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The Impact of Environmental Effects of Sustainable Development on Direct Investments

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Abstract*:* On the background of the exponential decrease of natural resources and the continuous and accentuated degradation of the quality of the environment, ensuring the sustainability of economic and social processes has become a reality of everyday life. However, the primary focus is on the degradation of the quality of the environment, which has the main effect of global warming. The idea of sustainable development is based on 3 fundamental pillars, namely the economic, the social and last but not least the environmental. In contemporary society, direct investment is often seen as a vital source for development and even sustainable development. Thus, the desire for development must go hand in hand with sustainable development, implicitly with the quality of the surrounding environment. At the level of the European Union, it is important that all member countries implement common measures on sustainable development. This is the generous context in which the paper aims to analyse the impact of environmental effects in the volume of direct investments. We will analyse the countries of European country in the period 2004-2020, and we will use the Stata program. Thus, following the running of the multiple regression equation, we found that in attracting direct investments in European country in the period 2004-2020, the environmental effects have a positive influence.

Keywords: environmental effects; sustainable development; direct investments; European countries.

JEL classification: Q01; O11; G28.

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1. INTRODUCTION

From a historical point of view, the concept of sustainable development appears for the first time in 1987 during the World Conference on Environment and Development. During this conference, was published the report named "Our common future" (Voica *et al.*, 2015). In this report, the definition of the term sustainable development was given for the first time as development that meets the needs of the present without compromising the ability of future generations to meet their own needs (WCED, 1987).

This term is composed of 3 dimensions, namely the economic, the environmental and the social. Worldwide, the United Nations is the leader that catalyzes international efforts to establish a balance between the 3 dimensions.

Globally, there is talk about the importance and role of direct investment in the economy. Thus, the specialists discuss one of the key issues, namely the one that refers to the relationship between direct investments and economic growth. All the economies of the European states are aiming for an increase in the level of direct investments. This statement is supported by the hypothesis that investment is the driver of long-term economic growth (Herman, 2011).

Currently, we are witnessing a new trend in the field of investment, namely increasing interest in green growth and sustainable development. Thus, the question of the impact of direct investment on green growth, the environment and ultimately on sustainable development has become imperative.

2. LITERATURE REWIEW

Baliamoune-Lutz (2004) highlight the potential for FDI to contribute to political stability through efficient allocation of corporate resources. And it is considered that direct investments have a positive effect on economic growth (Johnson, 2006; Elkomy *et al.*, 2016)

A study (Lee, 2013) find that clean energy use strongly leads to economic growth while it is in negative relation to an increase in CO2 emissions. The finding implies that clean energy use has played a critical role in boosting economic growth while it has reduced a large portion of CO2 emissions. The finding also implies that clean energy use may have been accentuated because technological advancement accompanied by FDI may have led to a rapid improvement in the use of clean energy and the development of clean energy resources, and thus resulted in reducing CO2 emissions.

Another study (Sarkodie & Strezov, 2019) reveals a strong positive effect of energy consumption on CO2 emissions and a weak effect on non-CO2 GHG emissions. This is because China, India, Indonesia, Iran and South Africa have industrial economies and are largely dependent on fossil fuel energy technologies for energy-intensive foreign direct investment inflows and carbon-intensive industries for to boost its economic development.

In recent years we have all witnessed the growing concerns of states regarding climate change, but also the ways in which it will determine economic activities and human development. Developed countries that have a more sophisticated financing system than developing countries have better competitive advantages that attract a larger volume of direct investment (Aust *et al.*, 2020).

However, an important and frequently raised issue regarding direct investment is the negative potential on the environment. However, the results of a study (Demena & Afesorgbor, 2019) demonstrate that the basic effect of FDI on environmental emissions is close to zero. And accounting for heterogeneity across studies, direct investment is found to significantly reduce environmental emissions. The results remain robust after disaggregating the effect for countries at different levels of development as well as for different pollutants.

The findings of a study (Nong *et al.*, 2021) shows that developing countries, which experience relatively low production costs due to cheap labour, capital, and natural resources, suffer relatively high emission costs from a uniform carbon tax rate of US $15.

It is noted that the studies presented above do not present what are the conditions and components that could determine a consistent positive relationship between direct investment and sustainable development. Thus, the present study focuses on a pillar of sustainable development, namely the environmental one.

Related to the Research Hypotheses we want to demonstrate that there is a relation between identified variables: direct investment and indicators that measures de environmental effects of the sustainable development. In this case, the null hypothesis is that:

***H0**: There is an influence of the level of environmental effects on direct investment,* meaning that the coefficient of the variable (direct investment, especially) is statistically significant (p-value is above 0.1, at 10% level).

3. DATA AND METHODOLOGY

The study on the impact of the environmental effects of sustainable development on direct investment, in the period 2004-2020, extracted from the total population represented by the states of the world only European countries, numbering 27 (Austria, Belgium, Bulgaria, Switzerland, Czechia, Germany, Denmark, Greece, Spain, Finland, France, Croatia, Hungary, Ireland, Iceland, Italy, Lithuania, Luxembourg, Latvia, Malta, Netherlands, Norway, Poland, Portugal, Romania, Sweden, Slovenia, Slovakia). The sample was limited to this number depending on the availability of data collected from the EUROSTAT database (Balance of payment statistics, 2022).

3.1 Data description

The identified variables, their description, but also the sources of other studies performed that considered the variables identified in our study are presented in Table no. 1.

Table no. 1 - Variables definition

Variable symbol	Variable name type	Description	Units
Country	*Country*	The sample includes 27 countries.	
YEAR	*Year*	The time is 2004-2020.	
DI	*Direct investments, Flows*-dependent variable	This is a category of investment whereby an investor establishes a lasting interest in an enterprise located in an economy that differs from that investor's resident economy.	% of GDP

Variable symbol	Variable name type	Description	Units
GAS	*Greenhouse gas emissions per capita*-independent variable	This indicator measures all national emissions, including carbon dioxide (CO2), methane (CH4), nitrous oxide (N2O), and the so-called F-gases (hydrofluorocarbons, perfluorocarbons, nitrogen trifluoride (NF3) and sulfur hexafluoride (SF6)).	%
ENERGY	*Share of renewable energy in gross final energy consumption*-independent variable	This indicator measures the share of renewable energy consumption in gross final energy consumption according to the Renewable Energy Directive.	%
TAX	*Share of environmental taxes in total tax revenues*-independent variable	This indicator measures the share of environmental taxes in total revenues from taxes and social contributions.	%

Source: own processing

The summary of descriptive statistics is presented in Table no. 2.

Table no. 2 – Descriptive statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
Country	459	14	7.797379	1	27
year	459	2012	4.904325	2004	2020
DI	459	23.15699	113.418	-836.7	980
GAS	459	10.1537	4.097159	4.8	30.8
ENERGY	459	17.76677	11.54811	0.102	60.124
TAX	459	7.451699	1.70568	3.62	12.32

Source: own processing

The dataset has 459 observations, with a time lengths of 17 years, between 2004 and 2020. The unit panel is referring to 27 countries from European Union. The dependent interest variable DI has an average mean of 23.15699, a minimum of -836.7, a maximum of 980, and a standard deviation of 113.418. The independent interest variable is GAS, which has an average mean of 10.1537, a minimum of 4.8, a maximum of 30.8, and a standard deviation of 4.097159. The other variables are used as control variables. The variable ENERGY has an average mean of 17.76677, a minimum of 0.102, a maximum of 60.124, and a standard deviation of 11.54811. The variable TAX has an average mean of 7.451699, a minimum of 3.62, a maximum of 12.32, and a standard deviation of 1.70568.

3.2 Methodology

The data analysis methods used refer to the estimation of the regression equations. We use cross-data panel regression and before we begin to estimate the equations, we must test the independent variable for unit root and see if some of the variables are better estimated as level 1 or level 2 difference.

In this study we will use 4 unit root tests, respectively: Levin-Lin-Chu, Im-Pesaran-Shin and the Breitung and Hadri Lagrange multiplier stationarity test regarding the dependent variable direct investments.

The assumptions established for the tests considered are:

- for Levin-Lin-Chu is H0: Panels contain unit roots
- for Im-Pesaran-Shin is H0: All panels contain roots of unity
- for Breitung is H0: Panels contain roots of unity
- for the Hadri Lagrange multiplier stationarity test is **H0**: All panels are stationary.

Levin *et al.* (2002) tested the null hypothesis using

$$\Delta q_{it} = \alpha_{mi} d_{mt} + \delta q_{i,t-1} + \sum_{k=1}^{p} y_k \Delta q_{i,t-k} + \varepsilon_{i,t}' \quad (1)$$

Where d_{mt} denotes the deterministic parts, and $\varepsilon_{i,t}$ is assumed to be independently distributed across i and t, with $i = 1, \ldots, N$ and $t = 1, \ldots, T$. Once the normalized bias and the corresponding pseudo t-ratio of pooled OLS estimation of δ in (1) are appropriately normalized, convergence to a standard normal limit distribution is achieved as $N \to \infty, T \to \infty$ so that $\sqrt{N}/T \to \infty$.

Im *et al.* (2003) test is built on the estimation of (1), but changing δ with δ_i. The null hypothesis is rejected if there is a subset (N1) of stationary individuals. The first test proposed is the standardized group-mean Lagrange Multiplier (LM) bar test statistic.

$$\psi_{\overline{LM}} = \frac{\sqrt{N}\left[\overline{LM} - N^{-1}\sum_{i=1}^{N} E(LM_i)\right]}{\sqrt{N^{-1}\sum_{i=1}^{N} Var(LM_i)}} \quad (2)$$

with $\overline{LM} = N^{-1}\sum_{i=1}^{N} LM_i$, where LM_i denotes the individual LM tests for testing $\delta_i = 0$ in (1), and $E(LM_i)$ *and* $Var(LM_i)$ are obtained with the help of Monte Carlo simulation. The following test is the standardized group mean, t bar test statistic. This one has a similar expression of (2), with bringing up that it replaces $\overline{LM}$ and LM_i with $\bar{t}$ and t_i.

We outline $\bar{t} = N^{-1}\sum_{i=1}^{N} t_i$, where t_i denotes the individual pseudo t-ratio for testing $\delta_i = 0$ in (1), and $E(t_i)$ and $Var(t_i)$ are calculated using Monte Carlo simulation.

Breitung and Das (2005) propose a test based on robust standard errors. It has been shown that under the null hypothesis that

$$\mathrm{E}\left(\Delta y_{it}^{*}\tilde{y}_{i,t-1}\right) = s_t\left[(t-1)\sigma_i^2 - \frac{(t-1)\sigma_i^2}{T-t}(T-t)\right] = 0 \quad (3)$$

where $\sigma_i^2 = E(\varepsilon_{it}^2)$ (Breitung, 2000). Hence, the OLS estimator of ϕ in the regression

$$\Delta y_{it}^{*} = \phi \tilde{y}_{i,t-1} + u_{it}^{*} \quad (4)$$

can be shown to have a standard normal limiting distribution.

Hadri (2000) proposes a residual-based Lagrange multiplier (LM) test for a null that the individual observed series are stationary around a deterministic level or around a deterministic trend against the alternative of a unit root in panel data.

In the study, he relaxes the assumption on the errors y_{it} being $i.i.d\ N(0, \sigma_\varepsilon^2)$ over t to accommodate serial dependence cases. Also, he defined the consistent estimator of σ^2 as

$$\sigma^2 = \frac{1}{N}\sum_{i=1}^{N} \lim_{n\to\infty} T^{-1}(S_{iT}^2) \tag{5}$$

To estimate the regression equations, we used ordinary least squares panel data linear regression of the form:

$$y_{it} = f(X_{ij}, \beta) + \delta_i + \gamma_t + \varepsilon_{it} \tag{6}$$

Our specific case involves a linear conditional mean specification, so we obtain:

$$y_{it} = \alpha + X'_{it}\beta + \delta_i + \gamma_t + \varepsilon_{it} \tag{7}$$

where Y_{it} is the dependent variable, X_{it} is a k-vector of repressors and εit are the error terms for $i - 1, 2, \ldots, M$ cross-sectional units observed for dated periods $t - 1, 2, \ldots, T$. The α parameter represents the overall constant in the model while δ_i and y_t represent cross-section or period specific effects.

4. RESULTS

The correlation matrix in Table no. 3 suggests a direct relationship between the variables: direct investments and Greenhouse gas emissions per capita, respectively between direct investments and Share of environmental taxes in total tax revenues. We found that the highest correlation is established between Greenhouse gas emissions per capita and direct investments (0.3816), so the series will be interchanged using them as control (variables). In Figure no. 1A from Annexes, it can be seen in more detail the relationships that are established between the variables considered in this study.

Table no. 3 – The correlation matrix

	DI	GAS	ENERGY	TAX
DI	1.0000			
GAS	0.3816	1.0000		
ENERGY	-0.2328	-0.4180	1.0000	
TAX	0.0511	-0.0928	-0.0641	1.0000

Source: own processing

The results for unit root Levin-Lin-Chu, Im-Pesaran-Shin, Breitung, and Hadri Lagrange multiplier stationarity test regarding the dependent variable, direct investments, are presented in Table no. 4.

Table no. 4 - The unit root tests for environmental effects

Variables and tests	Results			
Variable name:	DI			
Tests	Levin-Lin-Chu	Im-Pesaran-Shin	Breitung	Hadri
Tests in levels	0.0011***	0.0007***	0.0025***	0.0001***
Tests in first difference	-	-	-	-
Tests in second difference	-	-	-	-
Variable name:	GAS			
Tests	Levin-Lin-Chu	Im-Pesaran-Shin	Breitung	Hadri
Tests in levels	0.0000***	-0.4064***	1.0000***	0.0000***
Tests in first difference	-	0.0000***	0.0000***	-
Tests in second difference	-	-	-	-
Variable name:	ENERGY			
Tests	Levin-Lin-Chu	Im-Pesaran-Shin	Breitung	Hadri
Tests in levels	0.9987***	1.0000***	1.0000***	0.0000***
Tests in first difference	0.3324***	0.0024***	0.0000***	-
Tests in second difference	0.0006***	-	-	-
Variable name:	TAX			
Tests	Levin-Lin-Chu	Im-Pesaran-Shin	Breitung	Hadri
Tests in levels	0.0313***	0.5345***	0.9978***	0.0000***
Tests in first difference	-	0.0000***	0.0000***	-
Tests in second difference	-	-	-	-

Source: own processing

As we can see from Table no. 4, direct investment is stationary at level with a statistical significance of 5% for all tests.

Greenhouse gas emissions is stationary at level though the tests Levin-Lin-Chu, and Hadri with a statistical significance of 5%, and though the tests Im-Persan-Shin, and Breitung that data became stationary at first difference with a statistical significance of 5%.

Share of renewable energy in gross final energy consumption is stationary at level though the tests Levin-Lin-Chu, and Hadri with a statistical significance of 5%, %, and though the tests Im-Persan-Shin, and Breitung that data became stationary at first difference with a statistical significance of 5%.

Share of environmental taxes in total tax revenues is stationary at level though the tests Levin-Lin-Chu, and Hadri with a statistical significance of 5%, and though the tests Im-Persan-Shin, and Breitung that data became stationary at first difference with a statistical significance of 5%.

In all the cases the null hypothesis is rejected by all the test and the statistical significance is lower than 5%.

After obtaining stationary data, we estimate the regression equations to see the influence of the environmental effects on direct investments.

We propose the next regression equation to illustrate the environmental effects:

$$DI = \beta_1 + \beta_2 * GAS + \beta_3 * ENERGY + \beta_4 * TAX + \varepsilon \quad (8)$$

To estimate this equation, we used the Panel Least Squares method with an adjusted sample from 2004 to 2020. The results of the estimation are presented in Table no. 5.

Table no. 5 – The regression results for the environmental effect

Sources	**SS**	**df**	**MS**		**Numer of obs**	**=**	**43**
					F(3, 427)	**=**	**26.7**
Model	918173.11	3	306057.703		Prob>F	=	0.000
					R-squared	=	0.158
Residual	4883099	427	11435.8303		Adj R-squared	=	0.152
Total	5801272.64	430	13491.3317		Root MSE	=	106.9
DI	Coef.	Std. Err.	t	p>ǀtǀ	95% Conf.	Interval	
GAS	10.08839	1.397254	7.22	0.000***	7.342039	12.8347	
ENERGY	-0.8004706	0.4988824	-1.60	0.094***	-1.781042	0.180100	
TAX	5.425173	3.077353	1.76	0.079***	-0.6234727	11.4738	
_cons	-104.3884	32.71542	-3.19	0.002***	-168.6917	-40.0850	

Source: own processing

As we can see from the null value of Prob(F-statistic) the model is viable, also the standard deviation of the dependent variable is higher than standard error of the regression, but from the value of R2 we conclude that 15.80% of the variation of DI is explained by the independent variables included in the model. We see from Table no. 5 that all independent variables have a statistical significance of 10% or lower.

The final regression equation for the environmental effect is:

$$DI = 104.3884 + 10.08839 * GAS + (-0.8004706) * ENERGY + 5.425173 * TAX \quad (9)$$

The share of renewable energy has a negative impact on the DI, while the rest of the independent variable has a positive effect.

We checked with the White test whether the errors were not correlated with each other. The test results showed a sig = 0.0000 less than 5%, so we reject the null hypothesis and accept the second hypothesis, namely that there is heteroscedasticity.

5. CONCLUSIONS

The results showed us that an important influence on direct investment is made by environmental effect of sustainable development.

The results of this study show that the environmental effects have a positive influence on the direct investments in the 27 European countries. Thus, environmental indicators have a positive influence on direct investment, explaining 15.80% of the evolution.

It can be seen that the environmental effect is becoming more and more important in the context of climate change, but also of ecological investment projects in business. And in the case of the objectives of reducing greenhouse gas emissions, direct investments ease the financing burden on the shoulders of European states.

In general, direct investment is targeted at green investments that generate increased clean energy production and clean technology innovation.

Currently, in the context of the European energy crisis, the development of renewable energy has become one of the most important fields of our time. Thus, reducing costs and increasing the efficiency of renewable sources generates an increasing flow of direct investment in this field.

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ANNEX

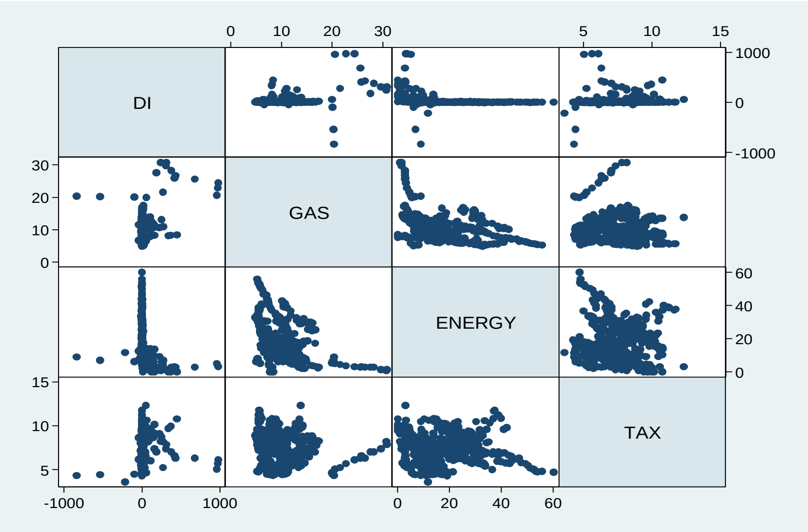

Figure no. 1A – The relationship between variables
Source: own processing