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Can Business and Leisure Tourism Spending Lead to Lower Environmental Degradation Levels? Research on the Eurozone Economic Space

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Abstract: This study aims to investigate the impacts and identify the causal links between tourism expansion and the environment among countries of the Eurozone from 1996 to 2019 in the context of the environmental Kuznets curve (EKC). To achieve this end, we used a new set of untested tourism proxies when elaborating the EKC. We disaggregated the tourism phenomenon and highlighted its heterogenous nature by including specific and high-impact market segments such as business and leisure tourism spending as well as capital investment spending. The research findings indicate the pivotal role that tourism proxies have on environmental degradation in terms of greenhouse gas emissions (GHGs). Specifically, the identified reciprocal causalities between leisure and investment spending and environmental degradation suggest some complementarities between these variables. In the case of business tourism spending, an increase (decrease) in this variable leads to an increase (decrease) in environmental degradation. The last two feedback hypotheses indicate that the primary and final energy consumption Granger cause GHGs and vice versa. Such a result offers evidence for incorporating the concept of energy efficiency in tourism. Practical implications should motivate supply and demand dimensions within the tourism system to improve efficiency in tourism flow management. The supply side should transfer the environmental message to visitors to spend wisely and consume smarter, whereas the demand side should perform pro-environmental behavior by spending wisely and acting responsibly at destinations.

Keywords: environmental protection costs; capital investments; greenhouse gas emissions; economic and mathematical modeling; environmental efficiency

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1. Introduction

In the context of quality issues, the interrelation between the economy in terms of growth rates and the environment has been subjected to comprehensive research under various theoretical perspectives (e.g., energy growth nexus discussion, tourism growth nexus discussion (indicatively, [1,2])). The environmental Kuznets curve (EKC) is a theoretical background that mirrors such a relationship. The EKC advocates that environmental deterioration escalates in the first stages of a nation's economic growth, whereas after a certain point in the process of an increased economy, environmental deterioration levels decline [3,4].

Tourism is widely connected with environmental concerns as it might affect good ecological status and quality levels [5]. However, recently developed studies have argued that tourism is far from being a pro-environmental industry [6] as 8% of global greenhouse emissions come from the tourism sector [7]. Hence, the need to investigate the relationship between the tourism sector and the basic EKC hypothesis is central given its importance and contribution to the global economy which, for instance, could be investigated by testing for higher emission levels [8]. This evolving need to focus on tourism as a high-leverage industry and to examine its role in reducing environmental pollution based on sustainable solutions is called the tourism-induced environmental Kuznets curve (T-EKC) [8].

Advancing the work of [8], the present study explores the potential impacts and causalities between tourism expansion and environmental quality as a function of the tourism-induced environmental Kuznets curve (T-EKC) hypothesis. Importantly, the T-EKC is investigated to perceive the tendency of the tourism sector as a key contributor in the process of economic growth as well as its role as a catalyst of the status of environmental degradation levels through its various activities [8]. The methodology followed does not merely re-examine the previously tested hypothesis concerning the EKC; on the contrary, we consider well-acknowledged market segments, such as business and leisure tourism, as growth variables in the relevant econometric models to advance a niche of how productivity growth that is generated by tourism impacts environmental quality [8]. Supportively, ref. [9] clearly states that the negative sloping downward of the EKC can be justified by other causal variables than the commonly used per capita income levels. Consequently, additional growth variables should be processed to test the EKC hypothesis [10]. We add to the relevant literature in the following ways: First, the study includes a new set of tourism proxies that remain unobserved in the relevant literature. We use business and leisure tourism spending as growth variables to test if they form an inverted U-shaped curve. Second, we consider the predictive power of capital investment that is directly spent in the travel and tourism sector instead of the traditional explanatory variable of foreign direct investment. Third, we holistically view the role of energy on environmental degradation. Holistically, we test the explanatory nature of both the primary and final energy consumption, which is an issue that needs to be more visible in the specific field of EKC.

In a competitive economic market, a wide range of today's environmental problems demand a deep understanding of how society, economy, and nature interact to make a whole picture. Notably, defining potential linkages between environmental quality levels and economic variables at a macro level is crucial for formulating relevant fiscal policies [11].

The paper proceeds as follows. Section 2 thoroughly covers all aspects of relevant research studies in the field of the EKC, where it justifies the contribution of the present study. Section 3 provides the econometrics for testing the EKC hypothesis. In Section 4, the research findings are presented. We also analyze all test results. Finally, Section 5 includes implications from the analysis with links to our present reality.

2. Literature

2.1. Environmental Kuznets Curve (EKC)

The EKC practically indicates that environmental pollution increases with GDP per capita and decreases as GDP per capita reaches a particular threshold (turning point), indicating an inverse U-shaped curve [12]. This trade-off between the economy and the environment (e.g., growth and degradation) in the context of the EKC provides research fields for elaborating the nexus concerning increases in per capita income and environmental quality levels [3].

Significantly, ref. [13] argues that the presence of the EKC in relevant research efforts is attributable to two main reasons: the first is the process and steps forward that have been created to achieve higher development rates in economic terms, including transitions from a clean agrarian economy to a contaminating industrialized economy to a clean economy based on services; the second is the disposition of individuals with increased income levels to ask and strive for advanced environmental quality levels. Interestingly, ref. [8] clearly states that the EKC is adopted to assess environmental quality issues stemming from economic growth, energy-related issues (e.g., consumption rates), tourism activities, and technology aspects. Moreover, variations in results when testing the EKC might be attributable to the econometric procedure followed by researchers. Ref. [14] state that the econometric model used to test the EKC hypothesis (e.g., the quadratic or cubic mathematical model implemented and signs of coefficients in the proxy of the economic growth variable used) is of great importance in determining the shape (e.g., inverted U-shaped, N-shaped, or inverted N-shaped), relevant turnaround points, and validating the empirical model.

A wide range of econometric models have been processed to test the EKC. Despite the significant research efforts so far, a consensus has not been achieved among scientists on whether the economy stops degrading the environment after a specific point in the process of growth, as there is no obvious or certain sign of fitting all contaminants concerning all places and times across the globe [15]. For instance, ref. [16] confirmed the EKC by employing the generalized method of moments (GMM) developed by [17]. They confirmed the EKC hypothesis for 14 Asian countries from 1990 to 2011. They contextualized and used gross domestic product (GDP) per capita as the growth variable. On the other hand, ref. [18] investigated the presence of a non-linear relationship between GDP per capita and per capita CO_2 emissions; they also adopted a two-step GMM estimator considering the non-stationary nature of the variables used for a widely heterogenous set of 120 countries from 2000 to 2009. The results revealed that the linkage between the income at a national level and the environmental degradation (e.g., pollution) is positive and monotone, whereas the coefficient of the quadratic GDP was insignificant in statistical terms. Specifically, the authors claim that this result directly connects with the literature strand that does not support the 'optimistic' argument that growth naturally leads to environmental quality improvements. Reviewing the literature, we find mixed results concerning an inverted U-shaped curve under the EKC hypothesis [19–21]. A possible explanation for these contradictory results might be the geographical location of the countries under investigation or the income distribution [18].

As is the case with many multivariate methodologies that investigate linkages and causalities (time series or panel analysis), the presence of diverse periods, different econometric approaches, or groups of countries in research have driven different research findings [22]. The variability of these findings might be relevant to the growth variables used. A growth variable reflecting the economic activity under research is used when testing the EKC hypothesis. Unsurprisingly, many studies include a nation's GD as the most popular economic measure of growth.

Different pollutants have different turning points beyond which type of economic growth does not pressure environmental quality levels [23]. Increased economic growth has brought variations in how nature (e.g., natural resources) and the economy (economic expansion or development) are interdependent at the interface of environmental quality (e.g., levels of degradation, pollution, pressures) and sustainable development. For instance, environmental pressures are often calculated regarding aggregated pollution or natural resource consumption levels [24]. Many research efforts have investigated the parameters that confirm or reject the EKC hypothesis, including the income elasticity of environmental quality, technique effects, and international trade [25]. However, based on robust econometric models, many studies have evidenced an N-shaped curve when elaborating on the impacts of growth on environmental deterioration issues. Ref. [26] found that the relationship between economic complexity and carbon dioxide emissions first forms an inverted U-shaped curve (the medium-run U-shaped curve); then, as the economy continues to develop, the curve is transformed into an N-shaped curve (long-term). Essentially, degradation starts to increase again after a certain point in the process of economic growth. Furthermore, ref. [27] confirmed an N-shaped curve when assessing how CO_2 as a stock pollutant relates to the per capita income in Latin American countries.

Consequently, evidence for confirming the EKC hypothesis has been questioned from several points of concern, which suggest that the question still needs an answer: "Can economic growth be part of the solution rather than the cause of the environmental problem?" [13]. It is common knowledge that a good ecological status of the natural environment keeps the global economy running. That said, it is essential to raise awareness, increase interest, and elaborate on empirical studies that offer insights into how the economy may become less dangerous for the environment and safeguard our current and future needs and demands at the interface of nature and economic systems.

2.2. Tourism-Induced Environmental Kuznets Curve (T-EKC)

The fact that the tourism industry is related to environmental concerns drives the international community's efforts to accomplish sustainable development goals [28]. Hence, it is important to test the EKC based on a comprehensive tourism analysis that improves the sector's productivity potential toward green growth achievements within a sustainable environment [8]. In this framework, many tourism-related activities interrelate with energy consumption and CO_2 emissions, attracting the interest of policymakers and marketers [8]. In this framework, many tourism-related activities interrelate with energy consumption and CO_2 emissions, which attracts the interest of policymakers and marketers [8].

Given this crucial role of tourism, a research opportunity appears to explore if tourism, widely known as the "smokeless industry", leads to environmental degradation [29]. Interestingly, high-impact sectors within a nation's economy (e.g., tourism) would not miss the opportunity to 'state' their position when answering the above question. Hence, the T-EKC evolved as a challenging research field across academia, comprehensively testing whether tourism expansion drives higher emissions and environmental pollution rates [8]. Thus, there is a need for further research, as tourism is not a static phenomenon. In contrast, it is evolving with time and developing in space because of its dynamic and multifaceted nature.

Having acknowledged the role of tourism in the economy, relevant environmental pressures should be identified. In this process, it is crucial to consider that for tourism-dependent economies, the sector is an integrated part of growth [8]. The tourism sector is a multifaceted and dynamic system and, in many cases, it can be considered the world's major job creator and income generator [30]. Thus, as the sector develops its potential, it is vital to test the adverse effects on the environment [8]. In this framework, many recently developed and well-acknowledged studies investigate tourism in its general form when elaborating on the T-EKC. In the T-EKC hypothesis, researchers contextualized tourism as a proxy of international receipts and tourist arrivals [31–33]. Interestingly, ref. [34] confirmed the EKC hypothesis by testing the impact of multiple international tourism indicators (e.g., international tourism expenditures and receipts, international tourist arrivals, and international tourism departures) on CO_2 and greenhouse gas emissions. Furthermore, many studies have adopted GDP as a growth variable for testing the traditional EKC as well as the T-EKC [35–37] inter alia, resulting in the need to test additional growth variables that mainly contribute to a nation's economy. Notably, economic sectors other than aggregate income are augmented into the traditional EKC hypothesis to search for the impact of those sectors on energy issues and degradation [38].

In light of such concerns, the present study contributes to the existing empirical literature in the following ways: First, unlike the traditional indicators applied to test the hypothesis of the EKC so far, the present study conceptualizes the tourism proxies used in terms of two discrete, dynamic, and profitable market segments in tourism globally; namely, we use business tourism spending and leisure tourism spending. Market segments offer us the opportunity to form 'green marketing' plans while they develop visitors' eco-friendly behavior [39]. In this context, ref. [40] asserts that tourism demand segmentation is vital for the efficient implementation of policies concerning resource protection issues.

Second, we examine the significance (if justified) and contribution (if evidenced) of capital investment to environmental quality. Many robust research studies have adopted the concept of foreign direct investment to investigate causalities in the environment [41–47]. By definition, foreign direct investment spending provides a valuable but aggregate measure of capital flows within a nation's economy. As such, capital investment spending in the travel and tourism sector has been overlooked in relevant research despite its magnitude and leverage on the environment and in tourism economics.

Many academics have tested the EKC hypothesis for various nations and country groupings [48]. The inadequate research on the Eurozone sphere further supports our effort. However, despite its importance in the status of the economy across the globe, the Eurozone is not present in the literature.

3. Materials and Methods

3.1. Data

This study investigates the potential linkages under the EKC hypothesis by empirically testing a new set of variables. The range of the analysis is from 1996 to 2019. First, we investigated the causal links for all countries that belong to the Eurozone (The Eurozone economic space is composed of Austria, Belgium, Cyprus, Estonia, Finland, France, Germany, Greece, Ireland, Italy, Latvia, Lithuania, Luxemburg, Malta, Netherlands, Portugal, Slovakia, Slovenia, and Spain). We then placed three econometric models into the process to test if the linkage between tourism expansion and GHG emissions takes an inverted U-shaped curve (Equations (1) and (2)). We processed a panel data analysis. The dataset was extracted from the World Travel and Tourism Council (WTTC), Eurostat, and World Bank. The data used are annual and balanced.

Model 1

$$\text{lngreenhpc} = \text{f}\ (\text{lnenergyppc}, \text{lnrbtspc}, \text{lnrbtspcsq}, \text{lnrinvestpc}) \tag{1}$$

Model 2

$$\text{lngreenhpc} = \text{f}\ (\text{lnenergyfpc}, \text{lnrltspc}, \text{lnrltspcsq}, \text{lnrinvestpc}) \tag{2}$$

In the above equations, energyppc stands for the per capita primary energy consumption and refers to a country's total energy demand. It concerns the energy sector's consumption, any losses during the process of transformation, the energy distribution, and the amount of energy consumed by end users.

rbtspc represents the per capita spending for business tourism concerning international and domestic visitors. rinvestpc stands for the per capita spending for capital flows from industries directly related to tourism. This proxy also encompasses spending for additional purposes, such as accommodation and passenger transport equipment and restaurants and leisure facilities for particular tourism purposes.

energyfpc represents the per capita final energy consumption. It accounts for a country's amount of energy consumed by end-users. This variable measures the energy consumption that is attributable to a wide range of end users within the economic system (industry, agriculture, services, and transportation sectors). It also includes household consumption. It excludes the amount of energy used by the energy sector and leakages due to transformation and distribution issues. rltspc constitutes the per capita spending for leisure purposes made in a country by that country's citizens and foreign visitors. lngdppc depicts the per capita gross domestic product at a national level.

The selection of variables has been conducted according to their significance in the process of tourism expansion [49]. In 2019, residents in the European Union made 125 million business trips, which represents 11% of the total trips that were made for tourism purposes [50]. However, because of the effect of the pandemic, worldwide business tourism spending substantially decreased in the year 2020 compared with the previous year. In total, for the year 2020, Germany presented the highest spending on business trips, with an amount of USD 36 billion, which was a reduction from the USD 66.5 billion spent in 2019 [51]. Furthermore, according to [52], the latest research of the Travel and Tourism Global Economic Impact for 2021, following a 61% decrease in 2020, spending on business travel globally is expected to increase by 26% in 2021 and by 34% in 2022, which indicates a 66% recovery when compared with 2019. In Europe, business spending is set to rise by 36% in 2021, more potent than leisure spending at 26%, followed by a 28% increase in 2022. Moreover, in Europe in 2019, residents of Germany dedicated most of their time to vacations, leisure, and recreational trips, spending over EUR 100 billion. Residents of France spent EUR 54.7 billion, which was the second highest amount in Europe [51].

After an extraordinary drop in energy consumption in Europe in 2020 due to the COVID-19 pandemic, the EU's final energy consumption increased by 5% between 2020 and 2021, indicating the highest increase on an annual basis since 1990 [53]. Moreover, between 2020 and 2021, the primary energy consumption increased by a record 5.6% to a total of 1306 Mtoe [53].

Capital investment spending in the travel and tourism sector significantly decreased from USD 986 billion in 2019, accounting for 4.4% of the total investment globally, to USD 693 billion in 2020, accounting for 3.2% of the total investment and representing a 29.7% fall [52].

GHG emissions in the European Union were reduced by 32% in the period 1990–2020, a remarkable accomplishment of the European Union's 2020 target of a 20% reduction. However, GHG emissions increased in 2021 due to the recovery from the pandemic and subsequent higher levels of energy use, with increased associated emissions occurring in the second part of 2021 [54].

These figures highlight the need to include such variables in econometric models when investigating the relationships between growth variables (e.g., tourism market segments) and environmental quality (e.g., CO_2 emissions). Hence, there is a need to investigate how spending is evolving in the tourism sector. Simultaneously, we should consider tourism spending not only as a pure macroeconomic factor but as a (or the) key determinant that may create positive externalities and multiplicative effects in a country's economy in terms of sustainability [55].

The monetary variables used in this study are real values. Based on the data availability, the time range of the analysis is 1996–2019. Box-Cox testing guided us to ln-transform all panel variables. Also, the transformation allows for the interpretation of regression coefficients as elasticities. In Table 1, we present the per capita descriptives of the panel variables.

Table 1. Descriptive statistics (per capita).

	greenhpc	energyfpc	energyppc	rbtspc	rltspc	rinvestpc
Mean	0.010535	2.65×10^{-6}	3.53×10^{-6}	405.544	2102.44	366.71
Median	0.009621	2.19×10^{-6}	3.17×10^{-6}	378.199	1800.56	285.58
Maximum	0.027958	9.63×10^{-6}	1.03×10^{-5}	1221.81	9697.8	3066.43
Minimum	0.004178	9.34×10^{-7}	1.56×10^{-6}	52.3542	131.96	20.35
Std. Dev.	0.004140	1.53×10^{-6}	1.59×10^{-6}	221.892	1633.9	367.43
Skewness	1.458757	2.492988	1.836214	0.7207	2.364	3.84
Kurtosis	5.872438	9.725007	6.744065	3.0465	9.877	22.60
Observations	456	456	456	456	456	456

In Table 1, the GHG emissions (greenhpc) are measured in thousands of tons of CO_2 equivalent, and the primary and final energy consumption (energyppc, energyfpc, respectively) are measured as million tons of oil equivalent (TOE); the spending for business tourism purposes (rbtspc), leisure purposes (rltspc), and investment flows (rinvestpc) are measured in the local currency.

3.2. Testing for Cross-Section Dependencies (CD)

CD tests provide evidence for potentially correlated regression residuals. If regression residuals are correlated and remain unobserved when processing the panel analysis, they can produce biased and inconsistent results (e.g., biased standard errors) and create interdependencies across panel units [56,57].

Interestingly, the global economy or interrelations across nations can provide an answer as to why CD phenomena are present when testing panel data [58]. To confront this issue, we employ the test from [59] to determine if CD is present (Equation (3)). This test provides reliable results and is appropriate for small-sample data. Such a test assumes that the errors are symmetrically distributed [60]. The following Equation (3) offers the test result based on whether we reject or accept the H_0.

$$CD = \sqrt{\frac{2T}{N(N-1)}} \sum_{i=1}^{N-1} \sum_{j=i+1}^{N} \hat{p_{ij}} \tag{3}$$

where T denotes the time interval, N stands for the number of cross-section units, and $\hat{p_{ij}}$ represents the correlation (pair-wise) concerning the cross-sections. In our case, CD is present, as the null hypothesis H_0 is rejected. Consequently, it is important to follow methodological approaches that accommodate CD across panel units.

3.3. Testing for Unit Roots

Unit roots determine whether the panel units' mean and variance do not change over time (remain constant). Specifically, if unit roots are present, then the panel variables are not stationary, and the regression models might provide unreliable results. Furthermore, we should employed unit root tests that consider CD phenomena and potential structural breaks across panel data. Ref. [61] first elaborated on the issue of structural breaks, arguing that leaving unobserved structural breaks or ignoring them results in losing power in our time series. Structural breaks are exogenous shocks that affect (change) the model parameters [62]. For these reasons, we used a test developed by [63]. This approach uses the Lagrange multiplier (LM) unit root test. We also used level and trend shifts to perform the test. If present, the test also treats heterogeneity in the panel data. Moreover, the test concerns structural breaks in the intercepts and coefficient slopes; it accommodates the nuisance parameter, which delivers indications for the locations of the structural breaks when trend shifts are present. If we leave this dependency on the nuisance parameter unnoticed, then we will experience serious size distortions [64]. The test statistics are given in the following Equation (4).

$$\text{LM.}\left(\widetilde{\tau}*\right) = \frac{\sqrt{N}[\bar{t} - \widetilde{E}(\bar{t})]}{\sqrt{\hat{V}(\bar{t})}} \tag{4}$$

where $\widetilde{E}(\bar{t})$ and $\widetilde{V}(\bar{t})$ are the mean and variance averages of $\bar{t}$. $\bar{t}$, depending on the number of truncation lags P and the number of breaks R. Then, we calulate the parameter values of P and R according to Equations (5) and (6).

$$\widetilde{E}(\bar{t}) = \frac{1}{N}\sum_{i=1}^{N} E\left(\bar{t}\left(\widetilde{R}_i, \widetilde{P}_i\right)\right) \tag{5}$$

$$\widetilde{V}(\bar{t}) = \frac{1}{N}\sum_{i=1}^{N} Var\left(\bar{t}\left(\widetilde{R}_i, \widetilde{P}_i\right)\right) \tag{6}$$

In Equations (5) and (6), $\widetilde{R}_i$ and $\widetilde{P}_i$ represent the estimated values of R_i and P_i in the panel regression of interest for the ith cross-section unit. These procedures permit the user different numbers of structural breaks and truncation lags. According to [63], the significance of such an approach is that the test statistic can be obtained regardless of the location of the structural breaks. Consequently, it is not necessary to receive different values at different structural break locations for the panels' means and variances using any other method. The H_0 hypothesis suggests that the panel data are non-stationary. Rejection of this hypothesis indicates that the unit roots are not present in our dataset.

We further proceed with our analysis by adopting a fixed effects regression with Driscoll–Kraay standard errors [65]. Equation (7) provides the steps of this regression analysis [66].

$$y_{it} = x'_{it}\theta + \varepsilon_{it} \tag{7}$$

In Equation (7), the y_{it} represents a scalar, and x_{it} stands for a $(K+1) \times 1$ vector of independent variables. The first element of the independent variables is 1. θ represents a $(K+1) \times 1$ vector of an unknown number of coefficients. i provides the number of cross-sectional units, and t provides the time dimension.

It is a two-step approach. In the first step, the panel variables are within-transformed (Equation (8)). Panel variables $z_{it}\ \varepsilon\ \{y_{it}, x_{it}\}$. Equations (9) and (10) calculate the $\bar{z}_i$ and $\bar{\bar{z}}$, respectively. The within estimator corresponds to the OLS regression of Equation (11).

$$\widetilde{z}_{\mathrm{it}} = z_{it} - \bar{z}_i + \bar{\bar{z}} \tag{8}$$

$$\bar{z}_i = T_i^{-1} \sum_{t=t_{i1}}^{T_i} z_{it} \tag{9}$$

$$\bar{\bar{z}} = \left(\sum T_i\right)^{-1} \sum_i \sum_t z_{it} \tag{10}$$

$$\widetilde{y}_{it} = x'_{it}\theta + \varepsilon_{it} \tag{11}$$

In the second step, the regression model provided by Equation (9) is estimated. The approach uses the pooled OLS estimation supported by Driscoll–Kraay standard errors [66]. The standard errors procedure in ref. [65] concerns heteroscedasticity in error terms and autocorrelation. Practically, the standard errors are obtained from the cross-section averages of products concerning the regressors and residuals. Then, the approach proposes the calculation of a non-parametric heteroscedasticity autocorrelation covariance matrix by taking the cross-section averages into consideration [67]. The non-parametric covariance matrix estimator creates standard errors that are robust to general forms of spatial (cross-section) correlation and temporal dependence [66]. Interestingly, the methodology provides an estimator that facilitates the process in two ways [68]. First, it treats potential serial correlation phenomena as concerning the residuals received by the same panel individual at different time periods. Second, it accommodates cross-serial correlation between different panel individuals at different times. Additionally, it treats cross-sectional correlation within the same time period [17].

3.4. Granger Non-Causality Tests

The Granger non-causality test proposed by [69] was processed in the present study. If we reject the null hypothesis, we can conclude that there is no homogeneous Granger causality in all cross-sectional units, whereas the alternative hypothesis indicates that there is at least one Granger causality in the panel data [70].

Equation (12) offers the causal links across the panel units. Equation (13) provides the average statistic $W_{N,T}^{H_{nc}}$ related to the null homogeneous non-causality (HNC) hypothesis.

$$y_{i,t} = a_\iota + \sum_{k=1}^{K} Y_{ik} y_{i,t-k} + \sum_{k=1}^{K} \beta_{ik} x_{i,t-k} + \varepsilon_{i,t} \tag{12}$$

where $i = 1, \ldots, N$, $t = 1, \ldots, T$, and $x_{i,t,}, y_{i,t}$ are observations of two stationary variables for individual i in period t; K is the lag order.

$$W_{N,T}^{H_{nc}} = \frac{1}{N} \sum_{i=1}^{N} W_{i,T} \tag{13}$$

where $W_{i,T}$ is the individual Wald statistic for the ith cross-section unit corresponding to the individual test $H_o : \beta_\iota = 0$. Such causality tests can be processed when T is greater than N and vice versa. Regression coefficients are assumed to be time-invariant and can differ among panel individuals [71]. The calculated Wald test statistic offers dependable results and takes small data properties and heterogeneous panels into consideration [70]. Importantly, the test can be employed for cross-sectional dependent panel data [70].

4. Results

4.1. Cross-Section Dependence Test (CD)

Based on the test developed by [59], the research findings evidence that our panel data in consideration (Eurozone countries) are CD as the null hypothesis of no cross-sectional dependent data is rejected (Table 2). CD phenomena constitute an important aspect that needs attention in panel data analyses. The root causes that create CD rely on unobserved factors that are included in the disturbance term [56]. Additionally, the CD can be explained due to common characteristics and/or reactions to external economic shocks among tested countries or among countries' dependencies due to spatial reasons [66]. In our case, Eurozone countries follow the same or similar procedures to adapt to common directives or converge to economic financial schemes, which create dependencies as well as common responses.

Table 2. Results of CD tests.

Model 1	
Dependent variable: lngreenhpc	
Regressors: lnenergyppc, lnrbtspc, lnrbtspcsq, lnrinvestpc	
Test statistic = 32.020	p value = 0.0000
Model 2	
Dependent variable: lngreenhpc	
Regressors: lnenergyfpc, lnrltspc, lnrltspcsq, lnrinvestpc	
Test statistic = 8.620	p value = 0.0000

4.2. Results of Unit Root Tests

The results of the panel LM test to examine if the panel variables are stationary was based on the approach of [63]. The research outputs evidence that the panel data are stationary. We implemented this test by searching for structural breaks in the panel series. Two structural breaks were identified. As presented in Table 3, the results are statistically approved. The corresponding p-value is less than 0.01. We then proceed by implementing panel regression models.

Table 3. Unit root test results.

Variables Tested	Statistic	Break 1	Break 2	Lags
lngreenhpc	−9.788	2018	1999	1
lnenergyppc	−10.783	2018	1996	0
lnenergyfpc	−14.271	2018	1997	0
lnrbtspc	−11.343	2018	2003	1
lnrltspc	−9.909	2018	2004	1
lnrinvestpc	−8.588	2018	2001	1
Panel LM test with level and trend shifts				
Testing with two breaks				
PDLM: −35.167		p-value: 0.000		

4.3. Results of Fixed Effects Regression with Driscoll–Kraay Standard Errors

The research findings provide interpretable and meaningful results. Model 1 and Model 2 confirm the T-EKC hypothesis. In particular, Table 4 presents the regression results when we tested the per capita business tourism spending (lnrbtspc) for the EKC hypothesis. The sign (+) of the coefficient of lnrbtspc as well as the sign (−) of the squared lnrbtspc indicate an inverted U-shaped curve that evidence the EKC. Furthermore, the regression results suggest that if we increase lnenergyppc by one unit, we should expect that lngreenhpc will increase by 1.2%. Additionally, if we increase lnrinvestpc by one unit, lnenergyppc will decrease by 0.049%.

Table 4. Results of the fixed effects regression with Driscoll–Kraay s.e. (Model 1).

Dependent Variable	Explanatory Variables	Coefficients	Driscoll–Kraay Std. Err.	t	$p > \|t\|$	95% Conf. Interval	
lngreenhpc	lnenergyppc	1.211946	0.1030475	11.76	0.000	0.9954511	1.42844
	lnrbtspc	0.3052674	0.1662558	1.84	0.083	−0.044023	0.6545578
	lnrbtspcsq	−0.0292647	0.0150217	−1.95	0.067	−0.060824	0.0022946
	lnrinvestpc	−0.0494458	0.0068211	−7.25	0.000	−0.063776	−0.035115
	Constant	10.19141	1.318716	7.73	0.000	7.420886	12.96192

In Table 5, we present the results of Model 2. The research findings evidence the EKC hypothesis when we test the per capita leisure tourism spending (lnrltspc). Particularly, the sign (+) of the coefficient for the lnrltspc explanatory variable as well as the sign (−) of the coefficient for the squared lnrltspc justify the EKC hypothesis. Moreover, the test results suggest that if we increase lnenergyfpc by one unit, lngreenhpc will increase by 1.24%. On the contrary, if we increase lnrinvestpc by one unit, lnenergyfpc will decrease by 0.049%.

Table 5. Results of the fixed effects regression with Driscoll-Kraay s.e. (Model 2).

Dependent Variable	Explanatory Variables	Coefficients	Driscoll–Kraay Std. Err.	t	$p > \|t\|$	95% Conf. Interval	
lngreenhpc	lnenergyfpc	1.248232	0.0904092	13.81	0.000	1.05829	1.438175
	lnrltspc	0.4414385	0.1978776	2.23	0.039	0.0257131	0.8571639
	lnrltspcsq	−0.0366919	0.0157228	−2.33	0.031	−0.069724	−0.003659
	lnrinvestpc	−0.0496642	0.009247	−5.37	0.000	−0.069091	−0.030237
	Constant	10.18876	1.122087	9.08	0.000	7.831344	12.54618

Model 1 and 2 provide the scientific argument in favor of the T-EKC hypothesis. The impacts identified by the above specifications are deemed statistically significant given the *p*-values received. Consequently, an opportunity to further elaborate on cause-and-effect relationships is presented.

4.4. Results of Granger Non-Causality Tests

The present paper adopts the Granger non-causality tests proposed by [69]. In Table 6, we present the test's results and disclose all causalities for the selected group of panel variables. The number of lags used in the tests was based on the Schwarz criteria (BIC) [72].

For Model 1, we identified one reciprocal relationship and one-way causality relationship. Particularly, the reciprocal causality runs from the primary energy consumption to the per capita GHG emissions, indicating a feedback hypothesis. Such a relationship suggests that if we increase (decrease) lnenergyppc, lngreenhpc will increase (decrease) too. The one-direction causality concerning the per capita business tourism spending indicates that if we increase relevant spending, we expect that GHG emissions will increase too. The justified one-way direction indicates that changes in the tested variables will follow the same direction when running from lnrbtspc to lngreenhpc.

Table 6. Results of the Granger non-causality tests.

Dependent Variable	Null Hypothesis	Z-Bar Tilde (Wald Statistic)	*p*-Values	The Decision for H_0
Model 1 lngreenhpc	lnenergyppc does not Granger-cause lngreenhpc	9.4276	0.0000	Reject
	lngreenhpc does not Granger-cause lnenergyppc	14.2260	0.0000	Reject
	lnrbtspc does not Granger-cause lngreenhpc	3.3303	0.0009	Reject
	lngreenhpc does not Granger-cause lnrbtspc	−0.0111	0.9911	Accept
Model 2 lngreenhpc	lnenergyfpc does not Granger-cause lngreenhpc	9.8753	0.0000	Reject
	lngreenhpc does not Granger-cause lnenergyfpc	14.7816	0.0000	Reject
	lnrltspc does not Granger-cause lngreenhpc	6.5577	0.0000	Reject
	lngreenhpc does not Granger-cause lnrltspc	3.7900	0.0002	Reject
Common variable for Model 1 and Model 2	lnrinvestpc does not Granger-cause lngreenhpc	3.7529	0.0002	Reject
	lngreenhpc does not Granger-cause lnrinvestpc	4.8680	0.0000	Reject

p-values < 0.10 indicate rejection of H_0 at a 10% significance level. *p*-values < 0.05 indicate rejection of H_0 at a 5% significance level. *p*-values < 0.01 indicate rejection of H_0 at a 1% significance level. Optimal lags based on BIC: 1 lag.

For Model 2, we identify two bi-directional causalities. The first reciprocal relationship runs from lnenergyppc to lngreenhpc and vice versa; the other bi-directional hypothesis holds for lnrltspc to lngreenhpc and vice versa. Such a causal linkage indicates that the tested variables are reciprocally influenced, confirming that changes in one variable will cause changes in the other variable in the same direction.

For both models (Model 1 and 2), we used an additional explanatory variable, per capita investment spending, which is directly connected to the travel and tourism sector (lnrinvestpc). Granger non-causality tests confirm that the feedback hypothesis is present. Hence, changes in lnrinvestpc are accompanied by changes to lngreenhpc in the same direction and vice versa.

The causality relationships evidenced in this research when testing tourism-related growth variables within the theoretical framework of the EKC are consistent with other noteworthy research efforts. For instance, ref. [73] employed Dumitrescu and Hurlin's Granger non-causality test to confirm the unidirectional relationship between tourism development (e.g., international tourism) and environmental degradation (e.g., CO_2 emissions). Also, in their work, ref. [70] adopted pairwise Dumitrescu–Hurlin panel causality tests between research variables with mixed results. When testing multifaceted phenomena, various differentiations or variations may be present in the test results. Possible explanations for this fact are the particularities of countries or regions used in the analysis, inconsistency of the items, time range of the analysis and datasets, different methodological approaches, statistical procedures, and assumptions, as well as the particular characteristics that each group of explanatory variables may carry.

The relationship between the tourism sector and environmental quality levels is outlined by [74]. Ref. [74] argues that all interested parties within the tourism ecosystem must achieve a mutual agreement concerning tourism's future resilience and ability to embrace a low-carbon pathway and cut emissions by 50% by 2030. The causality tests adopted in this research disclose the significance of all tourism proxies used, which are hardly met in the relevant literature.

5. Discussion

The EKC hypothesis has been investigated in various concepts and datasets. Our approach includes different tourism proxies to confirm or reject the EKC hypothesis. The research findings revealed that spending for business and leisure purposes impacts GHG emissions. Achieving or closely reaching sustainable development goals when deploying tourism plans is the concept that will focus visitors on the environmental message at destinations.

Also, the test results indicate causality relationships between the proxies of energy and the GHGs. In 2020, energy consumption in the EU was 5.8% below the 2020 energy goal and 9.6% over the 2030 goal [52]. As a result, energy consumption patterns must be altered and move towards energy-efficient technologies, energy-saving culture and eco-friendly energy sources. Understandably, the tourism industry's success highly interrelates to effective energy policies [75]. Supportively, the concept of efficiency when using resources is important for accomplishing potential energy saving goals and experiencing lower emission rates [76].

This is where the concept of a green tourism economy (e.g., spending behavior and energy consumption) comes into the equation. Green tourism means that we should strive to maintain a safe and clean environment on the basis of robust management plans that cover the needs of the community affected or supported by tourism schemes [77]. Research findings showcase the need for tourism (e.g., high-impact segments) to contribute to the green economy through more sustainable practices (e.g., investment spending) to limit environmental degradation, for instance, by increasing energy efficiency (e.g., primary and final energy consumption). In turn, the energy mix should be reformed on the basis of displacing fossil fuels with renewables. The main concern is to save energy in tourism, which is an issue deeply connected to carbon emission rates and low-carbon technology schemes [78]. Supportively, according to [79], in the context of the European Green Deal, tourism has a significant obligation to foster green transitions, invest in technologies that advance innovations and carbon-neutral tourism products, enable the interaction of tourism within the ecosystem, and embed sustainability into development plans. This might be the tourism response to environmental degradation, energy conservation, and tourism emissions reduction that bring a sustainable future closer to our modern reality.

The type of tourism deployment plans can explain the adverse effects of tourism indicators on environmental degradation followed so far, as optimizing the energy structure is essential for experiencing advanced environmental quality levels [80]. Such effects are mostly the product of unstructured policies, inefficient energy consumption, out-of-date technologies, old equipment, and high energy demand facilities (e.g., recreational facilities). Specifically, in the EU-27, the energy consumption fell to 1236 Mtoe, which is 5.8% better than the efficiency target for 2020. This amount is 9.6% away from the 2030 target [81]. Therefore, due to environmental concerns, and in light of our research results (confirmation of the T-EKC hypothesis), tourism development should be structured based on capital investment flows that integrate innovations and new technology to reduce energy demand without losing high performance standards. This assumption is in direct connection with the negative sign in front of the capital investment spending explanatory variable in the tested models (Model 1 and 2) as well as with the feedback causality identified from our research findings between capital investment spending and GHG emission. Unsurprisingly, tourism stakeholders need to acquire a pivotal leading role in alleviating environmental pollution throughout the tourism value chain [82]. Then, the level of GHG emissions can be expected to decrease and experience a better environment to act on and enjoy. If this is not the case, the future may not confirm our results, meaning that environmental degradation will negatively impact many aspects of quality in our life.

The present study elaborated on the Eurozone economic sphere and tested the T-EKC hypothesis. Research opportunities arise as scientists can use different market segments within the tourism industry or adopt additional growth variables to create valuable research outputs. Moreover, different statistical and econometric approaches, tested variables, and groups of countries ought to be in the process in view of adding to the relevant literature concerning the environment and tourism sector.

6. Conclusions

This research investigates the tourism-induced EKC curve hypothesis under a new set of growth variables in the relevant econometric models. For this reason, we consider business and leisure tourism spending as the growth variables and test if they form a U-shaped curve. We contextualize environmental degradation in terms of GHGs. Furthermore, in the models, we consider the impact of capital investment spending on GHGs, whereas we investigate the explanatory power of energy on environmental degradation. Specifically, we test how changes in primary and final energy consumption affect GHG releases. The set of variables used in Model 1 and 2 has received less attention in relevant research efforts. Consequently, our contribution lies in highlighting the predictive power of high-leverage tourism market segments in the process of growth at the interface of the economic system and natural environment (e.g., air quality). This is an especially major concern for all countries in the Eurozone economic space, which has been untested despite its importance in the global economic system. We processed a panel data analysis from 1996 to 2019 based on contemporary unit root and Granger non-causality tests.

The research findings indicate that all tested variables significantly impact GHG emissions, indicating that energy efficiency (e.g., primary and final energy consumption patterns) should be of great importance in our modern world. Additionally, the T-EKC hypothesis confirmed business tourism spending and leisure tourism spending. Such results disclose that these high-impact tourism market segments can be developed further without devastating the environment after a certain point as the economy develops.

The Granger non-causality tests suggest that business tourism spending forms a uni-directional causality relationship with GHG emissions, whereas leisure tourism spending holds a bi-directional causality relationship with GHG emissions. Furthermore, changes in the per capita investment spending are accompanied by changes in the per capita GHG emissions in the same direction and vice versa, which confirms the feedback hypothesis. Moreover, the test results disclose that an increase (decrease) in energy consumption patterns will create an increase (decrease) in GHG emissions and vice versa.

Practical implications call for the integration of energy efficiency into development plans in our current reality and moving them toward a sustainable future where tourism economic activities (e.g., business and leisure tourism) can deploy their potential without damaging the environment in the context of the EKC. Also, investments within the tourism system negatively affect GHG emissions, indicating that n growth patterns can be supported by capital spending in a sustainable manner. Last but far from least, greening all tourism activities is highly important as energy efficiency demands clean energy consumption patterns that limit GHGs and achieve sustainable development goals for the long term.

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