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Environmental issues, governmental policies, and accountability on the public communication agenda. Statistical results from Central and Eastern European countries

Silviu-Petru Grecu[1], Horia-Costin Chiriac[2]

Faculty of Philosophy and Social-Political Sciences, University "Al.I.Cuza", Iasi, Romania

silviu.grecu@uaic.ro; costinhoriachiriac@gmail.com

Abstract. This paper highlights the importance of environmental policies in a social and economic context characterized by multiple structural crises. The beginning of the XXI-st century proposes a new perspective, based on the transition from industrial to clean energy and green economies. In this context, environmental preservation should be seen as a main goal for decision-makers and the civic community. The paper aims to identify several relevant predictors that are involved in the further dynamics of the Environmental Performance Index. In order to argue the role played by economic factors in preserving the environment, the paper used quantitative and multivariate statistics, being based on linear, nonlinear, and multiple equations of regression. Using one-way ANOVA and nearest neighbourhood methods, the paper highlights the fact that environmental performance is strongly related to economic welfare, governmental coordination of climate policies, the level of sustainable development, and civic accountability.

Keywords. Environmental issues, governmental policies, sustainable development, GDP/ capita, civic accountability

1. Introduction

Multiple and combined structural crises characterize the beginning of the XXI-st century. Economic imbalances, social inequalities, health crises, and political mistrust are several features of the current disequilibrium. Therefore, environmental issues and sustainable development play an important role in the field of economic and political actions. The transition from traditional industries to a new economic paradigm, based on the tertiary sector and circular economy, creates opportunities for taking into account by the political decision-makers the environmental issues. Recent academic papers underlined the negative impact of the quality of the environment on public health and life expectancy (Beattie et.al. 2000; Bell et.al. 2011; Brunekreef et.al. 2002; Carter, 2018). Air pollution, issues in biodiversity, and decreased levels of environmental performance request complex and coordinated governmental strategies for optimizing the level of environmental indicators (Chiesa et. al. 2014; Cohen, 2018, pp.8-15; Daily et.al. 2009, pp. 21-28).

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In this context, our research question is related to: *why do we need the transition towards clean energy sources?* Both in academic literature and social practices we can identify several answers and arguments of the transition from traditional industries to clean energy and environment. One can easily observe the superposition of two major global crises: the global environmental crisis and the climate crisis. The use of fossil fuels generates a considerable amount of CO2 emissions which, in turn, represent the main cause of problems for the climate, environment, and human health (Tamil, 2023, p.1). The global solution suggested by various specialists in the field for attaining climate neutrality and avoiding greenhouse gas emissions involves the transition from fossil-based energy sources to renewable energy sources. From a scientific point of view, it is technically possible to replace the world`s energy system with a clean and sustainable one. However, the only barrier to energy transition seems to be related to political and economic concerns. Given the fact that many governments are interested in offering cheap energy sources to consumers and industries whilst the prices of energy obtained from fossils tend to increase, the whole problem of energy involves nowadays a significant communication effort. In order to maintain a proper balance between economic development and environmental protection, the real goals behind the environmental policies must be assumed systematically and coherently communicated and explained by the governments to local communities (Tamil, 2023, p.1). Due to the environmental impact and price fluctuations of fossil fuels, governments have to change their view regarding their responsibilities. Instead of being focused exclusively on the economic competitiveness of domestic industries, they need to take into account the possibility of maintaining a balance between economic development and environmental protection. Such an idea is covered by the concept of *sustainable energy development* and involves the understanding of the complex relationships among energy consumption patterns, greenhouse gas emissions, climate change, and environmental issues (Tamil, 2023, p.2).

Concerning the sustainable development perspectives in the environmental sector, scholars argued that clean energy, biodiversity preservation, clean air and transition to a green economy should be the main goals of the governmental public policies. In this respect, UN goals integrated into the *2030 Agenda* request a better integration of economic activities in the field of sustainable development and environmental protection. Moreover, national governments should manage "the major challenges we face, recognizing that poverty eradication requires strategies that can work on economic growth by ensuring environmental protection and managing a series of social needs including health, education, and gender equality" (Miola et. al. 2019). Environmental protection represents one of the main goals of the UN 2030 Agenda and requests a strong partnership between economic actors, citizens, and political decision-makers. In this respect, to shape an optimal framework for environmental policies these social and political actors should create a model of good governance (Van Zanten, 2020; Lu, 2015; Moyer, 2020; Sachs, 2015; Nerini, 2019; Fritz, 2019, pp. 922-930; Fonseca, 2020). Moreover, global partnerships and EU governance could provide a good political framework for further' environmental policies implementation (Mete, 2020; Gilek et.al. 2015; Lerum et.al. 2016; Inglis, 2010; Flint, 2008; Maxwell et.al. 2005).

Taking into account all these theoretical perspectives, our approach supports the idea that a robust partnership between different stakeholders such as economic actors, political decision-makers, civic society could advocate for environmental policy changes (Glass and Newig, 2021; Hammond, 2020).

2. Data and Research Methods

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This section shows the research design and points out the main research directions of the study. In accordance to the brief literature review, the paper aims to stress the presence of a complex and dynamic relationship among governmental policies, civic accountability, economic development and welfare, and the dynamics of the environmental issues in Central and European countries.

In the same time, the paper aims to follow several research objectives such as O_1: to estimate the impact of the economic factors in the field of environmental performance; O_2: to analyse the correlation between civic accountability and the environmental policies in Central and European democracies; O3: to measure the statistical association between the coordination of the climate policies and the dynamics of the environmental performance index within the research sample. Using a quantitative research design based on linear and nonlinear equations of regression, the paper tests several research hypotheses: H_1: Countries with an increased level of GDP growth are more likely to develop sustainable policies in the environmental field. H_2: An increased level of social welfare (GDP/ capita) is more related to an increased level of the environmental performance index. H_3: Countries characterized by the coordination of governmental policies with civic accountability are more prone to develop and sustain robust public policies for increasing the level of the environmental performance index.

In order to evaluate the economic, civic and governmental impact in the environmental field, the paper uses secondary statistical data collected from academic sources and reports. In this respect, data related to environmental performance and climate policy are collected from the Yale Centre for Environment, Law and Policy. This research institute provides statistical data related to environment performance (Environment Performance Index) in 180 countries using 40 performance indicators from 11 different categories. Data are measured on a scale between 0 to 100 stressing the differences which are specific for each indicator and each country integrated in the analysis. Economic data represented by both GDP growth and GDP/ capita are relevant for observing the impact of the economic determinants in the field of environmental policies across Central and Eastern European countries. These statistical data were collected from World Bank reports. The level of civic and political accountability is measured by the components of democracy (liberal, egalitarian, deliberative, electoral and participatory) by the V-Democracy Institute. This research institute provides statistical data related to democracy, society, and contemporary politics. Civic and political accountability is measured on a scale from 0 to 1. The value 1 is the most important value, related to an increased level of accountability. In correlation with political accountability, we introduced several research variables such as Freedom of Information and Public Procurement, scaled from 0 to 100 by the European Public Accountability Mechanism. Higher values signify a high level of state intervention and regulation. Moreover, for fulfilling the political factors sphere, we used as an independent factor the level of the Rule of Law Index, provided by the World Justice Project on a subunit size, where the highest values reflect an increased level of the rule of law. Also, we used secondary sources of data related to life expectancy and security and health index. Table 1 presents the research variables, units of measure and the sources for the secondary data:

Table 1. Research Variables

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Variables	Symbol	Units of measurement	Sources
Environmental Performance Index	EPI	0-100	Yale Center for Environmental Law & Policy https://epi.yale.edu/epi-results/2022/component/epi
Climate Policy	CP	0-100	Yale Center for Environmental Law & Policy https://epi.yale.edu/epi-results/2022/component/epi
GDP	GDP	US$	World Bank https://data.worldbank.org
GDP/ capita	GDP/ capita	US$/capita	World Bank https://data.worldbank.org
Sustainability Index	SI	0-100	Sustainable development Report https://dashboards.sdgindex.org/
Accountability	AC	0-1	V-Democracy Institute https://www.v-dem.net/data_analysis/VariableGraph/
Freedom of Information	FI	0-100	European Public Accountability Mechanism https://www.europam.eu/?module=country-profile&country=European%20Union
Public procurement	PP	0-100	European Public Accountability Mechanism https://www.europam.eu/?module=country-profile&country=European%20Union
Rule of Law Index	RL	0-1	World Justice Project https://worldjusticeproject.org/rule-of-law-index/
Life Expectancy	LE	years	https://www.worldometers.info/demographics/life-expectancy/
Global Health Security Index	GSH	0-100	Global Health Security Index https://www.ghsindex.org/

Using linear and nonlinear equations of regression we aim to identify relevant predictors that could explain the dynamics of EPI in a long-term statistical string from 2015 to 2022. Also, we used the comparative regional case studies among Central and Eastern European countries, including in this sample the Baltic States. In this respect, the sample is structured on 12 countries from these geographical regions such as Austria, Bulgaria, Croatia, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, Slovakia and Slovenia. Beyond the equations of regression the paper uses, as methodological tools, the Analysis of Variance and descriptive statistics for underling the statistical indicators changes and variations during 2015 and 2022. Also, we used these tools to create a deep and refined analysis of the environmental issues in a context characterized by multiple challenges and threats.

3. Environmental Performance in Central and Eastern Europe. A general view

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The academic literature stressed that environmental policies are incremental and should be implemented in the medium and long term. There is a concerted action that should be based on the complex interactions between citizens, decision-makers, economic actors, and different industries. Environmental issues, as it is pointed out in various academic researches, are involved in public health and could interfere with the individuals' quality of life and life expectancy. For these reasons, a coordinated environmental policy could be seen as an important goal related to UN sustainable goals and the 2030 Agenda. Post-communist countries are more likely to have decreased statistical values related to environmental performance and climate policy. The economic shift from industrial economies to the tertiary sector is quite difficult in most of the ex-communist countries. Regarding the historical perspectives, we can argue that different heavy industries, with relevant risks related to pollution and public health, are seen as an important economic vector for most of the post-communist countries. Technological advancement and industrial innovation are seen as the main goals and challenges for decision-makers and economic actors. In this respect, it is obvious that most of these countries have to make the environmental issues an important goal for the public agenda. Political communication and agenda-setting should be fulfilled by different sustainable strategies promoted by decision-makers for reducing the negative impact of pollution and other important elements related to the quality of the environment. Being an expensive public policy, the environmental policy is more likely to be relevant in the field of economically developed countries. In this respect, concerning the social, political, and economic impact of the environmental policies, we estimate the features related to our important predictors using the average level of the EPI. In order to create a descriptive statistical framework we used both One-way ANOVA and Mann Whitney U Test. However, data were split by the lowest level of EPI (< 58) and highest values of EPI (> 58.1). Table 2 presents the descriptive statistics results and both the levels of confidence and significance.

Table 2. One-Way ANOVA. Descriptive statistics

Variables	EPI < 58.00			EPI >58.1			
	Mean	Std. Dev.	C.I.(95%)	Mean	Std. Dev.	C.I.(95%)	*p*
Environmental Performance	**53**	2.48	50.81; 56.98	**62**	3.17	59.41; 65.27	*0.001*
Climate Policy	**47**	4.86	40.97; 53.06	**55.24**	4.39	51.18; 59.30	*0.012*
GDP	**467.91**	204.61	100; 103.6	**190.16**	66.01	28.64; 351	*0.160*
GDP/ capita	**30238.8**	2349.7	23714; 36762	**35666,1**	2173.1	26465; 52119	*0.023*
Sustainability Index	**76.57**	2.73	73.18; 79.96	**80.36**	1.20	79.24; 81.47	*0.008*
Accountability	**0.87**	0.02	0.81; 0.94	**0.93**	0.05	0.92; 0.95	*0.017*
Freedom of Information	**61.4**	7.48	40.61; 82.18	**62.41**	5.26	58.85; 74.81	*0.879*
Public Procurement	**67.4**	6.89	48.25; 86.54	**66.83**	3.62	58.85; 74.81	*0.902*
Rule of Law	**0.62**	0.04	0.49; 0.74	**0.72**	0.02	0.65; 0.78	*0.05*
Life Expectancy	**74**	0.6	73; 76	**78**	1.03	75; 80	*0.05*
Global Health Security Index	**54.6**	2.49	47.7; 61.5	**56.87**	2.31	51.20; 61.54	*0.531*

Statistical results show that there are significant differences between research variables in the field of EPI, CP, GDP/ capita, RL and LE. Environmental Performance Index and Climate

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Policy Index have the lowest averages in Poland (EPI= 50.6; CP= 38.8), Bulgaria (EPI= 51.9; CP= 49.8), Hungary (EPI= 55.1; CP= 48.1), Lithuania (EPI= 55.9; CP= 47.1) and Romania (EPI= 56; CP= 51.3). Austria and Slovenia have registered the highest values related to EPI and CP (Austria EPI= 66.5; Slovenia EPI= 67.3). Concerning the distribution of the GDP/ capita we observed that there are significant differences between countries with the lowest scores of EPI and countries with an increased level of environmental performance. In this respect, low values of GDP/ capita are relevant for countries with EPI < 58.0. In contrast, there is a positive association between GDP/ capita and EPI > 58.1 in economically developed countries.

Concerning the differences between average values, we emphasize the fact that there are significant statistical differences in the field of RL (F= 3.89, p = 0.05), AC (F= 8.11, p < 0.05), and LE (F= 4.89, p < 0.05). Taking into account the variable related to life expectancy (LE), there are differences between these two groups. In countries characterized by a low score of EPI the average value of Life Expectancy (LE) is 74 years, four years less than in countries with efficient environmental policies.

Regarding the importance of GDP growth in the field of environmental performance, statistical results indicate that there is a moderate positive, but nonlinear relationship between economic factors and governmental efforts for sustaining a clean and robust environment. Thus, Austria could be considered an important country with a high level of GDP associated with an increased level of the environment performance index. Moreover, in most part of the countries included in the sample, there is a moderate statistical association between the level of GDP (average= 305 billion US$) and the level of EPI (average 55). Empirical findings suggest that there isn't a strong direct association between economic performance and environmental preservation. As it is presented in Figure 1, the model which best fit the relation between these two variables of the research is a cubic equation as follows:

$$EPI = 2.41 \cdot 10^{-7} \cdot GDP^3 + 4.01 \cdot 10^{-4} \cdot GDP^2 - 0.144 \cdot GDP + 69.8;\ R^2 = 0.635$$

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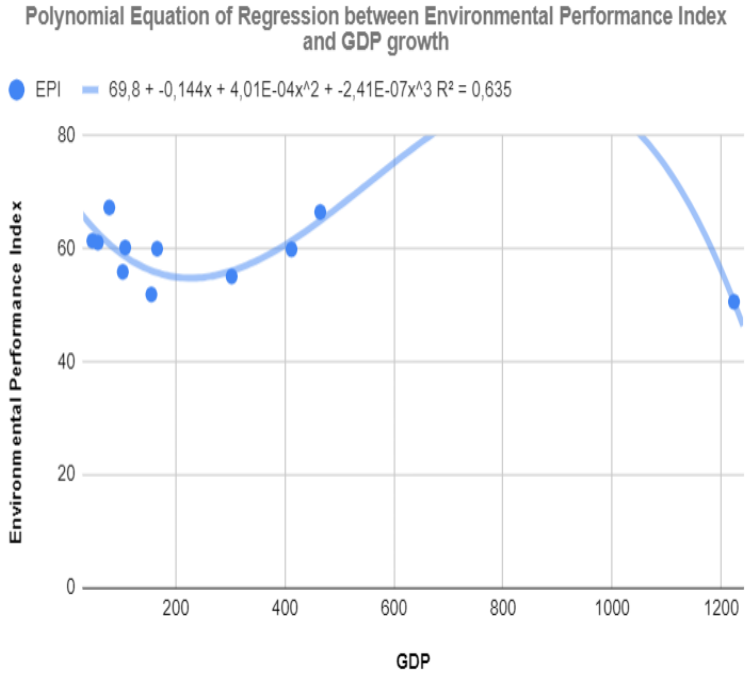
Figure 1. Polynomial Equation of Regression: EPI and GDP growth



A similar nonlinear relationship is observed in the field of civic accountability's impact in shaping an efficient environmental policy. The model that best fits the data is the cubic model, expressing an indirect effect that could have political and civic accountability in the field of the environment performance index. Austria (EPI=66.5; AC= 0.95), Slovenia (EPI=67.3; AC= 0.94) and Estonia (EPI=61.4; AC= 0.97) are significant countries for an increased level of political accountability and environmental performance. Ex-communist countries such as Romania (EPI=56; AC= 0.88), Poland (EPI=50.60; AC= 0.9), Bulgaria (EPI= 51.9; AC= 0.88) and Hungary (EPI= 55.10; AC=0.8) have registered both low rates of accountability and environmental performance. Concerning the role played by accountability in public policies, we argue that historical past and cultural heritage could be relevant factors for explaining the incremental evolution of governmental policies in countries like Bulgaria and Romania. Political mistrust and the lack of civic engagement are the main features of civic and political accountability in these post-communist countries. The nonlinear interaction between accountability and environmental performance index is expressed by the cubic equation of regression with R^2= 0.546. Following Figure 2, the polynomial model which best fits the correlation between these variables expresses a moderate positive association between accountability and environmental performance in Central and Eastern European countries.

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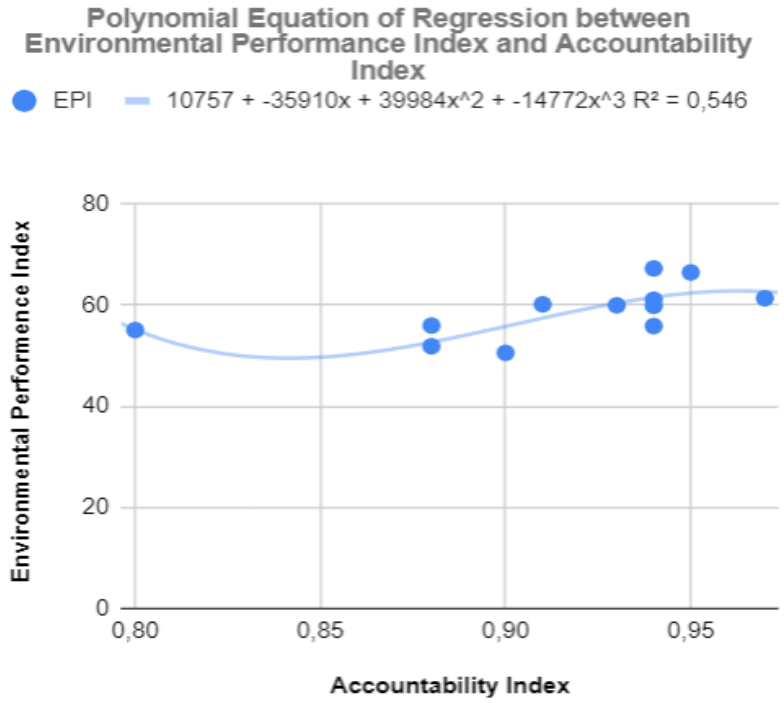
Figure 2. Polynomial Equation of Regression: EPI and Accountability



The nonlinear correlations between environmental performance and both GDP and accountability reflect the fact that economic growth and civic engagement could be seen as indirect factors that could explain and predict the further dynamics of the climate and environmental policies in Central and Eastern countries. It is obvious that civic and political engagement and accountability are important vectors of further governmental policies in the environmental sphere, but other economic or political factors are directly involved in predicting the current level of the EPI. In this respect, economic welfare, climate policy political coordination between economic actors, citizens, and decision-makers could be seen as independent variables that could generate changes in the structure of the environmental measures.

4. Predictors of Environmental Performance Index: welfare, political coordination and sustainable development

In order to explain the current evolutions related to environmental performance, this study shows several predictors that are linearly related to its dynamics. Using the multilinear regression we observe that economic welfare has an important impact in shaping environmental strategies and policies. In this respect, we argue that high-income countries are more prone to sustain and implement environmental policies than other countries from our sample. There is a strong linear correlation between economic welfare, measured through GDP/ capita, and the level of achieving an efficient strategy for environmental performance ($r = 0.882$, $p < 0.05$). Therefore, countries with increased GDP/ capita are more prone to configure policies for optimizing the quality of the environment. In contrast, we measured a moderate correlation between GDP/ capita and EPI in countries characterized by low income and welfare ($r = 0.58$,

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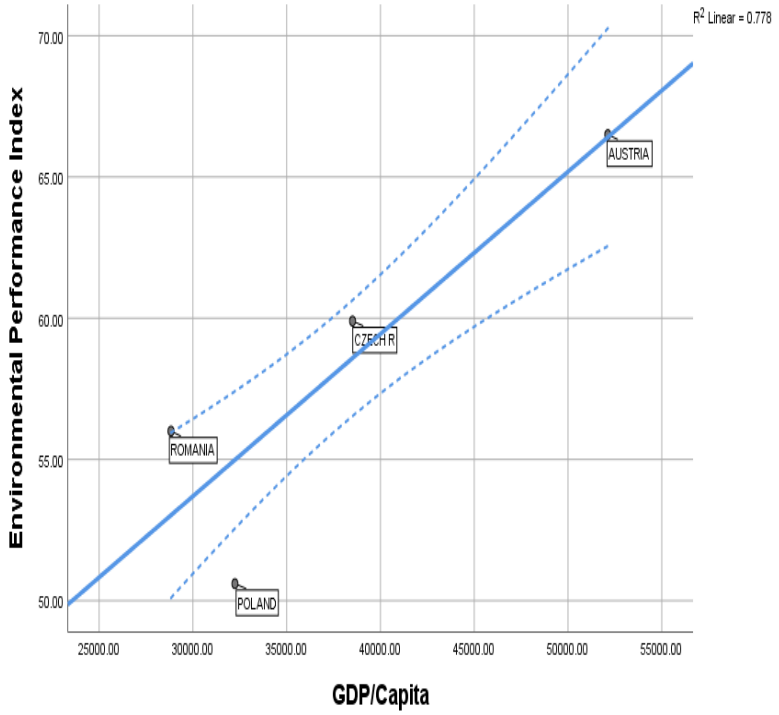
p <0.05). The Pearson' correlation coefficient is almost twice in the case of the economic developed countries as high as in other states. Therefore, we can sustain the hypothesis that economic welfare could be an important predictor for the further environmental performance positive evolutions. Figure 3 shows the linear association between environmental performance and economic welfare in Central and Eastern European countries:

Figure 3. Linear Equation of Regression: EPI and GDP/ capita (High- Income countries)



Taking into account countries like Austria, Czech Republic, Poland and Romania we observe that there is a linear association between the level of GDP/ capita and the dynamics of EPI. Moreover, a level of GDP/ capita upper than 40000$/ capita/ year is quite relevant for an upper level of environmental performance (EPI > 60). In this case, GDP/ capita < 35000$/ capita/ year is moderately related to decreased levels of EPI in Romania and Poland. In contrast with the high-income countries, in the rest part of the Central and European countries we observe a weak association between the level of individual welfare and environmental performance. In this respect, countries such as Latvia, Croatia, Slovakia and Estonia are characterized by a moderate level of GDP/ capita (average= 31144$/ capita/ year) and a middle level of environmental performance (average = 58). Countries like Hungary and Estonia have an increased level of GDP/ capita associated with low levels of environmental performance. The last position of this hierarchical distribution is represented by Bulgaria, with low levels of both GDP/capita and environmental performance index. The relationship between these variables and the confidence interval of mean are presented in the Figure 4.

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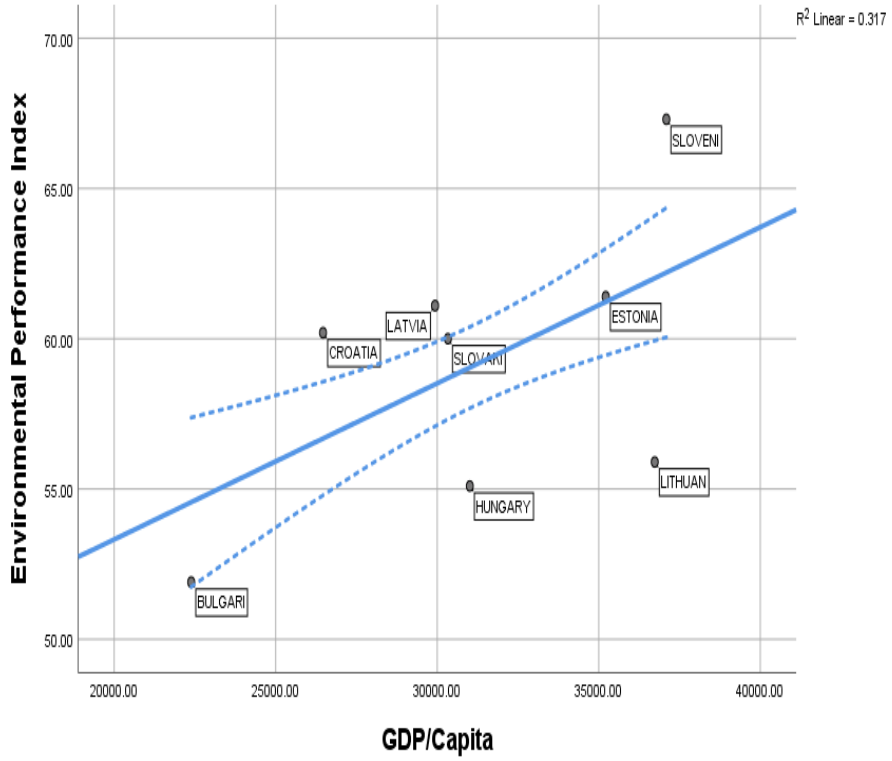
Figure 4. Linear Equation of Regression: EPI and GDP/ capita (Low- Income countries)



To predict the evolution of EPI in Central and Eastern European countries we used a multiple linear equation of regression as follows:

$$EPI = \alpha + \beta_1 \cdot CP + \beta_2 \cdot GDP/cap. + \beta_3 \cdot AC + \beta_4 \cdot FI + \beta_5 \cdot PP + \beta_6 \cdot RL + \beta_7 \cdot GSH + \varepsilon$$

Statistical results indicate that there are significant statistical correlations between environmental performance and economic welfare, governmental policies in the field of climate changes and the level of the sustainable development. In this respect, environmental policies should be shaped taking into account economic performance, goals of the sustainable development and global changes in the field of the climate policies. Achieving the main sustainable goals could be seen as a main priority for Central and Eastern European countries. In spite of the fact that there are increased values of the Sustainability Index both in Eastern and Central European countries, important issues in several sustainable development' sectors have been identified as well. Concerning the main issues in the field of the Central and Eastern European countries' sustainable development we underline that climate action (SDG 13), responsible consumption and production (SDG12) and reduced inequalities (SDG 10). In 32% of the countries of the sample, climate action is seen as an important goal which should be achieved until 2030. In accordance with this approach, in 28% of the statistical sample reduced inequalities and responsible consumption and production are relevant issues which should be sold for achieving an optimal level of sustainable development.

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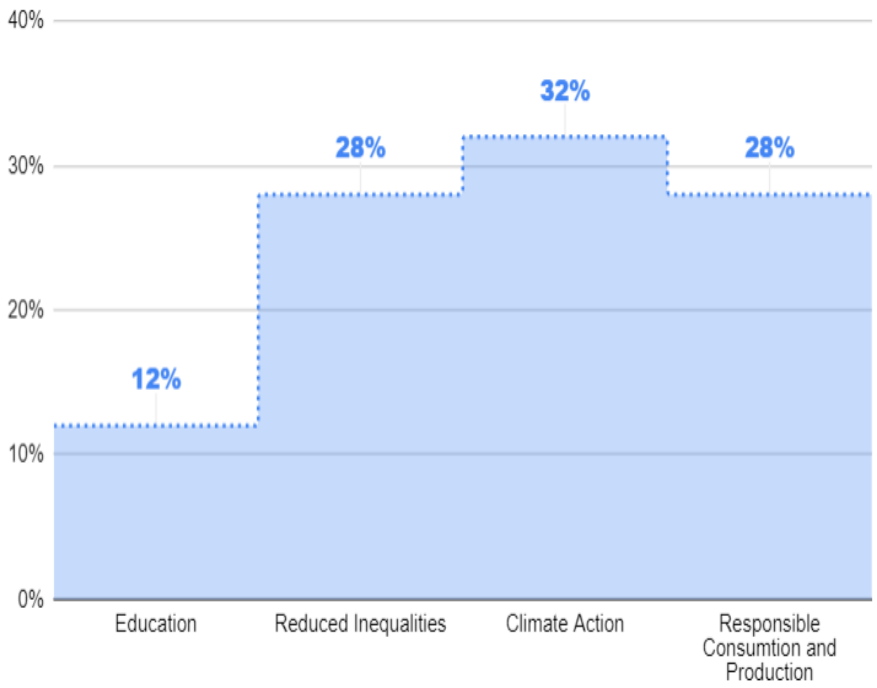
Figure 5. Issues in achieving SDG goals in Central and European Countries



The multiple linear equation of regression indicates that the variations of the EPI are positively related to sustainable development, governmental policy in the field of climate action and economic welfare, measured through GDP/ capita. The model has R^2= 0.95, F= 11.51 and p= 0.027. There are no residual autocorrelation effects in conditions in which the Durbin-Watson measure is 2.01. Moreover, the model is characterized by homoscedasticity with normal distribution values with the Shapiro-Wilk test = 0.653. Table 3 indicates the predictors of the study and their effects in correlation with the environmental performance measures.
In addition to the statistical results synthetized in Table 3, we support the idea that environmental performance could be explained by the interaction between sustainable development, GDP/ capita, and climate policy. In this respect, the model is described by the following multi-linear equation of regression:

$$EPI = -25.45 + 0.62 \cdot CP + 0.27 \cdot GDP/cap. + 0.34 \cdot SI$$

The trend line of the multiple linear regression shows a strong positive correlation between these factors and EPI, with the highest score in Slovenia and Austria. Average values related to both independent and dependent variables are specific for countries like Croatia, Estonia, Latvia, Czech Republic and Slovakia. In contrast, low values related to independent variables are met in Poland and Bulgaria.

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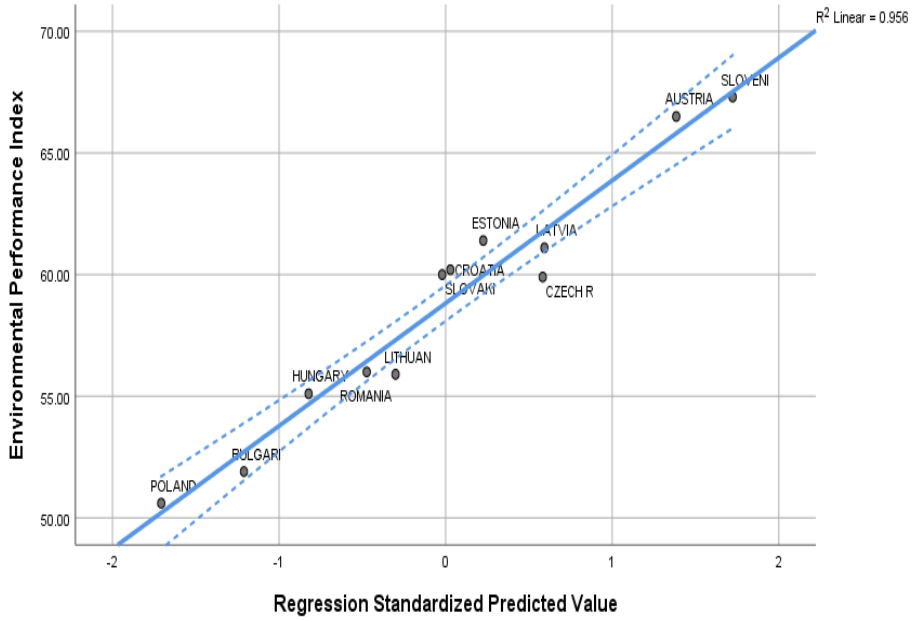
Table 3. Predictors of Environmental Performance Index

Variables	*β*	*T*	*p*	*VIF*
Climate Policy	0.620	7.750	0.01	1.76
GDP				
GDP/ capita	0.274	3.390	< 0.01	1.78
Sustainability Index	0.340	3.420	0.027	2.72
Accountability	0.112	2.06	0.131	1.46
Freedom of Information	0.010	0.128	0.907	1.17
Public Procurement	0.04	0.541	0.626	1.22
Rule of Law	0.08	1.046	0.626	1.79
Global Health Security Index	-0.06	-0.549	0.621	3.51
$R^2 = 0.95, p < 0.05$				

These combined factors could predict the evolution of EPI with values from 50.20 to 67.51 with an average of 58.82. Residual values have a normal distribution with symmetric values for minimum and maximum scores of the environment performance index.

Figure 6. Predictors of EPI in multiple regression



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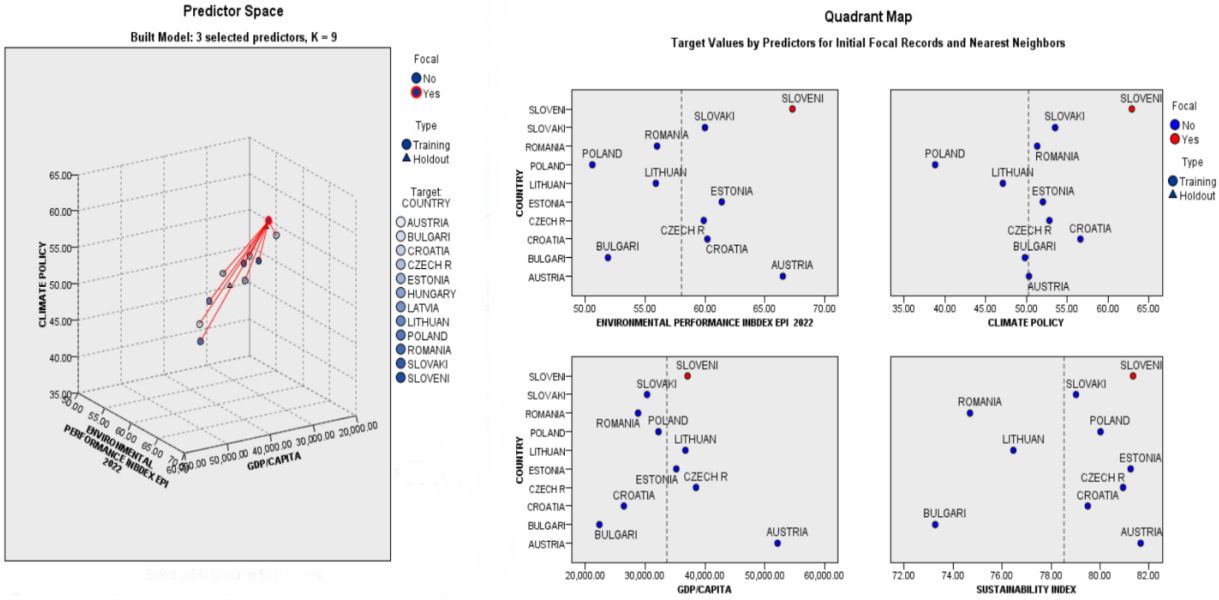
Using the nearest neighbourhood method we classified Central and Eastern European countries by the main relevant predictors. Therefore, we used two groups of classification with values before and after the arithmetic average. The method is based on the estimation of the Euclidean distance as follows:

$$Dx, y = \sqrt{\sum_{i=1}^{n} dx, y^2}$$

By the Euclidian distance, we obtained several categories related to the environment performance index, climate policy, GDP/ capita, and sustainability. Concerning the metrics related to the distribution of the EPI an important cluster with higher values is represented by the following countries: Slovakia, Slovenia, Estonia, Croatia, Czech Republic, and Austria. Generally speaking, Baltic and Central European states are more likely to develop efficient and sustainable environmental policies. In the field of climate policy, decreased statistical values are found in countries such as Poland and Lithuania. Although in most parts of the states included in the sample the level of GDP/ capita is quite similar, we can notice that high-income countries could be represented by Austria, Czech Republic, Baltic States, and Slovenia. In contrast to these increased values, Eastern countries are characterized by low income and serious issues in achieving an optimal level of sustainable development. Figure 7 presents the distances between statistical observations and the main clusters which are relevant for dependent and independent variables.

Figure 7. Predictors Space, Euclidian Distances and Nearest Neighbourhood



Synthetizing, this section emphasized the role played by economic welfare, climate policy, and sustainable development in the dispersion of the Environmental Performance Index. However, an efficient environmental policy should be shaped by combined political, economic, and societal factors.

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The coordination between these elements could increase the level of environmental performance and could improve the quality of public health and social life.

5. Conclusion

Environmental issues represent an important aspect of the contemporary social, economic, and political systems. Current social, economic, and health crises pointed out the relevance of environmental performance and protection in maintaining an optimal social and natural equilibrium as well as an optimal development. The UN goals related to the 2030 Agenda focused on the importance of environmental factors in shaping a new economic way of development. The green economy is an important trend in international economic practices, emphasizing the role played by green industries, green jobs, and clean energy for preserving natural resources and the environment. Therefore, in this context, the article stressed that economic, political, and civic factors could be relevant predictors of further environmental evolutions. In this respect, the paper analyzed comparatively the environmental performance in Central and Eastern European Countries.

The main research findings show that the coordination among political decision-makers, economic stakeholders, social and economic welfare, and civic accountability are the key concepts for understanding further environmental policies. Post-communist countries, such as the countries included in the sample, represent relevant examples regarding the economic efforts in sustaining and preserving a clean environment. Beyond the fact there are significant statistical differences between Central and Eastern Europe and Western or Scandinavian countries, we maintain the idea that the coordination among economic growth, welfare, climate actions and sustainable development represent relevant factors for future environmental policies. Public communication plays an important role in sharing relevant aspects of environmental strategies with the whole civic community. Statistical results and several theoretical perspectives related to this subject could improve the knowledge of both citizens and decision-makers interested in increasing the level of environmental performance.

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