Acta Montanistica Slovaca
ISSN 1335-1788
actamont.tuke.sk

Relationship between GDP and Government Expenditure on Environmental Protection and Environmental Tax Revenues

Ladislav SUHÁNYI[1], Alžbeta SUHÁNYIOVÁ[2] and Michaela KOČIŠOVÁ[3]*

Authors' affiliations and addresses:
[1] Tomori Pál College, Művelődés str. 21-27., 1223 Budapest, Hungary
Pavol Jozef Šafárik University in Košice, Faculty of Public Administration, Popradská 66, 04011 Košice, Slovakia
e-mail: ladislav.suhanyi@gmail.com

[2] Technical University of Košice, Faculty of Mechanical Engineering, Department of Business Management and Economics, Letná 9, 04200 Košice, Slovakia
e-mail: alzbeta.suhanyiova@tuke.sk

[3] Technical University of Košice, Faculty of Mechanical Engineering, Department of Business Management and Economics, Letná 9, 04200 Košice, Slovakia
e-mail: michaela.kocisova@tuke.sk

***Correspondence:**
Ladislav Suhányi, Tomori Pál College, Művelődés str. 21-27., 1223 Budapest, Hungary, Pavol Jozef Šafárik University in Košice, Faculty of Public Administration, Popradská 66, 04011 Košice, Slovakia
e-mail: ladislav.suhanyi@gmail.com

How to cite this article:
Suhányi, L., Suhányiová, A. and Kočišová, M. (2024), Relationship between GDP and Government Expenditure on Environmental Protection and Environmental Tax Revenues. *Acta Monstanistica Slovaca*, Volume 29 (2), 489-499

DOI:
https://doi.org/10.46544/AMS.v29i2.20

Abstract
One of the main aims set by the European Union (EU) is to protect the environment and improve its quality, which affects many industry sectors (such as mining, energy, transport and many others). But at the same time, it aims to achieve economic growth. The paper links these two ambitions of the EU. The paper aims to examine the relationship between the GDP and two environmental indicators, namely the government expenditure on environmental protection and the environmental tax revenues in the EU countries. The research uses freely available Eurostat database data and relativizes them by per capita conversion for comparability. Descriptive statistics and fixed effect panel regression models are used in the evaluation. All data for all EU countries from 2014 onwards are evaluated. The results showed that the level of GDP per capita in the European Union countries could be affected by government expenditure on environmental protection per capita (positive relationship validated) and environmental tax revenues per capita (positive relationship validated). The paper presents political implications in two dimensions. The one follows from the double positive effect of government expenditure on environmental protection – contribution to environmental sustainability and economic growth. The second one calls for caution in decision-making by the public authorities based on the interpretation of the positive relationship of environmental tax revenues since their growth may be accompanied by an increase in undesirable activities associated with threats to environmental sustainability.

Keywords
environmental protection, environmental sustainability, environmental taxes, government expenditure, public administration, GDP

Introduction

The state's current administration by public authorities is marked by the necessity of redistribution processes to fulfil the basic functions of the state. As the primary tool of economic policy, government spending is driven by the need to finance these functions, with tax revenues typically being the most substantial source of state budget income. Modern fiscal policies are designed to achieve a variety of objectives. Consequently, taxation is intended to generate the funds required for government spending and contribute to income redistribution, economic stability, efficient resource allocation, and support economic growth (Spulbar et al., 2021; Sinicakova and Gavurova, 2017).

The paper aims to examine the relationship between the productivity indicator – GDP per capita and two environmental indicators, namely the government expenditure on environmental protection per capita and the environmental tax revenues per capita, in the European Union (EU) countries. The stated aim of the paper directly follows two of the basic aims of the European Union and connects them. These are the following aims of the EU and activities connected with them (European Union, 2024):

- to achieve sustainable development based on balanced economic growth and price stability, as well as a highly competitive market economy characterized by full employment and social progress,
- to protect the environment and improve its quality.

One of the basic indicators of economic development is the GDP – Gross Domestic Product. GDP represents the final monetary value of all production (products and services) that is created in a specific country for a certain period. HPD is usually calculated for one year. In macroeconomics, GDP is a key indicator in determining the performance of a state's economy.

An environmental tax is a tax based on a physical unit (or replacement of a physical unit) of something that has a proven negative impact on the environment and is designated as a tax under ESA2010. Environmental tax statistics cover taxes paid by all sectors of the economy: producers/enterprises, households (as consumers), and non-residents. There are 4 main categories of environmental taxes: energy taxes, transport taxes, pollution taxes, and resource taxes (Eurostat, 2013). For example, in the Slovak Republic, the following taxes were included in individual categories of taxes with an environmental aspect:

- energy taxes: tax on mineral oils, tax on electricity, tax on coal, tax on natural gas, tax on the location of a nuclear facility, tax on payments for gas and liquid storage, emission quotas
- transport taxes: motor vehicle tax – road tax, motor vehicle registration fee, tax for entering and staying a motor vehicle in the historic part of the city
- taxes for pollution: fees for discharge of wastewater into surface waters, fees for air pollution, payments for mining space.

Environmental protection costs consist of environmental protection investments and current costs. It also evaluates the distribution of costs according to financing entities (business and public costs) (Ahmad et al., 2022; Skare et al., 2023). Investments for the protection of the environment are funds spent on the construction, purchase or procurement of capital assets that serve to protect the environment, i.e., j., for the protection of air, water, soil, and other components. Current environmental protection costs are non-investment costs incurred for activities related to environmental protection. Current costs include internal organizational costs (mainly wages) and costs that the organization pays to other entities for environmental services provided.

The efficiency of taxation, particularly the tax structure, is crucial in achieving economic growth and fiscal consolidation (Stoilova, 2016). In the book edited by Gordon (2010), Stiglitz argues that the most critical element of public policy is the structure and level of taxes. Taxation serves as a specific lever of fiscal policy and plays a vital role in developing national economies. For developed countries, the primary objective of fiscal policy is to attain economic stability.

Babatunde et al. (2017) conducted extensive research to examine the relationship between taxation and economic growth in Africa over the period from 2004 to 2013. The research results confirm a significant positive impact of tax revenues on gross domestic product. The findings align with Ibn Khaldun's theory of taxation, which suggests that lower taxes positively influence production and economic performance (Spulbar et al., 2021). It appears that the selected countries in Africa have successfully generated sufficient domestic tax revenues to ensure economic performance.

Environmental taxes have been proven to be the most cost-effective policy in reducing emissions, while redirecting the accumulated tax revenue back into the economy brings economic benefits (Tkacova & Gavurova, 2023; Rajabi, 2023, Linnenluecke & Smith, 2019, Baležentis et al., 2021).

Fiscal policy is the tool through which the government modifies its spending and revenue to shape the overall economy. In the literature, Judd (1985) was one of the pioneers in exploring the relationship between the

productivity of government spending and its effect on economic growth, particularly in relation to its financing through different types of taxes.

By altering the level of expenditures, the government can impact economic growth by stimulating or restraining short-term economic activity. The causal relationship between public sector expenditures and economic development can be interpreted through either the Keynesian approach or Wagner's Law. The Keynesian approach posits that public expenditure contributes to national income growth in the short term through multiplier effects. In contrast, Wagner's Law suggests that public expenditures also rise as national income increases (indicating economic growth). To summarize, causality from public expenditure to national income supports the Keynesian approach, whereas the reverse causality, from national income to public expenditure, aligns with Wagner's Law (Wagner, 1958). Nayak et al. (2021) argue that government expenditure is closely linked to the concept of economic growth and serves as a driving force for each country. Financial policies at the European level emphasize that concentrating public expenditures in areas that stimulate the GDP and using public resources more efficiently are key strategies for sustaining economic growth (Gavurova et al., 2017). Empirical evidence supports the premise that certain types of public expenditures can incentivize growth while others may negatively affect economic growth (Donath & Milos, 2009). In recent decades, numerous studies have investigated the causal relationship between GDP and various types of government expenditures, often producing conflicting results (Efthalitsidou et al., 2021; Babatunde, 2018; Gökmenoğlu & Yavuz, 2022; Simiyu, 2015; Altinok & Arslan, 2020).

The structure of the article results from the established aim of the research. The first part of the article contains an introduction and a literature review to lay the foundations and explain the current state of the issue being addressed. In the following part of the article entitled Material and Methods, the basic framework of the research, the data that was used, the method of their processing and the methods used in their processing and evaluation are presented. The chapter titled Results contains the presentation and description of the research results based on the data used. Subsequently, the results are interpreted and discussed. Implications resulting from them and limitations that limit research results are also presented.

Material and Methods

The research sample within this paper includes all the member countries of the European Union. This means an integration grouping of 27 countries, which are current member countries with a total population representing approximately 6% of the world's population.

The data source used in this research is the freely available Eurostat database. It provides a comprehensive source of statistical data in time series for EU countries. Eurostat, the statistical office of the European Union, is the main source of comparable EU data. Eurostat compiles statistics at the European level, which makes it possible to compare countries and regions with each other. It offers a wide range of data that governments, researchers, businesses, the education sector, journalists and the public can use in their work and everyday life. The database on the website https://ec.europa.eu/eurostat/data/database provides free access to all Eurostat statistics.

The time period examined in the research was from 2014 to 2021. Data were collected yearly. The length of the examined period was chosen based on the availability of data reported using the same collection methodology. The above shows that the maximum theoretical possible number of cases for the examined period was 216. This would be the case if each of the variables under study were available in each of the years under study. However, in the panel regression, it was necessary to omit several cases in the study when one of the investigated variables was not available. This is mainly due to missing data for the indicator 'government expenditure on environmental protection' in several countries before 2018. Countries must report this indicator starting from 2018, but most countries also published it for previous years. The resulting number of examined cases in this research study was 179.

The following variables were included in this research study:

- GDP per capita (purchasing power standards): The indicator is calculated as the ratio of GDP to the average population of a specific year. GDP measures the value of output of goods and services produced by an economy within a certain period of time. It includes goods and services that have markets and products which are produced by general government and non-profit institutions. It is a measure of economic activity and is also used as a proxy for developing a country's material living standards.
- Government expenditure on environmental protection per capita: The indicator is taken from the Eurostat dataset' National expenditure on environmental protection by institutional sector [env_ac_epneis1__custom_12727663]', specifically for the sector 'General government; non-profit institutions serving households'. The original data is expressed annually in millions of euros. The authors calculated the variable based on the average population of each country and expressed it in units of euros per capita.
- Environmental tax revenues per capita: The indicator is taken from the Eurostat dataset' Environmental tax revenues [env_ac_tax__custom_12726431]', specifically the 'Total environmental taxes'. The original data is expressed annually in millions of euros. The authors calculated the variable based on the average

population of each country and expressed it in units of euros per capita.

The paper aims to determine how the selected variables (government expenditure on environmental protection and environmental tax revenues) could affect the GDP in the countries of the European Union. The evaluation of the influence of the selected identifiers (indicators) in this study is based on the validation of the following working hypothesis:

H: *The level of the GDP per capita in the countries of the European Union can be affected by the government expenditure on environmental protection per capita (positive relationship assumed) and the environmental tax revenues per capita (positive relationship assumed).*

This study uses the fixed Effects Panel Regression Model to validate the hypothesis. Fixed effects play a fundamental role in statistical analysis, providing a way to account for specific variables or factors that remain constant across observations. These effects allow us to capture the individual characteristics of entities under study and control for their impact on the outcome of interest (Suhányi et al., 2023).

The fixed effect model can be used to study the relationship between time-varying predictors and outcomes. In general, time-invariant predictors are not utilized in these models (except for certain cases where there is an interest in testing for possible interactions between time-invariant and time-varying predictors) (Allison, 2009). With fixed effects models, individual cases serve as their own controls since they are measured over time. Moreover, there is no concern over omitted-variable bias due to differences between cases, as all time-invariant differences are controlled for. The only possibility for omitted-variable bias is when there is a failure to consider other time-varying predictors of an outcome.

A statistical software application, IBM SPSS Statistics version no. 29.0.2.0 (20) was used to apply the fixed effects panel regression model.

Results

In the following text and in Figure 1, the development of government expenditure on environmental protection and environmental tax revenues in the EU-27 countries is presented. Considering that the indicators are recalculated by the authors of this study and expressed in euros per capita and not in absolute total numbers, it is possible to consider this comparison as relevant.

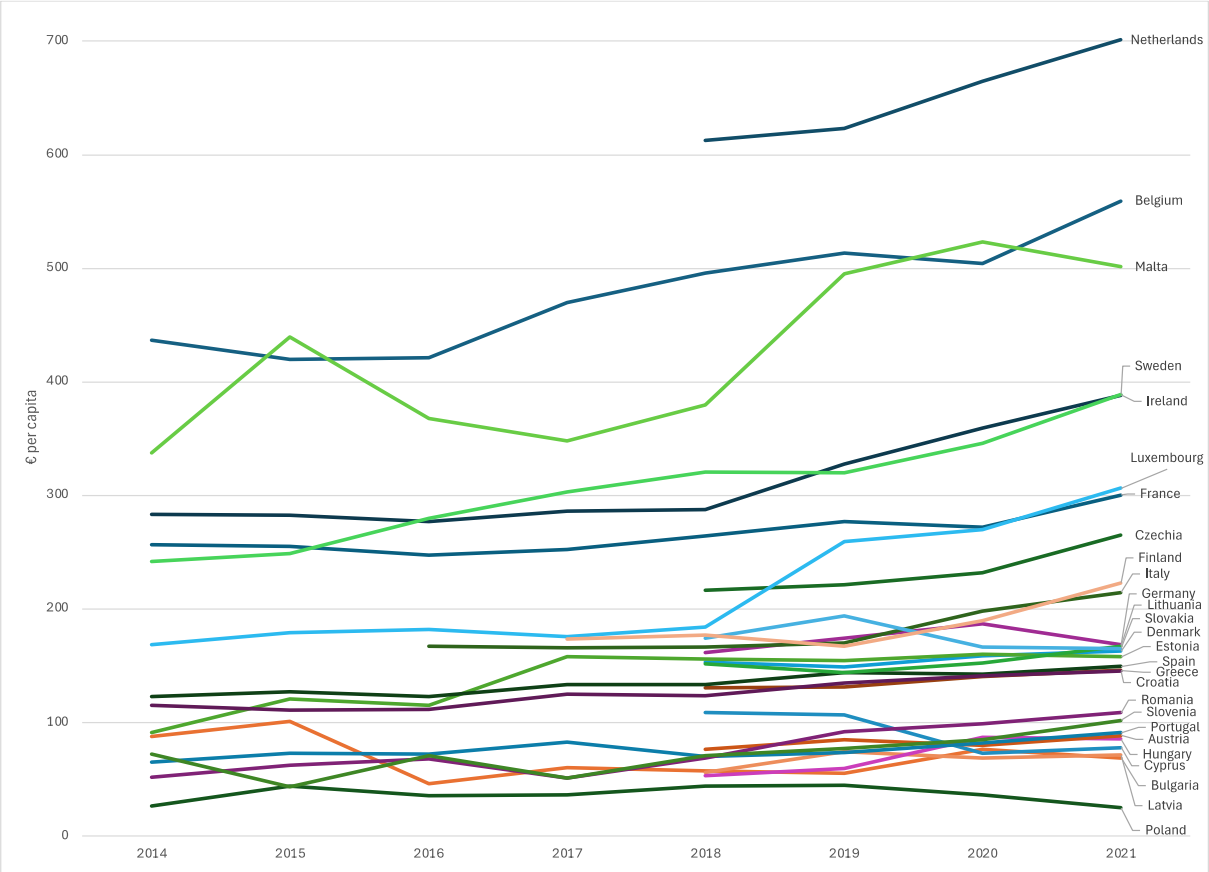

Fig. 1. Development of government expenditure on environmental protection in the EU27 countries

EU countries are obliged to publish data on expenditure on environmental protection from 2018, and the latest freely available data in the Eurostat database are from 2021. However, most EU countries reported statistical data using the given methodology earlier, and therefore, we extended the period under review and compared the period starting in 2014.

For the purposes of this article, specific data on government expenditures are monitored. Significant differences can be noted between countries. The government of the Netherlands spends the highest on environmental protection, followed by Belgium and Malta, which are at a significant distance. The governments of Sweden and Ireland spend approximately the same amount of money per capita, followed by Luxembourg and France, followed by the Czech Republic. The remaining EU countries could be divided into four other groups, Finland and Italy being one of them, thus belonging to roughly half of the countries in the field. Of these countries, the following larger group of countries is worse off: Germany, Lithuania, Slovakia, Denmark, Estonia, Spain, Greece and Croatia. Another larger group of countries with even lower public expenditures on environmental protection follows at a smaller distance: Romania, Slovenia, Portugal, Austria, Hungary, Cyprus, Bulgaria and Latvia. The lowest government expenditures are spent in the mentioned area, with another smaller gap in Poland, which, according to statistical data, has been at the bottom of the European Union since 2015.

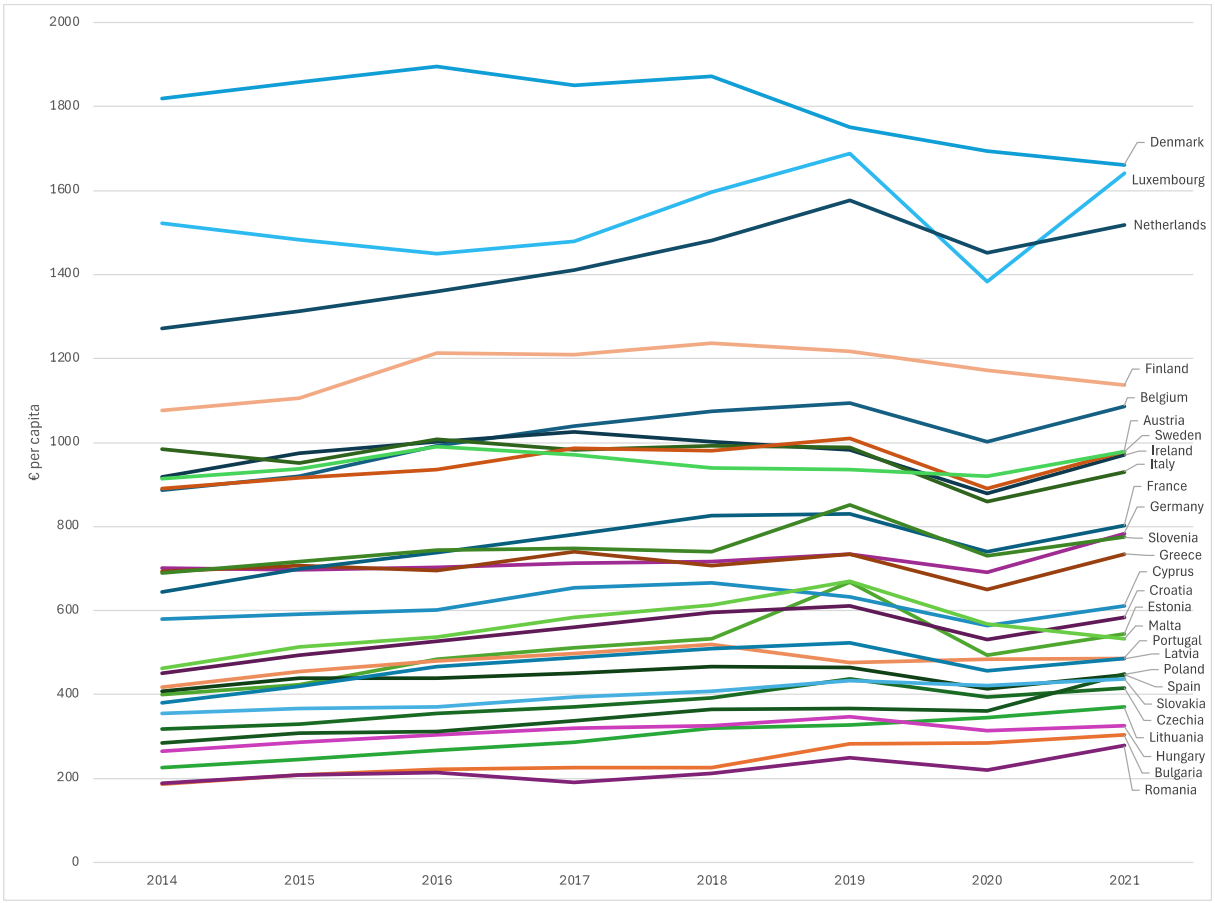

Fig. 2. Development of environmental tax revenues per capita in the EU27 countries

Another monitored indicator is environmental tax revenue, again expressed for countries in euros per capita (Figure 2). Compared to the previous indicator, the numerical differences in the indicator values between countries are even greater. The difference in the last year of the monitored period between the highest environmental tax revenues per capita (Denmark) and the lowest (Romania) is significant, amounting to 1383.5 Euros per inhabitant of the country. At the same time, Denmark has seen a significant decrease in environmental tax revenues in recent years. Thanks to this, as well as the prevailing general growth of environmental tax revenues (excluding the global crisis year 2020), Luxembourg and the Netherlands have already come close to Denmark, making them the group of countries with the highest environmental tax revenues. Romania has had the lowest environmental tax revenues per capita for a long time, but Bulgaria and Hungary are now approaching it.

The paper uses a fixed-effect panel regression model. The dependent variable is the GDP per capita. The presented results form the basis for validating the hypothesis outlined in the Materials and Methods section. The hypothesis assumes a relationship between the mentioned dependent variable and time-varying independent

variables (government expenditure on environmental protection – EnvExpend_perCapita and environmental tax revenues – EnvTaxRev_perCapita) in the 27 countries of the European Union. Table 1 shows the results of the descriptive statistics of the variables.

Tab. 1. Descriptive Statistics

	N	Mean	Std. Deviation	Min.	Max.
GDP_perCapita	179	45198.97866918807000	20872.970937276612000	17616.387946703253	131630.774358308120
EnvExpend_perCapita	179	185.873359402440900	137.664166662200530	24.924818325303427	701.173620197288600
EnvTaxRev_perCapita	179	719.404632270214600	420.559748288445900	187.22845171829948	1894.73882478645280

A total of 179 observations were evaluated, as data were available for each examined variable. This was due to the nature of the data, which were collected for 27 European countries across three different variables. If data for any variable were missing for a country in a given year, that case was excluded from the panel regression model.

Tab. 2. Model Summary

Regression Statistics	
Multiple R	0.980
R Square	0.961
Adjusted R Square	0.954
Standard Error of Estimate	4478.981168477267000
p	< 0.001
No. of cases	179

The resulting regression statistics (Table 2) show that the Multiple R-value (correlation coefficient) is 0.980. The closer this value is to 1, the stronger the dependence. In this case, there is a high degree of dependence between the variables. The R square value (coefficient of determination) is 0.961. When multiplied by 100, this indicates that the selected regression model explains approximately 96% of the variability in GDP among the EU-27 countries, with the remaining 4% attributed to unexplained variability, random variables, and other unspecified influences. The adjusted R square (adjusted coefficient of determination), which accounts for the number of estimated parameters and the number of measurements, is 95.4%. The Standard Error (standard error of the mean) should be as small as possible.

Tab. 3. Fixed Effects Panel Regression Model – dependent variable GDP per capita

	Unstandardized Coefficients		Standardized Coefficients	t Stat	Sig. (p)
	B	Std. Error	Beta		
(Constant)	8193.033	4178.444		1.961	0.050
EnvExpend_perCapita	105.152	12.182	0.694	8.632	< 0.001
EnvTaxRev_perCapita	26.104	6.689	0.526	3.903	< 0.001

The results of the fixed effects panel regression model (Table 3) indicate that a significant relationship is confirmed at the set significance level of α (with a p-value of 0.05 or less) for both examined time-varying independent variables.

Considering the GDP per capita as a dependent variable in the model, there is a positive predictive relationship between the government expenditure on environmental protection per capita and the environmental tax revenues per capita. However, for the strength of the relationship, the one with government expenditure on environmental protection appears to be four times more intense than the one with environmental tax revenues. It follows from the above that if we considered the other time-dependent variables unchanged, then the model would assume that with an increase in the country's expenditure on environmental protection per capita, the value of the GDP per capita would also increase. Analogously, it can also be assumed that, with other time-dependent variables unchanged, the GDP per capita value should also increase with increased environmental tax revenues per capita. The regression coefficients of the panel regression model are calculated for all the European Union countries (actually 27 member

countries), where the fixed effects of the countries are assumed in the model. The value of the intercept coefficient (constant) is 8193.033. The final estimation of regression coefficients indicates that if government expenditure on environmental protection per capita increases by one unit, GDP per capita will increase by 105.152 units. Additionally, if environmental tax revenues per capita increase by one unit, GDP per capita will increase by 26.104 units. These results cannot be quantified entirely in this way, but it appears that there is a link between the GDP and the government's environmental expenditure and environmental tax revenues that need to be taken into account in the decision-making of public authorities.

Based on the results, the following hypothesis stated within the present study can be validated:
The level of the GDP per capita in the countries of the European Union can be affected by the government expenditure on environmental protection per capita (positive relationship validated) and the environmental tax revenues per capita (positive relationship validated).

Next, the suitability of the selected fixed-effect panel regression model is assessed (Table 4). As outlined in the Materials and Methods section, this assessment is conducted using the Analysis of Variance (ANOVA) method.

Tab. 4. Testing the suitability of the model – Analysis of Variance

ANNOVA					
	Sum of Squares	df	Mean Square	F	Sig. (p)
Regression	74542012157.078	28	2662214719.896	132.704	< 0.001
Residual	3009190846.136	150	20061272.308		
Total	77551203003.214	178			

In the ANOVA, the null hypothesis tests whether the chosen regression model is unsuitable for explaining the relationship (with the alternative hypothesis suggesting the model is appropriate). The F test evaluates this hypothesis, and the *p*-value should be below 0.05 (the chosen significance level α). For the proposed regression model, the *p*-value is less than 0.001. Consequently, the null hypothesis (H0) is rejected, indicating that the model was appropriately selected. This result supports the validation of the hypothesis presented in the research.

Discussion

Based on the analyses carried out, the research in this article concluded that the established hypothesis was validated. This means that it is possible to assume that the investigated environmental indicators can affect the GDP of the countries of the European Union. These are two investigated indicators from the opposite spectrum – government expenditure on environmental protection and environmental tax revenues – one of which represents the side of environmental expenditures and the other the side of environmental revenues of the public administration. The results show that both have a positive relationship with GDP, which means that if they increase, it should positively affect GDP growth.

Generally, the causality between economic growth and public sector expenditure was already dealt with by representatives of the two basic theories, Wagner's Law (Wagner, 1958) and the Keynesian approach. While Wagner's Law follows a relationship in the direction of economic growth that can influence public expenditure, the Keynesian approach supports the findings in this article, according to which public expenditure can positively affect economic growth. An important body of literature, rooted in the aforementioned Keynesian principles, argues that government expenditure can form an exogenous macroeconomic policy tool to increase national income through multiplier effects on aggregate demand and, thus, on the level of output. (Arestis et al., 2020). Additionally, also the literature on endogenous growth models has highlighted the positive impact of government expenditures on economic growth. These are, for example, the following research of Ghose & Das (2013), Facchini & Melki (2013), Wu et al. (2010), Grossman (1990), and Ram (1986). All of them found evidence of a positive effect of government expenditures on economic growth.

The novelty of this study compared to the Keynesian approach is in the specification of the type of public expenditure. Government expenditure on environmental protection results not only from the national interests of individual countries, but is also a reflection of the established policy of the European Union and global problems with environmental sustainability. The type of expenditure can be fundamental when applying the Keynesian approach, as Neicheva (2006) also addressed in his research. When researching the effects of government expenditure on short-term output in Bulgarian, he concluded that government investment affects real growth in a Keynesian way while transfers and public consumption show non-Keynesian behaviour.

The causality between taxes and gross domestic product is also a debated issue among researchers. The findings of this paper indicate a positive effect of increased environmental tax revenues on GDP growth. It should be noted here that this is not usually the primary political motive in managing environmental taxes. The development of an ecological and sustainable low-carbon economy has become an international trend (Gavurova et al., 2018) due to increasingly serious environmental problems. The aim of environmental taxes is, for example, to motivate the choice of innovative and ecological technologies for reducing emissions. Nevertheless, there is a positive effect in relation to GDP, which is probably caused by the redirection of tax revenues back into the economy; the results of research done by several authors agree on this (Rajabi, 2023, Linnenluecke & Smith, 2019, Baležentis et al., 2021, Rajabi, 2022).

Political implications in relation to government expenditure on environmental protection result from the Keynesian view, which considers the increase in national income as a consequence of the increase in government expenditure, which is given autonomously and exogenously. From a Keynesian point of view, government expenditure is an important macroeconomic policy variable. This is very important because this variable can be used not only to promote economic growth but also to moderate short-term economic fluctuations. Thus, Keynes (1936) argued that the relationship is in the direction from government expenditure to national income. In Keynesian economics, increased government expenditure is seen as an engine for supporting output growth through fiscal multipliers and investment-accelerating mechanisms. When applying these principles to government spending on environmental protection, political decisions to introduce and increase them appear to be very positive. On the one hand, it is a policy of environmental sustainability and preservation of the planet for future generations, but on the other hand, it turns out to have a positive effect on economic development as well - which are often conflicting goals in other cases.

Political implications based on the results of this article in relation to environmental taxes should not be the first thing that comes to mind. They should not just be mechanically derived based on numbers. The fact that the article deals with tax revenues and not explicitly with the tax burden, or thus with tax rates, opens up another area for recommendations. In general, we could say that an increase in environmental tax revenues means an increase in activities that burden the environment. Environmental sustainability policy tries to discourage economic actors from exactly such activities (Suhányiova et al., 2023). Of course, this applies assuming unchanged conditions, tax rates and disregarding inflationary effects. A good environmental policy should, therefore, result in a gradual reduction of activities that have a negative impact on the environment, even if this should sacrifice the positive impact of environmental tax revenues on GDP. On the other hand, increasing the environmental tax burden and streamlining the control and collection of these taxes (which would result in an increase in environmental tax revenue) could positively affect both the environment and GDP. However, such a policy must be conducted carefully to maintain competitiveness vis-à-vis less environmentally responsible countries.

Conclusions

This paper aimed to examine the relationship between the productivity indicator – GDP per capita and between two environmental indicators, namely the government expenditure on environmental protection per capita and the environmental tax revenues per capita, in the European Union (EU) countries. The two indicators examined in the context of GDP are from opposite parts of the government budget – government expenditure on environmental protection and environmental tax revenues – one of which represents the side of budgetary expenses and the other the side of environmental revenues of the public administration. In this case, the GDP was considered the dependent variable and the environmental indicators as the independent variable. The research was performed on the research sample of the countries of the European Union. All the EU-27 countries were included. The selected indicators represent the interconnection between two of the basic aims of the EU. The interconnection of economic goal (sustainable development based on balanced economic growth and price stability, as well as a highly competitive market economy characterized by full employment and social progress) and environmental goal (protect the environment and improve its quality).

As part of the research, the development of both environmental indicators in the period from 2014 for 27 countries of the European Union was presented and compared. It turned out that there are relatively large disparities between countries, whether in the case of environmental expenditures of individual governments or in the case of environmental tax revenues. In the case of the expenditure on environmental protection indicators, in several EU countries, it was only possible to analyze the period from 2018 since only from then were they obliged to report the indicator in the given methodology. However, in most countries, data has been published since the beginning of the monitored period.

As part of further processing with statistical methods, a research hypothesis was stated, which was validated as follows: The level of the GDP per capita in the countries of the European Union can be affected by the government expenditure on environmental protection per capita (positive relationship validated) and the environmental tax revenues per capita (positive relationship validated). A fixed effects panel regression model was

used to validate the hypothesis. The stated results in relation to environmental expenses were confronted with the two basic theories, Wagner's Law and Keynesian approach. The results are in line with the Keynesian approach and supported by the research findings of other scientific studies. The novelty compared to the Keynesian approach is in the specification of the type of government expenditure on environmental protection. The results in relation to environmental tax revenues are also supported by the results of other scientific studies that found a positive relationship between taxes and economic development. However, this article specifically examined the levels of environmental tax revenues (not the level of taxes), which opened up space for suggestions regarding the implications.

Political implications were drawn based on the results in relation to both independent variables examined. Political decisions to introduce and increase government environmental expenses appear to be the right way to combine two simultaneous positive effects – supporting environmental sustainability and stimulating the country's economic development.

In the case of implications in relation to environmental tax revenues, the situation is not so clear, even if it seems so based on the results. It is assumed that the increase in revenues from environmental taxes may be accompanied by an increase in undesirable activities associated with threats to environmental sustainability. Therefore, governments must be careful when trying to increase the mentioned tax revenues. Increasing the environmental tax burden and streamlining the control and collection of these taxes (which would result in an increase in environmental tax revenue) could positively affect both the environment and GDP.

One of the limitations of the research results is their applicability to the examined sample of countries. The sample consists of EU countries with established common economic and environmental rules. Here it can be noted that, despite this, relatively large differences between countries are noticeable. Another limitation of the research is the relatively short period examined, which was mainly limited by the availability of the indicator 'government expenditure on environmental protection' reported by the given Eurostat methodology. The examined period also includes the period of the economic crisis caused by the global pandemic, and its impact could also be seen when analyzing the development of environmental variables. In the case of the 'environmental tax revenues' indicator, the dependence on the effects of inflation, changes in tax rates and the introduction of new taxes are a limitation that must be taken into account.

Further research into the solved issue could lead to the last-mentioned limitation. Research into real environmental tax revenues could show interesting results. Inflationary effects on goods subject to environmental taxes would be taken into account. At the same time, changes in tax rates and fees, as well as the introduction and cancellation of environmental taxes and fees, could be monitored as part of the research.

Another dimension of further research in the future should be its repetition a few years later with a larger investigated time period.

References

Allison, P.D. (2009). *Fixed Effects Regression Models.* SAGE Publications, Inc. eBooks. SAGE Publishing. https://doi.org/10.4135/9781412993869.

Altinok, H., & Arslan, M. O. (2020). The Relationship between Public Expenditures and Economic Growth in Southeastern European Countries: An Analysis of Bootstrap Panel Granger Causality. *Economic Computation and Economic Cybernetics Studies and Research, 54*(3/2020), 249–262. https://doi.org/10.24818/18423264/54.3.20.15

Ahmad, M., Ahmed, Z., Gavurova, B., & Oláh, J. (2022). Financial risk, renewable energy technology budgets, and environmental sustainability: is going green possible? *Frontiers in Environmental Science*, 10. https://doi.org/10.3389/fenvs.2022.909190

Arestis, P., Şen, H., & Kaya, A. (2020). On the linkage between government expenditure and output: empirics of the Keynesian view versus Wagner's law. *Economic Change and Restructuring*. https://doi.org/10.1007/s10644-020-09284-7

Babatunde, O. A., Ibukun, A. O., & Oyeyemi, O. G. (2017). Taxation revenue and economic growth in Africa. *Journal of Accounting and Taxation*, *9*(2), 11–22. https://doi.org/10.5897/jat2016.0236

Babatunde, S. A. (2018). Government spending on infrastructure and economic growth in Nigeria. *Economic Research-Ekonomska Istraživanja*, *31*(1), 997–1014. https://doi.org/10.1080/1331677x.2018.1436453

Baležentis, T., Butkus, M., Štreimikienė, D., & Shen, Z. (2021). Exploring the limits for increasing energy efficiency in the residential sector of the European Union: Insights from the rebound effect. *Energy Policy, 149*, 112063. https://doi.org/10.1016/j.enpol.2020.112063

Donath, L., & Milos, M. (2009). The influence of public expenses on GDP growth in selected countries of the European Union. *Industrial revolutions, from the globalization and post-globalization perspective: Banking, accounting and financial systems from the 21st century perspective*, 4, 220–229. WOS Id:000287985000033

Efthalitsidou, K., Zafeiriou, E., Spinthiropoulos, K., Betsas, I., & Sariannidis, N. (2021). GDP and Public Expenditure in Education, Health, and Defense. Empirical Research for Greece. *Mathematics*, *9*(18), 2319. https://doi.org/10.3390/math9182319

European Union. (2024). *Aims and values.* Available online: https://european-union.europa.eu/principles-countries-history/principles-and-values/aims-and-values_en (accessed on 28 April 2024).

Eurostat. (2013). *Environmental Taxes: A Statistical Guide.* Available online: https://ec.europa.eu/eurostat/web/products-manuals-and-guidelines/-/KS-GQ-13-005 (accessed on 28 April 2024). https://doi.org/10.2785/47492

Facchini, F., & Melki, M. (2013). Efficient government size: France in the 20th century. *European Journal of Political Economy*, *31*, 1–14. https://doi.org/10.1016/j.ejpoleco.2013.03.002

Gavurova, B., Kocisova, K., Behun, M., & Tarhanicova, M. (2018). Environmental performance in OECD countries: A non-radial DEA approach. *Acta Montanistica Slovaca, 23*(2), 206–215.

Gavurova, B., Soltes, M., & Kovac, V. (2017). Application of cluster analysis in process of competitiveness modelling of Slovak Republic regions. *Transformations in Business & Economics*, 16(3), 129-147.

Ghose, A., & Das, S. (2013). Government size and economic growth in emerging market economies: a panel co-integration approach. *Macroeconomics and Finance in Emerging Market Economies*, *6*(1), 14–38. https://doi.org/10.1080/17520843.2012.697075

Gökmenoğlu, M., & Yavuz, İ. S. (2022). The relationship between public expenditures and economic growth: case of the Fragile Five. *Mehmet Akif Ersoy Üniversitesi İktisadi ve İdari Bilimler Fakültesi Dergisi*. https://doi.org/10.30798/makuiibf.979789

Grossman, P. J. (1990). Government and growth: Cross-sectional evidence. *Public Choice*, *65*(3). https://doi.org/10.1007/bf00204946

Judd, K. L. (1985). Redistributive taxation in a simple perfect foresight model. *Journal of Public Economics*, *28*(1), 59–83. https://doi.org/10.1016/0047-2727(85)90020-9

Keynes, J. M. (1936). *General Theory of Employment, Interest, and Money*. Palgrave Macmillan, London.

Linnenluecke, M. K., & Smith, T. (2019). A Primer on Global Environmental Change. *Abacus*, *55*(4), 810–824. https://doi.org/10.1111/abac.12175

Nayak, S., Kumar, V. S. G., Mendon, S., Birau, R., Spulbar, C., Srikanth, M., & Doagă, I. D. (2021). The effects of government expenditure on sustainable economic growth in India: assessment of the circular economy. *Industria Textila*, *72*(01), 74–80. https://doi.org/10.35530/it.072.01.1791

Neicheva, M. (2006). Non-Keynesian Effects of Government Expenditure on Output in Bulgaria: An HP Filter Approach. *Post-Communist Economies, 18*(1), 1–12. https://doi.org/10.1080/14631370500505081

Rajabi, M. M. (2023). Carbon tax accompanied by a revenue recycling increases Australia's GDP: A dynamic recursive CGE approach. J*ournal of Cleaner Production*, *418*, 138187–138187. https://doi.org/10.1016/j.jclepro.2023.138187

Ram, R. (1986). Government Size and Economic Growth: A New Framework and Some Evidence from Cross-Section and Time-Series Data. *The American Economic Review, 76*(1), 191–203. Available online: http://www.jstor.org/stable/1804136 (accessed on 28 April 2024)

Simiyu, C. N. (2015). Explaining the Relationship between Public Expenditure and Economic Growth in Kenya using Vector Error Correction Model (VECM). *International Journal of Economic Sciences*, *IV*(3), 19–38. https://doi.org/10.20472/es.2015.4.3.002

Siničáková, M., & Gavurova, B. (2017). Single Monetary Policy versus Macroeconomic Fundamentals in Slovakia. *Ekonomický časopis/Journal of Economics*, 65(2), 158-172.

Skare, M., Gavurova, B., & Kovac, V. (2023). Investigation of selected key indicators of circular economy for implementation processes in sectorial dimensions. *Journal of Innovation & Knowledge*, 8(4), 100421. https://doi.org/10.1016/j.jik.2023.100421

Spulbar, C., Ehsanifar, M., Birau, R., Babaie, A. & Doagă, D.I. (2021). Advanced empirical research based on structural equation modeling (SEM) regarding the impact of tax revenue on GDP dynamics at EU-28 level. *Scientific Annals of Economics and Business*, *68*(3), 285–307. https://doi.org/10.47743/saeb-2021-0017

Stiglitz, J.E. (2010). *Development-Oriented Tax Policy.* In Gordon, R. H. (2010). *Taxation in Developing Countries. Six Case Studies and Policy Implications.* Columbia University Press. https://doi.org/10.7312/gord14862

Stoilova, D. (2017). Tax structure and economic growth: Evidence from the European Union. *Contaduría Y Administración*, *62*(3), 1041–1057. https://doi.org/10.1016/j.cya.2017.04.006

Suhányi, L., Suhányiová, A., & Kočišová, M. (2023), Renewable Energy Consumption in the Context of Economic Development, CO2 Emissions and Implications for Public Administration: The Case of Visegrad Group Countries. *Acta Montanistica Slovaca, 28*(4), 966–976. https://doi.org/10.46544/AMS.v28i4.14

Suhányiová, A., Korečko, J., & Suhányi, L. (2023). Renewable energy sources management in the EU-27 countries. *Acta Montanistica Slovaca, 28*(2), 479–495. https://doi.org/10.46544/AMS.v28i2.17

Tkacova, A., & Gavurova, B. (2023). Economic sentiment indicators and their prediction capabilities in business cycles of EU countries. *Oeconomia Copernicana*, 14(3), 977-1008. https://doi.org/10.24136/oc.2023.029

Wagner, A. (1958). Three Extracts on Public Finance. *Classics in the Theory of Public Finance*, 1–15. https://doi.org/10.1007/978-1-349-23426-4_1

Wu, S.-Y., Tang, J.-H., & Lin, E. S. (2010). The impact of government expenditure on economic growth: How sensitive to the level of development? *Journal of Policy Modeling*, *32*(6), 804–817. https://doi.org/10.1016/j.jpolmod.2010.05.011