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GOVERNMENT EXPENDITURE ON ENVIRONMENTAL PROTECTION AND ENVIRONMENTAL PERFORMANCE. EVIDENCE FROM EU COUNTRIES

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Abstract
During the last few years, environmental protection has become a much-debated topic at international, continental, and national level. The necessity of a green recovery is justified because such as COVID-19 virus had spread across borders, in the same way, the impact of climate change will be felt across the world. Thus, a green recovery is much needed based on policies that will simultaneously support economic recovery and environmental protection through investments in green projects. In this context, in December 2019, European Union (EU) launched the European Green Deal (EGD). In accordance with the EU's environmental policies, one of the EGD goals is for Europe to become the world's first 'climate-neutral' region, with net zero GHG emissions by 2050.
As a result, every EU member state has to make efforts to first accomplish this objective at national level. In this article, we want to investigate if, at this time, the EU member states and their governments allocate more funds and spend more money for environmental protection. Furthermore, we will investigate if there is a correlation between the government expenditure on environmental protection and environmental performance, measured according to the environmental performance index (EPI). For this purpose, we will apply the sigma-convergence approach to highlight the evolution over time of the cross-national dispersion in environmental spending for the period 2012-2021. Also, we want to identify if there is correlation between governmental expenditure and EPI. The results show that countries with higher government expenditure on environmental protection recorded a higher environmental performance index (EPI).

Keywords: *government expenditure on environmental protection; environmental protection; environmental performance index; sustainable development.*
JEL Classification: H50, N50, Q58.

1. INTRODUCTION

Preventing further environmental deterioration and slowing down climate change is one of the most pressing global issues of this century. Thus, present and future economic development must be supported by sound, robust, viable and efficient environmental sustainability policy that should channel public expenditures and encourage green investments because having a carbon free economy takes money and lots of it. The effectiveness and efficiency of spending such money on environmental protection are key to success.

During the last ten years, the European Union has improved its environmental protection policy, implementing different measures to achieve the development of a climate-neutral economy. Member States were urged to adjust their national environmental strategies and programs according to the EU environmental policy, to diminish discrepancies between them and to act together towards uniformity.

In December 2019, EU announced its climate-neutral growth strategy based on a set of political initiatives called EU Green Deal (European Parliament, 2021), which "provide the right policy tools for the transition towards environmentally sustainable businesses in Europe, while recovering from COVID-19 pandemic" (Dornean and Popescu, 2021, p. 411).

COVID-19 generated millions of tons of plastic waste because the use of facemasks, plastic food containers, and protective equipment (Wolf *et al.,* 2022) that needed recycling, which meant more pollution and greenhouse gas emissions (GHGs). Thus, during the 2021 Glasgow Climate Summit, the global community established a target of net-zero greenhouse gas emissions by 2050 and committed to more ambitious climate policies in pursuit of this goal.

The paper is structured in five sections as follows: the next section reviews the literature regarding the issue of environmental protection, in particular, the environmental protection expenditure and also the relationship between this type of public expenditure and environmental performance. Section 3 presents sample, data and methodology used in the present study. Section 4 illustrates and discuss the results. Finally, section 5 concludes the paper.

2. LITERATURE REVIEW

Eurostat, the statistical office of the EU, defines environmental protection expenditure as "the money spent on all activities directly aimed at the prevention, reduction and elimination of pollution or nuisances resulting from the production processes or consumption of goods and services" (Eurostat, 2016).

The efficiency of government expenditure on environmental protection is an important issue for achieving environmental protection and an important

determining factor for environmental quality (Halkos and Paizanos, 2013; Zhang *et al.,* 2019; Chang *et al.,* 2019).

A review of the literature in the field reveals an important number of studies which focused on China (Cheng and Chen, 2017; Zhang *et al.,* 2017; Wang, 2018; Zhang *et al.,* 2019; Jialu *et al.,* 2022; Tang *et al.,* 2022). The importance of environmental protection expenditure in China increased since the rapid development of China's economy which has been accompanied by various environmental problems. According to the 2022 EPI (Wolf *et al.,* 2022), China ranks the position 160 out of 180 countries and is the largest contributor to global carbon dioxide emissions.

In this context, we can mention the paper of Zhang *et al.* (2017), that investigated the relationship between the share of government expenditure over GDP and pollutant emissions with the objective to find the influence of the relative scale of government expenditure on environmental quality. The authors used the panel data of 106 Chinese cities for the 2002-2014 period and they found that the proportion of government expenditure does have a significant effect, but different, on pollutant emissions, namely: the estimated total effect of government expenditure is negative for sulfur dioxide (SO_2) and soot and chemical oxygen demand (COD), while it is positive for soot after GDP per capita reaching 7500 dollars. Also, the results obtained by Zhang *et al.* (2017) indicated that in a period of economic growth, the increase of GDP per capita was accompanied by a decrease of the SO_2 and soot emissions and an increase of the COD.

Furthermore, Wang (2018) analyzed the efficiency of public environmental expenditure using Data Envelopment Analysis (DEA)-Tobit Model for Central China over the period 2007-2015. The results of his study showed that government expenditure on environmental protection is inefficient, except for Hubei Province in Central China. Moreover, there are large differences among provinces in a different stage of scale return. From other perspective, the GDP per capita has a significant positive impact on the efficiency of fiscal expenditure on environmental protection, results which are in line with those obtained by Zhang *et al.* (2017).

Another paper examined the efficiency of government expenditure on environmental protection for China (Zhang *et al.,* 2019), using spatial econometric models on panel data of 30 provincial-level administrative regions in China over the period 2007-2016. Their conclusions highlighted three important results: first, the efficiency of government spending increased during the analyzed period; secondly, FDI is positively correlated with the efficiency of government environmental expenditure in terms of both quantity and quality of spending and it has a positive spillover effect; thirdly, financial decentralization is negatively correlated with the efficiency of environmental spending, but it improves the effect of FDI.

Other studies had investigated the impact of government expenditure on environmental protection on the economic growth (measured by GDP) of different countries. In this context, Krajewski (2016) conducted a study for eleven countries of Central Europe (Bulgaria, Croatia, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, Slovakia and Slovenia) in order to analyze the impact of public environmental protection expenditure on economic growth. Krajewski (2016) used an econometric panel model for the period 2001-2012 and his results revealed that the increase in public environmental protection expenditure has a positive effect on economic growth. A recent study (Levytska and Romanova, 2020) arrived to the same conclusion as Krajewski (2016). In their paper, Levytska and Romanova (2020) demonstrated that an increase of public environmental protection expenditure by 0.01% generated an increase of GDP by 0.36%. Their study was applied for Ukraine for a period of 18 years (2000-2017) and their results suggest that higher environmental expenditures in Ukraine can improve both environmental and economic situation.

Chang *et al.* (2019) conducted a comprehensive study regarding the impact of government expenditure on environmental protection among Asian countries. They have chosen to analyze Asia because it is the largest continent in the world in terms of both landmass size and population, and also because of the environmental pollution problems that Asia has been facing in tandem with the economic development. They analyzed 18 Asian countries from 2005 to 2014 and they obtained three important findings: first, higher environmental government expenditure generated a reduction of CO_2 emission and energy efficiency; secondly, excessive economic growth is detrimental to the environment, and increasing GDP per capita leads to increasing CO_2 emission, decreasing energy efficiency, and decreasing environmental performance; thirdly, FDI exerts a significantly negative impact on energy intensity and consequently on energy efficiency. To compare, Chang *et al.* (2019) included in their sample also 26 European countries covering the period 2008–2013. For these countries the impact was insignificant.

Contrary to Chang *et al.* (2019), Barell *et al.* (2021) demonstrated that higher environmental protection expenditures did not result in better environmental results. Barell *et al.* (2021) applied DEA methodology for the period 2005-2015 and their results revealed that Finland is the most effective in environmental protection, among the 30 analyzed countries (27 EU member countries, Switzerland, United Kingdom and Iceland).

One of the first empirical contributions to the academic debate on the efficiency of environmental expenditures in the European Union countries is the study of Ercolano and Romano (2018). They examined the correlation between the size and composition of public environmental expenditures and selected environmental performances and results. Ercolano and Romano (2018) identified

no significant bivariate correlation between EPI, public environmental expenditures in terms of GDP and GDP per capita.

Analyses dedicated to the level of environmental expenditures were conducted for OECD countries by Le Gallo and Ndiaye (2021). Using data from 1995-2017 on a sample of 28 OECD countries, Le Gallo and Ndiaye (2021) obtained that OECD countries consider their neighbors' behavior when making policy choices related to environmental expenditures which means that countries increased environmental expenditure as a response to the increase of environmental expenditure of their neighbors.

Thus, it is necessary to improve the efficiency of public environmental expenditure. Latif (2022) proposed a Comprehensive Environmental Performance Indicator (CEPI) using a composite index for 48 Asian economies, using six causal variables (Ecological Footprints Index (EFPI), Environmental quality index (EQI), Environmental vulnerability Index (EVLI), Environmental Sustainability Index (ESI), Adjusted Net Savings Index (ANSI), Pressure on Nature Index (PONI)) as determinants of environmental performance for the period 1996–2020. The index is useful for explaining the determinants of environmental performance and its contribution to economic growth and development. According to CEPI, the developed Asian economies presented better environmental performance compared to the low-income Asian economies.

The 2022 EPI (Wolf *et al.,* 2022) revealed that countries with the highest environmental quality are generally located in Europe (Australia being the exception). In particular, Denmark, United Kingdom and Finland are the top three, and most countries with the worst environmental performance are located in Africa and Asia, with India, Myanmar and Viet Nam making up the bottom three.

Resuming, studies proved that the efficiency of expenditures for environmental protection varies around the world. In some cases, environmental expenditures are direct proportional with the reduction of carbon emissions, while in other cases their efficiency fluctuates significantly because of their weak effectiveness. However, some European countries, including EU Member States, made good progress in protecting the environment as their environmental expenditures proved to be efficient.

3. METHODOLOGY AND DATA

3.1. Sample and methodology

For achieving our purpose, we have selected all the 27 EU countries, namely: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain and Sweden.

We use a sigma-convergence approach in order to investigate the evolution of the cross-national dispersion of government expenditure for environmental protection for the period 2012-2021.

Furthermore, we want to examine the correlation between government expenditure for environmental protection and Environmental Performance Index (EPI) for the analyzed period.

3.2. Data and descriptive statistics

All data for government expenditure for environmental protection were collected from Eurostat, for period 2012-2021, while the data for Environmental Performance Index (EPI) were collected from the web page dedicated to Environmental Performance Index (https://epi.yale.edu/). Since 2022, EPI is the most comprehensive global environmental indicator that leverages 40 performance indicators grouped into 11 issue categories, which are aggregated into three policy objectives: Environmental Health, Ecosystem Vitality, and Climate Change (Wolf *et al.,* 2022).

The descriptive statistics for the two selected variables are presented in Table 1. At a first glance, it can be observed that both variables increased during selected period (exception Portugal for which EPI decreased with 1.6). Regarding the government expenditure for environmental protection, the highest increase was recorded for Germany (7,460 mill. EURO), France (4,690 mill. EURO) and Italy (3,156 mill. EURO). At the same time, for the same period, the highest increase of EPI was recorded for Malta (25.40), Finland (21.00) and Croatia (17.20). Even so, EU expenditures on environmental protection remained relatively stable, ranging between 0.7% of GDP and 0.9% of GDP. Its share in total expenditure also remained relatively stable, varying between 1.4% and 1.7% of total expenditure (Eurostat, 2023b).

Table 1. Descriptive statistics

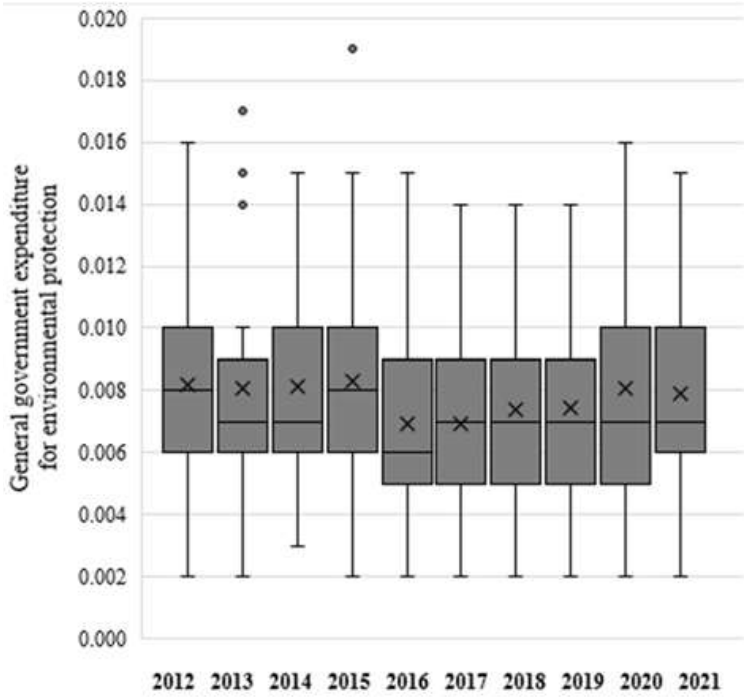
Country	General government expenditure for environmental protection period 2012-2021 (million euro) [a]				Environmental Performance Index (EPI) [b]		
	Average	Min	Max	Increase 2021 vs 2012	EPI 2012	EPI 2022	EPI (10 years change)
Austria	1,491	1,324	1,751	227	59.30	66.50	7.20
Belgium	5,914	5,059	6,755	1,076	52.10	58.20	6.10
Bulgaria	381	289	559	288	47.30	51.90	4.60
Croatia	483	258	868	687	43.00	60.20	17.20
Cyprus	59	44	90	54	52.00	58.00	6.00

Country	General government expenditure for environmental protection period 2012-2021 (million euro) [a]				Environmental Performance Index (EPI) [b]		
	Average	Min	Max	Increase 2021 vs 2012	EPI 2012	EPI 2022	EPI (10 years change)
Czech Republic	1,803	1,329	2,220	151	54.70	59.90	5.20
Denmark	1,187	1,018	1,259	283	63.00	77.90	14.90
Estonia	161	126	193	13	55.30	61.40	6.10
Finland	503	453	579	182	55.50	76.50	21.00
France	22,635	21,009	26,013	4,690	56.10	62.50	6.40
Germany	18,479	15,741	23,107	7,460	60.20	62.40	2.20
Greece	2,537	2,092	3,058	263	51.90	56.20	4.30
Hungary	964	576	1,341	400	53.10	55.10	2.00
Ireland	1,264	1,041	1,483	312	54.90	57.40	2.50
Italy	15,355	13,962	16,968	3,156	51.70	57.70	6.00
Latvia	162	135	188	17	52.90	61.10	8.20
Lithuania	238	187	300	24	52.70	55.90	3.20
Luxembourg	487	361	668	443	58.80	72.30	13.50
Malta	149	109	195	104	49.80	75.20	25.40
Netherlands	10,445	9,320	11,938	2,628	56.70	62.60	5.90
Poland	2,489	1,783	3,224	1,122	50.60	50.60	0.00
Portugal	1,222	1,031	1,721	714	52.00	50.40	-1.60
Romania	1,324	934	1,679	434	50.70	56.00	5.30
Slovakia	718	597	929	411	56.80	60.00	3.20
Slovenia	291	194	404	100	58.70	67.30	8.60
Spain	10,288	9,105	12,194	2,165	49.30	56.60	7.30
Sweden	2,251	1,936	3,017	1,316	56.90	72.70	15.80

Source: [a] – authors' calculation, based on Eurostat (2023a)
[b] – authors' calculation, based on EPI (2023)

4. RESULTS AND DISCUSSION

In Figure 1, we illustrate ten box plots built, by using cross-country yearly data for period 2012-2021, regarding general government expenditure for environmental protection as % from GDP.

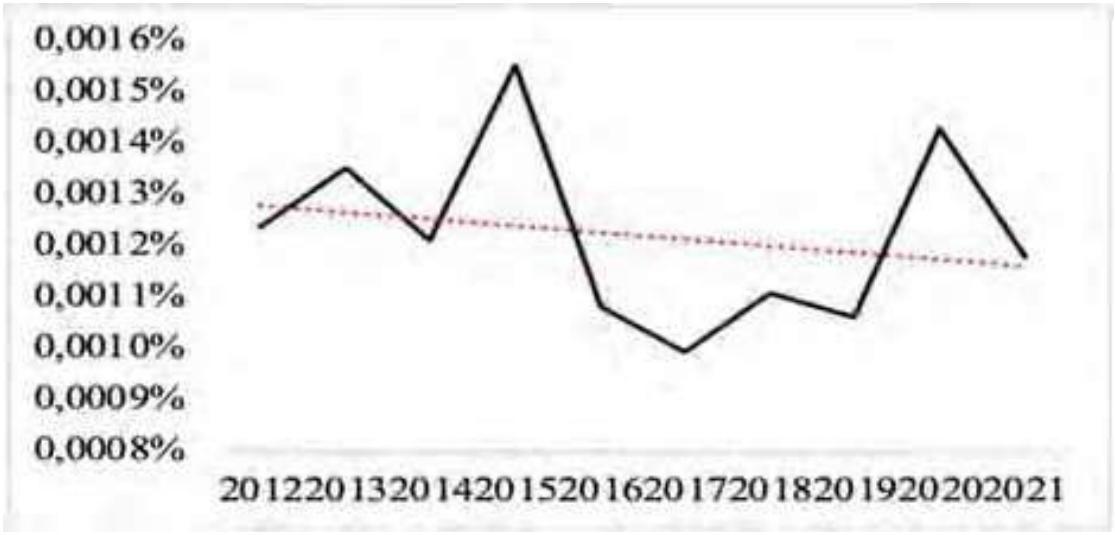


Source: suthors' calculation, based on Eurostat database (2023a)

Figure 1. General government expenditure for environmental protection in EU countries (% GDP)

We can observe that the median value of public expenditure for the environment slightly decreased over the period 2012-2021.

Overall, we can say that the expenditures allocated for environmental protection by UE countries remained relatively high during the analyzed period, even if the increase of this category varies across countries. However, in Figure 1 and Figure 2, we can identify that cross-country variability in public expenditure for environmental protection decreased slightly over the period 2012-2021. This evolution highlights that EU countries have different policies regarding environmental protection, as we are able to see from table 1. We are able to identify countries as Germany, France and Italy which increased the yearly spending in average with more than 300 million euro for analyzed period, while on the opposite side, there are countries as Cyprus, Estonia, Latvia, Lithuania, Slovenia which increased the yearly spending in average with less than 10 million euro for the same period. Of course, the explanation regarding this variation across EU countries is based on different levels of economic development, which means that the more developed countries can allocate more for environmental protection compared to the less developed countries.



Source: authors' calculation, based on Eurostat database (2023a)

Figure 2. Coefficient of variation calculated on yearly cross-national data of general government expenditure for environmental protection (% GDP) by year

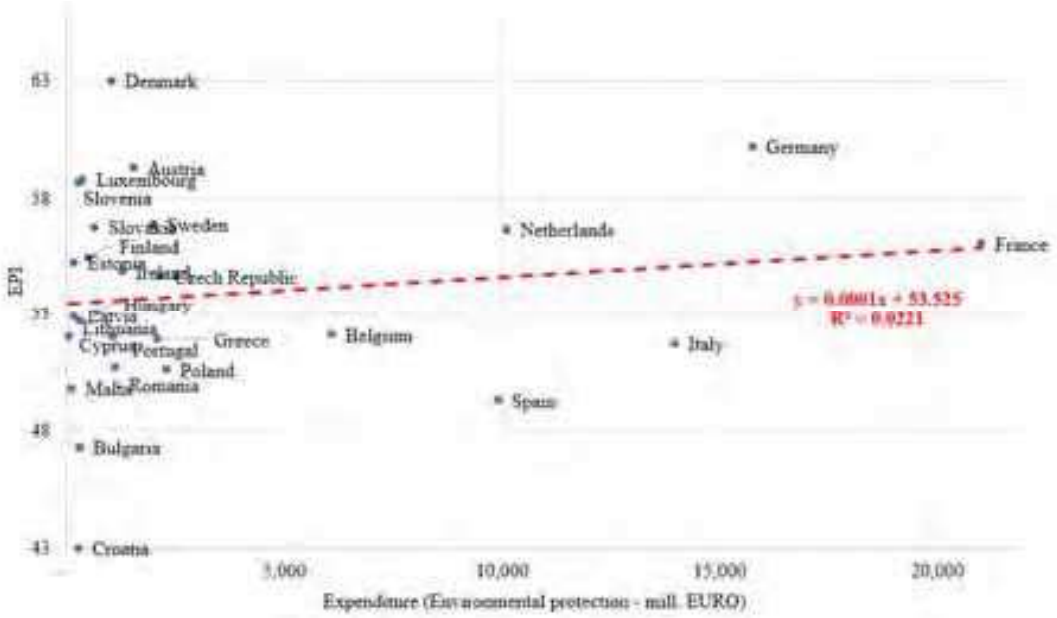
Next step is to analyze the correlation between governmental expenditure and EPI (Table 2). The interesting fact is that at the beginning of the period in 2012, there is recorded a positive correlation between these two analyzed variables, while at the end of the period the correlation becomes negative (even if the values is slow). Despite this, if we take into account the average values for the entire period, it looks that between governmental expenditure for environmental protection and EPI exists a positive correlation.

Table 2. Correlation coefficients between governmental expenditure and EPI

Period	Correlation
2012	0.1486
2022 [a]	-0.0775
AVG 2012 - 2022 [b]	0.0044

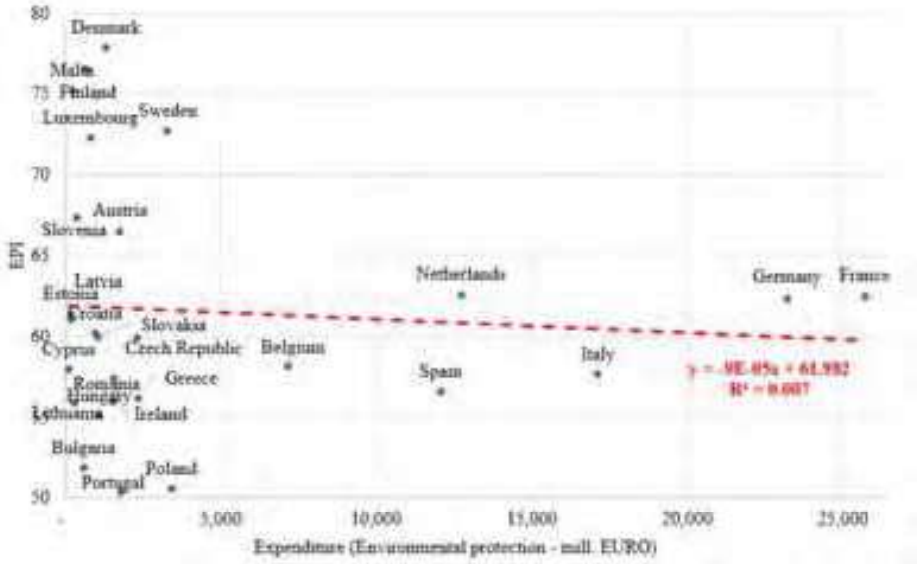
Source: [a] – Due to data availability we consider EPI for 2022 and government expenditure for environmental protection for 2021 (EPI, 2023; Eurostat, 2023a)
[b] – Average for government expenditure for environmental protection is calculated based on values for period 2021-2021, while the average for EPI is calculated for 2012 and 2022 (EPI, 2023; Eurostat, 2023a)

The same trend can be seen in Figures 3, 4 and 5, in which we had represented scatter plot reporting EPI and general government expenditure for environmental protection in 2012, 2021/2022 and the average for the entire analyzed period.



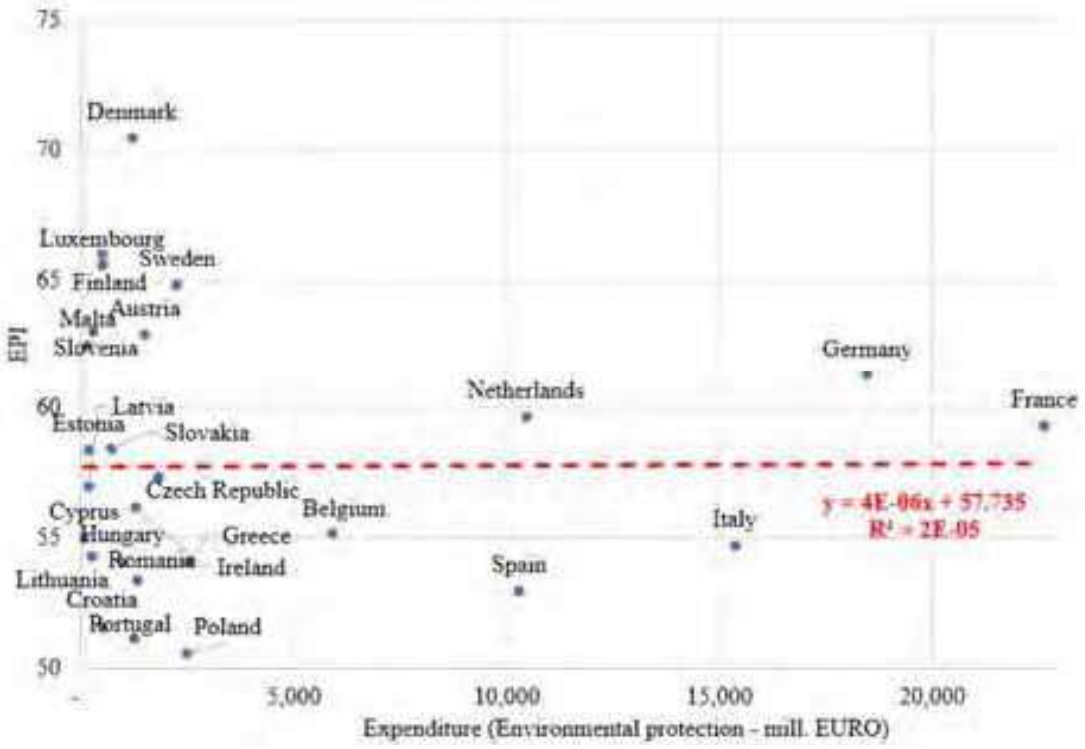
Source: authors' calculation, based on Eurostat database (2023a) and EPI database (2023)

Figure 3. Scatter plot reporting EPI and general government expenditure for environmental protection in 2012



Source: authors' calculation, based on Eurostat database (2023a) and EPI database (2023)

Figure 4. Scatter plot reporting EPI and general government expenditure for environmental protection for 2021/2022



Source: authors' calculation, based on Eurostat database (2023a) and EPI database (2023)

Figure 5. Scatter plot reporting EPI and general government expenditure for environmental protection for the period 2012-2022 (average)

5. CONCLUSIONS

This paper investigated the link between general government expenditure for environmental protection and EPI. Using data for the period between 2012 and 2022, we found that during this time, there was a shift in the correlation between these two indicators, respectively from a positive correlation recorded at the beginning of period to a negative correlation at the end of the period. Despite this, overall, for the entire period the correlation between EPI and general government expenditure for environmental protection remains positive. Thus, if EU countries want to accomplish the objective of EGD, and to become the world's first 'climate-neutral' region, with net zero GHGs emissions by 2050, they have to continue their effort in this direction.

Furthermore, analyzing the evolution of government expenditure for environmental protection for EU countries, we found that there is not a common direction in this respect, on the contrary, there are many divergent ones. We were able to identify countries such as Germany, France and Italy which increased the yearly spending in average with more than 300 million euro over the analyzed period, while on the opposite side, there are countries like Cyprus, Estonia, Latvia, Lithuania, Slovenia which increased the yearly spending in average with less than 10 million euro during the same period.

Our paper contributes to the literature in the field by empirically analyzing the efficacy of government spending for environmental protection, even if we are aware of the limitation of our research, using only EPI as indicator of environmental performance.

In the future, our analysis can be extended further in order to investigate not only the level of the government expenditure on environmental protection, but also the different composition of this expenditures according to the international classification of the functions of government (COFOG) (expenditure for waste management, expenditure for waste-water management, expenditure for pollution abatement, expenditure for protection of biodiversity and landscape, expenditure for research and development, other type of expenditure for environmental protection not elsewhere classified) and how these are correlated to different indicators that measure environmental performance.

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