

## The Impact of Economic Growth and Foreign Direct Investment on Environmental Quality in European Countries

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**Abstract:** *The paper provides an analysis of the dynamic mutual connection between economic growth, foreign direct investment inflows and environmental pollution. The primary focus of the research is to test the validity of the Ecological Kuznets Curve (EKC) and Pollutant Haven Hypotheses (PHH) in selected European countries over the period 1990 to 2021. Using the Dynamic Ordinary Least Squares method (DOLS), the long-term impact of international trade, energy consumption and population on environmental quality is analysed. The results obtained confirm the EKC and PHH hypotheses in European countries for the period 1990 to 2021. The research results indicate that foreign direct investment inflows have a positive impact on CO2 emissions, and therefore on environmental pollution. Based on the results obtained from the research, governments and policymakers are recommended to develop and implement policies to reduce CO2 emissions in order to stimulate economic growth and improve environmental quality. In addition, the introduction of "clean" energy should be supported, and innovations and technological inventions in the fields of hydropower, solar energy, wind energy, etc. should be encouraged.*

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**Keywords:** *income, environmental pollution, dynamic ordinary least squares, structural effect, new technologies*

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## INTRODUCTION

One of the most difficult tasks for experts, politicians and governments of the whole world is to oppose to the harmful consequences caused by climate change. The greenhouse gases pollute the environment and lead to the lack of clean air and water. Changes of climate seriously threaten to all living things. Therefore, the following task has been set ahead of the governments of countries of world: to confront the dangers caused by change of climate and, at the same time, provide sustainable and competitive economic development (5).

The growth of emissions of carbon dioxide and other harmful gases has led to the warming of the Earth. These gases are, also, the main cause of change of climate. So, the economic growth has led to the worsening of quality of the environment. Given idea was first presented by Gene M. Grossman, with Alan B. Kruger (12). This idea also called the environmental Kuznets curve. In fact, the environmental Kuznets curve represents an inverted-U curve that reflects the dependence between the growth of economy and the pollution of environment in the long time period.

Also, a greater inflow of foreign direct investments intended for sustainable economic development and new job creation is needed. There is no doubt that the countries – beneficiaries of foreign direct investments, are exposed to the environmental problems that are gaining more and more actuality due to the negative consequences that lead to climate changes. Despite this, foreign direct investment remains a significant source of the creating job and the growth of revenue in many countries.

Environmental or external of production costs have important role in the “delivery” of foreign direct investments in the weaker developed countries. The environmental costs of companies that pollute the environment are higher in developed countries than in the weaker developed countries, due to more flexible policy of environmental protection. Lower environmental costs and more flexible the policy of environmental protection enable developed countries moves their “dirty” industries to middle- and low-income countries. There is no doubt that this kind of environmental policy of rich countries affects the worsening of the quality of the environment of medium-developed and poor countries that with their dependence on the rich, stimulate the pollution.

This is also the topic of the hypothesis “a haven for polluters”. According to this hypothesis, developed countries invest in the weaker developed countries because those countries have low environmental standards and insufficient respect for the law (9).

The starting from the above arguments, in this paper we try to examine the dynamic mutual connection between economic growth, foreign direct investments and the worsening of quality of the environment in the weaker developed European countries in the period from 1990. to 2021. Besides that, the influence of international trade, consumption of energy from renewable sources and inhabitants on the quality of the environment is analyzed.

## THEORETICAL BACKGROUND AND EMPIRICAL LITERATURE

In the next chapter, it are considered the concept “environmental Kuznets curve”, the hypothesis of “a haven for polluters”, the influence of international trade, population and consumption of energy from renewable sources the quality of the environment. The topic of the second chapter is also the results of previous empirical research in this scientific field.

### **The Concept “Environmental Kuznets Curve” – the Interdependence of Economic Growth and the Environment**

The concept “Kuznets curve of environment” began to be applied in the nineties of the last century, whereas and it is based on the Kuznets curve that describes the relationship between the economic growth and inequality of the distribution income. It is a form the inverted-U letter. In other words, on beginning of economic growth, inequality in income distribution is not large, but it grows along with the economic development up to one point after which the difference in income begins to decrease.

A similar concept can be applied for viewing the relationship between the deterioration of quality of environment and gross domestic product per capita. The negative impact of economic activities on the environment initially grows as the gross domestic product per capita grows. When the country reaches the maximum level of environmental pollution, further growth, i.e. an increasing of gross domestic product per capita, is followed by a decreasing environmental pollution.

Grossman and Krueger are published the first research about “environmental Kuznets curve” in 1991 (12). They considered “environmental Kuznets curve” for the sulphur-dioxide (SO<sub>2</sub>), the smoke and the dust. For SO<sub>2</sub> as a “turning point” (the point where the improvement of the quality of the environment begins) they determined a level of income per capita from 4000 to 5000 dollars. The concentration of particles of dust decreases already at lower income levels. At income levels of 10000-15000 dollars, there is an increase of concentration of all three pollutants.

The results of other empirical studies of the EKC hypothesis are mixed. Shafik and Bandyopadhyay estimated the environmental Kuznets curve for 10 indicators. The sample included 149 countries over the period 1960 to 1990. The “turning point” appears at different levels of per capita income, depending on which indicator is it about. Shafik and Bandyopadhyay concluded that it is possible to outgrow certain environmental problems, but this mechanism is not automatic (21).

In the recent empirical literature about EKC, one comes across data did not consistent with this concept. Thus, Shahbaz et al. examined CO<sub>2</sub> emissions, studying EKC in 87 countries with high and low level of income. They noted that a U curve or inverted-U curve were confirmed in some countries. However, for many countries, none of them is not suitable (22). Aslanidie and Iranzo did not offer evidence on the validity of this concept, but they confirmed the existence of two regimes: the regime of low-income countries

and the regime of middle- and high-income countries. The conclusion of this research is that carbon dioxide emissions growth with economic growth in the low-income regime, while economic growth in the long term slows down the worsening of the quality of the environment in the regime of countries with medium and high-income (4).

The uncritical using of the ecological Kuznets curve represents a great challenge. In this sense, it should be kept in mind the following. As first, there are theorists who believe that development, described by the ecological Kuznets curve, represents a spontaneous or natural flow. In other words, the development is interpreted as the result of normal economic choice, and not of effective political solutions, institutional development and other changes of the social environment. As second, it must not be ignored another danger. If even oppositely directed economic forces cause change and be able to reach a new equilibrium, that stagnation in achieving equilibrium represents a “danger”. In this sense, one can speak about competition between negative tendencies and corrective mechanisms, and as can be seen from the examples of great civilizations, the first competitors can, in some cases, come to “victory” (10).

## International Trade and Foreign Direct Investments

Globalization processes significantly affect both the environment and environmental policy. Thus, international trade can significantly affect the worsening of state of the environment in that one cases when environmental costs are not taken into account in forming prices. Countries, that ignore these costs, have a comparative advantage due to dangerous environmental activity, which it frequently leads to the appropriate specialization and the significant environmental degradation. Furthermore, states may decrease environmental standards in order to attract foreign capital (20).

International trade can also stimulate the raw material sector of the economy, and accordingly, the export of natural wealth. In this case, a negligent relationship towards environmental costs gives competitive advantages. Thus, in countries with weak environmental administration, such as China and India, economic liberalization can lead to the worsening of state of the environment (19).

In general, international trade changes the environment through the effects of structure, scale, technology, and consumption. The effect of structure is manifested through the determination of specialization and production arrangements. This effect is neither positive nor negative. Depending on environmental policy, which decides who bears environmental costs, the state can choose between export products that do not pollute the environment or import products from “dirty” enterprises, or vice versa.

The scale (or size) effect, mostly, is negatively reflected on the environment, because the country's resources are burdened by the expansion of economic activity (16). The impact of technology on the environment is generally viewed from the “positive side” and consists in following: with the growth of the income of population, their demands in question the environment increase. As such, the population strives for stricter environmental standards

and the introduction of modern technology. The effect of consumption depends on the model of consumers, and therefore it is conditioned by the level of environmental knowledge of consumers.

The modeling trade between the rich North and the poor South shows that the effect of structure and the effect of scale cause the degradation of environment in developing countries. The countries with low and medium income specialize for ecologically dangerous production, then when the positive effect of the technological effect is minimal.

Besides that, due to economic liberalization, the total level of pollution in countries with low- and medium-income growth which become a “paradise” for polluters. The hypothesis “a haven for polluters”, that is very popular in Chinese and Indian scientific discourse, talks about dangerous production and the tendency of multinational firms, especially those that pollute the environment to a significant extent, to “migrate” into countries that have weak environmental administration and the decline of foreign direct investments (9).

According to the results of conducted empirical research, this hypothesis has not been clearly confirmed or refuted. Acharyya finds a positive impact of foreign direct investments on growth of economy and emission of CO<sub>2</sub> in India. Moreover, this research showed that during the 90s, foreign direct investments had a far greater impact on the carbon dioxide emissions through economic growth. So, this research approved the hypothesis of “a haven for polluters” (1). Al-Mulali et al. concluded that the inflow of foreign capital causes an increasing pollution and confirmed the validity of the hypothesis “a haven for polluters” in Vietnam (3). Mert et al. confirmed the existence of the pollution haven hypothesis in twenty-seven European countries, which they divided into two groups, depending on when they joined the EU (15).

## Population and Renewable Energy Sources

Empirical testing of the direct influence of demographic trends on the emission of harmful gases resulted in different findings. Many analyses point to the conclusion that the elasticity of CO<sub>2</sub> emissions in relation to the number of inhabitants almost one. Besides that, Cole and Neumayer find that the impact of the number of inhabitants on CO<sub>2</sub> emissions has the shape of a U curve (8). In contrast to the aforementioned studies, in which the elasticity of CO<sub>2</sub> emissions in relation to the number of inhabitants was estimated to be almost one, certain analyses show that it could even be more pronounced (18). DeHart and Soulé, for example, estimated an elasticity greater than one for total and commercial-industrial emissions (10).

Renewable energy sources are those that are available on Earth in unlimited quantities, and are partially or completely renewed or compensated, over and over again. The production of energy from renewable energy sources damages the environment, climate and health significantly less than the production of energy from fossil fuels. Extensive research about the external costs of electricity production from renewable and non-renewable sources show that the environmental damage, ie. the external costs of electricity production, are significantly higher with fossil fuels than with renewable sources (17). According to Chiu and Chang renewable energy sources can influence the reduction of

greenhouse gas emissions, if their share in the total electricity supply is at least 8.38% (7). Tiwari, also, points out that stimulating renewable energy sources can be significant for the reducing greenhouse gas emissions (23).

## METHODOLOGY

The object of this research is to examine the interconnection of CO<sub>2</sub> emissions, economic growth, international trade, foreign direct investments, energy consumption from renewable sources and the number of inhabitants in the period from 1990 to 2021. Below, the equation of the empirical model is given:

$$\ln CO2E_{it} = \beta_0 + \beta_1 \ln GDP_{it} + \beta_2 \ln GDP_{it}^2 + \beta_3 \ln FDI_{it} + \beta_4 \ln TRAdf_{it} + \beta_5 \ln RES_{it} + \beta_6 \ln POP_{it} + \varepsilon_{it} \quad (1)$$

where:  $i$  – cross-sectional data,  $t$  – time,  $\beta_1, \dots, \beta_6$  regression coefficients,  $\varepsilon_{it}$  – the residual,  $\ln$  – natural logarithm of variables. The explanations of the variables are presented in Table 1.

**Table 1.** Defining variables and data sources

Label	Description	Source
CO <sub>2</sub> E	The emissions of CO <sub>2</sub> that use as an indicator of pollution environment.	World Development Indicator
GDP	The gross domestic product <i>per capita</i> at purchasing power parity.	World Development Indicator
FDI	The inflow of foreign direct investments expressed as a % of GDP.	World Development Indicator
TRAdf	The indicator of international trade taken from the KOF Globalization index.	KOF Globalisation Index: Forecasts & Indicators
RES	The energy consumption from renewable sources expressed as the share in total final energy consumption.	World Development Indicator
POP	The average number of the country's population.	World Development Indicator

**Source:** Author's research based on (14) and (24)

To estimate model (1), data on the following European developing countries in the period from 1990 to 2021 are used: Albania, Azerbaijan, Belarus, Bulgaria, Croatia, Czech Republic, Estonia, Georgia, Hungary, Lithuania, Latvia, Moldova, Montenegro, North Macedonia, Poland, Romania, Serbia, Slovenia, Turkey, Slovakia and Ukraine.

The existence of EKC dependence can be confirmed by the values of the regression coefficients for the variables GDP and GDP<sup>2</sup>, ( $\hat{\beta}_1$  and  $\hat{\beta}_2$ ). Namely, the EKC dependence or the dependence of shape of inverted letter “U” exists if  $\hat{\beta}_1 > 0$  and  $\hat{\beta}_2 < 0$ .

When estimating the econometric model (1), it is necessary to check whether there is a unit root in the (panel) time series. For this purpose, several tests have been developed that are divided into first and second generation tests. In the literature, tests of cointegration

are frequently used as a supplement to tests of unit root. Cointegration tests based on the residual are used in this paper. If there is a unit root in the the relation errors, the variables are not cointegrated with each other. Conversely, the cointegration between variables exists if unit root is not present (6). The next step is to choose a tool (method) for the estimating cointegration. As the estimate of the method “ordinary least squares” has an asymptotic bias of the second order, alternative methods for estimation of panel cointegration are used in researches. These are: the method “fully modified ordinary least squares” (FMOLS) and the method “dynamic ordinary least squares” (DOLS).

The advantage of method “fully modified ordinary least squares” consists of its ability to correct problems related to serial correlation in the residuals and endogeneity of regressors. Also, this method helps to eliminate the problem of heterogeneous cointegration. It is similar with the method “dynamic ordinary least squares”. Using lagged independent variables, it also corrects for the autocorrelation and the endogeneity that are characteristic of the method “ordinary least squares” (2).

## RESULTS AND DISCUSSION

On the Table 2, the results of tests unit roots for the variables (or the level) and results for first differences is presented. The results point out the absence stationarity problem first differences for all variables in the model at the significance level of 5%. Thus, it is confirmed the combination of process  $I(0)$  and  $I(1)$ . Furthermore, it is examined the cointegration between the variables in given the model.

We applied two tests: Pedroni and Kao. The null hypothesis of these tests is that there is no cointegration, and the alternative assumes cointegration between the variables. The results of the Pedroni and Kao test are given in Table 3. The results of the tests show that there is a long-term dependence between the variables, ie. that they are cointegrated.

In continuation the estimate of the connection between the variables obtained by dynamic ordinary least squares is given (Table 4). Dynamic OLS gives better results than fully modified OLS, which is in the line with the conclusions of Kao and Chang who, by Monte Carlo method, showed that dynamic OLS was better than fully modified OLS on a finite sample (13). In addition, FMOLS requires that all variables have the same order of integration, and independent variables are not cointegrated with each other (2). In accordance with DOLS, these requirements are not needed and therefore she uses for estimating the model (1).

So, according to the results of the DOLS method, the coefficients of the logarithm of GDP per capita and the logarithm of the square of GDP per capita are statistically significant at the 1% significance level and have a positive and negative value, respectively (Table 4). This means that the concept “environmental Kuznets curve” has been confirmed for observed countries. The coefficient of logarithmic GDP per inhabitant shows that a one percent increase in GDP per inhabitant leads to an increase in  $CO_2$  emissions of 19.283% in the long term. The coefficient of the logarithmic square of GDP per inhabitant shows

that a one percent increase in the square of GDP per inhabitant leads to a reduction in CO<sub>2</sub> emissions of 0.7533% in the long term.

The coefficient of inflows of foreign direct investments is positive and statistically significant at the level of 2%. An increase in the inflows of foreign direct investments by 1 percent leads to an increase in CO<sub>2</sub> emissions by 0.0913%, and thus to the worsening of the quality of the environment. The obtained result is in accordance with the results of the research (3) and (15). The one percent increase in the size of international trade leads to a 0.689% decrease in CO<sub>2</sub> emissions. The obtained result is in accordance with the research (9). According to their opinion, when external trade leads to an increase in residents' income, their demands about environment increase. This can lead to the development of clean technologies and changes in the structure of production. The problem is that changes in the structure of production are not followed by the same kind changes in the structure of consumption, so industries that pollute the environment can migrate to the countries with a low level of income (for example, Serbia, Albania etc.). The relocation of industries, therefore, leads to an increase in pollution in low-income countries and a decrease in pollution in middle- and high-income countries from the sample.

The coefficient of energy consumption from renewable sources is statistically significant at the significance level of 5 percents and confirms the existence of a negative connection with CO<sub>2</sub> emissions. An increase in green energy consumption for 1 percent reduces CO<sub>2</sub> emissions by 0.237 percent in the long run. The obtained result corresponds to the results research (7,17,23). Finally, the coefficient of the variable "Population", in the long run, does not significantly affect the CO<sub>2</sub> emissions.

**Table 2.** The output of panel unit root tests

Tests	Levin-Linn-Chu	Im-Pesaran-Shin	ADF-Fisher	PP-Fisher
p-values (variables or at level)				
lnCO2E <sub>it</sub>	0.0000	0.0000	0.0000	0.0000
lnGDP <sub>it</sub>	0.0000	0.9947	0.9998	1.0000
lnGDP <sup>2</sup> <sub>it</sub>	0.0000	0.9954	0.9999	1.0000
lnFDI <sub>it</sub>	0.0003	0.0000	0.0000	0.0000
lnTRAdf <sub>it</sub>	0.0000	0.0000	0.0000	0.0000
lnPOP <sub>it</sub>	0.0000	0.9680	0.9956	1.0000
lnRES <sub>it</sub>	0.0000	0.0000	0.0000	0.0000
p - values (first differences of variables)				
ΔlnCO2E <sub>it</sub>	0.0000	0.0000	0.0000	0.0000
ΔlnGDP <sub>it</sub>	0.0006	0.0000	0.0000	0.0000
ΔlnGDP <sup>2</sup> <sub>it</sub>	0.0005	0.0000	0.0000	0.0000
ΔlnFDI <sub>it</sub>	0.0000	0.0000	0.0000	0.0000
ΔlnTRAdf <sub>it</sub>	0.0000	0.0000	0.0000	0.0000
ΔlnPOP <sub>it</sub>	0.0000	0.0000	0.0000	0.0000
ΔlnRES <sub>it</sub>	0.0000	0.0000	0.0000	0.0000

**Source:** Author's calculations with Eviews

**Table 3.** The output of panel cointegration tests

Panel tests cointegration		p-values
Pedroni	Panel v-Statistic	0.4505
	Panel rho-Statistic	0.4444
	Panel PP-Statistic	0.0076
	Panel ADF-Statistic	0.0055
	Group rho-Statistic	0.6447
	Group PP-Statistic	0.0034
	Group ADF-Statistic	0.0088
Kao	t-Statistic	0.0000

**Source:** Author's calculations with Eviews

**Table 4.** The output of DOLS method

Variables	Coefficient	Std. Error	t-Statistic	Prob.
$\ln \widehat{GDP}_{it}$	19.28321	10.11494	1.906409	0.0747
$\ln \widehat{GDP}_{it}^2$	-0.753326	0.362028	-2.080850	0.0539
$\ln \widehat{FDI}_{it}$	0.091398	0.032674	2.797257	0.0129
$\ln \widehat{TRADE}_{it}$	-0.689689	0.191589	-3.599837	0.0024
$\ln \widehat{POP}_{it}$	-22.97323	14.02871	-1.637586	0.1210
$\ln \widehat{RES}_{it}$	-0.237369	0.109136	-2.174973	0.0450
R-squared	-0.242577	Mean dependent var		10.19265
Adjusted R squared	-3.426679	S.D. dependent var		1.078604
S.E. of regression	2.269348	Sum squared resid		82.39907
Long-run variance	0.000440			

**Source:** Author's calculations with Eviews

## CONCLUSION

In the research we tried to estimate the degree of suitability of the concept “environmental Kuznets curve” and the hypothesis “a haven for pollutants” and to analyze the impact of international trade, energy consumption from renewable sources, and the number of inhabitants on the environmental quality in selected countries. In the paper, we used the method “dynamic least ordinary squares” to estimate connection between listed factors. The obtained results confirm the the concept “environmental Kuznets curve” and the hypothesis “a haven for pollutants”.

After a certain level of development (GDP per capita), when the economic growth continues the quality of the environment becomes better and thus the environmental Kuznets curve gets confirmation of its existence. At a higher level of development, structural changes in the economy (domination of service sector), increasing environmental

awareness, using environmentally friendly technologies, and higher spending on the environment result in a gradual reduction in degradation and improvement of environmental quality.

The obtained results show that the inflow of foreign direct investments is strongly linked to the emission of CO<sub>2</sub> and, as such, contributes to the worsening of the quality of the environment. This means that multinational companies find “a haven” in developing countries, where they move their (production) facilities which heavily pollute the environment.

The results of research allow the following recommendations to be given. First, to preserve the ecological system and the environment, governments should coordinately decide on target indicators and the reducing CO<sub>2</sub> emissions by taking adequate measures. For example, it has been proven the implementation of policy for forming carbon price creates conditions for lowering carbon dioxide levels. In addition, governments should develop and implement policies for encouraging economic growth in parallel with environmental protection policies. Second, since the validity of the hypothesis “a haven for the polluters” has been confirmed, the governments are obliged to encourage the inflow of foreign direct investments that positively affects the state of the environment and the transfer of energy-efficient technologies. Thirdly, the environmental pollution, that occurs as a result of the increase in total energy consumption, should be solved by stimulating the development and use of clean energy, encouraging innovation and modern technological solutions in the areas of hydropower, wind energy, solar energy.

## Acknowledgment

This research was financed by the Ministry of Education, Science and Technological Development of the Republic of Serbia (contract no. for the realization and financing of scientific research work: 451-03-33/2026-03/200124 ).

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## Uticaj ekonomskog rasta i stranih direktnih investicija na kvalitet životne sredine u evropskim zemljama

**Apstrakt:** U radu je data analiza dinamičke uzajamne veze između ekonomskog rasta, priliva stranih direktnih investicija i zagađenja životne sredine. Primarni fokus istraživanja je testiranje validnosti hipoteza ekološke Kuznjecove krive (EKC) i utočišta za zagađivače (PHH) u odabranim evropskim zemljama tokom perioda od 1990. do 2021. godine. Primenom metode dinamičkih običnih najmanjih kvadrata (DOLS), analizira se dugoročni uticaj međunarodne trgovine, potrošnje energije i broja stanovnika na kvalitet životne sredine. Dobijeni rezultati potvrđuju hipoteze EKC i PHH u evropskim zemljama za period od 1990. do 2021. godine. Rezultati istraživanja ukazuju da prilivi stranih direktnih investicija imaju pozitivan uticaj na emisiju CO<sub>2</sub>, a samim tim i na zagađenje životne sredine. Na osnovu rezultata dobijenih istraživanjem, vladama i kreatorima politike se preporučuje da razrade i realizuju politiku smanjivanja CO<sub>2</sub> emisije u cilju stimulanja ekonomskog rasta i poboljšanja kvaliteta životne sredine. Pored toga, treba podržati uvođenje „čiste“ energije, podsticati inovacije i tehnološke izume u oblasti hidroenergije, solarne energije, energije vetra itd.

**Ključne reči:** dohodak, zagađenje životne sredine, dinamička metoda običnih najmanjih kvadrata, efekat strukture, nove tehnologije