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THE IMPACT OF PUBLIC SPENDING ON ENVIRONMENTAL SUSTAINABILITY

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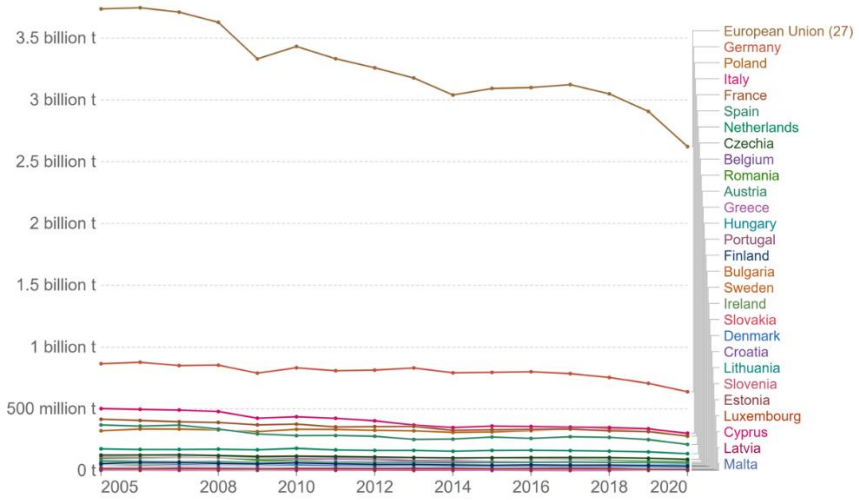
Abstract
The EU member states want to offer their citizens a harmonious life from 3 perspectives, namely social, economic, and environmental. This study investigates the impact of the greenhouse effects and investments on public spending. The greenhouse gas emission variable is included in observing environmental sustainability, and variable investments consider the beneficial effect on the economy. Public spending on education, science and research and development (R&D) is considered to bring positive effects on the sustainable development of a country, from the social effect point of view. This variable with Real GDP per capita-control variable and Direct investment in the reporting economy are used as o control variable. We use the ordinary least squares method and MG, PMD and DFE model (ARDL model). We will analyse the European country in the period 2005-2020, and we will use the Stata program. From the OLS method we conclude that 61.5% of the variation of general government expenditure variables is explained by the independent variables included in the model. And Gross domestic expenditures on research and development (R&D has a positive impact on the general government expenditure. From the ARDL model we concluded that a unit change in investment is associated with a 0.360 increase in general government spending. In this case, the investments and general expenditures of the governments show a direct relationship.
Keywords: *public spending; greenhouse gas emissions; investment; European Union countries; ARDL model.*
JEL Classification: H52; G23; O16

1. INTRODUCTION

In the contemporary global landscape, environmental challenges have gained heightened significance, with the greenhouse effect emerging as a pressing concern for all European Union member states. In response, the EU has implemented policies aimed at curbing carbon dioxide emissions. Nonetheless, climate change is a transnational issue that cannot be effectively addressed by individual nations alone. Tackling its adverse consequences necessitates broad international collaboration. In light of this, world leaders adopted the Paris Agreement during the 2015 United Nations Climate Change Conference (COP21). This landmark accord "includes commitments from all countries to

reduce their emissions and work together to adapt to the impacts of climate change and requires countries to strengthen their commitments over time" (Delbeke *et al.,* 2019, p. 36).

Traditionally, climate action has been understood primarily as the responsibility of national governments, focused on reducing greenhouse gas emissions (Tosun, 2022, p. 1). Nevertheless, recent developments in economic research suggest a more nuanced perspective. Scholars have increasingly emphasized that pursuing climate objectives often involves trade-offs with other dimensions of sustainable development (Boscarino, 2015, p. 5; Legagneux *et al*., 2018, pp. 3–4). Within this context, policy initiatives adopted by EU member states in recent years have contributed to a measurable reduction in carbon dioxide emissions, as illustrated in Figure 1.



Source: https://ourworldindata.org/co2-dataset-sources

Figure 1. Annual CO_2 Emissions in the European Union over the period 2005-2020

Figure 1 shows the evolution of annual CO_2 emissions from 2005-2020. Overall, according to the graph, a decreasing trend of CO_2 emissions can be observed in the EU member countries during the period analyzed. For example, in 2020 the EU had a total of 2.62 billion tons of CO2 emissions, and among the EU member states, the biggest producers of CO_2 are Germany (639.38 million tons), Poland (303.52 million tons) and Italy (302.28 million tons). In this context, the literature argues that investments are essential for firms to remain competitive or even viable in a carbon-constrained world (Jiang and Klabjan, 2012, p. 2). Despite public policy efforts, some studies exploring the connections between public spending and reduction of the CO_2 emissions (as Han *et al.,* 2022, p. 1) are

concluding that an increase in the GDP increases CO_2 emissions, while economic development significantly enhances environmental emissions. Anyway, it should be noted that the issue of environmental sustainability cannot be addressed only through (better) public spending, novel micro-policies intended to affect behaviors, technologies, and organizational practices being also needed (Guerrero and Castañeda, 2022, p. 1).

2. LITERATURE REVIEW

Cities are blamed for most of the greenhouse gas (GHG) emissions (Hoornweg *et al.,* 2011, p. 207). Dubeux and La Rovere (2007) state that the municipality can mitigate climate change by improving waste management systems. Here we can see the actions taken by which the citizens are obliged to sort out the waste. However, this small step must be taken more seriously. And the change should start right from each person's shopping cart. We are all tempted to buy large quantities of food that we can't eat and reach the expiration date. Thus, many of the purchased products will be transformed into food waste. And this waste will affect a family's budget in two ways. The first direction and the easiest to observe is the one related to resupplying the pantry with the food necessary for living, food that was initially bought but which for reasons of validity ended up in the garbage, but which in the end a family needs in daily food. There is a need for people to plan their meals, as well as their food needs. And the 2nd direction through which waste affects the personal budget is related to the increase in the level of sanitation fees. Municipalities are overwhelmed by the amount of waste, and this translates into higher taxes to purchase new technologies that help compost the waste. On the other hand, waste that is stored in landfills or on land near cities consumes large areas of land. In addition to this fact, this type of storage is not in line with the directions of sustainable development.

According to several studies (Wheeler, 2008; Gough *et al.,* 2011; Guyadeen *et al.,* 2019), currently, government policies focus on increasing carbon prices. And this fact leads to an increase in domestic energy prices. For this reason, these studies mention the need for radical changes in the monitoring of flows of, as well as directing policies towards the modernization of houses, coupled with "social" tariffs for household energy.

Government spending is one of the government's intervention strategies to ensure continued economic growth. However, public administrations face a dilemma between economic development and environmental protection, given that financial resources are limited. Thus, it realizes the efficiency of government spending for environmental protection is favorable to achieving the balance between economic growth and environmental protection.

The COVID-19 pandemic led to a severe economic recession that began with a health crisis. Thus, the EU member states had to develop large-scale action plans to overcome the demanding situation. Lahcen *et al*. (2020) quantify the potential

of government investment in green building projects to stimulate the economy. Currently, it is not enough to implement a project that will generate certain returns. The current business practice is mainly focused on respecting the environment. Thus, the profits that can be obtained must be based on an activity that reduces energy consumption and does not generate high levels of pollution. We can say that public policy also had a difficult word to say in this equation. Often, any good idea must also be based on a secure foundation, which is ensured by the public factor.

It can be noticed at the European level that the population is concerned about climate change, which is increasingly present in everyday life. The major problem that changes daily life is the possibility that food can no longer be easily procured. A recent study (Laborde *et al.,* 2021, pp. 2-4) analyzed a specific part of agriculture, namely the polluting one. These authors consider that over the years government support has stimulated the development of high-emission agricultural systems. Government support has a minor impact in inducing additional global GHG emissions from agricultural production. This is attributed to the fact that support is not systematically targeted towards high-emitting products. Also, trade protection drives up consumer prices.

Government investment and spending policies have the ability to increase economic growth (Prasetyo, 2020, pp. 471-472). For this reason, the allocation of financial resources to less environmentally efficient sectors should be discouraged, and resources should be allocated to more sustainable sectors. Also, according to Arfah (2021, pp. 50-52), government investments have a positive impact on the industrial sector.

The results of another study (Shahbaz *et al.,* 2020, pp. 11-12) support the fact that spending on research and development is beneficial for the environment. Policy making to reduce carbon emissions is vital to focus on allocating resources to innovation. Private research and development expenses are not sufficient in the production of innovative solutions, thus, the need for public financial support appears (Wu *et. al.,* 2021).

We are looking to demonstrate that government spending is influenced by greenhouse-green emissions and investments. So, we propose the following null hypothesis:

H_0: There is a negative influence of institutional investments and greenhouse-green emissions on government spending.

Our hypothesis is substantiated by other studies (Barrett, 2009; Su and Moaniba, 2017; Basu, 2018) which consider that government investments do not always influence the development and patenting decisions of climate technologies. Likewise, other studies (Zhang *et al.,* 2021; Kocak and Alnour, 2022, p. 1) demonstrate that there is a negative relationship between the green economy and public expenditure.

3. DATA AND METHODOLOGY

This study investigates the impact of institutional investments and net greenhouse gas on government expenditure across the 27 EU countries, during the period 2005-2020.

The identified variables, and their description are presented below (Table 1).

Table 1. Variables definition

Variable symbol	Variable name type	Units
SPE	*Public spending*	% of GDP
Inv	*Investment share of GDP by institutional sectors*-independent variable	% of GDP
GAS	*Greenhouse gas emissions*-independent variable	% of GDP
G_Exp	*Gross domestic expenditures on research and development (R&D)*-control variable	% of GDP
R_GDP	Real GDP per capita-control variable	Chain linked volumes, % change on the previous period, per capita
DI	*Direct investment in the reporting economy (stocks)*-control variable	% of GDP

Source: authors' own work

Table 2 contains a presentation of the descriptive statistics of the variables included in the analysis.

Table 2. Descriptive statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
Spe	432	45.18681	6.770417	24.2	64.9
Inv	432	22.08324	4.49282	10.69	53.59
Gas	432	9.931944	3.972457	4.5	30.8
G_Exp	432	1.535093	.8911517	.37	3.73
R_GDP	432	1.5	4.081212	-14.6	23.2
DI	432	404.5141	1175.557	11.7	731.2

Source: authors' own work

The dataset contains 432 observations, with a time span of 16 years, between 2005 and 2020. On average, all countries recorded a level of public spending of 45.18% of GDP in the period 2005-2022, which varies from this average by +/- 6.77%. The majority of General government expenditure in these countries have values between 24.2-64.9%. On average, all countries recorded a level of Investment of 22.08% of GDP in the period 2005-2022, which varies from this average by +/-4.49%. The majority of Investment in these countries have values

between 10.69-53-59%. On average, all countries recorded a level of Greenhouse gas emissions of 9.93% of GDP in the period 2005-2022, which varies from this average by +/-3.97%. The majority of Greenhouse gas emissions in these countries have values between 4,5-30.8%. On average, all countries recorded a level of Gross domestic expenditures on research and development of 1.54% of GDP in the period 2005-2022, which varies from this average by +/-0.89%. The majority of Gross domestic expenditures on research and development in these countries have values between 0.37-3.73%. On average, all countries recorded a level of Real GDP per capita of 1.50% of GDP in the period 2005-2022, which varies from this average by +/-4.08%. The majority of Real GDP per capita in these countries have values between -14.60-23.20%.

On average, all countries recorded a level of Direct investment in the reporting economy (stocks) of 404.51% of GDP in the period 2005-2022, which varies from this average by +/-1175.56%. The majority of Direct investment in the reporting economy (stocks) in these countries have values between 11.70-731.20%. We noticed a too-high value of the maximum and used the winsorize function, so the new maximum for this variable is 731.2.

4. METHODOLOGY

Our analysis is based on the use of ordinary least squares linear regression of panel data of the type reflected in Equation 1.

$$y_{it} = f(X_{ij}, \beta) + \delta_i + \gamma_t + \varepsilon_{it} \quad (1)$$

The present research imposes a linear conditional mean specification of the form in Equation 2.

$$y_{it} = \alpha + X'_{it}\beta + \delta_i + \gamma_t + \varepsilon_{it} \quad (2)$$

The re-parameterized ARDL (p, q, q, …, q) error correction model is specified as in Equation 3.

$$\Delta y_i t = \theta_i [y_{i,t-1} - \lambda'_i X_{i,t}] + \sum_{j=1}^{p-1} \xi_{i,t} \Delta y_{i,t-j} + \sum_{j=0}^{q-1} \beta'_{ij} \Delta X_{i,t-j} + \varphi_i + e_{it} \quad (3)$$

Here is the model specification (Equation 4):

$$\Delta Exp_{it} = \theta_i [Exp_{i,t-1} - \lambda'_i X_{i,t}] + \sum_{j=1}^{p-1} \xi_{ij} \Delta Exp_{i,t-j} + \sum_{j=0}^{q-1} \beta'_{ij} \Delta X_{i,t-j} + \varphi_i + e_{it} \quad (4)$$

5. RESULTS

Table 3 presents the results of a regression analysis aimed at examining the influence of institutional investments and net greenhouse gas emissions on government expenditure over the period 2005–2020. The following Panel Least Squares equation is used to model public spending (see Equation 5).

$$Exp = \beta_1 + \beta_2 * Invest + \beta_3 * Gas + \beta_4 * G\_Exp + \beta_5 * R\_GDP + \beta_6 * Di + \varepsilon \quad (5)$$

Table 3. The regression results

Variables	(1) spe
Inv	-0.432***
	(0.0492)
Gas	-0.236***
	(0.0641)
g_exp	3.997***
	(0.245)
r_gdp	-0.537***
	(0.0535)
Di	-0.000560**
	(0.000221)
Constant	52.01***
	(1.181)
Observations	429
R-squared	0.615

Notes: standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1.

Source: authors' own work

The variables introduced in the model are statistically significant with a probability of over 99%, except for the variable DI which is statistically significant with a probability of 95%. We conclude that the model characteristics represented by the independent and control variables are able to account for 61.5% of the variation in the Exp variable.

It is noted that there is a negative relationship between the dependent variable, Exp, and the independent variable Gas with a 95% probability. This result reinforces the idea that the effects of climate change on the economy are negative. Greenhouse gas emissions bring changes in the economy by negatively affecting incomes, which are strongly affected by the reduction of outdoor productivity of agricultural lands. On this line, changes are also being made in the level of tax collected on income or wages of workers in the agricultural sector.

In order to offset the effects of greenhouse gas emissions, we consider it appropriate to introduce a carbon tax. Such a tax would raise a state's revenue level to cover the budget deficit. Contemporaneity is marked by events that shook the economies of European states from their foundations. And finding innovative solutions to increase the level of income is a finding of every government.

In the analyzed period, government expenditures have a negative relationship with GDP, a fact attributed to the fact that the source of these expenditures is GDP itself, and their level exceeds 50%. This trend is maintained in the long term, especially in the conditions where expenditure measures were taken to combat the

effects determined by the Covid-19 pandemic. Thus, in the EU the level of expenses increased by 6.3% compared to 2019 (Government Finance statistics, 2022).

In Table 4 we presented the results of the ARDL model.

Table 4. The ARDL Model

Variables	(1) mg	(2) mg	(3) dfe	(4) dfe	(5) pmg	(6) pmg	(7) dfe	(8) dfe
Ec		0.386**		0.486**		0.433**		0.486**
		(0.106)		(0.206)		(0.196)		(0.206)
D.invest		0.360**		0.360**		0.299**		0.360**
		(0.151)		(0.176)		(0.166)		(0.176)
D.gas		1.102		1.172		1.162		1.172
		(0.771)		(0.872)		(0.872)		(0.872)
D.g_exp		-1.283		-1.383		-1.383		-1.383
		(4.961)		(5.067)		(5.067)		(5.067)
D.r_gdp		0.174**		0.191**		0.189**		0.194**
		(0.0790)		(0.0899)		(0.0790)		(0.0899)
D.di		-0.0762		-0.0861		-0.0761		-0.0861
		(0.192)		(0.141)		(0.192)		(0.141)
Gas	16.58		15.58		15.58		15.58	
	(12.90)		(11.90)		(11.90)		(11.90)	
g_exp	-11.20		-10.00		-10.09		-11.29	
	(9.854)		(9.953)		(9.954)		(9.954)	
r_gdp	-5.285		-5.075		-5.172		-5.345	
	(5.101)		(5.014)		(5.004)		(5.004)	
Di	0.391		0.401		0.501		0.361	
	(0.402)		(0.352)		(0.352)		(0.352)	
Constant		-24.06		-27.56		-28.06		-28.96
		(22.09)		(22.29)		(22.99)		(23.00)
Observations	402	402	402	402	402	402	402	402

Notes: standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1.

Source: authors' own work

We observe that in the short term the Invest and R_GDP variables have a negative influence on the Exp variable. We can say that the investments lead to a decrease in the public sector's expenses.

The present analysis shows the importance of fulfilling the often-repeated promises of decision-makers in increasing investments. Although public investments are considered to be a key factor of long-term economic growth, practice shows us that they are not fruitful. Through the perspective of the contribution of money brought into the economy through the creation of new infrastructures, the expenses that will be recorded by the states will be significantly lower. And contemporaneity has put us face to face with a reality in which economic inequality accentuates the old problems, namely economic

growth, the shortage of qualified labor, prominent levels of pollution, as well as the worsening of the health problems of the population.

The current confrontations between the states have led to an increase in the level of gas emissions, and environmental problems have become even more pronounced. They also created the conditions for the outbreak of a new economic crisis against the background of misunderstandings, as well as the limitation of export and import traffic of grain and natural gas. Uncertainty about tomorrow, which was created against the background of threats to escalate these misunderstandings at the global level, translated into panic among citizens.

5. CONCLUSIONS

Gas emissions are continuously increasing at the European level, although there are different trends from one country to another. Renewable energy and public investment in research and development contribute to stimulating economic growth and alleviating poverty. Thus, through the present study, we confirm the importance of investments, as well as greenhouse gas emissions, on government spending.

We believe that the achievement of healthy economic growth in the EU must also be achieved through investments in the idea of creating the conditions for people to acquire knowledge that will transform them into capable citizens of a country. And states should spend public money on developing both physical and human capital. And the creation of a partnership between public and private investments on at least these 2 levels, we consider to be a first step towards a more sustainable future. These priorities of the economy will be transposed into benefits that will be collected gradually on a constant flow.

This study offers new empirical evidence supporting the future shaping of fiscal and environmental policies. While a race to bigger budgets and increased expenditures/more large redistribution through public funds seem to be consecrated nowadays (instead of more rational or efficient spending), the fiscal policy should comprise new instruments targeted to limit greenhouse gas emissions. These instruments could include both specific taxes, as “penalties” for polluting activities, and targeted expenses conceived as “rewards” for those reducing their emissions. A sustainable reduction of greenhouse gas emissions (in the long term) depends also on the economic behavior of the agents, which is why public expenditures policy could be oriented to support better education in this respect.

References

1. Arfah, A. (2021). The Effect of Labor, Private Investment and Government Investment on Productivity in the Industrial Sector. *Golden Ratio of Social Science and Education*, 1(1), pp. 50-60.
2. Barrett, S. (2009). The coming global climate-technology revolution. *Journal of Economic Perspectives*, 23(2), pp. 53-75.
3. Basu, A. (2018). Grasping climate technology transfer: A brief discussion on Indian practice. *Journal of Intellectual Property Rights*, 23(1), pp. 51-59.
4. Boscarino, J. E. (2015). Paving the way or crowding out? The impact of the rise of climate change on environmental issue agendas. *Journal of Environmental Studies and Sciences*, 5(2), pp. 99-110.
5. Delbeke, J., Runge-Metzger, A., Slingenberg, Y. and Werksman, J. (2019). The Paris agreement. In*: Towards a Climate-Neutral Europe* (pp. 24-45). Routledge.
6. Dubeux, C. B. S. and La Rovere, E. L. (2007). Local perspectives in the control of greenhouse gas emissions–The case of Rio de Janeiro. *Cities*, 24(5), pp. 353-364.
7. Gough, I., Abdallah, S., Johnson, V., Ryan-Collins, J. and Smith, C. (2011). The distribution of total greenhouse gas emissions by households in the UK, and some implications for social policy. *LSE STICERD Research Paper No. CASE152*.
8. Government Finance Statistics (2022). [online] Available at: https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Government_finance_statistics [Accessed 31.10.2023].
9. Guerrero, O. and Castañeda, G. (2022). How does government expenditure impact sustainable development? Studying the multidimensional link between budgets and development gaps. *Sustainability Science*, 17, pp. 987–1007.
10. Guyadeen, D., Thistlethwaite, J. and Henstra, D. (2019). Evaluating the quality of municipal climate change plans in Canada. *Climatic Change*, 152(1), pp. 121-143.
11. Han, F., Farooq, M. U., Nadeem, M. and Noor, M. (2022). Public Spending, Green Finance, and Zero Carbon for Sustainable Development: A Case of Top 10 Emitting Countries. *Frontiers in Environmental Science*, 10:834195. https://doi.org/10.3389/fenvs.2022.834195.
12. Hoornweg, D., Sugar, L. and Trejos Gómez, C. L. (2011). Cities and greenhouse gas emissions: moving forward. *Environment and urbanization*, 23(1), pp. 207-227.
13. Jiang, Y. and Klabjan, D. (2012). *Optimal emissions reduction investment under green house gas emissions regulations.* Evanston: Northwestern University.
14. Kocak, E. and Alnour, M. (2022). Energy R&D expenditure, bioethanol consumption, and greenhouse gas emissions in the United States: Non-linear analysis and political implications. *Journal of Cleaner Production*, 374, 133887.
15. Laborde, D., Mamun, A., Martin, W., Piñeiro, V. and Vos, R. (2021). Agricultural subsidies and global greenhouse gas emissions. *Nature communications*, 12(1), pp. 1-9.
16. Legagneux, P., Casajus, N., Cazelles, K., Chevallier, C., Chevrinais, M., Guéry, L., and Gravel, D. (2018). Our house is burning: Discrepancy in climate change and biodiversity coverage in the media as compared to scientific literature. *Frontiers in Ecology and Evolution,* 5, 175.
17. Lahcen, B., Brusselaers, J., Vrancken, K., Dams, Y., Da Silva Paes, C., Eyckmans, J. and Rousseau, S. (2020). Green recovery policies for the COVID-19 crisis: modelling

the Impact on the economy and greenhouse gas emissions. *Environmental and Resource Economics*, 76(4), pp. 731-750.
18. Our World in Data (n.a.). *How do we construct our global data on CO_2 emissions*? [online] Available at: at https://ourworldindata.org/co2-dataset-sources [Accessed 01.09.2022].
19. Prasetyo, P. E. (2020). The role of government expenditure and investment for MSME growth: Empirical study in Indonesia. *The Journal of Asian Finance, Economics and Business*, 7(10), pp. 471-480.
20. Shahbaz, M., Nasir, M. A., Hille, E. and Mahalik, M. K. (2020). UK's net-zero carbon emissions target: Investigating the potential role of economic growth, financial development, and R&D expenditures based on historical data (1870–2017). *Technological Forecasting and Social Change*, 161, 120255.
21. Su, H. N. and Moaniba, I. M. (2017). Does innovation respond to climate change? Empirical evidence from patents and greenhouse gas emissions. *Technological Forecasting and Social Change*, 122, pp. 49-62.
22. Tosun, J. (2022). Addressing climate change through climate action. *Climate Action*, 1(1), pp. 1-8.
23. Wheeler, S. M. (2008). State and municipal climate change plans: The first generation. *Journal of the American planning association*, 74(4), pp. 481-496.
24. Wu, M., Wu, J. and Zang, C. (2021). A comprehensive evaluation of the eco-carrying capacity and green economy in the Guangdong-Hong Kong-Macao Greater Bay Area, China. *Journal of Cleaner Production*, 281, 124945.
25. Zhang, D., Mohsin, M., Rasheed, A. K., Chang, Y. and Taghizadeh-Hesary, F. (2021). Public spending and green economic growth in BRI region: mediating role of green finance. *Energy Policy*, 153, 112256.