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Relationships between Tourism and Hospitality Sector Electricity Consumption in Spanish Provinces (1999–2013)

María del P. Pablo-Romero [1,2,*], Rafael Pozo-Barajas [3] and Javier Sánchez-Rivas [1]

1 Department of Economic Analysis and Political Economy, Faculty of Economics and Business Sciences, University of Seville, Ramon y Cajal 1, Seville 41018, Spain; sanchezrivas@us.es
2 Research Directorate, Universidad Autónoma de Chile, Av Pedro de Valdivia 641, Santiago 7500138, Chile
3 Department of Financial Economy and Operations Management, Faculty of Economics and Business Sciences, University of Seville, Ramon y Cajal 1, Seville 41018, Spain; pozo@us.es
* Correspondence: mpablorom@us.es; Tel.: +34-954-557-611; Fax: +34-954-557-629

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Abstract: The EU is committed to a 40% reduction in their domestic greenhouse gas emissions by 2030. In order to reach this ambitious target, new measures affecting all economic sectors would be needed. This paper focuses on the tourism sector. Using econometric panel data techniques, the relationships between tourist overnight stays and the hospitality sector electricity consumption is studied for the Spanish provinces during the period 1999–2013. With this aim, an Energy-Tourism Kuznets Curve hypothesis is tested. The results show that the Energy-Tourism Kuznets Curve hypothesis is not supported. An increasing positive relationship between the hospitality sector electricity consumption and overnight stays is observed. Results also show that the hospitality sector electricity consumption elasticity values, with respect to tourist overnight stays, differ among the provinces, the values being within a range of 0.1–0.5 during the period. The highest values are observed for the Balearic Islands, the Canary Islands, Gerona, Tarragona and Malaga. Energy efficiency measures, the adoption of renewable energy systems and the development of energy management capabilities are recommended.

Keywords: tourism growth; electricity consumption; hospitality sector; Spain

1. Introduction

At the Paris Conference of the Parties (COP21) in 2015, 195 countries adopted the Paris Agreement [1]. The central aim of this Agreement is to strengthen the global response to the threat of climate change by limiting global average warming to well below 2 °C above pre-industrial levels, and to pursue efforts to limit the increase to 1.5 °C. The Paris Agreement, which entered into force on 4 November 2016, requires Parties to communicate their comprehensive Intended Nationally Determined Contributions (INDCs), including the targets they intend to adopt for the post-2020 period.

In 2015, the European Commission communicated that the European Union (EU) and its member states are committed to a binding target of at least a 40% domestic reduction in greenhouse gas emissions by 2030 compared to 1990, to be fulfilled jointly [2]. The new target represents a significant progression beyond its existing 20% emission reduction commitment by 2020. Thus, greater efforts will be needed. In that regard, the EU is already undertaking several actions to curb CO_2 emissions which are basically related to energy use, as more than 80% of total emissions in the EU-28 are currently caused by energy use and production. These actions affect all productive sectors.

Therefore, recent studies that analyze the relationships between energy consumption and growth from a sectoral point of view are of special interest. Among these studies, those related to the transport sector, such as the studies by Chandran and Tang [3], Azlina et al. [4] and Pablo-Romero et al. [5], may be highlighted. There is also a growing literature review related to the industry sector. Some of these studies refer to certain industry sub-sectors, such as the studies by Chen et al. [6] analyzing the iron and steel sector, and by Ansari and Seifi [7] studying the cement industry. Some others refer to the impacts of the industrial structure on energy consumption [8] or to certain countries [9,10]. Likewise, there are also studies referring to the residential sector. Among these studies, Nie and Kemp [11], Tso and Guan [12], Kessels et al. [13] and Pablo-Romero et al. [14] may be cited.

Nevertheless, there is a relatively smaller strand of studies in the literature referring to the tourism sector. Among them, the study by Becken et al. [15], which analyzes the energy use within the accommodation sector in New Zealand, may be highlighted. Along this line, Gössling [16] calculates that the use of energy associated with global tourism in 2000 was 14,000 PJ. In addition, Rutty et al. [17] update these data, indicating that tourism contributed approximately 5% to global anthropogenic emissions of CO_2 in 2005, the energy associated with global tourism being equal to 17,500 PJ. Thus, the authors consider that the environmentally undesirable effects of tourism, based on energy consumption, have not declined since 1990s, growing in both relative and absolute terms. Likewise, Becken et al. [18] analyze the energy use associated with different tourist travel choices. More recently, some authors have explored the econometric relationships between international tourism and energy consumption. The study by Katircioglu [19] analyzes the relationships between international tourism, energy consumption and environmental pollution in Turkey. Katircioglu et al. [20] estimate the tourism-induced energy consumption in Cyprus. In addition, Zaman et al. [21] investigate the relationship between economic growth, tourism development, energy demand and some other variables in various World regions. On the other hand, the study by Gössling et al. [22] places a substantial emphasis on the inter-relationships between water and energy, as a result of air conditioning, heating and water supply, for restaurants and accommodation.

These studies, related to energy consumption and tourism, are especially relevant as they may be useful tools for establishing how the tourism sector can contribute to achieving the Paris Climate Agreement targets. In this regard, studies such as those by Scott et al. [23,24] analyze the place of tourism in the Climate Change and the implication of the Paris Agreement for the sector, including impacts, adaptation, vulnerabilities, and mitigation. In addition, studies such as Scott et al. [25] analyze the costs associated with different policy pathways to achieve tourism sector emission reduction ambitions.

Following previous studies, the aim of this paper is to analyze the relationships between tourism growth and electricity consumption (both in per capita terms) in the hospitality sector in the Spanish provinces during the period 1999–2013. With this aim, econometric panel data techniques are used in order to estimate an electricity consumption function for the hospitality sector which depends on tourism, income and climate variables. In this paper, "tourism" is related to the stays made by people in places other than their usual environment, while "hospitality sector" refers to the accommodation and food services sectors. This study is limited to analyzing a part of the energy consumption generated by tourism, since it does not include, among others, the energy consumption associated with the trips of the tourists, nor the possible electricity consumption caused by the tourists in economic sectors other than accommodation and food and beverages.

Tourism is measured as total overnight stays as a proxy of earnings from tourism [26]. Thus, not only foreign tourists are considered, but also national visitors from other provinces. Additionally, the squared value of this variable is included. The inclusion of the squared variable gives greater flexibility to the model, allowing it to be determined if there are linear, increasing or decreasing relationships between electricity consumption in the hospitality sector and tourism. In that sense, the inclusion of the squared variable allows an Energy-Tourism Kuznets Curve hypothesis to be tested.

The environmental Kuznets Curve hypothesis states that there is a growing relationship between economic growth and emissions or energy consumption until some turning point is reached in per capita income. After this point, a decreasing relationship is observed [27]. Therefore, an Energy-Tourism Kuznets Curve would show that increasing earnings from tourism will bring about reduced electricity consumption from a threshold point, which could be related to the fact that more earnings could imply undertaking more energy efficiency measures. In this paper, it is tested whether this occurs, which, to our knowledge, has not been done before.

Some previous studies have emphasized the role of tourism on the EKC, indicating "tourism-induced emission" [21]. Likewise, some others have emphasized the link between tourism and energy consumption [28]. In addition, previous studies also indicate that those hotels that offer higher quality service use more energy [28,29]. Moreover, some others studies, such as Warnken et al. [30], also state that energy use per person, per night, is higher in hotels with higher quality service. Therefore, it may be expected that increasing tourism causes energy consumption growth.

Nevertheless, other papers highlight the energy saving potential in hotel buildings through the implementation of several efficiency measures [31], considering that the resulting environmental impacts are greater than those caused by other types of commercial buildings of similar size due to the low energy efficiency levels of hotels [32]. It is worth noting that Ben Aissa et al. [33] find that international attraction and market competition have a direct influence on hotel efficiency. Likewise, other studies indicate that the general predisposition of hotels to implement innovations are related, among other factors, to manager remuneration, and that possessing sufficient physical and financial resources is instrumental in achieving effective green marketing strategies [34,35]. Therefore, it may be expected that increasing tourism stays could increase the hospitality sector earnings, making it easier to carry out energy efficiency measures, and therefore reducing energy use. Testing the Energy-Tourism Kuznets Curve hypothesis could determine if increasing tourism beyond a certain point could reduce energy use.

In this regard, including the squared variable allows the calculation of the elasticity values of hospitality sector electricity consumption with respect to total overnight stays. These elasticity values are calculated, as in Pablo-Romero and Sánchez-Braza [36], for each year and province, analyzing whether there is a different behavior between provinces through time. Furthermore, this study enlarges the previous literature by focusing the analysis on Spanish provinces for which, to our knowledge, there are no previous studies. Focusing on Spain is especially relevant as it tops the Travel and Tourism Competitiveness Index Global Rankings produced by the World Economic Forum [37] and is the third most visited country in the world.

2. Materials and Methods

2.1. Data

This study covers the 50 Spanish provinces and the time period from 1999 to 2013, depending on the availability of data. The main data used in this study are related to the hospitality sector electricity consumption and the tourist overnight stays.

Hospitality sector electricity consumption data came from the Annual Electrical Statistics published by the Spanish *Ministerio de Energía, Turismo y Agenda Digital* [38]. Electricity consumption is disaggregated into 34 sectors. Sector 30 refers to hospitality. It covers electricity consumption in the accommodation and food services sectors, which correspond to sectors 55 (*Accommodation*) and 56 (*Food and beverage service activities*) of the Statistical classification of economic activities in the European Community (NACE). In this study, figures are expressed in natural logs of MWh per thousand inhabitants, with the population data coming from the INE [39].

Tourism data came from the INE [39]. Most of the studies that analyze the relationships between tourism and growth variables, such as GDP, income, exports, etc., usually measured either by the number of visitors or by the earnings obtained from tourism [26]. Nevertheless, the indicators used to measure tourism often depend on data availability, especially when the scope of the study is regional or provincial. Thus, for example, in the studies by Cortés-Jiménez and Pulina [40] and Gómez-Calero et al. [41], tourism is measured as the number of travelers staying overnight at hotels and additionally as the number of hotel overnight stays. However, overnight stays may be considered a better proxy of the earnings obtained from tourism [41]. In the case of Spain, the series of Hotel Occupation Surveys offered by the Instituto de Estudios Turísticos [42] provide information about the number of travelers and also the number of overnight stays in a year. In this study, total overnight stays are considered as a measure of tourism. Figures are expressed in overnight stays per thousand inhabitants in natural logs.

Additionally, to properly estimate the relationships between electricity consumption by the hospitality sector and tourism, two other variables have also been considered in this study. Firstly, GDP per capita by province has been considered as a measure of per capita income. These data came from the Spanish Regional Accounts published by INE [39]. Figures are expressed in millions of constant euros per thousand inhabitants in natural logs.

Secondly, a climate variable has been considered. In that regard, most of the studies that relate electricity consumption with income include climate variables as controls. Some studies, such as those by Lee and Chiu [43] and Gam and Ben Rejeb [44] use average temperature, others such as those by Fan and Hyndman [45] and Blázquez et al. [46] use heating and cooling degree days and others use similar measures, such as temperature range [47]. In this study, average temperature has been considered, measured in degrees Celsius. Nevertheless, an additional temperature measure has also been considered. This additional measure reflects the absolute value of the difference between the average annual temperature of each province and the national average. Higher values are thus related to more extreme temperatures. All temperature data are calculated from the INE database [39].

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 provinces than across time for all variables.

Table 1. Descriptive statistics.

Variables		Mean	Std. Dev.	Min.	Max.	Observations
Hospitality electricity consumption (per thousand inhabitants in logs)	overall	5.481993	0.4047839	4.529205	6.925865	N = 750
	between		0.3679403	5.014116	6.814748	n = 50
	within		0.1760692	4.965056	6.084888	T = 15
Total overnight stays (per thousand inhabitants in logs)	overall	8.135635	0.8214894	6.691607	11.17664	N = 750
	between		0.8198326	7.130201	10.8463	n = 50
	within		0 .123622	7.642712	8.536244	T = 15
GDP (per thousand inhabitants in logs)	overall	2.70558	0.2094818	2.2072	3.191021	N = 750
	between		0.2038602	2.365652	3.110151	n = 50
	within		0.0556817	2.534374	2.849879	T = 15
average temperature (Degrees Celsius)	overall	15.38988	2.837845	10.1	22.6	N = 750
	between		2.818936	11.07333	21.78	n = 50
	within		0.5054651	13.86988	18.30988	T = 15

2.2. Model

The starting point of the theoretical setting in this study is that tourism might be a determinant of electricity consumption, especially for the hospitality sector. Thus, the following functional relationships have been put forward in this study:

$$Elec_{it} = f(Tourism_{it}) \quad (1)$$

where *Elec* is the hospitality sector electricity consumption and *Tourism* is the variable representing the province tourism. Nevertheless, this electricity consumption may be influenced by other variables. In previous studies, models on electricity demand usually include income or GDP and temperature or similar climate variable as explanatory variables [43,44,46,48–53]. In this study, per capita income is included in the model in order to take into account the effect of the demand for hospitality services performed by residents of each province. A greater demand for services may affect the electricity consumption of the sector. Likewise, the average temperature has been included in the model as in, for example, Lee and Chiu [43] and Dulleck and Kaufmann [48]. Furthermore, alternatively, another temperature variable, named *absolute* has also been included in the model. This variable measures the absolute value of the difference between the average annual temperature of each province and the national average. In this sense, higher *absolute* values imply more extreme temperatures. Furthermore, as stated in Romero-Jordán et al. [47], while temperatures are more extreme, more electricity consumption is expected.

Therefore, the general specification model for testing the influence of tourism on the hospitality sector electricity consumption may be expressed as follows:

$$E_{it} = A_{it} + \beta_1 Y_{it} + \beta_3 T_{it} + \beta_4 T_{it}^2 + \beta_3 tem_{it} + e_{it} \quad (2)$$

where E is the hospitality sector electricity consumption in per capita terms expressed in logarithms, Y is the GDP per capita expressed in logarithms, T is the variable representing the province tourism, in this case the number of overnight stays in per capita terms also expressed in logarithms, tem is the annual average temperature, A represents the sum of the *time effect* and *country or individual effect* and i and t denote Spanish provinces and years, respectively. Finally, e is a random error term.

Multicollinearity among the explanatory variables has been observed in previous studies when including variables and their squared values in the estimated functions, as for example in Narayan and Narayan [54] when estimating Environmental Kuznets Curves. In this paper, the multicollinearity among the explanatory variables was analyzed by using the values of the variance inflation factors (VIFs). According to Pablo-Romero and Sánchez-Braza [36] the VIF value for each variable should not exceed the value 10, or 5 if a more stringent criterion is taken into account. The second column in Table 2 shows the VIF values obtained for the variables. As observed, the VIF values exceed 5 and also 10 for the variable T and T^2, respectively. In order to mitigate this problem, the data were converted to deviations from the geometric mean of the sample. The third column in Table 2 shows the VIF values for the transformed variables. As observed, the VIF values do not exceed the value of 5 for any of them. Therefore, possible problems of multicollinearity were ruled out.

Table 2. Variance inflation factors.

Variables	VIF (Variables)	VIF (Deviations from the Geometric Mean)
Y	1.20	1.20
T	251.86	2.13
T^2	254.43	1.99
tem	1.49	1.49
Mean VIF	127.25	1.70

This transformation is included in the equation by using a bar over variables to indicate these deviations as follows,

$$\overline{E}_{it} = \overline{A}_{it} + \beta_1 \overline{Y}_{it} + \beta_2 \overline{T}_{it} + \beta_3 \overline{T}_{it}^2 + \beta_4 \overline{tem}_{it} + e_{it} \quad (3)$$

This transformation implies that the meaning of the β coefficients changes. β_1, β_2 and β_3 now represent the per capita hospitality sector electricity consumption elasticity with respect to income per capita, tourist overnight stays and temperature in the central point of the sample, respectively [36].

Additionally, to properly estimate Equation (2) avoiding spurious estimates, the stochastic nature of the variables was examined. Firstly, the Pesaran CD test [55] was used to test the existence of cross-sectional dependence among the variables. If this dependence exits, it is convenient to use specific unit root tests which capture it. Table 3 shows the Pesaran CD test results. The null hypothesis of cross-sectional independence is rejected for all series. Therefore, a second generation panel unit root may be used.

Table 3. Panel cross-section dependence tests.

Variables	CD Test
Y	69.35 ***
T	34.53 ***
T^2	9.89 ***
tem	67.21 ***

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

Table 4 shows the results of applying the cross-sectionally augmented Im, Pesaran and Shin (CIPS) panel unit root tests, developed by Pesaran [56], to the series in levels and first differences. The CIPS test is adequate for testing for unit roots in heterogeneous panels with cross-sectional dependence. The null hypothesis assumes that all series are non-stationary. The results show that variables are I (1), as they are stationary in first differences and non-stationary in levels.

Table 4. CIPS test.

Variables	Level		First Differences	
	Intercept	Intercept and Trend	Intercept	Intercept and Trend
E	−1.061	−2.130	−2.783 ***	−3.271 ***
Y	−2.165 *	−2.467	−3.118 ***	−3.242 ***
T	−1.667	−2.291	−3.254 ***	−3.553 ***
T^2	−1.959	−2.157	−3.147 ***	−3.210 ***
tem	−2.511 ***	−2.777 *	−3.925 ***	−3.782 ***

Note: *t*-bar statistics *** denotes significance at the 1% level, ** at the 5% level and * at the 10% level. Lags included in each individual regression calculated with an iterative process from 0 to 4 based on F joint test. The truncated version of the test is applied limiting the excessive influence of extreme values.

Finally, in order to test for the existence of a structural long-run relationship among the series, the Westerlund co-integration test [57] was implemented, which can accommodate cross-sectional dependence through bootstrapping. In this study, 200 replications were made. This test calculates four statistics. Two of them (Gt and Ga) test if co-integration exists for at least one individual. The other two statistics (Pt and Pa) test if co-integration exists for the whole panel. The null hypothesis of these tests is no co-integration. Table 5 shows the Westerlund tests results. As can be observed, the null hypothesis of no co-integration cannot be rejected for three of the four statistics.

Table 5. Westerlund co-integration tests.

Dependent Variable	Independent Variables	Co-Integration Tests			
		Gt	Ga	Pt	Ga
E	Y, Y^2, Y^3, C	−1.487	−4.134	−9.331	−3.989

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. *** denotes significance at the 1% level, ** at the 5% level and * at the 10% level.

The previous test results suggest that it is adequate to estimate the model by using first-differences. Using Δ to indicate the first differences, Equation (3) may be rewritten as follows,

$$\Delta\overline{E}_{it} = \Delta\overline{A}_{it} + \beta_1\Delta_1\overline{Y}_{it} + \beta_2\Delta\overline{T}_{it} + \beta_3\Delta\overline{T}^2_{it} + \beta_4\Delta\overline{tem}_{it} + e_{it} \quad (4)$$

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

In order to determine the estimated model, the Wooldridge test for autocorrelation [58] and the Wald test for homoscedasticity [59] were also performed. According to the test results, the feasible generalized least squares model (FGLS) was used to estimate (4). The statistical software *Stata 13* was used to perform all tests and estimates.

Once Equation (4) is estimated, the β coefficients obtained may inform about the relationships between the electricity and tourism variable. If β_2 and β_3 coefficients are positive, then an increasing relationship exists between E and T. Nevertheless, if $\beta_2 > 0$ and $\beta_3 < 0$, then the Energy-Tourism Kuznets Curve hypothesis is supported, and increasing T will reduce E from a threshold level. Likewise, if $\beta_2 > 0$ and $\beta_3 = 0$, a positive linear relationship will exist.

The estimate results also allows us to calculate the per capita hospitality sector electricity consumption elasticity values with respect to tourist overnight stays for each Spanish province and year. It may be obtained as follows:

$$ela_{it} = \beta_2 + 2\beta_3\overline{T}_{it} \quad (5)$$

Therefore, these elasticity values measure the electricity consumption sensitivity of the hospitality sector with respect to the tourism growth for each province and year.

3. Results and Discussion

Table 6 shows the results of estimating Equation (4) to test the Energy-Tourism Kuznets Curve hypothesis for the hospitality sector electricity consumption in the Spanish provinces from 1999 to 2013. The feasible generalized least squares method is used. Column (a) shows the estimate results when the average annual temperature is used to measure the climate effect on the electricity consumption. Alternatively, columns (b) and (c) show the estimate results when the *absolute* variable or no climatic variable are included in the model.

Table 6. Estimate results of Equation (4).

Independent Variables	GLS Equation (4) (Average Temperature) (a)	GLS Equation (4) (Absolute Temperature) (b)	GLS Equation (4) (No Climatic Variable) (c)
Y	0.688 *** (0.164)	0.705 *** (0.161)	0.711 *** (0.160)
T	0.203 *** (0.038)	0.202 *** (0.037)	0.201 *** (0.037)
T^2	0.050 * (0.029)	0.054 * (0.029)	0.052 * (0.029)
Tem/abs	0.008 (0.006)	0.002 (0.004)	-

Note: Standard errors are shown in parenthesis, *** denotes significance at the 1% level, ** at the 5% level and * at the 10% level. All estimates include time dummies.

Column (a) shows that β_1 coefficient associated with the GDP per capita (Y) is positive and significant with a value equal to 0.688. Therefore, the hospitality sector electricity consumption elasticity with respect to GDP per capita is positive in the central point of the sample, meaning that increases in GDP per capita increase the hospitality sector electricity consumption. This positive value may be related to the fact that the hospitality sector includes the *Accommodation* and *Food and beverage service activities* subsectors, the latter probably being more linked to the province GDP per capita than the first.

Column (a) also shows that β_2 and β_3 coefficients, those associated with the tourist variables, are both positive and significant. Therefore, the Energy-Tourism Kuznets Curve hypothesis is refused, as an increasing relationship between the hospitality sector electricity consumption and overnight stays is supported, with no turning point observed. Therefore, as tourist overnight stays increase the electricity consumption in the hospitality sector increases. This result is important for environmental reasons, especially in Spain, as an increase of tourist visitors, which is happening in Spain [41], will mean a continued increase in electricity consumption. Therefore, some policy measures will be needed in order to control these increases in electricity use. In this regard, energy efficiency measures are recommended. Measures to improve efficiency in buildings related to the hospitality sector may be relevant, as hotels tend to use much more energy than buildings in other economic sectors. Thus, Sozer [32] finds that an efficient building may use 40.1% less energy than a conventional hotel in Turkey. Likewise, other studies show the notable savings that may be achieved by introducing efficiency measures. For example, AlFaris et al. [60] find that using integrated control methodology to optimize energy performance for the guest rooms can reduce total energy consumption by up to 31.5%. In addition, the promotion of technical systems for the use of solar energy may be convenient, especially in tourist areas associated with sun and beach tourism. Moià-Pol et al. [61] find that collective systems can reduce CO_2 emissions by about 60% using only solar thermal systems at Palma Beach, the area in the Balearic Islands with most tourism. In addition, Gallo et al. [62] show that it is possible to supply 50% of total energy with PV panels in Spanish and Italian hotels. Likewise, as stated in Pace [31], policy measures should also promote the development of energy management capabilities.

Finally, column (a) also shows that the temperature variable is positive but not significant. Therefore, Equation (4) was also tested using the *absolute* and no climatic variable. Columns (b) and (c) report the results of these estimates. As shown in column (b), the coefficients for the *absolute* variable are positive but also non-significant. However, the use of this climatic variable instead of the average temperature does not change the estimate values for the rest of the variables, which are very similar to previous estimate values. Likewise, as shown in column (c), eliminating the climatic variable for the estimate does not affect the value and significance of the rest of the variables included in the model. It is worth noting that Equation (4) is defined in first differences, so the constants effects are eliminated. In that regard, although temperature or climatic circumstances may affect electricity consumption, the changing of the temperatures through this period may not be so significant as to impact the electricity use.

From the estimate results, the hospitality sector electricity consumption elasticity, with respect to the tourism variable, may be calculated according to Equation (5). Therefore, elasticity values for each province and year were calculated as follows:

$$ela_{it} = 0.20 + 2 * 0.05 * \overline{T}_{it} \quad (6)$$

Figure 1 shows the evolution of the hospitality sector electricity consumption elasticity with respect to tourist overnight stays in per capita terms by Spanish provinces. These elasticity values are not constant over the analyzed period. The black line represents the elasticity median spline trend. It grows from 2000 until the beginning of the financial crisis. From 2007, the trend is slightly decreasing. Figure 1 also shows the elasticity trends for those provinces with higher and lower elasticity values during the period. Figure 1 shows notable differences among these provinces, the elasticity value difference being around 0.4 percentage points. Provinces with higher elasticity values are the Balearic Islands, Tenerife and Las Palmas in the Canary Islands, Gerona and Tarragona in the Catalonia region and Malaga in Andalusia. Provinces with lower elasticity values are Jaen, Badajoz, Ciudad Real and Biscay. The increasing trend through the latter years for Las Palmas and Tenerife, and through the whole period for Biscay may be noted.

It may be highlighted that higher elasticity values are observed for the provinces with more tourism. Therefore, it may be adequate to diversify the tourism supply in other provinces, in such a way that the provinces with less tourism can be made more attractive for visitors. Thus, a displacement of tourists from provinces with a greater number of visitors to provinces with a low tourism level can be beneficial in order to reduce the electricity consumption in Spain. In that regard, it could be said that high tourist concentrations negatively affect sustainability.

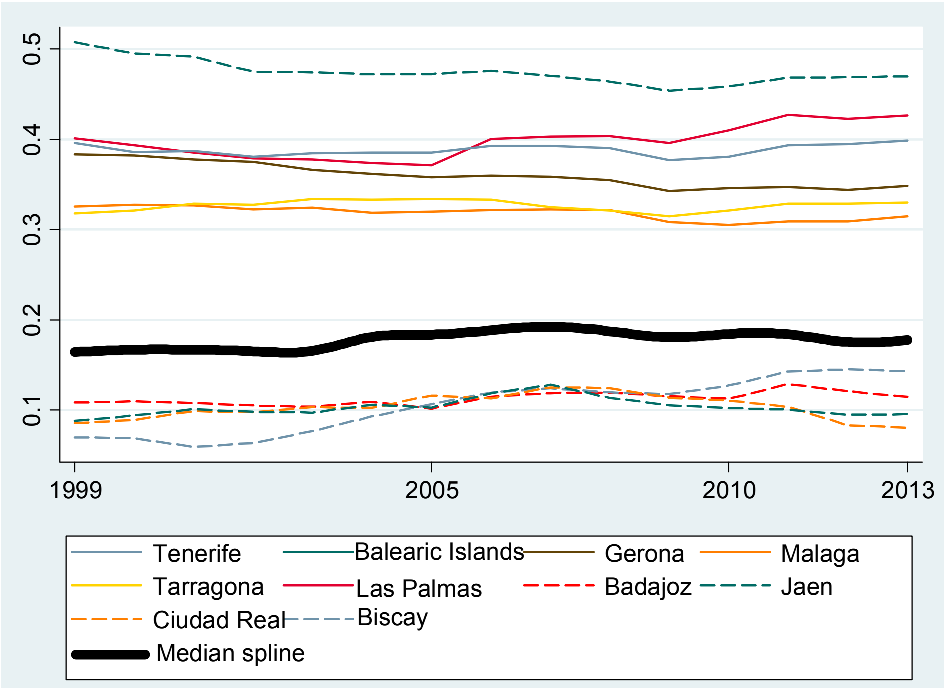

Figure 1. Hospitality sector electricity consumption elasticity with respect to tourist overnight stays by Spanish provinces.

4. Conclusions

At the Paris Conference of the Parties (COP21) in 2015, 195 countries agreed to strengthen the global response to the threat of climate change. Along this line, the EU is committed to a 40% reduction in their domestic greenhouse gas emissions by 2030. This new target represents a significant progression beyond its existing 20% emission reduction commitment by 2020. Thus, greater efforts will be needed affecting all productive sectors in order to reduce CO_2 emissions and energy consumption.

Following the previous literature focused on the sectoral analysis of the relationships between energy consumption and economic growth, this paper focuses on the tourism sector. By using econometric panel data techniques, the relationships between tourist overnight stays (as a measure of tourism earnings) and the hospitality sector electricity consumption is studied for the Spanish provinces during the period 1999–2013. In doing so, an Energy-Tourism Kuznets Curve hypothesis, similar to an Environmental Kuznets Curve, is tested. The Energy-Tourism Kuznets Curve hypothesis would state that there is a growing relationship between tourism growth and energy (electricity) consumption until some turning point from which a decreasing relationship is observed. In order to test this hypothesis, the tourism variable is also considered in squared terms.

The results show that the Energy-Tourism Kuznets Curve hypothesis is not supported. Instead, an increasing relationship between the hospitality sector electricity consumption and overnight stays is supported. Therefore, as tourist overnight stays increase the electricity consumption in the hospitality sector increases. This result is especially important in Spain because of the continuously growing number of tourists. Therefore, increases in the hospitality sector electricity consumption would be expected if no environmental measures are adopted. Consequently, promotion of energy efficiency measures, the adoption of renewable energy systems and the development of energy management capabilities may be recommended.

The results also show differences among the Spanish provinces. Hospitality sector's electricity consumption elasticity values with respect to tourist overnight stays differ among the provinces, the values being within a range of 0.1–0.5. The highest values are observed for the Balearic Islands, the Canary Islands, Gerona, Tarragona and Malaga.

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