

The Linkage of Environmental Taxes and Tourism Toward Sustainable Development

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Abstract

Tourism plays an important role in taxing the environment for sustainable development. International tourism has been the largest contributor to the growth of tourism and the economy. As a result, the emissions caused by tourists have increased, raising the issue of sustainable development. To improve environmental performance, environmental taxes play an important role. The aim of this paper is therefore to analyse the impact of environmental taxes, international tourist arrivals and environmental regulations on sustainable development in 19 EU countries in the period 2003-2020. A dynamic panel regression model was used to obtain empirical results in the short and long run, using estimators for the mean group and the pooled mean group. The empirical results show that environmental regulations and gross domestic product per capita have a negative long-term impact on CO₂ emissions. However, environmental taxes have a positive effect on CO₂ emissions in the long run. On the other hand, increasing gross domestic product and the number of tourists have a positive effect

on CO₂ emissions in the short run, implying that they are the cause of increasing pollution.

Keywords: tourism, sustainable development, environmental taxes, EU, panel regression

JEL: H20, H23, Z30

1. Introduction

Every year, increasing tourism consumption and economic growth give rise to a number of ecological and environmental problems. In addition, the environmental dimension of tourism has become critical due to globalisation (Ozcan et al. 2022). Although tourism has a huge impact on economic, social, and environmental aspects, there is a question of sustainable tourism development. Also, as a service-oriented industry, tourism is a channel to make a better life for local people and future generations. Therefore, the concept of sustainable tourism becomes a great concern for the government at all levels. As such, this can be achieved only through the fair and equitable use of natural, cultural, human, and economic resources. In addition, the following principles defined by UNEP and WTO (2005) should be considered: 1) make optimal use of environmental resources that are key elements in tourism development, maintain

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essential ecological processes, and help conserve natural heritage and biodiversity; 2) respect the socio-cultural authenticity of host communities, conserve their built and living cultural heritage and traditional values, and contribute to intercultural understanding and tolerance; and 3) ensure viable, long-term economic operations, providing socio-economic benefits to all stakeholders that are fairly distributed, including stable employment, income-earning opportunities, and social services to host communities, and contribute to poverty alleviation. The overall aim of these principles is to support local communities and the economy, protect the environment, and provide enriching experiences for tourists in a sustainable manner. Therefore, various instruments from different perspectives should be included, such as legislation, regulation, land use planning, taxes and charges, financial incentives, codes of conduct, and marketing and information services. Consequently, efforts to develop this type of tourism should remain sustainable in the future (Amerta, 2018).

Tourism greatly contributes to carbon emissions, with international tourism having a negative impact on the environment by raising CO₂ levels (UNWTO, 2019). The transportation sector accounts for the majority of greenhouse gas emissions in tourism, with planes and cars emitting the highest CO₂ per passenger mile. Tourism accounts for around 8% of global carbon emissions, with visitors from high-income nations contributing the most (Khatib, 2023). According to United Nations World Tourism Organisation and International Transport Forum research, transport-related emissions from international tourism would increase by 45% between 2016 and 2030, reaching 665 Mt CO₂. These findings highlight the need for sustainable tourist development,

with an emphasis on low emissions and highly efficient operations, as well as increased collaboration with the transport sector to enable the implementation of a high-ambition scenario set by EU policies. A possible solution can be found within one instrument of fiscal policy, i.e., environmental taxes. They can be used as a tool to promote sustainable development and mitigate the environmental impact of tourism. By internalising the societal cost of environmental pollution and ecological loss, environmental taxes can help cover the expenses of environmental harm, efficiently decrease pollution, and enhance the ecological environment, according to Sarpong et al. (2023). In the tourism industry, environmental taxes can be used to reduce other taxes, providing both environmental improvements and positive economic outcomes. Revenue from environmental taxes and charges can be used to manage growth in a sustainable and inclusive manner, with appropriate levels of investment to maintain and improve existing tourism offerings and develop new products (Trstenjak et al., 2023).

Overall, the linkage between environmental taxes and tourism and sustainable development is a complex issue that requires a holistic approach, considering both economic and environmental factors. By promoting sustainable development in the tourism industry, environmental taxes can help reduce the environmental impact of tourism and contribute to the achievement of sustainable development goals. Therefore, the aim of this paper is to investigate how environmental taxes, international tourist arrivals, and environmental regulations impact sustainable development in 19 EU countries in the period 2003–2020. Furthermore, the motivation of the paper is to answer the following research questions:

- 1) What is the linkage between environmental regulation, as measured by the environmental performance stringency index, and environmental damage caused by international tourist flows?
- 2) Do environmental taxes influence the development of tourism through CO₂ emissions, and is there a difference in the short and long term?

The novelty of the paper can be found in the evaluation of environmental taxes, international tourist arrivals and environmental regulations measured by the index of environmental policy stringency on sustainable development in EU countries. The contribution of the paper is twofold. First, we examine the empirical analysis of the linkage between environmental taxes, tourism, and environmental regulations towards sustainable development in 19 EU countries that have a very well-developed tourism sector. Second, based on empirical results, we provided specific recommendations to achieve sustainable development that can be relevant to policymakers.

The paper is organised as follows: After a brief introduction, section 2 provides an overview of related literature and empirical studies. The description of the data set and the measurement is presented in section 3. Section 4 presents the implementation of the estimation methodology, while section 5 presents the empirical results. The final section summarises the paper with corresponding policy recommendations as well as recommendations for further research.

2. Literature review

Since tourism constitutes a significant part of the economy, it also destroys tourism resources and the environment. Therefore, several studies examined the relationship

between tourism, sustainable development, and environmental taxation (Palmer and Riera, 2003; Dwyer et al. 2012; Dogan, 2017; Meng and Pham, 2017; Niñerola, et al. 2019; Balli et al. 2019; Katircioglu et al. 2020; Leitão et al. 2020; Haibo et al. 2020; Eyuboglu and Uzar, 2020; Sharpley, 2020; Cao et al. 2021; Khan et al. 2021; Usman and Alola, 2023). All of the mentioned studies showed interesting results, but there was no unique conclusion among academics and researchers.

2.1. Tourism and environmental performance

Nowadays, the increasing flow of tourists in all EU countries, especially during the summer season, raises the question of environmental sustainability and the attractiveness of tourist destinations. It is widely recognised that a variety of tourism activities associated with the tourism industry have a significant impact on the environment, in most cases negative. For example, the expansion of tourist accommodation, i.e. infrastructure, is now devastating land that was previously dedicated to agriculture. This has an impact not only on the soil, but also on water, CO₂ emissions and waste management. Consequently, the quality of natural capital in general will deteriorate. Even though the topic has already been researched, there are always new findings from different perspectives.

The study by Dogan (2017) on the 10 most visited countries shows that real GDP and tourism contribute to an increase in CO₂ emissions, while renewable energies reduce them, which emphasises the need for regulatory measures to promote sustainable tourism. Katircioglu et al. (2020) analyse the impact of tourism on greenhouse gas emissions in Cyprus and highlight the significant environmental impact of the tourism sector

and the importance of using environmental indicators for sustainable development. However, Leitão et al. (2020) find in the EU-28 that trade openness and renewable energy sources reduce CO₂ emissions, with tourism arrivals showing a negative correlation with emissions, suggesting a shift towards more sustainable tourism practises. They found that the rate at which production and CO₂ emissions behave, differ significantly in relation to responses to carbon tax, productivity and low-carbon technological shocks in the tourism sector. Balli et al. (2019) investigated the impact of tourism on economic growth taking into account carbon emissions by using panel data techniques and a heterogeneous causality test for a sample of Mediterranean countries for the period 1995–2014. The results show that tourism contributes to economic growth in Mediterranean countries where policy makers should implement sustainable tourism without harming the environment. Usman et al. (2020) analysed the importance of tourism development, economic growth and institutional quality for environmental performance using a sample of EU-28 countries for the period 2002–2014. They found that tourism development and economic growth reduce environmental quality performance. Tan et al. (2017), using a sample of 811 firms from the casino industry (223), hotel industry (142), restaurant industry (235) and airline industry (211), investigated the influence of environmental performance on tourism development as measured by financial performance by establishing a link between tourism industry and environmental performance. The results showed that the relationship between these dimensions is moderated by scarce resources. Furthermore, there are differences between Western and Eastern EU countries. Paramati et al. (2017)

found that tourism reduces pollution in countries in the western part of the European Union and accelerates pollution in countries in the eastern part. Although there is no universal solution, it can be concluded that although tourism promotes job creation, income and economic growth, on the other hand, it poses a significant threat to the environment. The solution to this problem can be found in the creation of green tourism, which is not only environmentally friendly and sustainable for tourists, but also for the environment. In order to achieve the desired goal, additional public and private funding is essential. According to a study by Wilson et al. (2001), the lack of financial resources is one of the biggest obstacles to the promotion of destinations and sustainable tourism.

2.2. Tourism and environmental taxation

In every EU country, tourism makes a significant contribution to the economy. On the one hand, this helps to promote destinations, but on the other hand, it destroys the environment. This can be controlled and monitored with appropriate fiscal instruments. One of the possible solutions is environmental taxes. They have a dual function. Firstly, to increase tax revenues, and secondly, to change consumer buying habits. In order to achieve positive revenues, all stakeholders in the communities (each on their own) need to work together on sustainable development and recognise more the role of sustainable tourism policies and destination management to achieve better social responsibility of destinations, especially with regard to the environment and anti-environmental behaviour of tourists (Khan et al., 2021). This requires effective policies, such as environmental taxes, to secure the necessary funds. According to

OECD (2014, p. 76), tourism taxes contribute (directly or indirectly) “to the generation of tax revenues, the financing of environmental protection and public investment, and the development of infrastructure to improve the management of tourism impacts in sensitive areas.” In addition, Cárdenas-García et al. (2022) found that tourism taxation is a fiscal instrument that effectively secures financial resources for the development of measures to improve the environmental performance of the destination and sustainable development. Numerous studies have therefore analysed the effectiveness and impact of environmental taxes on tourism. However, there is still no clear consensus among researchers.

By using the dynamic stochastic general equilibrium, Cao et al. (2021) explored how carbon tax and economic policy impact the development of the tourism sector. They discovered that the rate at which output and CO₂ emissions behave differ significantly across the tourism sector in terms of responses to the carbon tax, productivity, and low-carbon technological shocks. On the other side, Meng and Pham (2017) found that Australia’s carbon tax of US\$23 per tonne yields a significant emission reduction, but not without causing some economic constraints, such as a decline in real tourism expenditure, especially from inbound and domestic tourism demand. Usman and Alola (2023) analyse the effectiveness of environmental taxes in lowering the impact of tourism on environmental performance in the EU-28 nations between 2002 and 2019. Empirical results from the panel threshold regression model suggest that the impact of tourism on environmental performance is influenced by the level of environmental taxes. When environmental taxes are less than the criteria level of 9.43%, tourism has little impact on

environmental performance. Dogan et al. (2023) found that both, environmental taxes and energy taxes have a negative impact on renewable energy deployment in EU countries. Hence, tourism would improve environmental performance after environmental taxes reached a certain level.

Despite much research, there is still no link between environmental taxes, tourism and sustainable development. To contribute to the existing literature, this paper analyses the link between environmental taxes, international tourist arrivals and environmental regulations on sustainable development in 19 EU countries in the period 2003–2020. Based on the above literature, our hypothesis is that environmental taxes have a positive effect on CO₂ emissions and that environmental regulations are effective in reducing environmental damage that affects sustainable development.

3. Data and Measurement

This study investigates the effects of environmental taxes, stringent environmental regulations, and international visitor arrivals on sustainable development of 19 EU economies. According to He et al. (2019) rigorous environmental rules and tariffs are effective indicators of reducing environmental degradation. Furthermore, based on earlier studies and published works, our study also includes control variable, such as GDP per capita.

CO₂ emissions is the dependent variable in this study, with tourist arrivals, environmental taxes, stringent environmental regulations, and GDP per capita serving as independent variables. To examine the association between the selected variables, the model below is used:

$$\ln\text{CO}_{2\text{it}} = \beta_0 + \beta_1 \ln\text{TOUR}_{\text{it}} + \beta_2 \ln\text{ETAX}_{\text{it}} + \beta_3 \ln\text{EPS}_{\text{it}} + \beta_4 \ln\text{GDPpc}_{\text{it}} + e_{\text{it}} \quad (1)$$

where CO₂ emissions are carbon dioxide gas emissions in thousand tons; TOUR is the number of international tourist arrivals; ETAX is environmentally related tax revenue measured in constant 2015 million US\$ PPP; EPS represents Environmental Policy Stringency Index and GDPpc is real gross domestic product per capita in constant 2015 US\$. Annual data for variables ETAX, EPS, and GDPpc are from the OECD database, TOUR is from the World Bank, and CO₂ emissions are from Eurostat. We analysed 19 EU countries from 2003 until 2020 since. The sample selection is limited by the accessibility of the data, since data for EPS are available only until 2020.

A globally comparable way to assess how strict environmental policies are is through the use of the OECD Environmental Policy Stringency Index (EPS). Stringency is defined as the extent to which environmental rules impose an explicit or implicit price on polluting or environmentally detrimental activity. The rating is based on the stringency of 13 environmental policy tools, with a focus on climate and air pollution. In addition, it addresses solutions related to regulation, green taxation, and incentives for technological development. According to OECD (2016), it consists of three equally weighted subindices, which group market-based (taxes, permits, and certificates), non-market-based (performance standards), and technology support policies. Technology support policies are further divided into upstream (R&D support) and downstream (feed-in tariffs, auctions) technology support measures (p. 9). Market-based instruments refer to policies that put a price on pollution, while non-market-based instruments refer to policies that impose emission limits and standards. Technology support policies refer

to policies that support clean technological innovation as an important determinant of sustainable development. All these instruments share a common goal: reducing environmental degradation and mitigating climate change. The index runs from 0 (not strict) to 6 (the maximum degree of stringency). Since the natural logarithm is used to express all variables, the coefficients can be understood as the CO₂ emissions' elasticities with regard to GDP, environmental regulations, tourist arrivals and environmental taxes.

4. Estimation Methodology

The empirical contribution of the study begins with the cross-sectional and unit root tests.

4.1. Cross-sectional dependence test

Due to the increasing economic integration within the EU through trade, foreign direct investment and financial markets, the member states are increasingly interconnected. This interdependence often leads to cross-sectional dependence (CD) in panel datasets, where economic shocks originating in one country can significantly affect outcomes in other countries (Bilgili et al., 2017). Not taking CD into account can lead to biased and inconsistent parameter estimates and thus undermine the reliability of the empirical results.

To formally assess the presence of CD, the test by Pesaran (2007, 2015) was applied. This test is often used when analysing panel data, especially when the number of cross-sectional units (N) is large and the time periods (T) are moderate or small. It tests the null hypothesis of independence of cross-sectional data and is robust to various data-generating processes.

4.2. Panel Unit Root test

In view of the detection of CD, second-generation panel unit root tests were applied, in particular the Cross-sectionally Augmented Dickey-Fuller (CADF) and the Cross-sectionally Augmented IPS (CIPS) test. These methods include cross-sectional averages of the variables in their regressions in order to control for common factors and interdependencies. As such, they are particularly suitable in an environment such as the EU, where economic and political shocks are not limited to national borders. The use of these second-generation tests ensures more robust and consistent inferences about the stationarity properties of the panel series, even in the presence of strong cross-sectional linkages.

4.3. Panel Cointegration Test

The concept of cointegration is based on the idea that although individual time series may be non-stationary at the levels, a linear combination of these variables may be stationary, indicating the existence of a long-run equilibrium relationship between them. As Pedroni (1999) explains, cointegration implies that the variables under consideration have a common stochastic trend and move together over time despite short-term deviations.

In order to analyse whether the variables in the panel data set are cointegrated (i.e. whether they maintain a stable long-term relationship), two complementary tests are used in this study. The first one is the Pedroni cointegration test (Pedroni, 1999), which allows for heterogeneity between the cross-sectional units in both the long-run cointegrating vectors and the short-run dynamics. This test is widely used due to its flexibility in accounting for individual heterogeneity in the intercepts and slopes of the cointegration relationship. The

second test is the Westerlund cointegration test (Westerlund, 2005), which focuses on error correction dynamics and not on residual approaches. This test examines whether there is evidence of error correction for individual units or for the panel as a whole, providing stronger support for the presence of cointegration. It is robust to cross-sectional dependence and structural breaks and is therefore particularly suitable for panels with integrated and interconnected economies. By using both tests, the analysis ensures robustness in detecting long-run relationships between variables while accounting for heterogeneity, cross-sectional dependence and dynamic equilibrium adjustments.

4.4. Dynamic panel regression

This paper uses the Mean Group (MG) and Pooled Mean Group (PMG) estimators developed by Pesaran, Shin and Smith (1999) to produce reliable and robust estimates of the long-run relationships between CO₂ emissions and key explanatory variables such as tourist arrivals, environmental taxes, environmental regulation and GDP per capita.

The MG estimator allows for heterogeneity in both long-run and short-run coefficients across cross-sectional units by estimating separate regressions for each country and then averaging the coefficients. In contrast, the PMG estimator enforces homogeneity in the long-run coefficients, while the short-run dynamics and error variances can differ across units. This flexibility makes the PMG estimator particularly suitable when theoretical considerations suggest a common long-term relationship, but countries may differ in their speed of adjustment or short-term responses due to institutional, structural or policy-specific factors. By comparing the results of the MG and PMG estimators and testing the validity of

the homogeneity restriction with the Hausman test, the analysis improves the robustness and credibility of the long-run coefficient estimates within the dynamic panel.

5. Empirical results

In this study we investigate the impact of international tourist arrivals, environmental taxes, environmental regulations and GDP on CO₂ emissions in 19 EU countries in the period 2003–2020. The test and results are discussed as follows. First, we did preliminary tests for the consistency and accuracy of the model.

The descriptive statistics of these five variables for the countries under observation are compiled in Table 1. For every variable, the mean, standard deviation, minimum, and maximum values were calculated.

Carbon dioxide emissions in the 19 EU countries averaged 168 kilotons between 2003 and 2020. The largest amount was reported in Germany in 2003 (919 kilotons), and the lowest was recorded in Estonia in 2020 (9 kilotons). On average, 35 million international tourist arrivals were reported in 19 EU nations, with the most recorded in France in 2019 (218 million) and the lowest in Luxemburg in 2020 (525,000). In terms of environmental tax revenue, the average in our sample is 20.041 US dollars, with Estonia having the lowest in 2003 and Germany having the highest in 2003. The average value of the Environmental Policy Stringency Index was 3, with the highest reported in France in 2020 and the lowest in Slovenia in 2003. The average value of GDP per capita was US\$42,9 billion. The country with the highest GDP per capita was Luxemburg in 2007, while the lowest value was recorded in Poland in 2003.

Table 2 shows the correlation matrix for all variables included in the model. The Pearson

correlation coefficients range from -1 to +1, with values closer to +1 indicating a strong positive linear relationship, values closer to -1 indicating a strong negative linear relationship and values close to 0 indicating little to no linear correlation between the variables. This matrix provides an initial insight into the direction and strength of the correlations between the most important explanatory and dependent variables.

The correlation matrix shows several relationships between the key variables. A strong positive correlation is observed between CO₂ emissions and environmental taxes, suggesting that higher emissions may have prompted the introduction or increase of such taxes, rather than the taxes being effective in reducing emissions. Tourist arrivals also show a strong positive correlation with CO₂ emissions, indicating the environmental impact associated with tourism.

In contrast, GDP per capita is weakly negatively correlated with CO₂ emissions, possibly reflecting the impact of clean technologies or structural economic shifts in more developed countries. A very weak negative correlation is also found between environmental regulations and CO₂ emissions, which means that there is no meaningful linear relationship in this sample.

To assess the presence of multicollinearity among the explanatory variables, the Variance Inflation Factor (VIF) test was performed. Results are shown in Table 3.

As shown in Table 3, all VIF values are well below the generally accepted threshold of 10, with the highest VIF value being 3.42 for the international tourist arrivals variable. The mean VIF value is 2.22, which indicates an overall low degree of multicollinearity in the model. According to standard interpretation guidelines (e.g. Hair et al., 2010), VIF values

Table 1. Results of descriptive statistics for 19 EU countries

Variables	Obs	Mean	Std. Dev.	Min	Max
CO ₂	342	168741,3	203971,9	9310,99	919059,3
TOUR (million)	342	34,90	46,80	0,53	218
ETAX	342	20041,72	23151,92	540,09	87157,13
EPS	342	2,99	0,63	0,53	4,89
GDPpc	342	42900,83	18525,35	16799,31	114804,6

Source: Own calculation.

Table 2. Results of Correlation Matrix

	lco2	lgdp	letax	ltour	leps
lco2	1				
lgdp	-0.2196	1			
letax	0.9353	-0.1074	1		
ltour	0.7743	-0.3986	0.7768	1	
leps	-0.0293	0.2673	0.1019	0.0455	1

Source: Own calculation.

Table 3. Variance Inflation Factor (VIF) test

Variables	VIF	1/VIF
ltour	3.42	0.292758
letax	2.87	0.347952
lgdp	1.48	0.673847
leps	1.11	0.901031
Mean VIF	2.22	

Source: Own calculation.

Table 4. Results of CD and unit-root tests

Variables	CD-test	CADF		CIPS	
		Level	Difference	Level	Difference
lco ₂	44.377***	-1.585	-3.392***	-2.316**	-3.963***
ltour	35.855***	-2.034	-2.196*	-1.854	-3.327***
letax	12.723***	-2.073	-2.286***	-1.920	-3.654***
leps	37.35***	-2.597	-3.335***	-2.640***	-4.796***
lgdppc	31.056***	-1.7609	-2.362	-1.065	-2.260**

Notes: ** and *** denote the statistical significance at 5 % and 1 % level.

Source: Own calculation

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between 1 and 5 indicate a moderate correlation that is not problematic, while values above 10 typically indicate serious multicollinearity problems. In this case, the results confirm that multicollinearity is not a threat to the validity of the estimated coefficients and that the explanatory variables can be reliably interpreted in the regression analysis.

Table 4 shows that carbon emissions, international visitor arrivals, ecologically related tax revenue, the Environmental Policy Stringency Index, and real income per capita become stationary at the first difference. It can be inferred that the variables under investigation are integrated of order one based on the statistical significance of the results at the 1% level.

Next, we checked if there is a long run relationship between analysed variables. The premise behind cointegration, according to Pedroni (1999), is that a linear combination for the set of first-order integrated variables may be stationary. The cointegration test results are displayed in Table 5.

The results of the Pedroni and Westerlund cointegration tests consistently indicate that the variables of the model are cointegrated, i.e. that they exhibit a long-run equilibrium relationship. This justifies the use of long-run estimators such as pooled mean group (PMG) or mean group (MG) and suggests that the variables move together over time, although the short-run dynamics may vary.

This paper further employs the MG and PMG estimators to produce reliable and robust estimates of the long-run coefficients on the effects of tourist arrivals, environmental taxes, environmental regulation, and GDP per capita on CO₂ emissions. The findings are shown in Table 6.

The paper applies both PMG and MG estimators to assess the long and short-run determinants of CO₂ emissions in 19 EU countries. The PMG estimator, supported by the Hausman test, is favoured for the interpretation of the long-run relationships.

The empirical results show that environmental regulations and GDP per capita have a negative long-term impact on CO₂ emissions. Most importantly, the stringency index, or the proxy used to account for environmental regulation, has a negative and strongly significant coefficient, suggesting that regulations are effective in reducing environmental damage in the long run. However, environmental taxes have a positive long-run effect on CO₂ emissions, suggesting that higher taxes are a policy response to rising emissions rather than effective mitigation. Specifically, a 1% increase in environmental taxes leads to a 0.316% increase in carbon dioxide emissions. The impact of tourism on emissions is negative, but not statistically significant in the long run.

GDP has a negative impact on CO₂ emissions, a concept that is intertwined with the theory of the Environmental Kuznets Curve (EKC). This theory states that environmental conditions tend to improve when a nation's income exceeds a certain threshold. As the 19 EU member states are categorised as high-income economies, they are likely to exceed this threshold, which is consistent with the EKC hypothesis. Numerous studies focusing on the EU and wealthy countries support this hypothesis (Mohammed et al. 2024).

Conversely, the impact of tourist arrivals and economic growth on carbon dioxide emissions is clearly positive and significant in the short term, suggesting that higher levels of emissions occur with increasing tourism or economic growth in the 19 EU countries. This

Table 5. Results of Pedroni and Westerlund cointegration tests

Pedroni cointegration		Westerlund cointegration	
	Statistics		Statistics
Modified Phillips-Perron t	1.7890**		
Phillips-Perron t	-4.214***	Variance ratio	-1.8588**
Augmented Dickey-Fuller t	-3.234***		

Notes: **, *** represents the statistical significance at 5% and 1% level

Source: Own calculation.

Table 6. Estimation results of the dynamic panel model

Variables	19 EU countries	
	PMG	MG
Long-run coefficients		
ltour	-0.040 [0.031]	0.170 [0.203]
letax	0.316*** [0.074]	0.459 [0.252]
leps	-0.802*** - [0.062]	0.184 [0.154]
lgdppc	-0.467** - [0.169]	0.314 [0.458]
Short-run coefficients		
ECT	-0.213** [0.061]	-0.769** [0.083]
D.ltour	0.099** [0.032]	0.085 [0.097]
D.letax	0.001 [0.098]	0.163 [0.099]
D.leps	0.079 [0.045]	0.111* [0.050]
D.lgdppc	0.616*** [0.121]	0.693** [0.226]
_cons	3.147** [0.920]	9.409** [1.273]
Number of observations	323	323
Number of groups	19	19
Hausman test	6.03 [0.1968]	

Note: The asterisks *, **, ***, indicate significance level of 10%, 5% and 1%. The p-value for the Hausman specification test is given in square brackets.

Source: Own calculation.

suggests that the tourism sector contributes to an increase in pollution in these countries in the short term. Despite the EU's extensive efforts to promote sustainable tourism, further measures to mitigate this environmental problem are essential. The ECT coefficient of -0.213 indicates how long it will take CO₂ to return to equilibrium. If CO₂ emissions stray from the regression line, it takes around 4.5 years to return to equilibrium (calculated as $1/0.213$).

The significant positive long-run relationship between environmental taxes and CO₂ emissions found in the PMG results may reflect reverse causality, where taxes are introduced in response to increasing environmental degradation rather than as effective instruments to curb pollution. Furthermore, in some EU countries, environmental taxes may be primarily focused on revenue generation and have limited environmental impact due to suboptimal policy design or implementation (OECD, 2011). It is noteworthy that while environmental taxes have an increasing impact on CO₂ emissions, environmental policies reduce CO₂ emissions. It appears that EU policies to promote sustainable development have been able to reduce CO₂ emissions. In the research results of Savranlar et al. (2024), it is evident that an increase in environmental taxes reduces CO₂ emissions by 0.14% in the EU. In a sample of G-7 countries, Rakpho et al. (2023) found that increasing environmental tax rates substantially reduced carbon emissions. They also found that implementing environmental policy through environmental taxation mechanisms affects various economic sectors, leading to lower carbon emissions. However, European countries should continue to take the necessary measures to protect

the environment and raise awareness about sustainable tourism.

6. Conclusion

The characteristic of 19 EU countries is the attractiveness of international tourism inflows, which cause environmental pollution through various sectors such as transport, catering, hotels and restaurants, accommodation, and others. Therefore, to protect the environment and achieve sustainable development, environmental taxes play a key role. Moreover, many studies have shown that tourism and environmental taxes interact with each other, resulting in environmental-friendly development. Hence, this paper aims to examine the linkage between environmental taxes, international tourist arrivals, and environmental regulations that impact sustainable development in 19 EU countries in the period 2003–2020. The empirical results show that regulations are effective in decreasing environmental damage in the long run. In addition, environmental taxes have a long-term positive effect on CO₂ emissions. Specifically, a 1% rise in environmental taxes leads to a 0.316% increase in carbon dioxide emissions. This is also evidence that environmental taxes intend to internalise the negative externalities that are engaged in environmental pollution by changing behaviour towards a cleaner environment and sustainable development.

Based on the above-mentioned results, the paper suggests the following policy recommendations:

- The first recommendation is to ensure appropriate rates and stricter regulations to facilitate environmental protection according to tourism demand for sustainable development. That means that by imposing higher environmental

taxes, governments at all levels, as well as individuals, would be induced to change behaviours towards environmentally friendly products and services. However, policymakers should be careful not to burden tourism receipts and cause a significant decrease in the tourism industry.

- The second recommendation is to implement new policy instruments, such as a carbon tax, to decarbonise the tourism industry. This should be observed as a long-term investment in sustainable tourism, which requires cooperation and joint action at all levels of government, policymakers, the tourism sector, and experts.

As with every paper, this one has its own limitations. The first limitation lies in limited data availability for variables and countries to extend the current research, and the second is in applying the econometric method. Based on the mentioned limitations, recommendations for future research should focus on a longer time period and disaggregate environmental taxes into different categories, including energy tax, resource tax, pollution tax, and transport tax. In addition, separate analyses for each EU country and for different sectors of the tourism industry would be valuable. Nevertheless, an important determinant is government decisions on environmental policies to prevent mass tourism.

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