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Relationships between Hotel and Restaurant Electricity Consumption and Tourism in 11 European Union Countries

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Abstract: Tourism is a major economic activity in the world. However, while tourism has a noticeable positive impact on economic development, it also contributes to environmental degradation by increasing energy consumption and therefore emissions. This paper analyzes the relationships between Hotel and Restaurant electricity consumption and tourism growth in 11 European Union countries for the period 2005–2012, for which there is sufficient data availability. Panel data techniques are used to test an electricity consumption function for this sector, which depends on tourism, its squared value, energy price, income and a climate variable. The results show that the Energy–Tourism Kuznets Curve hypothesis is not supported. Instead, an increasing relationship is observed between the Hotel and Restaurant sector electricity consumption and overnight stays. Results also show the effects of income and low temperatures in increasing electricity consumption, while prices have no effects. Energy efficiency measures and the adoption of renewable energy systems are recommended, with further investments therefore being necessary.

Keywords: tourism growth; electricity consumption; Hotel and Restaurant sector; European countries; panel data

1. Introduction

Tourism is a major economic activity in the world. Its total contribution to GDP was USD 7613.3 bn, representing 10.2% of GDP and 9.6% of total employment [1]. However, while tourism has a noticeable positive impact on economic development, improving the balance of payments, boosting investments and generating employment, it also contributes to environmental degradation by increasing CO_2 emissions. Studies such as those by Scott et al. [2–4] analyze the effect of tourism on Climate Change and the implication of the Paris Agreement for the sector, including impacts and mitigation and adaptation policies.

Likewise, there are an increasing number of papers highlighting that tourism significantly impacts on emissions. From a theoretical point of view, Becken and Simmons [5] and Gössling [6], for example, consider that tourism increases energy consumption, especially due to transport activities which emit CO_2 into the atmosphere. From an accounting point of view, some other studies have measured the impact of tourism on CO_2 emissions. Along this line, the studies by Becken and Patterson [7], Gössling and Hall [8], Kelly and Williams [9], Peeters et al. [10], Kuo and Chen [11], Perch-Nielsen et al. [12], Tang et al. [13], Tang [14], Meng et al. [15], and Ragab and Meis [16] may be highlighted. Finally, from an econometric point of view, few papers have analyzed the relationship between tourism and emissions. Among them may be highlighted the studies by Lee and Brahmasrene [17] referring to the EU countries; León et al. [18] to

developed and less developed countries; Katircioğlu [19] to Singapore; Al-Mulali et al. [20] to 48 tourism destinations; Durbarry and Seetanah [21] to Mauritius; Zaman et al. [22] and Paramati et al. [23] to developed and developing countries; Raza et al. [24] to the USA; Işik et al. [25] to Greece; Paramati et al. [26] to Eastern and Western EU countries; and Sherafatian-Jahromi et al. [27] to Southeast Asian countries.

Many of the previous studies consider that tourism impacts on emissions due to energy consumption increases. Thus, some papers focus on the energy use associated with global tourism or that derived from specific tourism activities or services. Among the first, Gössling [6] calculated that the use of energy associated with global tourism in 2000 was 14,000 PJ, while Rutty et al. [28] updated these data, indicating that energy associated with global tourism was equal to 17,500 PJ in 2005. Among the second may be highlighted the studies by Becken et al. [29] and Becken et al. [30] which analyzed the energy use within the accommodation sector and associated with different tourist travel choices, respectively. Recently, some authors have explored the econometric relationships between tourism and energy consumption. The study by Katircioglu [31] focuses on Turkey, while the study by Katircioglu et al. [32] estimates the tourism-induced energy consumption in Cyprus. Moreover, Zaman et al. [22] examine the relationship between economic growth, tourism, energy use and some other variables in a range of world regions. Likewise, the study by Gössling et al. [33] emphasizes the inter-relationships between water and energy, as a result of air conditioning, heating and water supply, for restaurants and accommodation. In addition, focusing on restaurants and accommodation, the study by Pablo-Romero et al. [34] analyzes the relationships between tourist overnight stays and the hospitality sector electricity consumption for the Spanish provinces, by testing the Energy–Tourism Kuznets Curve hypothesis. Finally, the study by Qureshi et al. [35] examines the relationship between sustainable tourism, energy, health and wealth, in a panel of 37 tourist countries, showing that inbound tourism has a positive relationship with energy demand.

Following these previous studies, the aim of this paper is to analyze the relationships between Hotel and Restaurant electricity consumption and tourism in 11 European Union (EU) countries, for the period 2005–2012, for which there is sufficient data availability. Focusing on the EU countries is especially relevant as the EU has been the first choice for international tourists during the last few decades. The European Union region represents the highest travel and tourism direct contribution to GDP and visitors' exports (money spent by foreign visitors) across the world, being equal to 26.5% and 29.8%, respectively [36]. Likewise, countries such as France, Spain, Italy, Germany and the UK (included in the sample data of this study) ranked among the top ten holiday destinations in the world in 2016 [37]. Therefore, energy consumption linked to tourism is especially relevant. In addition, the country selection was also made taking into account the effort that EU countries have to make to comply with their emissions targets. Thus, according to the European Environment Agency [38], the EU countries need to rapidly step up efforts to match their objectives in shifting to a low-carbon economy. To this end, the EU will need to double the current investments in renewable energy and energy efficiency. In this regard, the tourism and industry sectors are among the largest sectors in which to invest.

Panel data techniques are used to estimate an electricity consumption demand function for the Hotel and Restaurant sector, which depends on tourism (measured by total overnight stays), energy price, income and a climate variable. Therefore, this study is limited to analyzing just a part of the energy consumption generated by tourism, since it only includes the electricity consumption caused by tourists in the accommodation, food and beverages sector. Nevertheless, it is worth noting that this sector has a large environmental footprint. Based on 2005 data, the study by the World Tourism Organization and the United Nations Environment Programme [39] estimates that accommodation generates 21% of tourism's total greenhouse gas emissions.

In addition to these variables, the squared value of the tourism variable is included in the model. The inclusion of this squared variable allows testing the Energy–Tourism Kuznets Curve hypothesis, as in Pablo-Romero et al. [34]. The Energy–Tourism Kuznets Curve hypothesis states that increasing tourism produces an energy consumption increase until some turning point is reached,

from which a decreasing relationship is observed between the variables. In this paper, it is tested whether this Energy–Tourism Kuznets Curve hypothesis is supported for Hotel and Restaurant electricity consumption when analyzing 11 European countries, which, to our knowledge, has not been done before.

Most of studies related to the traditional Environmental Kuznets Curve (EKC) consider that the confirmation of the EKC hypothesis is due to the fact that, at higher income levels, more technologies that improve energy efficiency, energy saving and renewable energy are available. It is therefore possible to reduce energy consumption, or to use alternative, less polluting energy sources [40,41]. Some previous papers have highlighted the energy savings and energy efficiency gains that are obtained in the Hotel and Restaurant sector when tourism grows. In that sense, the study by Ben Aissa et al. [42] finds that international attraction and market competition have a direct influence on hotel efficiency, while other studies, such as those of Razumova et al. [43] and Leonidou et al. [44], indicate that hotels are more predisposed to implement effective green strategies when they have sufficient physical and financial resources. Therefore, as stated in Pablo-Romero et al. [34], increasing the Hotel and Restaurant sector earnings through tourism stays increases, for example, the ease of implementing energy efficiency measures, thereby reducing energy use. Nevertheless, it is worth noting that some other papers also highlight that hotels that offer higher quality services use more energy [45–47], causing energy consumption growth. Therefore, it is of interest to test the Energy–Tourism Kuznets Curve hypothesis, i.e. to test whether the energy efficiency gains due to tourism increases are enough to reduce the energy consumption in the sector.

This paper is organized as follows: Section 2 describes Materials and Methods, including the database for the 11 EU countries used in Section 2.1, and the methodology used in Section 2.2. Results and discussions are contained in Section 3. Finally, Section 4 presents the conclusions.

2. Materials and Methods

2.1. Data

This study covers the 11 EU countries for which Hotel and Restaurant electricity consumption data are available for the period from 2005 to 2012. The EU countries for which there are available data are the following: Cyprus, Denmark, France, Germany, Italy, Malta, The Netherlands, Portugal, Spain, Sweden, and the United Kingdom.

Hotel and Restaurant electricity consumption data came from the online Odyssee European Energy Efficiency Database [48], published by Enerdata. The electricity series in this study has been built from research queries in the Odyssee online database. This database offers information about energy consumption by sectors. The energy consumption of the service sector is divided into eight branches, one of them being Hotels and Restaurants, which corresponds to Section I of the International Standard Industrial Classification (ISIC) of economic activities. It covers electricity consumption in the provision of short-stay accommodation for visitors and other travelers, and the provision of complete meals and drinks fit for immediate consumption. In this study, figures are expressed in natural logs of thousand tons of oil equivalents (ktoe) per thousand inhabitants, with the population data also coming from the same database.

Tourism data came from the Eurostat database [49] In this study, total overnight stays are considered as a measure of tourism; therefore, it is measured as nights spent at tourist accommodation establishments, which include hotels, holiday and other short-stay accommodation, camping grounds, recreational vehicle parks and trailer parks. In particular, the nights spent at tourist accommodation establishments' series was used (sample number code tour_occ_ninat). Total overnight stays have been used before as a proxy to measure tourism, such as in the studies by Cortés-Jiménez and Pulina [50] and Gómez-Calero et al. [51], and more recently in the study by Pablo-Romero et al. [34]. Figures are expressed in overnight stays per inhabitants in natural logs.

In addition, to properly estimate the relationships between Hotel and Restaurant electricity consumption and tourism, some other variables have also been taken into account. GDP per capita by country has been considered as a measure of per capita income, as in Pablo-Romero et al. [34]. These data also came from the online Odyssee database [48], from which the GDP series was also built from queries. Figures are expressed in thousands of 2005 constant Euros per inhabitants in natural logs.

Moreover, a climate variable has been considered to take into account possible differences in energy consumption associated with differences in climate conditions. In this sense, recent studies relating electricity consumption with GDP include some kind of climate variables as controls, for example, Lee and Chiu [52] use average temperature. Nevertheless, more recent studies tend to use heating and cooling degree days (HDD and CDD, respectively), e.g. Fan and Hyndman [53], Mohammadi and Ram [54], and Serrano et al. [55]. In this study, only HDD have been considered, as CDD data are not available for the studied period. The HDD is measured as the difference between the daily temperature mean (Tm—high temperature plus low temperature divided by two) and 18 °C, being zero if Tm is greater than 15 °C. These values are summed to obtain the annual HDD. Again, data come from the Odyssee database [48], directly from the macro data subsection. The figures are expressed in degrees Celsius.

Finally, electricity prices have also been considered. Some previous studies have included energy prices when estimating electricity demand functions, for example for households, such as in Silva et al. [56], or transport energy functions, such as in Pablo-Romero et al. [57] for European countries. Following this latter study, Eurostat database [49] energy price data have been considered. In particular, the HICP (2015 = 100) series was used (sample number code prc_hicp_aind). Prices are expressed as the annual rate of change in electricity, gas, solid fuels and heat energy in harmonized consumer price indices, which is analogous to logarithm differences of the indices' values. No more detailed prices are available.

Table 1 shows the main descriptive statistics of the variables. It can be observed that the typical standard deviations of the data are higher across countries than across time for all variables. As shown in Table 1, the sample is shaped by five variables, eleven countries and eight years. Therefore, the total sample number is 440.

Table 1. Descriptive statistics.

Variable	Description		Mean	Std. Dev.	Min.	Max.	Obs.
E	Hotel and Restaurant electricity consumption (ktoe per thousand inhabitants in logs)	overall	5.097661	1.689213	3.188856	8.508734	N = 88
		between		1.754979	3.198233	8.486791	n = 11
		within		0.020763	5.026690	5.178418	t = 8
T	Total overnight stays (per thousand inhabitants in logs)	overall	8.807063	0.511674	8.200749	9.915400	N = 88
		between		0.525529	8.312859	9.823252	n = 11
		within		0.077328	8.665719	9.269538	t = 8
Y	GDP (per thousand inhabitants in logs)	overall	3.159336	0.462218	2.106534	3.754082	N = 88
		between		0.478739	2.160682	3.679537	n = 11
		within		0.036639	3.033032	3.242757	t = 8
tem	HDD (Heating Degree Days in degrees Celsius in logs)	overall	7.549002	0.592663	5.725557	8.326285	N = 88
		between		0.600270	6.301532	8.172024	n = 11
		within		0.132196	6.973027	7.993882	t = 8
P	Electricity prices (annual rate of change in harmonized consumer price indices)	overall	6.556250	7.382081	−14.30000	29.1000	N = 88
		between		3.411276	2.912500	13.3500	n = 11
		within		6.611790	−19.268750	22.3062	t = 8

2.2. Model

Following the previous study referring to the relationships between tourism and the hospitality sector electricity consumption [34], the starting point of the modeling setting in this study is that Hotel and Restaurant electricity consumption may not only be conditioned by tourism, but also by other factors. Therefore, the general specification model for testing the influence of tourism on Hotel and Restaurant electricity consumption may be expressed as follows:

$$E_{it} = A_{it} + \beta_1 Y_{it} + \beta_3 T_{it} + \beta_4 T_{it}^2 + \beta_3 tem_{it} + e_{it} \tag{1}$$

where *E* is the Hotel and Restaurant electricity consumption in per capita terms expressed in logarithms, *Y* is the GDP per capita expressed in logarithms; *T* is the variable representing the country tourism, expressed in overnight stays in tourist accommodation establishments in per capita terms, also expressed in logarithms; *tem* is the temperature variable measure in terms of *HDD*, also in logarithms terms; *A* represents the sum of the *time effect* and *country effect*; and *i* and *t* denote each one of the European countries considered in the study and years from 2005 to 2012, respectively. Finally, *e* is a random error term.

GDP is included in the model to take into account the effect of restaurant services demanded by residents. In that regard, it may be expected that greater demand for restaurant services may affect the electricity consumption of the sector, which may be related to residents' income. Likewise, the temperature has been included in the model as in, for example, Fan and Hyndman [53], Mohammadi and Ram [54], and Serrano et al. [55]. These measures are used to take into account that energy consumption depends strongly on weather conditions. If the temperatures are low, more energy is consumed for heating, while, if temperatures are high, more energy is also consumed for cooling.

Finally, the squared value of Tourism is initially included in the model, as in Pablo-Romero et al. [34], to test if the electricity consumptions tend to vary when the tourism level changes. Nevertheless, when also including squared variables in the estimated functions, multicollinearity may appear among these explanatory variables [58]. The second column in Table 2 shows that multicollinearity exists among T and T2. According to previous studies [59,60], the values of the variance inflation factors (VIF) for each variable should not exceed the value of 5, or at most 10, being much higher for these variables. To mitigate this problem, the data were converted to deviations from the geometric mean of the sample, thereby ruling out the multicollinearity problem. The third column in Table 2 shows that no VIF value for the transformed variables exceeds the value of 5.

Table 2. Variance inflation factors.

Variables	VIF (Variables)	VIF (Deviations from the Geometric Mean)
Y	1.09	1.09
T	270.38	1.09
T^2	271.62	1.05
tem	1.04	1.04
Mean VIF	136.03	1.07

To correctly estimate the Equation (1), the stochastic nature of the variables was analyzed. Firstly, in order to determine if it is convenient to use the second generation panel unit root, cross-section dependence in the data was tested by using the Pesaran CD test [61], under the null hypothesis of cross-section independence. As shown in Table 3, the null hypothesis is rejected in all cases, except for the tourism squared variable. Therefore, second generation panel data are used to investigate the presence of unit roots in all variables, except for this one.

Table 3. Panel cross-section dependence tests.

Variables	CD Test
E	11.96 ***
Y	7.01 ***
T	5.08 ***
T^2	1.05
tem	9.68 ***

Note: *** denotes significance at the 1% level.

Table 4 shows the results of applying the CIPS test proposed by Pesaran [62], which captures the cross-sectional dependence that arises through a single-factor model, for E, Y, T and tem variables. In addition, Table 4 shows the results of applying the Maddala and Wu test [63], which assumes cross-section independence for the T^2 variable. Both tests consider the null hypothesis of non-stationarity. The results show that variables are I (1), as they are stationary in first differences and non-stationary in levels, when considering intercept and trend.

Table 4. Unit root test.

Variables	Test	Level	First Differences
		Intercept and Trend	Intercept and Trend
E	CIPS	−2.918 *	−2.968 **
Y	CIPS	−1.697	−3.042 **
T	CIPS	−1.941	−3.748 ***
T^2	MW	21.1123	70.2637 ***
tem	CIPS	−2.066	−2.396 **

Note: *t*-bar statistics *** denotes significance at the 1% level and ** at the 5% level. Lags included in each individual regression calculated with an iterative process from 0 to 2 based on F joint test.

Finally, Table 5 shows the computed values of the Westerlund co-integration tests [64], which examine the existence of a structural long-run relationship among the series. The null hypothesis of these tests is no co-integration. The advantage of these tests is that they can accommodate the cross-sectional dependence in the series through bootstrapping. In this study, 100 replications were made. The test results show that the null hypothesis of no co-integration cannot be rejected for any of the four statistics. Thus, the model may be estimated by using first differences.

Table 5. Westerlund co-integration tests.

Dependent Variable	Independent Variables	Co-Integration Tests			
		Gt	Ga	Pt	Ga
E	T, T^2	−0.809	−0.388	−0.140	−0.009

Note: Test regression fitted with constant and trend. Kernel bandwidth set according to the rule 4(T/100)2/9. The *p*-values are for a one-sided test based on 200 bootstrap replications.

Using Δ to indicate the first differences and a topline over variables to indicate that variables have been converted to deviations from the geometric mean of the sample, Equation (1) may be rewritten as follows,

$$\Delta \overline{E}_{it} = \Delta \overline{A}_{it} + \beta_1 \Delta_1 \overline{Y}_{it} + \beta_2 \Delta \overline{T}_{it} + \beta_3 \Delta \overline{T}^2_{it} + \beta_4 \Delta \overline{tem}_{it} + e_{it} \qquad (2)$$

where $\Delta \overline{A}_{it} = \delta_t$.

Due to the price variable being expressed in annual rate of change, and variables in Equation (2) being in logs and first differences which are analogous, it is possible to incorporate the price variable into the model to test its effect on the electricity consumption. Therefore, the new equation to be estimated is now expressed as

$$\Delta \overline{E}_{it} = \delta_t + \beta_1 \Delta_1 \overline{Y}_{it} + \beta_2 \Delta \overline{T}_{it} + \beta_3 \Delta \overline{T}^2_{it} + \beta_4 \Delta \overline{tem}_{it} + \beta_4 P_{it} + e_{it} \qquad (3)$$

where *P* is the annual rate of price change.

To properly estimate this model, the Wooldridge test for autocorrelation [65] (under the null hypothesis of no first-order autocorrelation), and the Wald test for homoscedasticity [66] (under the null hypothesis of homoscedasticity), were also performed. Table 6 shows no first-order autocorrelation

and heteroscedasticity, therefore the feasible generalized least squares model (FGLS) was used to estimate Equation (3).

Table 6. Autocorrelation and Homoscedasticity test.

Wooldridge Test	Wald Test
0.223	2396.03 ***

Note: *** denotes significance at the 1% level.

Once Equation (3) is estimated, the β coefficients obtained may inform about the relationships between the electricity and the tourism variables. If β_2 is positive and significant, tourism affects Hotel and Restaurant energy consumption positively. Additionally, if the β_3 coefficient is also positive, an increasing relationship exists between both variables. However, if this value is negative, a decreasing relationship exists between both variables and the Energy–Tourism Kuznets Curve hypothesis may be supported.

3. Results and Discussion

Table 7 shows the results of estimating Equation (3) for 11 EU countries in the period 2005–2012 using the FGLS model. The second column shows the estimate results when only T and T^2 are taken into account. The following three columns show the estimate results when P, HDD and Y variables are added to the model. Finally, the last column shows the estimate results when the P variable is excluded.

Table 7. Estimate results of Equation (3).

	FGLS (a)	FGLS (b)	FGLS (c)	FGLS (d)	FGLS (e)
T	0.020 *** (0.006)	0.022 *** (0.006)	0.028 *** (0.007)	0.024 *** (0.005)	0.026 *** (0.009)
T^2	0.012 ** (0.007)	0.014 ** (0.007)	0.020 *** (0.007)	0.027 *** (0.006)	0.024 *** (0.007)
P	-	−0.00003 (0.000)	−0.00002 (0.000)	−0.00005 (0.000)	-
Tem	-	-	0.012 *** (0.004)	0.012 *** (0.004)	0.014 *** (0.003)
Y	-	-	-	0.040 *** (0.007)	0.048 *** (0.010)

Note: Standard errors are shown in parenthesis, *** denotes significance at the 1% level and ** at the 5% level. All estimates include time.

The results show that coefficients associated with the T in all estimates are positive and significant, with values from 0.02 to 0.028. Therefore, the Hotel and Restaurant electricity consumption per capita elasticity with respect to tourism per capita is positive in the central point of the sample, meaning that increases in tourist overnight stays tend to raise the electricity consumption in the Hotel and Restaurant sector. Along this line, a positive relationship between tourist arrivals and energy consumption is also observed in the study by Katircioglu et al. [32] which referred to Cyprus, while Qureshi at al. [35] found that inbound tourism also has a positive relationship with energy demand in their study, which referred to the top 80 international tourist destination cities.

The results also show that the values of the T^2 coefficients are positive and significant in all estimates. Therefore, an increasing relationship between Hotel and Restaurant electricity consumption per capita and tourist overnight stays is observed. The results do not support the Energy–Tourism Kuznets Curve hypothesis, but an increasing relationship between the variables is observed. Therefore, if tourism tends to grow, the electricity consumption will grow more and more. These results are in line with those obtained for the Spanish provinces [34], where an increasing relationship, between energy consumption and tourist stays, are also observed. In addition, Katircioglu [31] also observed that tourism development in Turkey

leads to significant increases in energy consumption, especially in the long term, the degree of its effects growing stronger over time, which could be due to tourism growth.

As T^2 coefficients are significantly different from zero, the Hotel and Restaurant electricity consumption per capita elasticity with respect to tourism per capita differs between countries. These elasticity values may be obtained by deriving Equation (3) with respect to T and using the estimated results shown in Column (e) in Table 7, as follows:

$$Elasticity_{it} = 0,026 + 0.024\overline{T}_{it}$$

Table 8 shows the temporary average elasticity for the 11 EU countries studied. Higher values are obtained for Malta and Cyprus, followed by Spain and Italy, with lower values for Germany. Therefore, a more intense energy policy is recommended for countries with higher elasticity values.

Table 8. Average Hotel and Restaurant electricity consumption per capita elasticity with respect to tourism per capita.

Country	Average Elasticity	Country	Average Elasticity
Cyprus	0.074	The Netherlands	0.012
Denmark	0.011	Portugal	0.004
France	0.015	Spain	0.035
Germany	0.001	Sweden	0.012
Italy	0.023	United Kingdom	0.003
Malta	0.077		

The energy efficiency gains linked to tourism increases do not seem to be enough to reduce the energy consumption in the sector. Therefore, some energy policy measures will be needed in order to control these increases in electricity use. In this regard, some more energy efficiency measures are recommended. Some authors, such as Blanco et al. [67] and Becken [68], have highlighted that accommodation and food providers have stronger environmental motivations than providers from other sectors, their environmental initiatives being more linked to these strong environmental values than to economic motivations [69–71]. Becken and Dolnicar [72] found that companies have the perceptions that sustainability initiatives are not always compatible with maximizing profitability and consider that the financial cost of implementing environmental measures are a barrier. Financial support is needed to promote initiatives in energy efficiency, especially when it is considered that technology plays a major role in exploiting the massive potential benefits of reducing energy consumptions in non-residential buildings [73]. Focusing on Italian hotels, Bianco et al. [74] found that it may be possible to achieve energy savings of 1.6 TWh (13%) in 2030, by implementing energy efficiency measures such as the substitution of current bulbs with LED bulbs, installation of heat pumps, wall insulation, substitution of windows, and installation of condensation boilers. Likewise, these authors show that the implementation of the proposed measures can be considered financially feasible if loans with competitive rates are assigned to the investors. This may be especially relevant for smaller companies, which are less satisfied with their investment into resource efficiency measures [72].

In addition to energy efficiency measures, the promotion of renewable energy systems could also be adequate to control the CO_2 emissions derived from the electricity consumption increases in the sector. According to Hendrikx [75], the largest amount of total hotel energy consumption (up to 40%) is related to hot-water production, which could be produced, at least partially and depending on climate conditions, by solar energy [76]. According to Chan et al. [77], the hotel professionals preferred solar-based renewable energy-related technology, which could supply up to 50% of hotels in Southern EU countries, such as Spain and Italy [78]. In addition to solar energy, other studies have pointed out the possibilities of using refuse derived biomass fuel energy for hot water and heating systems in the hotel industry [79], and combining solar and wind energy, depending on weather conditions. Thus, for example, the study by Meschede et al. [80], which referred to Canary Islands' hotels, established that the optimal share of renewable electricity generation is 63%, of which 67% was photovoltaic, and 33% wind power.

The results also show that all the control variables included in the model are significant and positive, except for the price variable. Price coefficients show negative but non-significant values. However, as these values are close to zero, it may indicate that energy prices do not significantly affect the electricity consumption in the sector. Prices often do not seem to have a notable effect on electricity consumption in previous estimates, related to household's behavior, especially for those with high-level income [81,82]. This result is also in line with those obtained for the water demand in Mallorcan (Spain) hotels [83]. The authors also obtain negligible coefficient values corresponding to price. Nevertheless, it is worth noting that the estimate results obtained in our paper should be interpreted with caution, because the available price data used in this study refer not only to electricity, but also to gas, solid fuels and heat energy.

Secondly, temperature coefficients are also positive and significant. Thus, lower temperatures tend to increase electricity consumption, especially for heating, in the Hotel and Restaurant sector. In that regard, the changing of the temperatures through this period is significant in affecting the electricity use. It is worth noting that perhaps higher temperatures would have more effect on electricity consumption than lower ones, due to space cooling needs, being especially relevant for south European countries, which also have high elasticity values, as shown in Table 8. Some authors have pointed out the increasing needs of cooling due to climate change [84]. For example, for hotels in Greece [85], an increase of 248% in cooling demand is expected, while the case study of a hotel in Lisbon shows a potential increase of the primary energy for cooling load of 25% [86], in the most severe scenarios of climate change. Therefore, it is desirable to elaborate CDD series for European countries, which to date are not available, to analyze the effect of higher temperatures on Hotel and Restaurant electricity consumption. The CDD series could provide information to test the climate effects, specifically the effects of global warming, on energy consumption in general, and on hotels and restaurants in particular.

Finally, estimated coefficients for income also show positive and significant values. Therefore, as income grows, so does the electricity consumption in the studied sector. This increased economic growth will induce electricity consumption; therefore, energy efficiency measures are once again needed to control the electricity increase in the sector.

4. Conclusions

This paper analyzes the relationships between Hotel and Restaurant electricity consumption and tourism in the EU countries for which data are available, for the period 2005–2012. Panel data techniques are used to test the Energy–Tourism Kuznets Curve hypothesis.

The results show that the Hotel and Restaurant electricity consumption per capita elasticity, with respect to tourism per capita, is positive, meaning that as tourist overnight stays increase, the electricity consumption in the Hotel and Restaurant sector also increases. The results are in line with several previous studies which show a positive link between energy and tourism. The results also show that the Energy–Tourism Kuznets Curve hypothesis is not supported. Instead, an increasing relationship between the variables is observed, provoking increasing elasticity values as income grows. These results are similar to those obtained previously when referring to Spanish provinces. In addition, elasticity values differ between countries depending on their respective tourist stays per capita. The highest values are observed for Malta and Cyprus, with the lowest being for Germany.

These results may indicate that some energy efficiency measures are necessary to control the increasing elasticity values and therefore control the electricity consumption. In this regard, financial support is needed to promote initiatives in energy efficiency. Thus, loans with competitive rates for investors may be appropriate, especially for smaller companies. In addition, promoting renewable energy in the tourism industry may also be adequate. If electricity consumption tends to grow in the tourism sector, then it would be convenient to use renewable electricity to reduce the emissions impact. Solar technologies are among the most used in the hospitality sector, while biomass is used in rural spaces.

The results also show that HDD and income variables are significant and positive in the Hotel and Restaurant sector, while the price variable is not significant, indicating that energy prices do not noticeably affect electricity consumption. Therefore, pricing does not seem to be the most convenient method to reduce the electric consumption in the sector.

Temperature coefficients are positive and significant. Thus, lower temperatures tend to increase electricity consumption, especially for heating, in the Hotel and Restaurant sector. The lack of available data has not allowed us to control for high temperatures, although it seems that temperature increases may be having a clear effect on electricity consumption, especially to cover cooling needs. In this regard, it is desirable to produce the CDD series for European countries. These series could provide adequate information to test the global warming effects on energy consumption in general, and on hotels and restaurants in particular.

Finally, estimated coefficients for income also show positive and significant values. In that regard, increased economic growth will induce the electricity consumption, reinforcing the need for energy efficiency measures and renewable energy promotion.

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