AN ECONOMETRIC PERSPECTIVE ON PUBLIC ENVIRONMENTAL CAPITAL FORMATION AND INDUSTRIAL EMISSIONS: EVIDENCE FROM SEVEN EU COUNTRIES

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Abstract: This paper investigates the dynamics and relationship between greenhouse gas emissions from industrial processes and product use (GHG), and general government expenditures on environmental protection in gross fixed capital formation (GFCF). Based on data extracted from Eurostat covering the period from 2005 to 2022, we employed ordinary least squares regression models to assess the degree to which general government expenditures in environmental protection in gross fixed capital formation impact greenhouse gas emissions from industrial processes, and product use. The results show a negative and statistically significant relationship between GFCF and GHG in France, Germany and Romania and the assumptions of linear regression were met, or corrections were employed using the Prais-Winsten procedure.
In contrast, there is no clear linear relationship between the indicators analysed in Bulgaria, the EU, Hungary and Poland.
The results show that public expenditures on gross fixed capital formation in environmental protection have a heterogeneous effect on greenhouse gas emissions across the selected countries. Therefore, each country should tailor its strategies to mitigate emissions.

Keywords: emissions, public investments, industry, environment, econometrics

JEL Classification: C33, C51, H54, Q53

1 Introduction

One of the EU's priorities is to achieve climate neutrality by 2050. To this end, greenhouse gas emissions should be reduced in stages, by 55% in 2030 and by 90% in 2040. These ambitious targets entail significant changes in industrial production, specifically its transformation from a linear, extract-produce-waste model to the circular one, based on a reuse, repair and recycle model. How to achieve these targets is a topic of discussion among scholars and decision-makers across the EU. This paper aims to provide an assessment tool that demonstrates how public investments in gross fixed capital formation in environmental protection could impact industrial greenhouse gas emissions across the analysed countries of the EU.

According to Statista (2025a), in 2023, the power sector was the largest generator of GHG emissions, accounting for 15 gigatonnes of carbon dioxide equivalent, of which coal-fired power plants produced 70%. The transportation sector ranks second, accounting for up to 16% of global emissions, mainly from road vehicles, particularly passenger cars. In this context, mitigating the emissions from industrial processes and product use becomes relevant for scholars and decision-makers who shape environmental policies.

From 2000, when the USA was the largest emitter of GHGS, to 2023, the EU decreased GHG emissions by 28%, and the United States by 17%. By contrast, China boosted GHG emissions by 163% (Statista, 2025b).

According to Eurostat (2025a), general government expenditures in environmental protection in gross fixed capital formation (GFCF) include public investment in long-term, physical assets intended to prevent, reduce, or eliminate pollution and other environmental degradation(Eurostat, 2025a) and greenhouse gas emissions from industrial processes, and product use (GHG) include data on carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), perfluorocarbons (PFCs), hydrofluorocarbons (HFCs), sulphur hexafluoride (SF6) and nitrogen trifluoride (NF3).

2 Literature review

Zioło et al. (2019) found that energy productivity substantially impacts greenhouse gas emissions and emphasised that environmental taxes help mitigate emissions, particularly in developed countries.
Kaur et al. (2022) discovered a positive relationship between greenhouse gas emissions and expenditures for implementing mitigation strategies to address climate change.

Tang et al. (2024) show that environmental public spending reduces regional carbon emissions. Spada et al. (2019) showed that agricultural research and development investments decrease the livestock sector's impact on GHG emissions and the environment. Mohamued et al. (2021) found a positive effect of innovation on GHG emissions reduction initiatives in oil-importing countries.

In Spain, Retegi et al. (2014) identify sectors responsible for 71% of all industrial greenhouse gas emissions, namely the manufacture of other non-metallic mineral products, the manufacture of chemicals and chemical products, the manufacture of food products and the manufacture of basic metals.

Beke-Trivunac et al. (2014) demonstrate that only a small portion of environmental spending is allocated to long-term investments, most of it being diverted to pollution abatement, waste and wastewater management and biodiversity protection for operating expenses.

Dincă et al. (2023) emphasise that public spending in the southern EU region is influenced by greenhouse gas emissions from the agricultural sector, temperature and GDP.
Lim and Moon (2020) argue that increased awareness of environmental threats positively leads to greater support for growing public spending and lower living standards. In addition, Kulin and Sevä (2019) suggest that people support increasing government spending on the environment if they believe public institutions are fair, effective and incorruptible.

Azaki and Lutfi (2022) underline that "a green infrastructure investment policy framework can be developed through five main approaches: alignment of policy goals and targets, policies that enable investment to grow through incentives, development of investment schemes/financial instruments, strengthening of alternative resources and institutional capacities, and promoting the importance of green investment."

This paper examines the previously unexplored impact of general government expenditures on environmental protection in gross fixed capital formation on greenhouse gas emissions from industrial processes and product use, emphasising immediate and delayed effects of this relationship through robust economic models across seven EU countries.

3 Methodology

The data on greenhouse gas emissions from industrial processes, product use (GHG), and general government expenditures in environmental protection in gross fixed capital formation (GFCF) were extracted from the Eurostat database (Annexes 1 and 2). We selected Romania's neighbouring countries, Bulgaria and Hungary, as well as France, Germany, Italy, and Poland, countries that rank high in the EU's rankings regarding the selected indicators.

First, we analysed the percentage change of the selected indicators from 2005 to 2022, to ascertain their trends and compare them, thereby adding a better understanding of the results of the second step, namely the econometric analysis. We used ordinary least squares regression in Gretl based on the log-transformed GHG as the dependent variable and the log or log-lag GFCF as the predictor to reveal how a 1% increase in GFCF in the same or previous year impacts GHG as a percentage. The identified statistically significant relationships were tested to determine if they met the linear regression assumptions of linearity, homoskedasticity, normality, and lack of autocorrelation. Autocorrelation was corrected with the Cochrane-Orcutt or Prais-Winsten procedures.

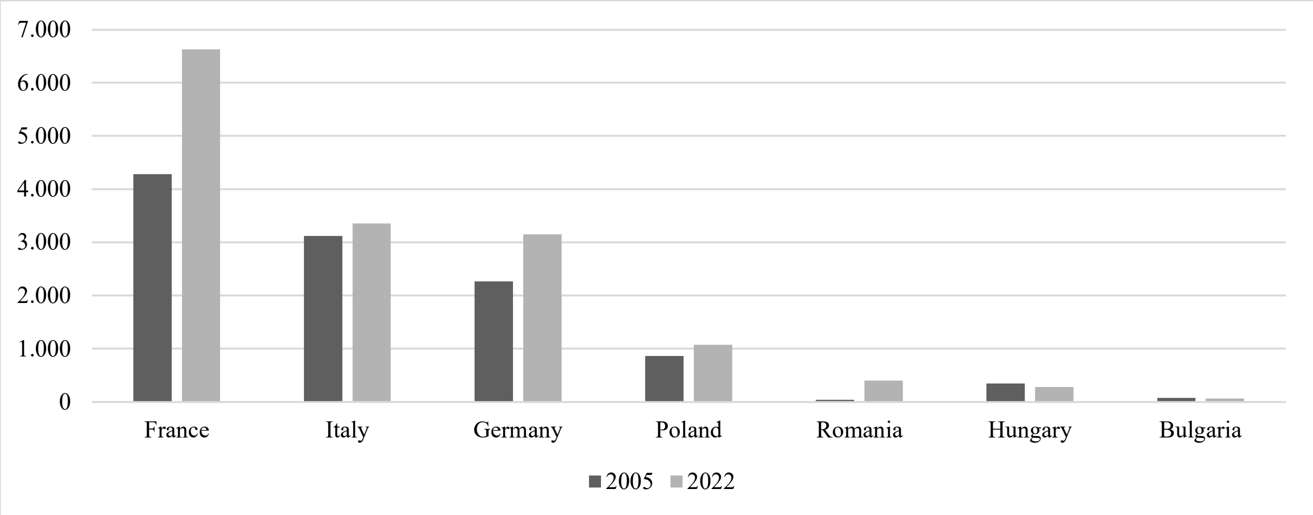
4 Quantitative analyses

Between 2005 and 2022, in the EU, general government expenditures on environmental protection in gross fixed capital formation increased by 34.5%, from 18.2 billion euros to 24.5 billion euros.

In 2022, France ranked first in the EU with 6.6 billion euros, representing a 54.73% increase from 2005 (Figure 1). It was followed by Italy (3.4 billion euros with a 7.4% increase) and Germany (3.1 billion euros with a 39.1% increase in the analysed interval). From the former Eastern Bloc, Poland spent the most on environmental protection, namely 1.1 billion euros, a 24.2% increase from 2005, seconded by Romania (400 million euros and a boost of 994% in the same interval, the highest among the EU countries), Hungary (277 million euros and a decrease of 19%), and Bulgaria (63.5 million euros and a drop of 13.7%).

It is worth mentioning that during the first year of COVID-19 pandemic, some countries increased government expenditures on environmental protection in gross fixed capital formation: Italy (by 7.72%), Germany (by 3.65%), Poland (by 1.79%) and Romania (by 1.68%), while the rest of the analysed countries decreased it: France by 10.61%, Hungary by 1.06%, Bulgaria by 0.98%. Overall, the EU decreased GFCF by 0.44% between 2019 and 2020.

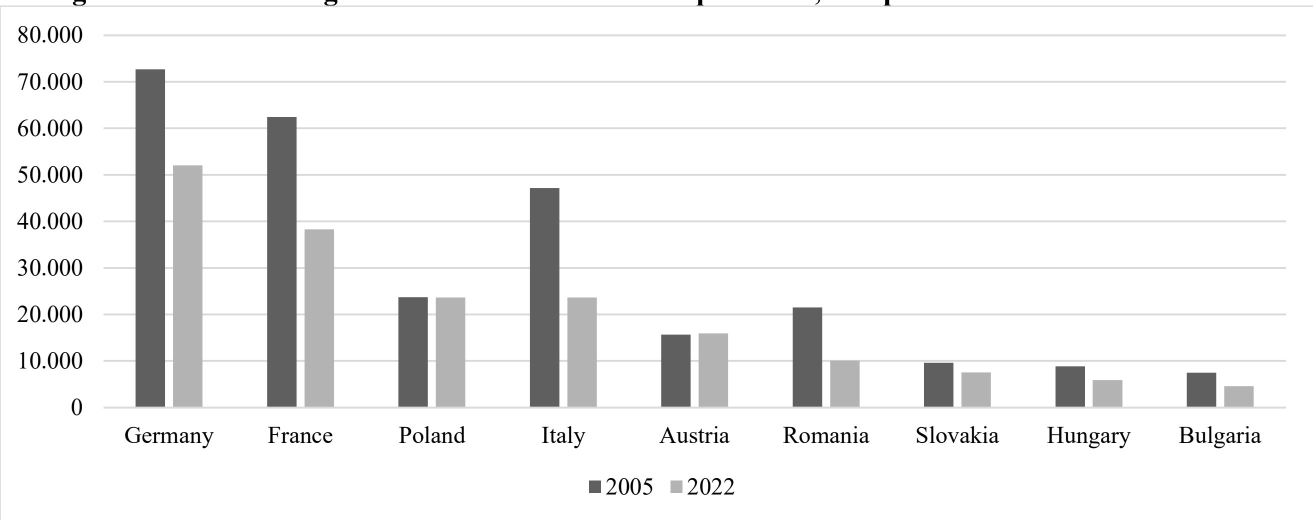
Figure 1. General government expenditures in environmental protection in gross fixed capital formation - million euro -



Source: Eurostat (2025a).

In the same time interval, greenhouse gas emissions from industrial processes and product use (GHG) in the EU decreased by 32.12%, from 430 million tonnes in 2005 to 292 million tonnes in 2022.

Figure 2. Greenhouse gas emissions from industrial processes, and product use - Thousand tonnes

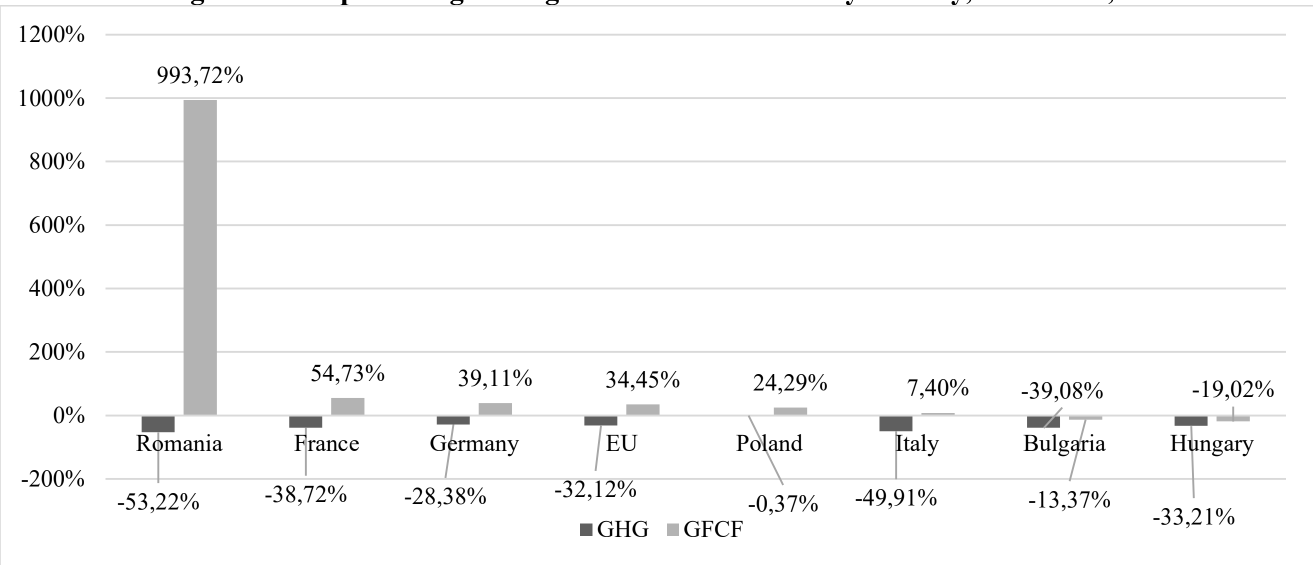


Source: Eurostat (2025b).

Regarding GHG emissions, in 2022, Germany was the largest polluter in the EU, with 52 million tonnes, a 28.4% decrease from 2005, followed by France (38.3 million tonnes, and a drop of 38.7%) and Poland (23.6 million tonnes and a slight decline of 0.37% from 2005). Romania registered the highest reduction in GHG emissions, by 53.2%, from 21.5 million tonnes in 2005 to 10 million tonnes in 2022. It was followed by Italy (-50%) and Bulgaria (-39%).

Between 2019 and 2020, the first year of the COVID-19 pandemic, the highest reductions in GHG emissions were recorded in France (-13%), Italy (-11%) and Germany (-7%). Increases were registered in Romania (0.92%) and Hungary (0.22%).

Figure 3. The percentage change in GHG and GFCF by country, 2005-2022, %



Source: Author's based on data from Eurostat (2025a and b).

Regarding the percentage change over the analysed time frame, the highest increase in GFCF was recorded in Romania (993.72%), accompanied by a reduction in GHG of 53.22%, followed by France, which experienced a 54.73% increase in GFCF and a decrease in GHG of 38.72% and by Germany that recorded a 39.11% growth in GFCF associated with a decline of 23.38% in GHG.

Despite a 24.29% increase in GFCF, Poland recorded virtually no reduction in emissions. By contrast, Italy achieved a significant reduction in GHG with minimal expenditures.

Bulgaria and Hungary represent a special category of countries in which the emissions decreased against the background of reduced expenditures.

5 Econometric analysis

The econometric analysis was based on the data from Annexes 1 and 2. We used a log-log Ordinary Least Squares model (OLS) in which both dependent and independent variables are log-transformed using Gretl, Add, and Logs of selected variables. The models allowed us to estimate elasticity directly: a 1% change in X, the independent variable (GFCF), results in a ß% change in Y, the dependent variable (GHG).

Model log-log lag (OLS regression) for Romania

For Romania, we used the log GFCF and the log GHG. Under Gretl, we used the following steps: Model and Ordinary Least Squares. In the window (gretl: specify model), we selected l_GFCF as regressor and under (lags…) we selected lag order 1 to 1. The dependent variable was l_GHG. The results of the regression model are displayed in Table 1. For Romania, we used log-transformed data on general government expenditures in environmental protection in gross fixed capital formation (GFCF) lagged by one year to achieve better results, and log-transformed data on greenhouse gas emissions from industrial processes, and product use (GHG).

Table 1: OLS, using observations 2006-2022 (T = 17). Dependent variable: l_GHG

	Coefficient	*Std. Error*	*t-ratio*	*p-value*	
const	10.8290	0.240617	45.01	<0.0001	***
l_GFCF_1	−0.227843	0.0413905	−5.505	<0.0001	***

Mean dependent var	9.514634	S.D. dependent var	0.206086
Sum squared resid	0.225004	S.E. of regression	0.122476
R-squared	0.668888	Adjusted R-squared	0.646814
F(1, 15)	30.30189	P-value(F)	0.000061
Log-likelihood	12.63928	Akaike criterion	−21.27856
Schwarz criterion	−19.61214	Hannan-Quinn	−21.11292
rho	0.094300	Durbin-Watson	1.621227

The linear relationship was tested at a 95% confidence level to see if it was statistically significant.

The null hypothesis (H_0) implied that there was no statistically significant linear relationship between l_GFCF_1 and l_GHG in Romania.

The alternate hypothesis (H_a) supported a statistically significant linear relationship between the two variables.

H_0: $\rho = 0$. H_a: $\rho \neq 0$.

The regression statistics are displayed in Table 1.

Since the P-value = 0.0001, smaller than the significance level: $\alpha = 0.05$, the null hypothesis (H_0) is rejected (Table 1).

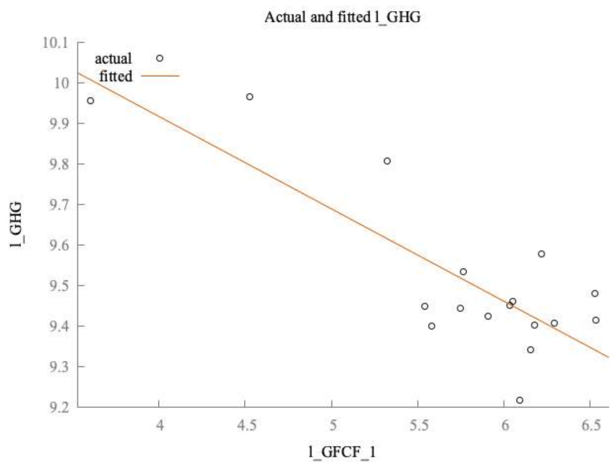
Therefore, we are 95% confident that a statistically significant linear relationship exists between l_GFCF_1 and l_GHG in Romania.

Table 2: The results of tests to verify the assumptions

Lagrange Multiplier (LM) test for non-Linearity (squared terms), Null hypothesis: relationship is linear, α = 0.05	Test statistic: LM = 0.28034 with p-value = P(Chi-square(1) > 0.28034) = 0.596478 P-value> α, we fail to reject the null hypothesis Relationship is linear
White's test for heteroskedasticity, Null hypothesis: heteroskedasticity not present, α = 0.05	Test statistic: LM = 1.22527 with p-value = P(Chi-square(2) > 1.22527) = 0.541922 P-value> α, we fail to reject the null hypothesis Homoskedasticity
Test for normality of residuals, Null hypothesis: error is normally distributed, α = 0.05	Test statistic: Chi-square(2) = 0.024551 with p-value = 0.9878, P-value> α, we fail to reject the null hypothesis Error is normally distributed
Breusch-Godfrey test for autocorrelation up to order 3, Null hypothesis: no autocorrelation, α = 0.05	Test statistic: LMF = 1.2428 with p-value = P(F(3, 12) > 1.2428) = 0.33741, P-value> α, we fail to reject the null hypothesis No autocorrelation
Estimated Equation of the regression line	*Log(GHGt)=10.83-0.23log(GFCFt-1) (Figure 4)*

According to the model, in Romania, a 1% increase in GFCF in the previous year is associated with a 0.23% decrease in GHG in the current year.

Figure 4: Actual and Predicted Log(GHG) in Romania Based on Lagged GFCF (2006–2022)



The model is statistically significant at a 95% confidence level ($\alpha = 0.0001<0.05$). R-squared = 0.6689, suggesting that 67% of the variation in GHG is explained by the relationship between the two selected variables.

The same methodology, with various procedures, was applied to the EU, as well as to Bulgaria, France, Germany, Hungary, and Poland, as shown in Table 3.

Table 3: Summary table of linear regression statistical data and associated tests

Country/ Indicators	EU	Bulgaria	France	Germany	Italy	Hungary	Poland	Romania
r	-0.043	0.156	0.779	0.648	0.655	0.174	0.236	0.818
R^2	0.001	0.024	0.607	0.419	0.429	0.030	0.056	0.669
P-value	P-value, $0.871>\alpha$	P-value, $0.548>\alpha$	P-value, $0.0002<\alpha$	P-value, $0.0004<\alpha$	P-value, $0.004<\alpha$	P-value, $0.505>\alpha$	P-value $0.362>\alpha$	P-value. $0.0001<\alpha$
Intercept	14.189	8.198	22.959	14.937	5.931	9.059	10.465	10.829
Slope	−0.157	0.071	−1.424	−0.485	0.566	−0.038	−0.049	−0.228
Statistical significance at a 95% confidence level	No	No	Yes	Yes	Yes	No	No	Yes
Lagrange Multiplier (LM) test for non-Linearity (squared terms) Null hypothesis: relationship is linear, α=0,05			Test statistic: LM = 0.400558 with p-value = P(Chi-square(1) > 0.400558) = 0.526801 p-value >α Relationship is linear	Test statistic: LM = 0.570652 with p-value = P(Chi-square(1) > 0.570652) = 0.45 p-value >α Relationship is linear	Test statistic: LM = 1.86598 with p-value = P(Chi-square(1) > 1.86598) = 0.171936 p-value >α Relationship is linear			Test statistic: LM = 0.28034 with p-value = P(Chi-square(1) > 0.28034) = 0.596478 p-value >α Relationship is linear
White's test for heteroskedasticity, Null hypothesis: heteroskedasticity not present, α=0,05			Test statistic: LM = 0.779211 with p-value = P(Chi-square(2) > 0.779211) = 0.677324 p-value >α Homoskedasticity	Test statistic: LM = 4.75071 with p-value = P(Chi-square(2) > 4.75071) = 0.0929817 p-value >α Homoskedasticity	Test statistic: LM = 2.28152 with p-value = P(Chi-square(2) > 2.28152) = 0.319576 p-value >α Homoskedasticity			Test statistic: LM = 1.22527 with p-value = P(Chi-square(2) > 1.22527) = 0.541922 p-value >α Homoskedasticity
Test for normality of residuals, Null hypothesis: error is normally distributed, α=0,05			Test statistic: Chi-square(2) = 3.45389 with p-value = 0.177827 p-value >α Error is normally distributed	Test statistic: Chi-square(2) = 1.39718 with p-value = 0.497287 p-value >α Error is normally distributed	Test statistic: Chi-square(2) = 3.51922 with p-value = 0.172112 p-value >α Error is normally distributed			Test statistic: Chi-square(2) = 0.024551 with p-value = 0.9878 p-value >α Error is normally distributed
Breusch-Godfrey test for autocorrelation up to order 3, Null hypothesis: no autocorrelation, α=0,05			Test statistic: LMF = 6.70819 with p-value = P(F(3, 12) > 6.70819) = 0.0065656 p-value <α **Autocorrelation**	Test statistic: LMF = 2.5853 with p-value = P(F(3, 13) > 2.5853) = 0.0978873 p-value >α No autocorrelation	Test statistic: LMF = 3.6965 with p-value = P(F(3, 12) > 3.6965) = 0.0429664 p-value <α **Autocorrelation**			Test statistic: LMF = 1.2428 with p-value = P(F(3, 12) > 1.2428) = 0.33741 p-value >α No autocorrelation
Equation of the linear regression line			$Log(GHG_t)= 18.75-0.93log(GFCF_{t-1})$ From Prais-Winsten procedure (Table 4)	$Log(GHG_t)= 14.94-0.49log(GFCF_t)$	$Log(GHG_t)= 11.2754-0.1906log(GFCF_{t-1})+\varepsilon_t$			$Log(GHG_t)= 10.83-0.23log(GFCF_{t-1})$

The models for France and Germany indicate a statistically significant relationship between the log-transformed data on greenhouse gas emissions from industrial processes, and product use (GHG), and the log-transformed data on general government expenditures in environmental protection in gross fixed capital formation (GFCF), lagged one year in the case of France.

France: As with Romania, we used log-transformed data on general government expenditures in environmental protection in gross fixed capital formation (GFCF) lagged one year and log-transformed data on greenhouse gas emissions from industrial processes and product use (GHG) to achieve better results. Therefore, a 1% increase in government expenditure in year (t-1) is associated with a 0.93% decrease in greenhouse gas emissions from industry in year t. Autocorrelation was corrected using the Prais-Winsten procedure, resulting in a more accurate model.

Table 4: France: Prais-Winsten, using observations 2006-2022 (T = 17)
Dependent variable: l_GHG
rho = 0.908516

	Coefficient	*Std. Error*	*t-ratio*	*p-value*	
const	18.7492	1.66015	11.29	<0.0001	***
l_Generalgovernmentexpendit_1	−0.932045	0.194903	−4.782	0.0002	***

Statistics based on the rho-differenced data:

Sum squared resid	0.036454	S.E. of regression	0.049298
R-squared	0.901623	Adjusted R-squared	0.895065
F(1, 15)	5209.610	P-value(F)	1.75e-20
rho	−0.027889	Durbin-Watson	1.986368

Statistics based on the original data:

Mean dependent var	10.83607	S.D. dependent var	0.144972

Germany: To get a better model that meets the regression assumptions, we used the log-transformed data on GHG and GFCFA. The results demonstrate that a 1% increase in GFCF is associated with a 0.49% decrease in GHG in the same year.

Italy: Autocorrelation was corrected with the Cochrane-Orcutt procedure (Table 5), but the resulting model was not statistically significant (p-value =0.08>α).

Tabel 5: Italy - Cochrane-Orcutt, using observations 2007-2022 (T = 16)
Dependent variable: l_GHG
rho = 0.93366

	Coefficient	*Std. Error*	*t-ratio*	*p-value*	
const	11.2754	0.823785	13.69	<0.0001	***
l_GFCF_1	−0.190592	0.104186	−1.829	0.0887	*

Statistics based on the rho-differenced data:

Sum squared resid	0.029952		S.E. of regression	0.046254
R-squared	0.939457		Adjusted R-squared	0.935132
F(1, 14)	3.346504		P-value(F)	0.088723
rho	−0.315429		Durbin-Watson	2.506563

For Bulgaria, Hungary and Poland, the relationship has a very low correlation coefficient and is not statistically significant.

6 Interpretation of the results of quantitative and econometric analyses

In Table 6, we presented the centralised results of the quantitative and qualitative analyses. In the quantitative analysis section, we identified three groups of countries based on the dynamics of GFCF and GHG. France, Germany, Italy, and Romania, in which the increase in GFCF is accompanied by a decline in GHG. Poland, the outlier, where the rise in GFCF was associated with almost no decrease in GHG. And Bulgaria and Hungary, where both indicators declined.

Table 6: Quantitative and econometric indicators of the relationship between GHG and GFCF

Country	GHG Change	GFCF Change	Statistical Significance	Relationship Type	Elasticity (approx.)
Romania	-53.22%	993.72%	Yes	Lagged	-0.23
France	-38.72%	54.73%	Yes	Lagged	-0.93
Germany	-28.38%	39.11%	Yes	Current	-0.49
Italy	-49.91%	7.40%	No	Lagged	-0.19 (not statistically significant)
Poland	-0.37%	24.29%	No	None	No clear pattern
Bulgaria	-39.08%	-13.37%	No	None	No clear pattern
Hungary	-33.21%	-19.02%	No	None	No clear pattern

Examining Table 6, we identified two additional groups: (1) the effective expenditure countries (France, Germany, and Romania) and (2) the paradoxical countries (Bulgaria, Hungary, Italy, and Poland).

Group 1: In these countries, there is a negative, statistically significant relationship between GFCF and GHG. The impact of investments is lagged in France and Romania, meaning that spending in year t leads to a reduction in emissions in year t+1.

In Germany, this effect is immediate, within the same year, indicating an even more efficient allocation of funds to mitigating emissions.

Group 2: Italy experienced a substantial drop in emissions, accompanied by a minimal increase in expenditures, which could be attributed to other factors that require further investigation, as in the cases of Bulgaria and Hungary, where emissions dropped despite a decline in expenditures or Poland, where the increase in GFCF did not translate in a decrease in GHG.

7 Conclusion

In this paper, we investigated the impact of general government expenditures in environmental protection in gross fixed capital formation on greenhouse gas emissions from industrial processes and product use in the EU and six member states between 2005 and 2022. Using econometric models (log-log and log-log lag), we found negative and statistically significant relationships between the selected indicators in France, Germany and Romania. For France and Romania, the use of log-log lag data on GFCF generated better models, demonstrating that a 1% increase in GFCF in the previous year is associated with a 0.93% and a 0.23% decrease in GHG, respectively. The best result for Germany involved using the log-log econometric model, without the lag of GFCF, which revealed a decline of 0.49% of GHG for a 1% increase in GFCF in the same year.

In Italy, the relationship became negative after addressing autocorrelation with the Cochrane-Orcutt procedure, but it lost its statistical significance at a 95% confidence level.

In the EU, Bulgaria, Hungary and Poland, we did not identify a statistically significant relationship regardless of the data transformation employed.

The results emphasised heterogeneities among the analysed countries regarding the analysed relationship, suggesting different effects of public environmental expenditures on mitigating greenhouse gas emissions. The significant cross-country differences indicate that a single EU policy may not be effective for all the member states.

Future research should focus on identifying the causes of these heterogeneities, particularly for the member states in which the relationship proved to be statistically insignificant, to provide decision-makers with additional practical tools for shaping customised policies and institutions that mitigate greenhouse gas emissions and achieve climate neutrality by 2050.

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Annexe 1: General government expenditures in environmental protection in gross fixed capital formation-million euro

Year	EU	Bulgaria	France	Germany	Hungary	Italy	Poland	Romania
2005	18,201.4	73.3	4,283.0	2,263.0	341.8	3,121.0	864.3	36.6
2006	21,180.2	164.5	4,351.0	2,986.0	450.6	3,030.0	966.1	92.4
2007	22,084.1	119.4	4,754.0	2,523.0	386.3	3,180.0	992.7	204.7
2008	22,675.6	88.0	4,994.0	2,489.0	375.4	3,433.0	1,106.7	265.5
2009	22,790.4	220.0	5,074.0	2,618.0	212.3	3,404.0	1,085.4	318.8
2010	22,090.1	55.9	5,133.0	2,647.0	369.5	2,814.0	1,328.0	500.8
2011	22,039.4	56.1	5,361.0	3,429.0	399.1	2,629.0	1,541.5	683.0
2012	20,897.3	63.9	5,214.0	3,210.0	374.2	2,653.0	1,213.5	470.3
2013	20,729.0	169.4	5,112.0	3,402.0	625.1	2,234.0	1,261.0	480.7
2014	20,060.2	69.6	5,079.0	3,332.0	739.4	1,896.0	1,354.7	540.0
2015	20,698.9	111.6	4,811.0	3,248.0	952.8	2,064.0	1,416.0	688.6
2016	17,243.1	54.0	4,486.0	3,500.0	119.1	1,955.0	537.0	369.1
2017	17,216.1	48.4	4,771.0	3,124.0	159.0	1,774.0	540.4	255.6
2018	18,870.0	72.0	5,053.0	3,326.0	249.6	1,785.0	1,058.5	313.6
2019	20,946.7	71.2	5,692.0	3,372.0	396.9	2,240.0	1,032.6	416.8

Year	EU	Bulgaria	France	Germany	Hungary	Italy	Poland	Romania
2020	20,853.7	70.5	5,088.0	3,495.0	392.7	2,413.0	1,051.1	423.8
2021	21,845.4	128.6	5,633.0	2,890.0	352.9	2,845.0	1,011.2	443.5
2022	24,471.3	63.5	6,627.0	3,148.0	276.8	3,352.0	1,074.2	400.3

Source: Eurostat (2025a).

Annexe 2: Greenhouse gas emissions from industrial processes, and product use - Thousand tonnes

Year	EU	Bulgaria	France	Germany	Italy	Hungary	Poland	Romania
2005	429,934.6	7,509.51	62,438.15	72,688.4	47,132.13	8,873.8	23,732.01	21,542.78
2006	433,497.4	7,325.19	63,964.76	73,025.88	43,607.01	8,509.39	26,007.17	21,098.28
2007	445,324.19	7,775.21	64,995.49	76,125.84	43,661.65	8,348.01	28,402.24	21,297.07
2008	420,550.31	6,854.38	60,715.42	71,967.46	41,095.54	7,251.44	27,121.82	18,190.75
2009	347,914.74	3,829.88	50,614.99	64,002.71	35,735.18	6,252.28	21,736.51	12,106.43
2010	364,531.89	4,087.85	53,743.64	61,782.62	36,590.78	6,435.29	22,882.28	13,845.19
2011	364,191.16	4,631.54	53,282.44	63,192.75	36,346.48	6,594.06	25,638.89	14,444.51
2012	348,869.02	4,351.29	51,152.96	60,409.07	33,226.21	6,291.51	24,635.59	13,121.85
2013	345,396.29	4,237.03	52,889.53	60,269.99	31,758.76	5,674.5	23,627.67	11,411.74
2014	351,993.52	4,528.69	52,328.8	60,544.87	30,995.96	6,426.67	25,107.47	12,140.63
2015	342,573.38	5,162.41	50,802.88	59,778.25	29,093.66	7,007.67	24,356.91	12,183.45
2016	344,828.89	5,366.52	50,557.7	61,485.48	28,470.01	6,545.85	24,557.56	12,271.79
2017	351,267.33	5,245.92	51,774.28	65,346.74	28,005.55	7,230.19	25,068.7	12,402.01
2018	344,206.57	4,921.23	49,114.92	62,437.21	28,608.26	7,466.07	25,563.33	12,694.56
2019	331,028.81	4,591.88	45,951.67	59,352.38	27,329.77	7,353.36	25,081.12	12,629.4
2020	307,232.58	4,321.05	39,977.19	55,254.65	24,289.62	7,369.28	24,526.59	12,745.97
2021	317,997.1	4,582.44	42,322.67	57,046.25	25,300.24	7,144.36	24,588.76	12,843.27
2022	291,844.53	4,574.92	38,262.97	52,061.33	23,608.99	5,927.06	23,645.03	10,077.72

Source: Eurostat (2025b).