	18.4	27.6	2.9
East Asia & Pacific*	717.91	273.28	36.5	27.1	3.0
European Union			21.9	33.3	
North America			54.2	8.0	
High income			26.6	31.4	
World			22.3	31.9	2.9
2020					
Africa Eastern and Southern			34.2	31.2	2.5
Africa Western and Central					2.9
South Asia	827.99	385.33	27.2	41.6	3.0
East Asia & Pacific*	3269.43	834.65	33.1	31.1	3.1
European Union			18.0	31.7	
North America			53.6	8.0	
High income			22.5	29.5	
World			24.8	33.1	2.9

** Excluding high income countries*

Source: World Bank: World Development Indicators (2022) and Worldwide Governance Indicators (2022)

Before the European Commission initiatives, the United Nations adopted the 2030 Agenda to steer the transition towards a sustainable and inclusive economy. This commitment involves 193 member states and comprises 17 Sustainable Development Goals (SDGs) and 169 targets (European Commission, 2018). Sustainable (green) finance has become a key cornerstone for the achievement of these goals. However, there are no regulations requiring borrowers to specify their "green" intentions in writing. Nevertheless, the EU has developed a green bond standard that emphasizes the alignment of issuer activities with the EU taxonomy for sustainable activities.

Since the 2015 Energy Transition Law in France, institutional investors are required to be transparent about their

integration of environmental, social, and governance (ESG) criteria into their investment strategy.

Empirical research has shown the limited effect of voluntary disclosure policies (Mesonnier and Nguyen, 2021). Mehar (2020) concluded that the granting of Generalized System of Preferences (GSP) and GSP Plus status by the European Union to developing and least developed countries (LDCs) was an ineffective tool for improving environmental, social, and governance conditions in partner countries.

There is no doubt that sustainable development can be achieved through economic policies that link individual benefits with national and global interests. However, measuring ESG-related externalities is a complex task, and relying solely on administrative and regulatory measures may not be the most effective way to achieve desired goals.

Various tools and devices in monetary and fiscal policies have been suggested to enhance environmentally friendly investments. Researchers have proposed several measures in monetary and fiscal policies. Green refinancing operations (offering lower interest rates when banks refinance themselves from central banks based on issuing a certain volume of loans for green projects), green collateral frameworks (excluding polluting assets from collateral eligibility), and green quantitative easing (restricting central banks' asset purchases to green bonds) are considered instruments of green monetary policy.

Sustainable finance, or green finance, refers to the set of financial regulations, standards, norms, and products aimed at achieving environmental objectives, particularly facilitating the energy transition. It enables the financial system to connect with the economy and its populations by providing financing to its agents while maintaining a growth objective. This concept gained prominence with the adoption of the Paris Climate Agreement, which emphasizes the need for "finance flows consistent with a pathway towards low greenhouse gas emissions and climate-resilient development" (United Nations Organization, 2015).

The Paris Agreement on climate change underscored the importance of standardizing reporting practices related to green bonds to prevent greenwashing. Legally, green bonds are not significantly different from traditional bonds. The promises made to investors are not always explicitly included in the contract and are rarely binding. Issuers of green bonds generally adhere to standards and principles set by private-led organizations. Green bonds are loans issued in the market by public or private organizations to finance environmentally friendly activities. These bonds can support investment in environmentally focused Sustainable Development Goals (SDGs), such as climate action, affordable and clean energy, and sustainable cities and communities.

Commercial banks have proposed a "Green-supporting factor" on banks' capital requirements to incentivize increased green lending. However, this proposal is met with opposition from central bankers and nonprofit organizations (The European Money and Finance Forum, 2021). In contrast, central banks and nonprofit organizations propose a "Brown-penalizing factor" that introduces additional capital charges on polluting and potentially risky activities.

Non-governmental organizations (NGOs) and consumer associations suggest that central banks should support the issuance of green loans for home renovation by introducing lower interest rates on refinancing operations.

According to the United Nations Conference on Trade and Development (UNCTAD, 2022), sustainable finance experienced significant growth across various asset classes during the pandemic and as a result of recovery plans. The total value of sustainable financial products reached $5.2 trillion, a 63% increase from 2020. This included sustainable funds, which grew by 53% to $2.7 trillion, and sustainable bonds (including green, social, and mixed-sustainability bonds), which grew by 72% to $2.5 trillion. Global issuance of sustainable bonds surpassed $1 trillion in 2021, with the green bond market exceeding $517 billion and social and mixed-sustainability bonds totaling $395 billion. The European Union and the corporate sector are expected to be key players in 2022, driving social and mixed-sustainability bond issuance to new heights in support of the Sustainable Development Goals (SDGs) and the 2030 Agenda. However, UNCTAD analysis reveals that not all investments in sustainable finance are truly sustainable, and alignment with the SDGs remains limited. Many investors still do not disclose or report on sustainability-related risks and are not moving quickly enough to realign portfolios, particularly in terms of climate-related action.

Based on this context, it is evident that an overemphasis on regulatory and administrative measures alone has not achieved the desired targets for sustainable financing. Instead of relying solely on monetary measures, this study explores the use of fiscal policy tools to address environmental issues. The study examines the effects of direct and indirect taxes, public debt, and health expenditures on private health expenditures, communicable diseases, and life expectancy.

3. Methodology: Impacts of Carbon Emissions and Depletion of Natural Resources

In light of the aforementioned background, we have developed a model to examine the role of carbon emission and depletion of forest and natural resources in determining public and private health expenditures, the spread of communicable diseases, and life expectancy. The study investigates the impacts of environmental variables through two parts: The first part tests the influence of carbon emission and sociopolitical governance on public and private health expenditures, hypothesizing that higher levels of carbon (CO2) emission and poor sociopolitical governance negatively affect health expenditure. The second part examines the effects of forest and natural resources depletion on life expectancy and the severity of communicable diseases.

We have established the following model to identify the determinants of public and private health expenditures, communicable diseases as causes of death, and life expectancy. The primary objective of this model is to examine the impacts of various factors that affect the magnitude of the dependent variables. The model consists of five equations, each incorporating different environment-related variables. The explanatory variables in these equations include CO2 emissions (CO2EMS), methane emissions (METHEMS), nitrous oxide emissions (NITREMS), net forest depletion as a percentage of gross national income (DPLTFRS), natural resources depletion as a percentage of gross national income (DPLTNAT), and access to clean fuels and technologies for cooking (CLEANCK). The inclusion of these variables aims to assess the effects of environmental conditions on per capita private health expenditures (HLTHPCIP), total health expenditures as a percentage of GDP (HLTHTGDP), public sector health expenditures as a percentage of GDP (HLTHGVGDP), average life expectancy (LIFE), and communicable diseases as causes of death (DEATH). Additionally, several control variables have been incorporated into the equations, which will be explained in the subsequent section.

To estimate the impacts of the explanatory factors on per capita private health expenditures (HLTHPCIP), total health expenditures as a percentage of GDP (HLTHTGDP), public sector health expenditures as a percentage of GDP (HLTHGVGDP), average life expectancy (LIFE), and communicable diseases as causes of death (DEATH), the following models have been established:

The description of the aforementioned variables and sources of data are provided in Table 5. It is worth noting that the patterns of public and private expenditures on health, life expectancy, and the spread of communicable diseases may be influenced by the unique social and economic characteristics of highly industrialized nations belonging to the Group of Eight (G8) countries. To account for this, we have created a dummy variable for countries in the G8 group. The value of this variable is '1' for countries belonging to the G8, which include Canada, France, Germany, Italy, Japan, Russia, United Kingdom, and United States, and '0' for other countries.

In the first equation, we hypothesize that per capita private health expenditures in country 'i' (HLTHPCIP) depend on CO2 emissions (CO2EMS) and per capita metric ton of methane emissions (METHEMS) in the same country. The impact of social, economic, and political development in highly industrialized countries (G8) and public sector outstanding debt (DBTPBL) are included as control variables in the regression analysis.

The second and third equations in the model explain the determinants of total expenditures as a percentage of GDP (HLTHTGDP) and public sector health expenditures as a percentage of GDP (HLTHGVGDP) in country 'i' in year 't'. The explanatory variables in these equations include per capita carbon emissions (CO2EMS), government effectiveness index (EFCTV), political stability and absence of violence index (STBLTY), and the transparency, accountability & corruption in the public sector index (CRPTN). The impact of social, economic, and political development in highly industrialized countries (G8) and outstanding debt (DBTPBL) are also tested in these equations. Additionally, direct taxes as a percentage of total revenue (DTXTRV) and indirect taxes as a percentage of total revenue (ITXTRV) are included as control variables. We hypothesize that direct and indirect taxes can have different effects on health expenditures, hence the inclusion of these variables separately. In the determination of public sector health expenditures (HLTHGVGDP), population density (DNSTY) may play an important role. Providing services to dispersed populations can be challenging and expensive, hence the inclusion of population density (DNSTY) as a control variable in these equations. Similarly, in the determination of total health expenditures (HLTHTGDP), total outstanding debt (DBTTOT) is included as a control variable, while for the estimation of public sector health expenditures (HLTHGVGDP), public sector outstanding debt is included in the equation.

The fourth equation in the model identifies the determinants of the magnitude of deaths caused by communicable diseases and nutrition conditions as a percentage of total deaths (DEATH) in country 'i' in year 't'. It is postulated that the magnitude of deaths caused by communicable diseases and nutrition conditions is determined by the magnitudes of net forest depletion as a percentage of GNI (DPLTFRS), natural resources depletion as a percentage of GNI (DPLTNAT), and population density (DNSTY). The impacts of social, economic, and political development in highly industrialized countries (G8) and the COVID-19 pandemic (COVID-19) are measured using dummy variables. The COVID-19 dummy variable is

equal to "1" for 2020 and 2021 to represent the COVID-19 pandemic, and "0" otherwise (COVID).

The fifth equation explains the determinants of average life expectancy (LIFE) in a country 'i'. It is hypothesized that environmental-related variables such as net forest depletion as a percentage of GNI (DPLTFRS), natural resources depletion as a percentage of GNI (DPLTNAT), and access to clean fuels and technologies for cooking (CLEANCK) contribute to the determination of average life expectancy in a country 'i'. Additionally, per capita income (PCI) and per capita health expenditures (HLTHPCI) are important determinants of average life expectancy. Higher per capita income (PCI) and per capita health expenditures contribute to the determination of living standards and access to health facilities. The impact of social, economic, and political development in highly industrialized countries (G8) is also measured in this equation.

In this study, we used data from 187 countries for a period of 14 years (from 2008 to 2021), resulting in a total of 2618 observations. This sample provides us with unbalanced panel data. We applied the panel least squares technique to estimate the effects of explanatory variables. The data for other countries could not be included in the model due to the unavailability of data on some indicators that are included in the analysis. However, data on health expenditures and carbon emissions are not available for 2020-2021. Therefore, the impact of COVID-19 on health expenditures could not be tested. As a result, the net effects of the explanatory variables on health expenditures have been estimated without the policy biases that may have been adopted due to the COVID-19 crisis. Similarly, data on cause of death (DEATH) is only available for 2010, 2015, and 2019. Therefore, we have estimated this equation using a smaller number of observations. However, this reduction in degrees of freedom has not affected the significance of the results when applying the panel least squares (PLS) method on unbalanced data. The t-statistics, AIC, Schwarz criterion, and H-Q criterion support the validity of the statistical estimations.

The data for this analysis was extracted from the World Development Indicators' Data Bank (2022), Wealth Account (World Bank: 2021), Environment, Social and Governance Indicators Report (World Bank: 2022), and Worldwide Governance Indicators (World Bank: 2022).

The data for access to clean fuels and technologies for cooking is obtained from the WHO Global Household Energy Database. Survey sources include Demographic and Health Surveys, Living Standards Measurement Surveys, Multi-Indicator Cluster Surveys, World Health Survey, other nationally developed and implemented surveys, and government agencies (such as ministries of energy and utilities). Access to clean fuels and technologies for cooking is defined as the proportion of the total population primarily using them. According to WHO guidelines, kerosene is not considered a clean cooking fuel.

The World Bank has obtained data on CO2 emissions through the United States Department of Energy's Carbon Dioxide Information Analysis Center. This data is based on estimates of annual anthropogenic emissions derived from information on fossil fuel consumption (obtained from the United Nations Statistics Division's World Energy Data Set) and a survey of global cement manufacturing (conducted by the US Department of Interior's Geological Survey in 2011). While global estimates of CO2 emissions are likely accurate within a 10% margin of error, country-specific estimates may have larger uncertainties. The estimates exclude fuels supplied to ships and aircraft in international transport due to the challenges of

allocating fuel consumption to specific benefiting countries. CO2 emissions include those resulting from the burning of fossil fuels and the production of cement. This encompasses CO2 emissions generated during the consumption of solid, liquid, and gas fuels, as well as emissions from gas flaring. The sources of CO2 emissions include the burning of oil, coal, and gas for energy purposes, the burning of wood and waste materials, and industrial processes such as cement production. Different fossil fuels release varying amounts of CO2 for the same energy output, with oil emitting approximately 50% more CO2 than natural gas, and coal emitting roughly twice as much. The manufacturing of cement results in the release of approximately half a metric ton of CO2 for each metric ton of cement produced. CO2 emissions constitute the largest share of greenhouse gas (GHG) emissions and are closely associated with global warming. Environmentalists advocate for transitioning from liquid fuels to natural gas as a means of protecting the environment. Natural gas is lead-free and does not emit sulfur or particulate matter. Compared to petrol, it emits only one-tenth of the CO2, making it a highly environmentally friendly fuel for motor vehicles. It also produces lower CO2 emissions than diesel oil, thereby mitigating the global warming impact of GHGs (Raza, 2009).

CO2 is a naturally occurring gas fixed by photosynthesis into organic matter. A byproduct of fossil fuel combustion and biomass burning, CO2 is emitted by land-use changes and other industrial processes. It is the principal anthropogenic greenhouse gas that affects the Earth's radiative balance. It is the reference gas against which other greenhouse gases are measured. Burning of carbon-based fuels since the industrial revolution has rapidly increased concentrations of atmospheric CO2, increasing the rate of global warming and causing anthropogenic climate change. CO2 is also a major source of ocean acidification since it dissolves in water to form carbonic acid. This leads to an increase in the Earth's surface temperature and to related effects on climate, sea-level rise, and world agriculture. Emission intensity is the average emission rate of a given pollutant from a given source relative to the intensity of a specific activity. Emission intensities are used to compare the environmental impact of different fuels or activities. The related terms—emission factor and carbon intensity—are often used interchangeably. The Kyoto Protocol, an environmental agreement adopted in 1997 by many parties to the United Nations Framework Convention on Climate Change (UNFCCC), is working to curb CO2 emissions globally.

The regressions have been estimated in five alternative options to test the robustness of the parameters. We have also included some control variables to capture their effects.

Table 5. List of Variables and Sources of Data

Abbreviation	Definition	Source
CLEANCK	Access to clean fuels and technologies for cooking (% of population)	Environment, Social and Governance Indicators; World Bank (2022)
CO2EMS	CO2 emissions (metric tons per capita)	Environment, Social and Governance Indicators; World Bank (2022)
CRPTN	Transparency, Accountability & Corruption in Public Sector Index (in units of a standard normal distribution, ranging from approximately -2.5 to 2.5)	Worldwide Governance Indicators; World Bank (2022)
DBTPBL	External outstanding debt (public and publicly guaranteed) in billion USD	World Development Indicators; World Bank

DBTTOT	External outstanding debt (total) in billion USD	World Development Indicators; World Bank (2022)
DEATH	Cause of death, by communicable diseases and maternal, prenatal and nutrition conditions (% of total)	Environment, Social and Governance Indicators; World Bank (2022)
DNSTY	Population density (people per sq. km of land area)	World Development Indicators; World Bank (2022)
DPLTFRS	Net forest depletion (% of GNI)- A measurement for adjusted savings	Wealth Account; World Bank (2021)
DPLTNAT	Natural resources depletion (% of GNI)- A measurement for adjusted savings	Wealth Account; World Bank (2021)
DTXTRV	Taxes on income, profits and capital gains (% of revenue)	World Development Indicators; World Bank (2022)
EFCTV	Government Effectiveness Index (in units of a standard normal distribution, ranging from approximately -2.5 to 2.5)	Worldwide Governance Indicators; World Bank (2022)
HLTHGVGDP	Domestic general government health expenditure (% of GDP)	World Development Indicators; World Bank (2022)
HLTHPCI	Total health expenditure per capita (USD)	World Development Indicators; World Bank (2022)
HLTHPCIP	Private health expenditure per capita (USD)	World Development Indicators; World Bank (2022)
HLTHTTGDP	Current health expenditure (% of GDP)	World Development Indicators; World Bank (2022)
ITXTRV	Taxes on goods and services (% of revenue)	World Development Indicators; World Bank (2022)
LIFE	Life expectancy at birth (years)	World Development Indicators; World Bank (2022)
METHEMS	Methane emissions (metric tons of CO2 equivalent per capita)	Environment, Social and Governance Indicators; World Bank (2022)
NITREMS	Nitrous oxide emissions (metric tons of CO2 equivalent per capita)	Environment, Social and Governance Indicators; World Bank (2022)
PCI	Per capita income in USD	World Development Indicators; World Bank (2022)
POP	Population (in million)	World Development Indicators; World Bank (2022)
STBLTY	Political Stability and Absence of Violence Index (in units of a standard normal distribution, ranging from approximately -2.5 to 2.5)	Worldwide Governance Indicators; World Bank (2022)
COVID	Dummy variable equal to “1” for 2020 and 2021 to represent COVID-19 pandemic and “0” otherwise	Author’s description

RCSN	Dummy variable equal to “1” for 2008 and 2009 to represent recession, and “0” otherwise	Author’s description
G8	Dummy variable equal to “1” if country belong to ‘The Group of Eight’ refers to the highly industrialized nations, and “0” otherwise	Author’s description

Source: Author’s compilation

4. Empirical Findings: Determinants of Health Expenditures and Communicable Diseases

The results of the regression analysis have been presented in tables 6 to 10. These results quantify the impacts of explanatory variables and indicate the significance of parameters and overall goodness of fit in the equations.

The adjusted R-squares and F-statistics show the goodness of fit in all estimated equations, indicating that the explanatory variables included in the models significantly explain the effects. All the equations in the models are well-fitted, as confirmed by the adjusted R-squares and F-statistics. The magnitudes of the Durbin-Watson test, Akaike information criterion, and other estimators support the statistical validity of the results.

The robustness of the estimated parameters has also been checked using alternative options, and falsification tests have been conducted. For this purpose, some control variables have been included in the regression analysis.

Table 6 shows that per capita private health expenditures increase with higher levels of carbon (CO2EMS) and methane (METHEMS) emissions. The parameters are significant and robust in all alternative scenarios. This result is of significant importance from an environmental policy standpoint. To reduce private health expenditures, the levels of carbon and methane emissions should be restricted. The positive association between outstanding public debt and per capita health expenditures suggests that countries with higher debt burdens have to allocate a larger share of their fiscal resources to debt repayments and interest expenditures. This can reduce their ability to allocate funds to health services, leading to higher private expenditures on healthcare. The per capita private expenditures on health care services in highly industrialized countries (G8) are lower than in other countries, indicating that people in middle and lower-income countries have to bear a higher burden of healthcare expenses.

Table 7 shows that carbon emission (CO2) is a highly significant variable positively associated with total health expenditures as a percentage of GDP. This result is significant and robust in all alternative scenarios, while outstanding debt is negatively associated with health expenditures. The empirical evidence shows that highly industrialized countries (G8) spend more on health expenditures compared to other countries. This finding explains the lower magnitude of per capita private health expenses in industrialized countries compared to middle and lower-income countries. It is notable that total health expenditures are approximately twice the health expenditures paid by the public sector. Indirect taxes affect the ability of common people to spend on healthcare products and services. Indirect taxes lead to inflation, and a higher rate of inflation leads to lower spending on health. This indicates that in the presence of a higher rate of inflation, governments and people may need to allocate more spending towards other essential items such as food and clothing. On the other hand, direct taxes are typically paid by higher-income individuals. The payment of direct taxes does not directly affect their ability to spend on healthcare services. However, the revenue from direct taxes can provide fiscal

space for the government to allocate more spending towards health services. The role of government effectiveness and stability is not clear, and the negative impact of nitrous oxide emission is surprising and goes against common intuition.

Similar findings can be observed in the estimation of government health expenditures as a percentage of GDP (Table 8). Governments have to increase their spending on healthcare facilities when the level of carbon emission (CO2EMS) increases. The associations of methane and nitrous oxide emissions with government health expenditures are not clear. The betas associated with methane emission and nitrous oxide emission are insignificant and not robust. Similarly, the association of government health expenditures with outstanding debts is not clear. The negative and insignificant correlation between health expenditures (HLTHGVGDP) and emissions from methane (METHEMS) and nitrous oxide (NITREMS) goes against logical expectations, but it may be due to multicollinearity among the independent variables included in this study.

Apparently, it seems that public sector spending on health services in high-income countries is greater than in other countries (Table 2). However, statistical analysis indicates that public sector spending on health services in highly industrialized countries (G8) is lesser than in other countries, keeping other factors constant. Empirical evidence confirms lower spending by governments on health services during the recession period. More government expenditures on health services are expected in case of a higher level of political stability and absence of violence (STBLTY). The effectiveness of a government (EFCTV) is also a factor in higher government spending on health services. The effect of population density (DNSTY) is insignificant, which implies that crowdedness or higher concentration in big cities does not affect public sector spending on health services. This result goes against common views.

A significant positive effect of external outstanding debt on per capita private health expenditures (HLTHPCIP) and a negative effect on nationwide aggregate health expenditures as a percentage of GDP (HLTHTGDP) have been observed (Tables 6, 7, and 8). This corroborates that in the case of higher outstanding debt, the burden of health expenditures is shifted from the government to households.

According to the empirical evidence (Table 9), the number of deaths due to communicable diseases and nutrition conditions in a country is positively associated with the depletion of forests (DPLTFRS) and natural resources (DPLTNAT). This finding is consistent in all alternative scenarios, and robust parameters have been observed. Moreover, the effective role of a government (EFCTV) is also a significant determinant in reducing the number of deaths due to communicable diseases and poor nutrition conditions. The significant positive impact of COVID-19 on the number of deaths has been captured by a dummy variable equal to '1' for the year 2020. The population density (DNSTY) and per capita income (PCI) have not been proven to be significant factors in determining the number of deaths due to communicable diseases and nutrition conditions.

It was noted that access to clean fuel and technologies for cooking is a highly significant variable in determining the average life expectancy (Table 10). Access to clean fuel for a larger population can improve the average life expectancy in a country. The parameters are significant and robust. On the other hand, the depletion of forests (DPLTFRS) and natural resources (DPLTNAT) negatively affect the average life expectancy. These three findings provide significant justification for improving environmental conditions. Similarly, per capita income and per capita health expenditures are also

significant determinants of the average life in number of years (LIFE). These findings are consistent in all alternative scenarios, and robust parameters have been observed. In relation to this finding, it is important to note that in a previous study, Mehar (2020a) reported that the availability of clean fuel reduces per capita health expenditures.

Table 6. Dependent Variable: Private health expenditure per capita in USD (HLTHPCIP)

Method: Panel Least Squares

Sample (adjusted): 2008-2019

Periods included: 12; Cross-sections included: 119; Total (unbalanced) observations: 1389

Independent Variable/Option	I	II	III	IV	V
Constant	50.9167*** (16.8294)	45.3373*** (14.8326)	67.9790*** (18.2858)	68.2199*** (18.3527)	83.0583*** (19.7217)
CO2EMS: CO2 emissions (metric tons per capita)	18.3026*** (17.0030)	18.2951*** (17.8396)	16.4512*** (16.3286)	16.2193*** (15.9776)	13.4502*** (12.2355)
METHEMS: Methane emissions (metric tons of CO2 equivalent per capita)	8.1633*** (6.7994)	8.5461*** (7.1600)	7.8165*** (6.7664)	7.6571*** (6.6137)	8.8224*** (7.5652)
G8: Dummy variable equal to “1” if country belong to ‘The Group of Eight’ and “0” otherwise	-87.0234*** (-3.4949)	-154.1268*** (-5.9860)	-121.790*** (-4.8564)	-123.133*** (-4.9116)	-99.2662*** (-3.9588)
DBTPBL: External outstanding debt (public and publicly guaranteed) in billion USD		0.5450*** (9.5159)	0.5627*** (10.1657)	0.5842*** (10.3188)	0.4557*** (7.7590)
DBTTOT: External outstanding debt (total) in billion USD	0.0707*** (4.8610)				
CRPTN: Transparency, Accountability & Corruption in Public Sector Index			35.1302*** (10.0221)	30.0322*** (6.6352)	0.2004 (0.0325)
STBLTY: Political Stability and Absence of Violence Index				5.8320* (1.7783)	4.8032 (1.4819)
EFCTV: Government Effectiveness Index (in units of a standard normal distribution					41.5240*** (6.6473)
NITREMS: Nitrous oxide emissions (metric tons of CO2 equivalent per capita)					-8.0118** (-2.1214)
Adjusted R^2	0.2929	0.3325	0.3772	0.3782	0.3996
F-statistics	144.5070	173.8324	169.1462	141.7026	116.4516
Akaike Information Criterion	11.5663	11.5532	11.4845	11.4837	11.4502
Schwarz Criterion	11.5852	11.5721	11.5072	11.5101	11.4841
H-Q Criterion	11.5734	11.5603	11.4930	11.4936	11.4629
D-W Statistics	0.0645	0.0744	0.0788	0.0780	0.0757

#T-Statistics in parenthesis

**p < 0.1; **p < 0.05; ***p < 0.01*

Source: Author's Estimations

Table 7. Dependent Variable: Current health expenditure as % of GDP (HLTHTTGDP)

Method: Panel Least Squares

Sample (adjusted): 2008-2019

Periods included: 12; Cross-sections included: 88; Total (unbalanced) observations: 879

Independent Variable/Option	I	II	III	IV	V
Constant	5.2273*** (16.4791)	5.1547*** (14.5708)	5.1504*** (14.0743)	5.4668*** (17.0176)	6.1390*** (17.1670)
CO2EMS: CO2 emissions (metric tons per capita)	0.1276*** (3.5792)	0.1265*** (3.3676)	0.1208*** (3.1581)	0.1034*** (2.8760)	0.1276*** (3.5235)
G8: Dummy variable equal to "1" if country belong to 'The Group of Eight' and "0" otherwise	-1.4430** (-2.1277)	-1.8654*** (-2.6020)	-1.7752** (-2.4602)	-1.4761** (-2.1904)	-2.2768*** (-3.3063)
DBTTOT: External outstanding debt (total) in billion USD	-0.0010* (-2.3832)	-0.0010** (-2.3291)	-0.0009** (-2.3139)	-0.0011*** (-2.6113)	-0.0011*** (-2.8643)
EFCTV: Government Effectiveness Index (in units of a standard normal distribution	0.0611 (0.2657)	0.0275 (0.1194)	-0.0091 (-0.0390)	0.3314 (1.3860)	-0.0103 (-0.0470)
CRPTN: Transparency, Accountability & Corruption in Public Sector Index	0.2168 (1.0178)	0.2279 (1.0642)	0.2502 (1.1664)	0.1010 (0.4716)	-0.3632* (-1.7277)
STBLTY: Political Stability and Absence of Violence Index	-0.2654** (-2.3082)	-0.2527** (-2.1110)	-0.2387** (-1.9741)	-0.3420*** (-2.9226)	0.0268 (0.2292)
ITXTRV: Taxes on goods and services (% of revenue)	0.0256*** (4.5019)	0.0272*** (4.5419)	0.0277*** (4.5666)	0.0277*** (4.8737)	-0.0018 (-0.2813)
DTXTRV: Taxes on income, profits and capital gains (% of revenue)	-0.0272*** (-4.0016)	-0.0268*** (-3.9227)	-0.0257*** (-3.7426)	-0.0281*** (-4.1540)	-0.0201*** (-3.0636)
NITREMS: Nitrous oxide emissions (metric tons of CO2 equivalent per capita)		-0.3258**	-0.3166**		-0.4619***

		(-2.1520)	(-2.0849)		(-3.0713)
METHEMS: Methane emissions (metric tons of CO2 equivalent per capita)		0.1402 (1.3032)	0.1354 (1.2428)		0.3400*** (2.9564)
DNSTY: Population density (people per sq. km of land area)				-0.0016*** (-3.9232)	
DPLTNFRS: Net Forest depletion (% of GNI)- A measurement for adjusted savings			-0.0268 (-0.8681)		0.1013*** (3.2002)
DPLTNAT: Natural resources depletion (% of GNI)- A measurement for adjusted savings					-0.1451*** (-10.2344)
Adjusted R^2	0.0608	0.0637	0.0645	0.0762	0.1691
F-statistics	8.1061	6.9686	6.4869	9.0238	15.7840
Akaike Information Criterion	4.2720	4.2712	4.2692	4.2597	4.1517
Schwarz Criterion	4.3209	4.3310	4.3346	4.3143	4.2228
H-Q Criterion	4.2907	4.2940	4.2942	4.2806	4.1789
D-W Statistics	0.0704	0.0710	0.0709	0.0711	0.0944

#T-Statistics in parenthesis

**p < 0.1; **p < 0.05; ***p < 0.01*

Source: Author's Estimations

Table 8. Dependent Variable: Government health expenditure as % of GDP (HLTHGVGDP)

Method: Panel Least Squares

Sample (adjusted): 2008-2019

Periods included: 12; Cross-sections included: 119; Total (unbalanced) observations: 1385

Independent Variable/ Option	**I**	**II**	**III**	**IV**	**V**
Constant	1.8295*** (29.0400)	1.8376*** (28.6799)	2.4917*** (32.4875)	2.4944*** (32.6569)	2.5293*** (32.473)4
CO2EMS: CO2 emissions (metric tons per capita)	0.3458*** (19.5305)	0.3216*** (18.8250)	0.2456*** (13.8526)	0.2408*** (13.6022)	0.2418*** (13.6728
METHEMS: Methane emissions (metric tons of CO2 equivalent per capita)	-0.0203 (-1.0093)	-0.0171 (-0.8443)	-0.0379** (-2.0163)	-0.0423** (-2.2574)	-0.0426** (-2.2784)

NITREMS: Nitrous oxide emissions (metric tons of CO2 equivalent per capita)	-0.1848*** (-2.7510)	-0.1691 (-2.5009)	-0.0538 (-0.8576)	-0.0709 (-1.1305)	-0.0708 (-1.1306)
DNSTY: Population density (people per sq. km of land area)	0.0000 (0.2612)	0.0000 (0.2663)	-0.0001 (-0.7855)	-0.0001 (-0.7380)	-0.0001 (-0.7816)
G8: Dummy variable equal to “1” if country belong to ‘The Group of Eight’ and “0” otherwise	-2.0405*** (-4.9834)	-1.9826*** (-4.6237)	-0.9175** (-2.2692)	-0.9847** (-2.4427)	-0.9611** (-2.3869)
DBTTOT: External outstanding debt (total) in billion USD	-0.0008*** (-3.2080)				
DBTPBL: External outstanding debt (public and publicly guaranteed) in billion USD		-0.0010 (-1.0708)	-0.0017* (-1.7985)	-0.0009 (-0.9670)	-0.0011 (-1.1626)
EFCTV: Government Effectiveness Index (in units of a standard normal distribution			0.4023*** (3.9459)	0.3753*** (3.6863)	0.3791*** (3.7287)
CRPTN: Transparency, Accountability & Corruption in Public Sector Index			0.5627*** (6.1518)	0.4189*** (4.1996)	0.4210*** (4.2262)
STBLTY: Political Stability and Absence of Violence Index				0.1859*** (3.5395)	0.1812*** (3.4521)
RCSN: Dummy variable equal to “1” for 2008 and 2009 to represent recession, and “0” otherwise					-0.1916** (-2.2152)
Adjusted R^2	0.2267	0.2149	0.3321	0.3377	0.3395
F-statistics	68.5430	64.1255	87.0225	79.3934	72.1478
Akaike Information Criterion	3.3440	3.3568	3.1965	3.1889	3.1867
Schwarz Criterion	3.3705	3.3832	3.2305	3.2267	3.2283
H-Q Criterion	3.3539	3.3667	3.2092	3.2030	3.2023
D-W Statistics	0.0731	0.0776	0.0851	0.0850	0.0879

#T-Statistics in parenthesis

**p < 0.1; **p < 0.05; ***p < 0.01*

Source: Author’s Estimations

Table 9. Dependent Variable: Cause of death is communicable disease, maternal/ prenatal and nutrition conditions as % of total deaths (DEATH)

Method: Panel Least Squares

Sample (adjusted): 2010-2020

Periods included: 6; Cross-sections included: 177; Total (unbalanced) observations: 518

Independent Variable/Option	I	II	III	IV	V
Constant	16.8912*** (18.3941)	17.5790*** (18.8131)	22.1466*** (22.0555)	17.7410*** (17.3233)	17.9979*** (17.2041)
DPLTFRS: Net-forest depletion (% of GNI)- A measurement for adjusted savings	2.8036*** (10.9081)	2.7681*** (10.8592)	2.3791*** (9.8828)	1.9686*** (8.7584)	1.9883*** (8.8130)
DPLTNAT: Natural resources depletion (% of GNI)- A measurement for adjusted savings	0.5616*** (4.3322)	0.5349*** (4.1555)	0.5067*** (4.2351)	0.2120* (1.8635)	0.2077* (1.8183)
COVID: Dummy variable equal to “1” for 2020 and 2021 to represent COVID-19 pandemic and “0” otherwise	36.7713** (2.1472)	36.1235** (2.1286)	32.2719** (2.0458)	30.0971** (2.0792)	30.0684** (2.0686)
G8: Dummy variable equal to “1” if country belong to ‘The Group of Eight’ and “0” otherwise		-11.7684*** (-3.2372)	-2.3178 (-0.6556)	0.2319 (0.0713)	-0.5080 (-0.1549)
PCI: Per capita income in USD			-0.0004 (-9.0554)	0.0000 (0.5809)	0.0000 (0.7361)
DNSTY: Population density (people per sq. km of land area)	-0.0008 (-0.6195)	-0.0008 (-0.6916)	0.0012 (1.0118)	0.0022** (2.1089)	
POP: Population (in million)					0.0019 (0.4344)
EFCTV: Government Effectiveness Index (in units of a standard normal distribution				-11.2514*** (-9.8504)	-11.0379*** (-9.6519)
Adjusted R^2	0.3115	0.3239	0.4163	0.5086	0.5045
F-statistics	59.4648	50.5467	62.4528	77.4522	76.2079
Akaike Information Criterion	8.5262	8.5098	8.3648	8.1945	8.2029
Schwarz Criterion	8.5672	8.5590	8.4223	8.2602	8.2685
H-Q Criterion	8.5423	8.5291	8.3873	8.2203	8.2286
D-W Statistics	0.0000	0.0000	0.0000	0.0000	0.0000

#T-Statistics in parenthesis

**p < 0.1; **p < 0.05; ***p < 0.01*

Source: Author's Estimations

Table 10. Dependent Variable: Life expectancy at birth in number of years (LIFE)

Method: Panel Least Squares

Sample (adjusted): 2008-2019

Periods included: 12; Cross-sections included: 174; Total (unbalanced) observations: 2034

Independent Variable/Option	I	II	III	IV	V
Constant	69.5194*** (375.9216)	65.4863*** (241.0852)	60.8856*** (241.9020)	63.4833*** (194.8234)	63.0721*** (188.152)3
DPLTFRS: Net-forest depletion (% of GNI)- A measurement for adjusted savings	-0.6257*** (-14.4779)	-0.5624*** (-14.2351)	-0.0516 (-1.4823)	-0.0737** (-2.1636)	-0.0763** (-2.2503)
DPLTNAT: Natural resources depletion (% of GNI)- A measurement for adjusted savings	-0.1990*** (-9.4423)	-0.0943*** (-4.8324)	-0.1740*** (-10.5526)	-0.1503*** (-8.7054)	-0.1466*** (-8.5218)
CLEANCK: Access to clean fuels and technologies for cooking (% of population)			0.1211*** (32.0124)	0.1033*** (26.1297)	0.1031*** (26.2271)
G8: Dummy variable equal to "1" if country belong to 'The Group of Eight' and "0" otherwise	2.0373*** (2.9341)	-1.5052** (-2.4266)	-0.2864 (-0.5789)	-0.4149 (-0.8691)	-0.4474 (-0.9421)
PCI: Per capita income in USD	0.0002*** (13.1403)	0.0001*** (18.8831)	0.0001*** (10.4574)	0.0000*** (5.5955)	0.0000*** (5.2336)
HLTHPCI: Total health expenditure per capita (USD)	0.0000 (0.2129)	1.4354*** (19.0583)	0.5847*** (8.9337)	0.5019*** (7.7289)	0.5904*** (8.7908)
CO2EMS: CO2 emissions (metric tons per capita)			0.0226 (0.7981)	-0.0607* (-1.8397)	-0.0547* (-1.6643)
METHEMS: Methane emissions (metric tons of CO2 equivalent per capita)				0.3140*** (3.8181)	0.3134*** (3.8299)
NITREMS: Nitrous oxide emissions (metric tons of CO2 equivalent per capita)				-1.7228*** (-10.0762)	-1.7247*** (-10.1395)
				1.9694***	1.7737***

EFCTV: Government Effectiveness Index (in units of a standard normal distribution				[illegible] (9.8821)	[illegible] (8.7601)
DNSTY: Population density (people per sq. km of land area)					0.0008*** (4.8142)
Adjusted R^2	0.5073	0.5821	0.7402	0.7618	0.7644
F-statistics	419.6617	567.4466	820.8449	645.2311	594.5821
Akaike Information Criterion	6.3620	6.1973	5.7267	5.6414	5.6313
Schwarz Criterion	6.3786	6.2138	5.7490	5.6720	5.6647
H-Q Criterion	6.3681	6.2033	5.7349	5.6526	5.6436
D-W Statistics	0.0219	0.0206	0.0189	0.0237	0.0236

#T-Statistics in parenthesis

**p < 0.1; **p < 0.05; ***p < 0.01*

Source: Author's Estimations

5. Policy Implications

The significant and robust effects of carbon emissions, depletion of forests, depletion of natural resources, and access to clean fuel for cooking on health expenditures, communicable diseases, and average life expectancy justify the importance of investing in improving environmental conditions. Investing in improving environmental conditions can significantly reduce health expenditures, and there is a direct association between average life expectancy and environmental conditions. These two outcomes provide significant justification for improving environmental conditions.

Empirical evidence shows that carbon emissions are a significant cause of increasing public and private health expenditures. However, an important consideration in this conclusion is the association between health expenditures and poverty levels. According to the World Bank (2022), private spending on health care is one of the major factors pushing people below the poverty line. Interestingly, the proportion of the global population spending more than 25 percent of household income on out-of-pocket health care expenditures is around 4.0 percent (latest available estimate). This was 2.1 percent in 2000. However, this ratio is 6 percent in South Asia and 2 percent in high-income countries (World Health Organization and World Bank: 2021). This ratio is also 2 percent in low-income countries, which may be influenced by the role of international NGOs and governments in those countries. The proportion of the population pushed below the poverty line (based on 1.90 USD at 2011 PPP) due to out-of-pocket health care expenditures was 1.6 percent in 2017 (latest estimate), compared to 2.0 percent in 2005. This ratio is 1.0 percent in East Asia and the Pacific, 1.0 percent in South Asia, and 0 percent in high-income countries. The significant impacts of forest and natural resource depletion and carbon emissions on health expenditures and health conditions call for policy interventions to reduce the cost of health care and improve health conditions. The role of fiscal and monetary policies becomes important in reducing the cost of health insurance and health expenditures. This study validates the recommendations by Durrani, Rosmin, and Volz (2020)

who recommended that financial institutions need to enhance their ability to assess climate-related financial risks, including physical risks and transition risks (Durrani, Rosmin, and Volz: 2020). Financial institutions and their regulatory bodies must consider the environmental risks and the costs associated with the depletion of natural resources and carbon emissions.

The significant positive effect of external outstanding debt on per capita private health expenditures and the negative effect on nationwide aggregate health expenditures as a percentage of GDP is an interesting aspect of fiscal policy. It confirms that when external debt increases, the burden of health expenditures is shifted from the government to households. This highlights the need for prudence in debt financing from external sources. The results of this study suggest that governments should avoid heavy reliance on indirect taxes. Indirect taxes lead to inflation and affect people's spending power on health services. On the other hand, a higher ratio of direct taxes in government revenue improves public sector spending on health services. In this regard, the ongoing international tax reforms led by the Group of Twenty (G20) are a major step towards ensuring that multinational companies pay their fair share of taxes in the countries where they operate. These reforms have the potential to significantly boost tax revenues in developing countries.

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