THE IMPACT OF ENVIRONMENTAL PROTECTION EXPENDITURE ON ENVIRONMENTAL PROTECTION IN ROMANIA. EMPIRICAL ANALYSIS

Raluca Mihaela DRĂCEA
The Bucharest University of Economic Studies
6 Piata Romana, District 1, Bucharest, RO
raluca.dracea@eam.ase.ro

Laura CIOBANU
The Bucharest University of Economic Studies
6 Piata Romana, District 1, Bucharest, RO
laura.ciobanu@eam.ase.ro

Anca Alina BUZIERNESCU
University of Craiova
A.I. Cuza, no 13, Craiova, RO
ancabuziernescu@yahoo.com

Abstract
The specialists in environmental problems have searched for tens of years to find the right methods for durable management of the natural resources that could assure the environment protection and, at the same time, stimulate the income generation. The majority of the world's governments integrated this objective in their national politics, as it has become increasingly important in the current conditions of climate change and environmental risks. In this context, the present study analyses the influence of the environmental expenses upon environment protection in Romania. The paper aims to identify the factors that contribute to improving environmental protection in Romania. Unlike in the existing studies, in this article, we use the ecological footprint of Romania as an indicator measuring the environment degradation and which implies expenses and investments meant for restoring and maintaining. The analysis covers the period between 2009-2018 and takes into account both the direct effect of environmental expenditures on pollution reduction and also the indirect effect of these expenses on the GDP level per capita, in the context of Kuznets' hypothesis (1960). The data used for this analysis (available at EUROSTAT for the period 2009-2018) was processed with the EViews software. The analysis was done based on a dynamic model used to approach both the direct effect and also the indirect effect of the governmental expenses upon the environment protection. The results that have been obtained confirm the fact that the economic growth is an important factor for improving the environmental protection, but in the countries with a low GDP per capita, such as Romania, the governmental expenses for the environment protection can be associated with the deterioration of the economic performances. At the same time, the results obtained by this study show that an increase of the environmental governmental expenses with 1% within GDP (by maintaining constant the rest of the explanatory variables) can lead to a reduction of the ecological footprint per capita with 0.01%. This fact would be the equivalent of growth for economic prosperity correlated with a reduction of the carbon footprint, determined by the modern sustainable techniques and practices and the prioritization of energy efficiency.

Keywords
Ecological footprint; environmental expenditure; environmental protection; environmental investments; economic growth.

Introduction

In the last decades, the quest for sustainable development has generated an increased interest in the study of the relationship between economic growth and the environment. This relation has been studied extensively since the 1990s, documenting inverted U-shaped relations between per capita income and indicators of environmental degradation (Andrée & al, 2019). However, despite the important influence that public environmental expenditure may have on pollution, this relationship has not been studied extensively in the literature.

Unlike the existing studies, in this study, we'll use the ecological footprint of Romania, as an indicator measuring the environment degradation and which implies expenses and investments meant for restoring and maintaining. The ecological footprint represents an inventory instrument for natural resources, a concept that has been developed at the begging of the years 1990 by Bill Rees.

The size of the ecological footprint reflects the possibility of the ecosystems from our country to produce useful biological materials and to absorb the produced residue (especially CO2) (Barrett et al., 2018). Now, it is one of the most used methods for monitoring the progress of a country towards a sustainable future.

Literature review

There are several reasons why pollution can be influenced by the level and composition of government expenditure. Lopez et al. (2011) identify four mechanisms by which the level and composition of fiscal spending may affect the overall level of pollution, namely the scale, composition, technique, and income effects. The first one is generated by economic growth that in some (most) cases can lead to higher environmental pressures and to the apparition/increase of/in specific problems which the government is required to address; this leads to an increase of the specific public spending.

The second effect measures the change in environmental degradation due to changes in the range of goods produced and can be positive or negative depending on the pattern of trade-induced specialization, leading to the general conclusion that human activities caused by the accumulation of human capital rather than physical capital are more harmful to the environment.

The technique effect - that measures the change in aggregate pollution resulted from switching to more environmentally sustainable production techniques, is specific and can be better observed in wealthier countries that are generally more willing and able to protect their resources mainly in two ways: by establishing higher environmental standards and by investing a lot more in sustainable technologies. The fourth effect accompanies income growth that makes it possible for people to care more about the environment and put more pressure on the government to increase its specific expenditure (Zhang & al, 2017).

These effects are directly related to the way the state responds to different phenomena's, response that can be best evaluated by analyzing the government expenditure. The effect of government spending on the environment may be

distinguished between direct and indirect effects. López and Galinato (2007) proposed a taxonomy of government expenditures that makes a clear distinction between expenditures in public goods that, in their opinion, are generally more helpful because they tend to alleviate the negative effects of market failures, and government expenditures in private goods (that include input subsidies, farm programs, subsidies to the production of fossil fuel or energy consumption) which can lead to a worsening of the effects of market failures. Higher government expenditure will increase income equality and thus determine a higher demand for environmental quality. For the quality environment demand to rise, it needs to be treated (importance and allocation of expenditure) as any other public good, independently of the government size (Frederik & Lundstrom, 2001).

The existing literature regarding determinants of pollution is still dominated by analyses that mainly focus on the effects of per capita income and trade policies in search of the so-called environmental Kuznets curve (Grossman & Krueger, 1995; Lopez & Palacios, 2010). Thus, in most studies, the key explanatory variable remains the per capita income, totally disregarding the effect of the public since government spending, energy taxes, and environmental regulations are not uniquely determined by per capita income, these estimates are potentially affected by omitted variable biases. Even if these studies use country fixed effects, the problem remains a problem that has been acknowledged in the literature. Unlike these studies, in this paper, we'll use the ecological footprint of Romania, as an indicator measuring the environment degradation and which implies expenses and investments meant for restoring and maintaining.

Methodology

Starting from the aim taken into consideration, we'll use a dynamic model through which we'll approach both the direct and the indirect effect of the environmental governmental expenses (as a percentage from GDP) upon the environment protection. The basic model is presented in the relation (1), mentioning the fact that all the variables are expressed in logarithms.

$$EF_t = c(1) + c(2)GDP_t + c(3)GEE_t + c(4)EIT_t + c(5)VAP_t + \varepsilon t \quad (1)$$

where:
EF – the ecological footprint expressed in tons of emissions per capita;
GDP – the gross domestic product per capita (Euro);
GEE – the governmental expenses for the environment protection (share of GDP);
EIT – the energy intensity (kg of energy resources which is the equivalent of the petroleum at 1000 Euro);
VAP – the added value of the production (share of GDP).

The direct effect is the result for the usual formulation of the ecological footprint (relation 1), and the *indirect effect* (Narayan & Narayan, 2010) is the expression of the incomes (GDP) depending on the governmental expenses for the environment protection and on other factors (in this situation we have chosen the environment protection investments), and thus we get the relation (2):

$$\mathbf{GDP_t = c(1) + c(2)GEE_t + c(3)INV_t + \varepsilon t} \quad (2)$$

where:
INV – investments for environmental protection.

In both models, the sample has a relatively small size. For the estimation of the two equations (1) and (2), a standard approach is required which supposes the use of the models with fixed and random effects. Hallkos (2012) says that, when we refer to the analysis of the correlations, in the case of the pollutants, there will appear some characteristics which are specific forever country and which include the differences of climate, geographical position, fossil fuel, all these being possibly correlated with the emissions.

On the other side, there could also exist some specific characteristics for the country, which have not been observed and that could be correlated with the GDP and the other explanatory variables and for this reason, it is preferred to estimate the fixed effects. The data series 2009-2018 which are available at EUROSTAT have been used for this analysis, these data being logarithms.

Results

The basic model takes into consideration the ecological footprint (AE) as an indicator measuring the environment degradation and implying expenses and investments meant for restoring and maintaining. The ecological footprint is a complex notion measuring the activities exercised upon the biosphere during a year, taking into consideration the technology that has been used and the administration of the resources from that year (Borucke & al 2013). According to Borucke's specifications, the ecological footprint is an aggregation of six ecological components referring to the cropland, grazing, fishing, forests, carbon dioxide, and the infrastructure footprints.

The descriptive characteristics of the variables, including the investment variable from the equation (2), are presented in table 1.

Table 1. Descriptive data for the variables

Descriptive Statistics	N	Minimum	Maximum	Mean
AE	10	.76343	.80618	.7807294
GDP	10	3.79169	3.94151	3.8504950
GEE	10	-0.09421	0.00000	-0.121188
EIT	10	1.94082	2.13379	2.0468059
VAP	10	.92840	1.13450	1.0026499
INV	10	-.43719	.03383	-.2209070
Valid N (listwise)	10			

(own processed data based on the EUROSTAT data and transformed in logarithms)

Figure 1 indicates the existence of a connection between the governmental expenses for the environment protection (share of GDP) and the gas emissions equivalent to CO2 (kt/capita).

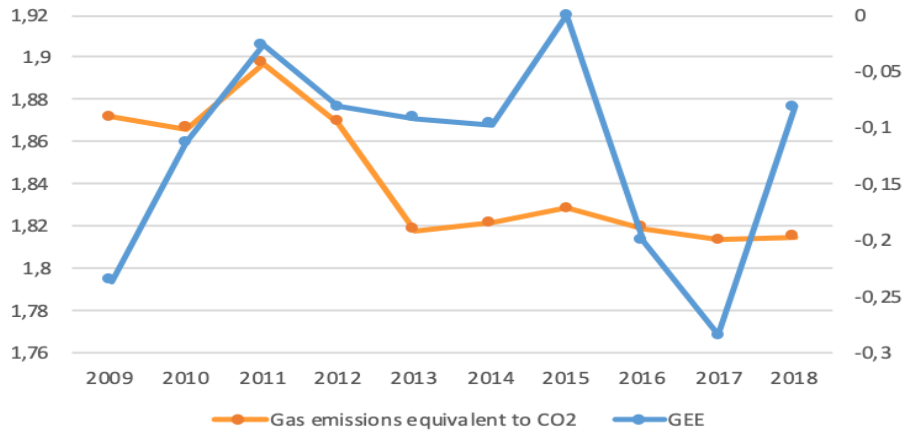

Figure 1. The dynamics of the governmental expenses for the environment protection and gas emissions (logarithmic data)
(belongs to the authors)

The ADF test (Unit root tests result) presented in table 2 was applied, taking into consideration the integration characteristics of the variables.

Table 2. Unit Root Test Results

Variables	ADF -Fisher Chi-square		Im, Pesaran and Shin W-stat		PP - Fisher Chi-square
	Statistic	Prob	Statistic	Prob	Statistic
AE	7.77076	0.9933	1.10015	0.8644	28.0269
GDP	0.05449	1.0000	7.44166	1.0000	0.01123
GEE	52.5895	0.0001	-3.59254	0.0002	45.2607
EIT	1.69726	1.0000	3.35307	0.9996	0.05824
VAP	48.1124	0.0004	-3.19779	0.0007	41.9557
INV	4.34374	0.9999	2.03882	0.9793	13.3053

(data processed by the authors)

The probabilities for the Fisher test are calculated using an asymptotic Chi. The distribution is unsure but all the other tests suppose asymptotic normality.

In table 3 there is presented a GDP estimation per capita, by using different estimation methods, taking into consideration the variables which are specific for the equation (2).

Table 3. Econometric results concerning the impact of the governmental expenses for the environment protection on the GDP per capita

Model / Estimations	OLS	Fixed Effects	Random Effects	TSLS (Two-Stage Least Squares)
GEE (log)	-0.144436	-0.144436	-0.144436	-0.144436
INV (log)	-0.241280	-0.241280	-0.241280	-0.241280
R-squared	0.550307	0.550307	0.550307	0.550307
Adjusted R-squared	0.548800	0.548800	0.548800	0.548800
F statistic				181.7250

We remark that, no matter what model we use, the estimations for the variables are identical and they produce effects which are significant from the statistical point of view, on the environmental governmental expenses (share of GDP), the significance level being of 1%.

The obtained estimations indicate the fact that an increased environment governmental expenses (share of GDP) with 1%, by constantly maintaining the rest of the explanatory variables, can lead to a reduction of the GDP per capita with 0.44%.

We'll do the same to identify the impact of the environmental governmental expenses on the ecological footprint, taking into consideration the variables which are specific for the equation (1).

Table 4. Econometric results concerning the impact of the governmental expenses on the ecological footprint per capita

Model / Estimations	OLS	Fixed Effects	Random Effects	TSLS (Two-Stage Least Squares)
GDP /capita (log)	0.733470	0.733470	0.733470	0.733470
GEE (log)	-0.014599	-0.014599	-0.014599	-0.014599
EIT (log)	0.761455	0.761455	0.761455	0.761455
VAP (log)	-0.075567	-0.075567	-0.075567	-0.075567
R-squared	0.923857	0.923857	0.923857	0.923857
Adjusted R-squared	0.923241	0.923241	0.923241	0.923241
F statistic				150.1473

Like in the previous case, we remark that, no matter what model we use, the estimations of the variables are identical and the produce negative effects, which are significant from the statistical point of view, on the environment governmental expenses (share of GDP, %), the significance level being of 1%. The obtained estimations indicate the fact that an increase in the GDP for the value of the environment governmental expenses with 1%, by constantly maintaining the rest of the explanatory variables, can lead to a reduction of the ecological footprint per capita with 0.01%.

We are practically speaking of two effects, more exactly: the indirect effect and the direct effect, approximatively equal as an influence which can be synthesized in Table 5.

Table 5. Impact of the governmental expenses on the environment

Model / Estimations	OLS	Fixed Effects	Random Effects	TSLS (Two-Stage Least Squares)
Direct effect	-0.014599	-0.014599	-0.014599	-0.014599
Indirect effect	-0.144436	-0.144436	-0.144436	-0.144436
Total effect	-0.0290426	-0.144436	-0.144436	-0.144436
Signal changing point	7320 Euro/capita, corresponding to the year 2014			

The model of the total effect is amplified by the form of the indirect effect. This aspect is explained by the impact of the pollutants on people's health but also by the technological capacities used to reduce the atmospheric levels, and, as a consequence, by the environmental degradation associated with them. The evolution of the total effect of the governmental expenses on the environment is given in figure 2.

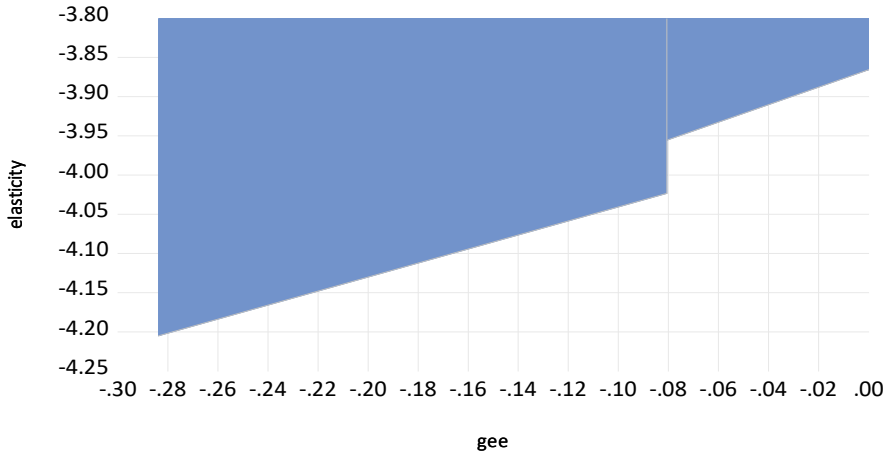

Figure 2. The effect of the governmental expenses on the environment (data processed by the authors)

Conclusions

The specialists in environmental problems have looked tens of years to find methods for a durable administration of the natural resources that could assure the environment protection and stimulating at the same time the generation of incomes. The majority of the world's governments integrated this objective into their national politics, this objective becoming more and more important in the current conditions of climate change and environmental risks.

The majority of the governments in the case of the less developed countries, such as Romania, does not allocate sufficient funds for the durable administration of the environment protection (the allocation of the governmental expenses for environment protection was a percentage of about 0.8% share of GDP, according to National Institute of Statistic data). However, in Romania, we register a positive aspect, in the sense that, *we have the smallest ecological footprint from the states of the European Union*, the biggest part coming from the carbon emissions (1.4 hgc compared with the world average of 2.8 hgc and the European average of 2.1 hgc, at the level of the year 2018). This aspect is rather connected to the collapse of the Romanian industry than to the government thinking concerning the environment protection in Romania. At the same time, the results obtained by this study show that *an increase of the environmental governmental expenses with 1% within GDP* (by maintaining constant the rest of the explanatory variables), *can lead to a reduction of the ecological footprint per capita with 0.01%.* This fact would be the equivalent of growth for economic prosperity, at the same time with a reduction of the carbon footprint, determined by the modern sustainable techniques and practices and the prioritization of energy efficiency.

The aim which has been pursued through this study was of analyzing the environmental governmental expenses depending on the significant impact that they have on the environment and which should be integrated into the budgeting process corresponding to the environment. To measure the impact of the government expenses on the environment from Romania, there have been taken into consideration two equations in light of the relations between the variables.

The analysis that has been done revealed the fact that both the direct and the indirect effect of the environment governmental expenses are important, the indirect one increasing the total effect.

The estimation of the direct effect of the governmental expenses on the environment pollution was completed by the estimation of the indirect effect and the results confirm the theoretical and empirical evolutions concerning the existence of s connection between GDP level and pollution, as well as between the size of the government and the economic performance. The model of the total effect was amplified by the form of the indirect effect. This aspect is explained by the impact of the pollutants on the people's health but also by the technological capacities of reducing the atmospheric levels, and, as a consequence by the environmental degradation associated with them.

This study confirms the fact that economic growth is an important factor to improve environmental protection, but in countries with a low GDP level per capita, such as Romania, the governmental expenses for environmental protection can be associated with the deterioration of the economic performance. The same aspects are not specific for the countries with a big income per capita, which contributes, both to obtain economic performances and also to improve the environment quality.

Taking into consideration that at the world's level in the last 50 years, the ecological footprint (reflecting the measure for the consumption of natural resources) has increased by about 190% (Barrett & al, 2018), we appreciate that to assure the durability of the Romanian economic system, there is necessary a series of major changes both in the production activities and also in the consumption activities.

The proposed analysis also presents some limitations, especially connected to information availability. The results that have been obtained should be carefully interpreted because the effects on the environment should be seen through 6 objectives: biodiversity, mitigation and adapting climate changes, water and waste management, and the fight against pollution.

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