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The role of tourism growth in generating additional energy consumption: empirical evidence from major tourist destinations

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Abstract
This study investigates the role of tourism growth in generating additional energy consumption in the case of major tourist countries. Panel data that range from 1995 to 2014 have thus been constructed. Significant results of this study confirm long term economic effects of tourism growth in energy usage in tourist destinations; tourism exerts positively significant but inelastic effects on the overall energy consumption. Finally, this study finds that changes in exchange rates cause changes in tourism and changes in tourism cause significant changes in energy consumption in the same direction; therefore, it is proposed that tourism sector acts as a successful mediator between exchange rate changes and energy consumption which is an essential policy concern for countries heavily depending on foreign energy imports.

Keywords Energy consumption · Exchange rates · Tourism · Urbanization

1 Introduction

Energy is an indispensable element of modern life and one of the crucial factors for the advancement of global economies. Limited resources of energy production and wasteful energy consumption are severe concerns on achieving sustainable standards of living. It is recently reported that the growth rate of the global economy

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has doubled; therefore, energy consumption has increased by 30%, and the overall energy consumption is expected to rise at a fast pace (BP Energy Outlook 2017). Since energy usage is at the core of the production of goods and services, experiencing a global energy shortage would severely disrupt the economic development of nations worldwide. Apart from that, energy usage has environmental implications as well. Although energy alternatives such as renewables have been encouraged in the last decade, oil and coal remain the dominant sources of energy (World Energy Outlook 2017; Sodeyfi and Katircioglu 2016). Relying on energy use with a substantial amount of fossil fuel has often been shown as one of the reasons for environmental degradation (Mukhopadhyay and Forssell 2005; Bölük and Mert 2014). Hence, driving factors for energy consumption is an important study area for researchers. There has been tremendous attention in investigating the determinants of energy consumption among the energy economics literature with this respect (Tiba and Omri 2017). It can be observed that the vast majority of the studies in this area have focused on the relationship between energy consumption and economic growth. Many studies confirmed that real income is the primary driver of energy consumption.

However, there are still further research opportunities in the relevant literature to study driving forces for energy consumption. To the best of our knowledge, there are limited numbers of studies focusing on sectoral roles or effects on energy consumption in the countries. It has been pointed out that by holding into the theoretical nature of the energy-income nexus, constructing multivariate models with relevant economic aggregates would provide a better understanding of the relationship (Karanfil 2009). In this context; for example, foreign exchange and urbanization are essential factors in driving energy consumption (Liu 2009; Chiou-Wei et al. 2016). Changes in foreign exchange rates are essential not only for energy-importing countries but also for energy-exporting countries due to their significant role in international prices (Sodeyfi and Katircioglu 2016). An increase in exchange rates (depreciation of domestic currency) means inflation and deterioration in the other macroeconomic balances in energy import depending countries (Al-Abdulhadi 2014; Anoruo and Elike 2009). Therefore, exchange rates are of fundamental importance for the trading activities of a nation (Ćorić and Pugh 2010; Mukherjee and Pozo 2011). Furthermore, energy commodity prices such as natural gas and coal are also likely to be affected by exchange rate volatilities which in turn could affect the energy industry of the local markets (Yu and Mallory 2014).

Urbanization is another driving force behind energy consumption that can have significant implications with the level of energy use. The process of shifting from rural areas to the crowded cities may generate significant changes in energy consumption. Urbanization can lead to increases in energy use through different channels such as increased use of transportation, a higher volume of goods and services or higher household density in city areas (Katircioglu and Katircioglu 2018; Katircioglu et al. 2018b). In countries where efficient management of the urban population is achieved, urbanization might reduce the overall level of energy use (Poumanyvong and Kaneko 2010; O'Neill et al. 2012). Furthermore, a unique number of studies have started to focus on sectoral economic effects and their relevance as determinants of energy consumption (Sadorsky 2010, 2011; Topcu and Payne 2017). For example, international tourism is one of the significant sources of income in the countries as proved in the literature (Katircioglu 2009a, b, c, 2010; Gunduz and Hatemi-J 2005; Balaguer and Cantavella-Jorda 2002). By its ability to create export revenues through foreign exchange income, international tourism can aid economies in offsetting current account deficits, financing industrial production, and generating employment. Besides that, tourism is an energy-demanding sector as the needs such as transportation and accommodation are highly associated with energy consumption as again documented in the literature (Katircioglu et al. 2014; Katircioglu 2014). Hence, tourism stands as an essential sector to be investigated in terms of its role as a determinant of energy consumption. The majority of the tourism-related energy studies target to estimate total energy consumption and energy consumption patterns across various sub-sectors of the tourism sector while there is still a gap at the macro-level (Katircioglu et al. 2018a, 2019).

This study aims to present new evidence to the empirical literature by searching the role of tourism in generating additional energy consumption in the selected major tourist destination countries. Although similar empirical studies attempted to resolve the determinants of energy consumption, the examination of tourism has been highly ignored. To the authors' best knowledge, the role of tourism on energy use has not yet been examined in a panel setting until the moment. In this study, econometric panel procedures are applied for the case of top tourism destination countries. Given that the selected sample contains both developed and developing countries, it is believed that the results will provide an informative perspective in terms of energy conservation capabilities for all tourism-oriented countries around the world. Furthermore, selecting major tourist countries would provide important implications for policymakers.

The rest of the paper is organized as follows; a review of the literature, elaboration on the methodological process and data, empirical results, and conclusion.

2 Literature review

Energy economics literature contains an impressive number of studies that discuss the energy-economic growth nexus. Following the introduction by the study of Kraft and Kraft (1978), the relationship between energy consumption and economic growth has got much attention. Kraft and Kraft (1978) found that economic growth is the primary driver of energy consumption and there is a unidirectional causality running from economic growth to energy consumption. This finding implies that energy conservation policies will have a minor or no adverse effect on economic growth. This phenomenon is referred to conservation hypothesis. The conservation hypothesis has been confirmed by many other studies (Abosedra and Baghestani 1989; Lotfalipour et al. 2010). However, there are significant numbers of studies that provide conflicted outcomes with that of the conservation hypothesis. In this context, three additional hypotheses have been put forward to explain the energy-economic growth nexus. The first one is the growth hypothesis, which suggests that energy use is a determinant of economic growth, and energy conservation policies will result in deterioration of economic growth. A finding of a unidirectional causality running from energy consumption to economic growth supports this hypothesis

(Soytas et al. 2001; Lee and Chang 2005; Say and Yucel 2006; Chontanawat et al. 2008; Payne 2009; Wang et al. 2011). Next is the feedback hypothesis which argues that energy consumption and economic growth are interrelated and are represented by a two-way causal relationship (Yoo 2005; Odhiambo 2009; Apergis and Payne 2010; Tiwari 2011; Mohammadi and Parvaresh 2014). According to this hypothesis, energy conservation policies are likely to cause economic disruption, and changes in economic growth are expected to alter the level of energy consumption. At last, the neutrality hypothesis denies the existence of a relationship between energy consumption and economic growth. Nonexistence of a causal relationship between energy consumption and economic growth is supported by some studies as well (Eden and Jin 1992; Altinay and Karagol 2004; Yildirim and Aslan 2012; Smiech and Papiez 2014).

Investigation of a possible economic stimulation through tourism has garnered significant attention in the past decade, and the relationship between economic growth and tourism has been discussed under the tourism-led growth hypothesis (TLGH). According to that, international tourism activities can generate foreign exchange earnings, which aid in overcoming current account deficits and lead to economic growth (Oh 2005; Katircioglu 2009a, b, c). Moreover, as the tourism sector is capable of generating skilled labor, it can create employment for the local markets (Blake et al. 2006). TLGH has been subject to numerous empirical studies. The study of Balaguer and Cantavella-Jorda (2002) was the first empirical investigation for the hypothesis. Taking Spain as their sample, the authors provided evidence for a positive and significant long-run impact of the tourism sector on economic growth. Gunduz and Hatemi-J (2005) also confirmed the TLGH for the case of Turkey based on their leveraged bootstrap causality analysis. They showed unidirectional causality running from tourism to economic growth. Many other empirical studies supported the TLGH for a variety of different countries and regions. Studies of Belloumi (2010), Katircioglu (2010), Katircioglu (2011), Kreishan (2011) and Jackman (2012) are some of the researches that confirmed tourism as a factor to stimulate economic growth.

On the contrary to the given empirical link between tourism and economic growth, a group of studies provided conflicting results. For the case of Cyprus, for instance, Katircioglu (2009a, b, c) has found a long-run equilibrium between tourism and economic growth with an inverse directional relationship to the TLGH. So it was the economic growth which leads to tourism development and not vice versa. This phenomenon is called as output-driven tourism hypothesis, and it is supported by several other studies (Narayan 2004; Payne and Mervar 2010; He and Zheng 2011; Odhiambo 2011; Wang and Xia 2013). Empirical evidence of some studies has concluded that both TLGH and output-driven tourism hypothesis hold as the causal linkage between the tourism sector and economic growth is bi-directional. Investigating the case of Spain, Nowak et al. (2007) demonstrated that international tourism activities lead to economic stimulation through financing the imports of capital goods and at the same time, economic expansion promotes tourism in the country. For the case of Turkey, Demiroz and Ongan (2005), Othman et al. (2012) revealed bi-directional causality, and their results were supportive of both TLGH and output-driven tourism hypothesis. Such a two-way directional causal relationship has also determined for numerous other case studies (Katircioglu 2009b; Ghartey 2013; Kareem 2013; Massidda and Mattana 2013). Despite the number of studies that put evidence for the significance of tourism on economic growth, some have failed to prove the TLGH. Based on the applications of the ARDL approach, Katircioglu (2009c) has rejected the TLGH for the Turkish market as the long-run equilibrium results were insignificant between the variables of international tourism and economic growth. Moreover, Jackman and Lorde (2010), Kasimati (2011) and Georgantopoulos (2013) have also denied the existence of the TLGH.

The energy-intensive nature of the tourism sector makes it critical to understand the impact of tourism on energy use. In this regard, several numbers of studies centered on the comparison between divisions of the tourism sector in terms of their energy consumption and energy efficiency implications. For instance, Becken et al. (2001) examined the accommodation sector of the tourism industry in order to reveal its energy consumption patterns and its significance on the level of energy use. In the study, the accommodation sector has found to be energy efficient as its contribution to energy consumption is not substantial among the commercial market of New Zealand. By categorizing the functions of tourism into different sub-sectors as transportation, accommodation, and attraction/activities, Becken et al. (2003) investigated the association of tourism activities with energy use. Their analyses pointed on transportation as the most energy-intense sector, and the high energy consumption of tourist activities is based mainly on motorized transportation in the case of New Zealand. In addition to the given examples, more studies have explored sub-sectors of tourism on energy use (Gössling 2000, 2002; Becken and Simmons 2002; Warnken et al. 2004; Kumar 2005; Nepal 2008; Tsagarakis et al. 2011). Although some studies focus on the interactions between energy consumption and sub-sectors of tourism, there are only a handful of studies that investigate tourism as a determinant of energy consumption at the macro level. Katircioglu et al. (2014) studied tourism-induced energy consumption in the case of Cyprus. Their outcome revealed a long-run equilibrium relationship between international tourism, energy consumption, and carbon dioxide (CO_2) emissions and Granger causality results presented a unidirectional causality running from tourism to energy consumption. In a panel sample of the top ten tourism destination countries, Ben Jebli and Hadhri (2018) examined the causal links between CO_2 emissions from transport, real GDP, energy use, and international tourism. They documented a bi-directional causal relationship between international tourism and energy use.

Urbanization is one of the variables whose effect on energy consumption has been investigated widely. For instance, investigating the relationship between urbanization and energy consumption in China, Liu (2009) showed the existence of a long-run equilibrium relationship among energy consumption, gross domestic product (GDP), and urbanization. The study further indicated that among all the variables, there is only a unidirectional causality exists running from urbanization to energy consumption in both the short and long-term. Li and Lin (2015) investigated the impact of urbanization in an econometric panel setting, which contains three different income country groups. The dynamic threshold regression estimations showed that urbanization reduces the energy consumption in low-income countries, increases for the middle-income countries and does not have any impact on the high-income countries. Although many studies provided evidence for the significant positive effect of urbanization on energy consumption, some studies produced mixed empirical results depending on country characteristics (Hossain 2012). Also, various studies are devoted to investigating the interactions between exchange rate fluctuations and the level of energy use as they are the significant determinants of energy trade markets. For example, employing a bi-variate exponential GARCH model on a sample of Asia Pacific countries, Chiou-Wei (2016) found that economic uncertainties originated from exchange rate volatilities make a negative effect on energy consumption. Examining the interactions between energy consumption and imports for the case of Turkey, Katircioglu et al. (2017) demonstrated that in the long run, there is unidirectional causality from energy consumption to real exchange rate prices. In another study, causal relationships produced from a dynamic panel sample of 65 countries found no linkages between exchange rate and energy consumption (Omri and Kahouli 2014).

3 Methodology

3.1 Theoretical setting

As it is previously discussed, investigating the sectoral effects can make significant contributions to understanding energy consumption determinants. The theoretical setting of the present study is based on the argument that tourism development might be one of the determinants of energy consumption. By studying the comprehensive background on the subject of energy consumption determinants into account, the impacts of GDP, exchange rate, and urbanization should also be examined alongside tourism. Thus, the following functional relationship is proposed as follows:

$$ENUSE_t = f(GDP_t^{\alpha_1}, EXR_t^{\alpha_2}, URB_t^{\alpha_3}, TP_t^{\alpha_4}) \quad (1)$$

where ENUSE is the level of energy consumption, GDP is the gross domestic product, EXR is inflation-adjusted exchange rate, URB is urbanization, and TP represents tourism development proxy.

3.2 Data

The annual data set used in the present study covers the periods 1995–2014. Based on the country rankings of the World Tourism Organization of the United Nations (UNWTO 2017), the data for the World's top tourism destination countries are collected under the panel setting.[1] The variables of the study are energy consumption (lnENUSE) (kg of oil equivalent per capita), GDP (lnGDP) (constant USD, 2010),

[1] According to UNWTO (2017), top ten tourism destination countries are listed as; Turkey, Thailand, Mexico, Germany, United Kingdom, Italy, China, Spain, United States and France. The sample used in this study contains all of the given countries except for China. China had to be excluded from the sample due to the unavailability of data.

urban population (lnURB) and tourism development proxies (TP). In parallel to suggestions from literature studies (Katircioglu 2009a, b, c), Eq. (1) will be estimated under four different model options with alternative tourism proxies which are (1) international tourist arrivals (TA), (2) international tourism receipts (TR) (2010 = 100 in USD), (3) international tourism expenditures (TE) (2010 = 100 in USD), and composite tourism index (TI).

Tourism receipts, tourist arrivals, and tourism expenditures are used interchangeably in the relevant literature to assess tourism development in an econometric framework (Munandar 2017). A possible downside of selecting only one of the mentioned variables as the proxy of tourism development is failing to capture the full extent of the sector. On the other hand, applying all of the variables in a single model would create redundancy of information due to close interrelations between the tourism development indicators. Therefore, the current study employs principal component factor analysis to produce a composite tourism development index (see Katircioglu et al. 2018c). The following functional relationship can define composite tourism development (TD):

$$\mathrm{TD} = \mathrm{f}\,(\mathrm{TA},\ \mathrm{TE},\ \mathrm{TR}) \tag{2}$$

By transforming several correlated variables into their principal components, while maintaining the majority of the variability in the data, the principal component analysis allows us to generate a smaller number of uncorrelated variables (see Feridun and Sezgin 2008 and Katircioglu and Taspinar 2017). The extracted factors from the principal component analysis are applied to compose an overall score or composite tourism development index based on the following equation:

$$TD\ \mathrm{Index} = \sum_{\mathrm{i=1}}^{\mathrm{n}} \mathrm{w_i} \times FS_i \tag{3}$$

where w_i is the weight or ratio of variation identified by each tourism variable divided by the variation identified by all tourism variables, and FS_i is the associated factor score of each tourism variable. The extraction of w_i, is expressed as follows:

$$w_i = \left(\frac{\sigma_i}{\sum_{i=1}^{n} \sigma_i} \right) \times 100 \tag{4}$$

where w_i is the weight of each ith factor for the tourism variable, σ_i is the variance defined by each ith factor, and n is the number of factors (see also Chen 2010).

All series in this study are accessed through Worldbank (2018) and converted into logarithmic forms to capture growth effects (Katircioglu 2010).

3.3 Cross-sectional dependence

Due to the possibility of having common factors across the studied panel, our empirical investigation starts with the preliminary diagnostic checking for cross-sectional dependence. Although it can be expected for major tourist destinations to share some specific characteristics, countries under examination differ from each other in terms of their macroeconomic structures. Hence, it is also safe to assume that the disturbances for the panel are cross-sectionally independent. Since ignoring cross-sectional dependency across the panel might lead to a spurious empirical outcome, a bias-adjusted version of Breusch and Pagan (1980) Lagrange Multiplier (LM) cross-section independence test is applied in this study. In their proposition of the test, Pesaran et al. (2008) documented that the bias-adjusted LM test performs actively in controlling the size of the panels while keeping the power at a satisfactory level with exogenous regressors and standard errors.

3.4 Panel unit root tests

To specify stationarity characteristics, Im et al. (IPS) (2003), Choi (2001) and Harris and Tzavalis (HT) (1999) unit root tests are employed for the series under examination. By following asymptotic distribution properties, many unit root tests assume that the time dimension, T, tends to infinity. This happening can lead to incorrect decisions about the integration orders of the series in small datasets. Harris and Tzavalis (1999) offered a unit root test, which assumes that the T is fixed. Computation of the HT test statistic is based on an Ordinary Least Square (OLS) estimator, α, which can be written in the regression model:

$$y_{it} = \alpha y_{i,t-1} + g_{it}'\theta_i + \varepsilon_{it} \tag{5}$$

where $g_{it}'\theta_i$ shows that panel-specific means and trends are allowed in the given equation. HT test assumes that the tested cross-sections contain a common autoregressive parameter and therefore, it tests the existence of unit roots under the null hypothesis against the alternative hypothesis that suggests all panels are stationary.

Unlike several approaches that consider a common autoregressive parameter for an entire panel to be tested, IPS (2003) unit root testing procedure follows a more relaxed assumption. The test applies an Augmented Dickey-Fuller (ADF) test to each cross-section under the panel and computes an overall t statistics based on the average t-stats of the separate cross-sections.

$$\Delta z_{it} = \pi z_{it-1} \sum_{k=1}^{\alpha_i} \beta_{ik} \Delta y_{it-k} + X_{it}'\partial + \varepsilon_{it} \tag{6}$$

In the ADF equation given above, the term π represents the autoregressive coefficient that can vary freely across cross-sections. IPS (2003) tests the null hypothesis, which states all panels contain a unit root against the alternative hypothesis that states some panels are stationary.

Although the IPS (2003) test allows heterogeneity across units, its critical values are sensitive to the requirement of choosing a different lag length in individual ADF regressions. Maddala and Wu (1999) and Choi (2001) proposed an ADF based non-parametric unit root test, which utilizes the heterogeneity across panels under the Fisher approach. In order to generate an overall test value, Choi's (2001) unit root test combines p-values of the t-statistics in each cross-sectional unit. The panel test statistics of Choi (2001) is written as:

$$Z^C = N^{-\frac{1}{2}} \sum_{i=1}^{N} \tau^{-1}(p_i) \tag{7}$$

where τ^{-1} is the inverse of the standard normal cumulative distribution function, and p_i represents the p-value. All individual cross-sections are tested for non-stationarity under the null hypothesis against the alternative hypothesis, which states at least one series is stationary.

3.5 Panel cointegration tests

Following the identification of integration properties, cointegration relationships among the series are examined. Pedroni (1999, 2004) proposed a heterogeneous cointegration test which can be performed by the following equation:

$$Y_{it} = \beta_i + \vartheta_i t + \mu_{1i} EN_{it} + \mu_{2i} GDP_{it} + \mu_{3i} EXR_{it} + \mu_{4i} URBAN_{it} + \mu_{1i} TAR_{it} + \varepsilon_{it} \tag{8}$$

where i = 1, …, N for every cross-section in the panel and t = 1, …, T is the sample period. The parameter β_i allows for cross-section fixed effects, and the term ϑ lets deterministic trends to be identified. The null hypothesis of ρ = 1, no cointegration, is tested by conducting the following unit root test on the residuals:

$$\varepsilon_{it} =_i \varepsilon_{it-1} + q_{it} \tag{9}$$

The cointegration test of Pedroni (1999, 2004) presents several test statistics that are generated by averaging the individual autoregressive coefficients of the residuals for every cross-sectional unit across the panel. The test statistics are grouped into "within" (panel-v, panel-rho, panel-PP, and panel-ADF) and "between" (group-rho, group-PP, and group-ADF) dimensions.

Johansen-type Maddala and Wu (1999) cointegration tests are also applied in this study. Following Fisher's (1932) approach, the test combines individual test statistics from all cross-sections and generate new statistics for the entire panel. Under the null hypothesis of "no cointegration" Johansen-type cointegration test is performed by generating trace and maximum eigenvalue statistics.

3.6 The ARDL approach

In order to generate the short and long-term coefficients of the variables among energy consumption, Pesaran et al. (1999) Autoregressive Distributed Lag-Panel Mean Group (ARDL-PMG) approach is employed. By identifying the long and short-term relationships, the ARDL model categorizes all the coefficients under an error correction model (ECM). An essential advantage of this methodology is to eliminate the issues based on endogeneity by allowing lag length for both endogenous and exogenous variables. Furthermore, the ARDL approach can be applied without necessitating a particular integration order of the variables. Unless the variables under a model are integrated with order 2 (I(2)), the test can be applied to whether I(1) or jointly integrated I(0) and I(1) variables. According to Pesaran et al. (1999), the long-term relationship between a given set of variables can be defined by the following equation:

$$\Delta Y_{1,it} = \beta_{li} + \varphi_{li} Y_{1,it-1} + \sum_{l=2}^{k} \varphi_{li} X_{1,it-1} + \sum_{j-1}^{p-1} \lambda_{1ij} \Delta Y_{1,it-j} + \sum_{j=0}^{q-1} \sum_{l=2}^{k} \lambda_{lij} \Delta X_{1,it-j} + \varepsilon_{1,it} \tag{10}$$

where Y represents the dependent variable while X is the exogenous variable with l = 1,2,…, Z. ε_{it} is the error term and the symbol Δ used as the operator for the first difference. Also, the dynamic short-term relationship under an ECM can be written as follows:

$$\Delta Y_{1.it} = \beta_{li} + \sum_{j=1}^{p-1} \alpha_{1ij} \Delta Y_{1,it-j} + \sum_{j=0}^{q-1} \sum_{l=2}^{k} \alpha_{lij} \Delta X_{1,it-j} + \theta_{li} ECT_{1,it-1} + \varepsilon_{lit} \tag{11}$$

where the parameter gives the speed of adjustment to the equilibrium level, the θ_{li} estimators of the ARDL model are obtained by employing the PMG methodology of Pesaran et al. (1999). As the authors demonstrate, the PMG procedure is entirely consistent since it is a maximum likelihood method that takes individual characteristics (such as countries) into account.

3.7 Panel causality test

After obtaining short and long-term coefficients, directional relationships between the variables are determined by employing Dumitrescu and Hurlin (DH) (2012) causality test. Unlike the standard panel Granger causality test, the DH test takes heterogeneity into account among the cross-sections. The homogeneous condition between the two variables will lead to nonsensical interpretation if at least one unit from the sample has a parameter different from the others. Hence, Dumitrescu and Hurlin (2012) propose the null hypothesis of homogeneous non-causality, which is defined as:

$$H_0 : \gamma_i = 0 \mu i = 1, \ldots, N \tag{12}$$

where N represents a set of countries and γ_i represents individual vectors among the panel with $\gamma_i = \left(\gamma_i^{(1)}, \ldots, \gamma_i^{(K)}\right)$. The given null hypothesis states that there exists no causal relationship from the variable X to Y. Under the alternative hypothesis, authors present a less strong assumption by allowing for some, but not all, of the singular vectors, γ_i to be equal to 0.

$$H_1 : \gamma_i = 0 \mu i = 1, \ldots, N_1$$

$$\gamma_i \neq 0 \mu i = N_1 + 1, N_1 + 2, \ldots, N \tag{13}$$

Table 1 Bias-adjusted LM test of cross-section independence

Model	LM_{adj} statistic	p-value
EN = (GDP,EXC,URB,TA)	− 0.842	0.399
EN = (GDP,EXC,URB,TE)	− 1.018	0.309
EN = (GDP,EXC,URB,TR)	− 0.630	0.530
EN = (GDP,EXC,URB,TI)	− 0.679	0.497

Rejection of the null hypothesis implies for a causal relationship for all individuals of the panel under the setting that estimators of the parameters can be different across the panel (heterogeneous regression model).

4 Empirical results

Table 1 presents the results of the bias-adjusted LM test. Under the null hypothesis of cross-sectional independence, generated t-statistics reject this hypothesis and suggest there is no dependency across panels for the case of four models tested. This finding implies that series under consideration are not interrelated across countries.

In the next stage, panel unit root tests proposed by Harris-Tzavalis (1999), (Im et al. 2003), Maddala and Wu (1999), and Choi (2001) are employed to check stationarity and integration orders of variables. Table 2 documents the estimated results of these tests. According to Harris-Tzavalis and IPS tests, the null hypothesis of unit root existence cannot be rejected at the level for any of the variables except the exchange rate. Both tests confirm that the exchange rate variable is stationary at the level, which means the variable is integrated at order zero (I(0)). In addition to the exchange rate, Fisher type unit root test confirms the stationarity for TEXP, INDEX, TAR, and TR variables at their levels. The second panel of Table 2 shows the unit root estimations at first differences. Here it is reported that the variables are stationary at a one percent significance level.

In order to search for the long-run relationship between the variables for each given model, Pedroni and Johansen Fisher-type cointegration tests are employed. The estimations of the Pedroni cointegration test can be seen in Table 3 which reports within dimensions (panel-v, panel-PP, and panel-ADF) and between dimensions (Group-PP and Group-ADF) and reveal that the associated test statistics are statistically significant. This finding indicates the existence of a cointegration relationship among energy consumption, GDP, exchange rate, urbanization, and tourism proxies. Results of the Johansen Fisher-type cointegration test are reported in Table 4, which supports the long-run relationship in Eq. (1) of this study. According to the computed trace and maximum eigenvalue statistics, the null hypothesis of no cointegration can be rejected at a one percent significance level for all four models.

Once the cointegration has been obtained in Eq. (1), then long-run elasticity coefficients of GDP, exchange rate, urbanization, and tourism proxies concerning energy consumption are estimated by adapting panel ARDL methodology. Including the constructed tourism development index, tourism proxy variables have been added under a separate model to avoid a possible multicollinearity problem. Long-run and

Table 2 Panel unit root tests

	EN	GDP	EXC	URB	TE	TI	TA	TR
Levels								
Harris–Tzavalis	3.038	2.750	− 4.212[a]	3.260	0.854	0.859	2.266	− 0.571
Im–Pesaran–Shin	− 0.291	− 1.611	− 2.119[b]	0.648	− 1.719	− 1.569	− 0.877	− 1.621
Choi Fisher-type	− 0.420	− 0.723	− 4.128[a]	− 0.555	− 4.577[a]	− 3.954[a]	− 1.453[c]	− 5.221[a]
First difference								
Harris–Tzavalis	− 16.096[a]	− 12.734[a]	− 21.012[a]	− 10.815[a]	− 12.638[a]	0.264[a]	− 19.122[a]	− 11.546[a]
Im–Pesaran–Shin	− 4.516[a]	− 2.868[a]	− 4.264[a]	− 2.208[a]	− 3.461[a]	− 3.929[a]	− 3.787[a]	− 3.479[a]
Choi Fisher-type	− 4.998[a]	− 6.534[a]	− 6.623[a]	− 5.857[a]	− 7.256[a]	− 6.472[a]	− 8.041[a]	− 6.003[a]

The selection of lag lengths is determined based on the Schwarz Information Criterion

[a], [b] and [c] denote rejection of the null hypothesis at the 1%, 5%, and 10% levels respectively

Table 3 Pedroni panel cointegration test

	Model 1 EN = (GDP,EXC,URB,TA)		Model 2 EN = (GDP,EXC,URB,TE)		Model 3 EN = (GDP,EXC,URB,TR)		Model 4 EN = (GDP,EXC,URB,TI)	
	Intercept	Intercept and trend	Intercept	Intercept and trend	Intercept	Intercept and trend	Intercept	Intercept and trend
Panel v-statistic	0.897	− 0.061	1.370	0.311	1.302	0.112	1.364	0.297
Panel rho-statistic	0.712	1.196	0.221	0.494	− 0.017	0.687	− 0.049	0.597
Panel PP-statistic	− 2.296[a]	− 2.359[a]	− 2.571[a]	− 4.075[a]	− 2.660[a]	− 3.747[a]	− 2.917[a]	− 3.701[a]
Panel ADF-statistic	− 2.086[a]	− 2.667[a]	− 2.705[a]	− 4.667[a]	− 2.240[a]	− 4.634[a]	− 2.704[a]	− 4.731[a]
Group rho-statistic	1.462	2.085	1.105	1.610	0.786	1.839	0.746	1.730
Group PP-statistic	− 4.553[a]	− 5.138[a]	− 4.372[a]	− 5.987[a]	− 4.817[a]	− 5.860[a]	− 4.985[a]	− 6.023[a]
Group ADF-statistic	− 4.378[a]	− 4.604[a]	− 3.961[a]	− 5.487[a]	− 3.733[a]	− 5.829[a]	− 4.259[a]	− 5.716[a]

[a]Denotes rejection of the null hypothesis at the 1% level

Table 4 Johansen Fisher panel cointegration test

	Model 1 EN = (GDP,EXC,URB,TA)		Model 2 EN = (GDP,EXC,URB,TE)		Model 3 EN = (GDP,EXC,URB,TR)		Model 4 EN = (GDP,EXC,URB,TI)	
	Trace statistic	Max-eigen Test	Trace statistic	Max-eigen Test	Trace statistic	Max-eigen test	Trace statistic	Max-eigen test
None	308[a]	173.9[a]	282.1[a]	152.5[a]	328[a]	214.6[a]	329.2[a]	207.7[a]
At most 1	177.9[a]	110.9[a]	161[a]	71[a]	157.3[a]	77.33[a]	168.7[a]	86.42[a]
At most 2	87.35[a]	58.24[a]	105.3[a]	53.13[a]	95.48[a]	49.42[a]	98.89[a]	48.19[a]
At most 3	48.79[a]	40.04[a]	73.09[a]	50.58[a]	67.12[a]	48.81[a]	72.6[a]	48.87[a]
At most 4	36.45[a]	36.45[a]	59.31[a]	59.31[a]	51.54[a]	51.54[a]	60.45[a]	60.45[a]

[a]Denotes rejection of the null hypothesis at the 1% level

Table 5 Panel ARDL test results

Variable	Model 1 EN = (GDP,EXC,URB,TA)		Model 2 EN = (GDP,EXC,URB,TE)		Model 3 EN = (GDP,EXC,URB,TR)		Model 4 EN = (GDP,EXC,URB,TI)	
	Coefficient	t-statistic	Coefficient	t-statistic	Coefficient	t-statistic	Coefficient	t-statistic
Panel A: long-run coefficients								
GDP	1.255[a]	13.978	0.455[a]	5.887	0.565[a]	4.391	0.617[a]	5.913
EXC	− 0.840[a]	− 9.656	− 0.437[b]	− 3.816	− 0.294[a]	− 4.675	− 0.545[a]	− 4.443
URB	1.388	1.392	− 0.281	− 0.624	− 0.110	− 0.174	− 2.870[a]	− 5.533
TA	0.633[a]	5.652						
TE			0.053[a]	3.660				
TR					0.142[a]	3.253		
TI							3.296	0.766
Panel B: short-run coefficients and ECT								
ECT	− 0.320[c]	− 1.832	− 0.736[a]	− 3.996	− 0.382[b]	− 2.011	− 0.207[c]	− 1.768
DGDP	0.072	0.223	0.546[a]	3.162	0.582[a]	4.333	0.658[a]	6.048
DEXC	0.107	1.062	0.034	0.766	0.110	0.117	0.105	1.483
DURB	12.555	0.683	8.470	1.194	7.614	0.898	− 0.266	− 0.215
DTA	− 0.068	0.169						
DTE			− 0.053	− 1.338				
DTR					− 0.028	− 1.186		
DTI							− 0.043	0.210

[a], [b] and [c] denote rejection of the null hypothesis at the 1%, 5% and 10% levels respectively

Table 6 Dumitrescu and Hurlin causality test

Null hypothesis	W-statistic	Zbar-statistic	Causality
TA does not cause EN	7.212	10.077[a]	Yes
TA does not cause URB	10.240	8.318[a]	Yes
EXC does not cause TA	6.199	1.772[c]	Yes
TE does not cause EN	5.471	3.282[a]	Yes
EXC does not cause TE	2.472	2.207[b]	Yes
TE does not cause EXC	3.467	3.859[a]	Yes
EXC does not cause TR	3.039	3.147[a]	Yes
TR does not cause EXC	2.379	2.053[b]	Yes
TI does not cause EN	5.753	3.579[a]	Yes
EXC does not cause TI	10.587	2.177[b]	Yes
TI does not cause EXC	10.716	2.238[b]	Yes

[a], [b] and [c] denote rejection of the null hypothesis at the 1%, 5% and 10% levels respectively

short-run coefficients are displayed in Table 5. For example, the long-run coefficient of GDP is positive and statistically significant ($\beta = 1.255$, $p < 0.01$) revealing that a one percent change in GDP would lead 1.255 percent change in energy consumption in the same direction. Furthermore, Table 5 shows that the long-run coefficients of tourism proxies are inelastic but positively significant (tourist arrivals: $\beta = 0.633$, $p < 0.01$; tourism expenditures: $\beta = 0.053$, $p < 0.01$; tourism revenues: $\beta = 0.142$, $p < 0.01$). However, when the tourism index is regressed on energy consumption, it is seen that the long-run coefficient of this tourism proxy is not statistically significant ($\beta = 3.296$, $p > 0.10$). The second panel of Table 5 provides ECTs as well for each model. It is seen that energy consumption in this panel data set approaches to its long-run equilibrium path significantly through the channels of tourism and the other regressors. For example, in the model with tourist arrivals, energy consumption approaches towards its long-run equilibrium path significantly by 32 percent speed of adjustment every year ($\beta = -0.320$, $p < 0.01$); this is because this ECT is negatively significant as per econometric theory (Gujarati 2003). The second panel of Table 5 also provides the short-run coefficients of regressors from which it is observed that short-run coefficients of regressors except GDP are not statistically significant. At this moment, it is concluded that it is only real income, which is a determinant of energy consumption in the short run periods.

Finally, Table 6 presents significant causality test results among the series under consideration. It is important to note that insignificant causality tests have not been reported due to page space constraints. Table 6 reveals that there exists unidirectional causality that runs from tourism growth to energy consumption growth in the panel data set proving that a change in tourism volume precedes changes in the volume of energy consumption as far as major tourist destinations are concerned. It is found that exchange rate changes precede changes in tourism volume; thus, we can conclude that tourism sector in the major tourist countries acts as a successful mediator between exchange rate changes and energy consumption; that is to say, a change in exchange rates leads to a change in tourism activity while a change in tourism activity leads to a change in energy consumption. Table 6 also provides evidence of unidirectional causality that runs from tourist arrivals to urbanization.

5 Conclusion

This study aimed to search the effects of tourism on the aggregate energy consumption in top-ranking tourist countries. A panel data that ranged from 1995 to 2014 have been selected with this respect. The results of this study confirm the long term economic impact of tourism growth on energy consumption growth in the major tourist countries. The tourism sector exerts positively significant but inelastic effects on the levels of energy consumption. This significant finding suggests that changes in tourism volume precede less but statistically significant changes in the overall energy use in the same direction. On the other hand, this study finds that tourism acts as a successful mediator between energy and other economic aggregates. For example, it is found that tourism mediates the relationship between exchange rate movements and energy consumption growth: changes in exchange rates lead to changes in tourism while changes in tourism volume also lead to changes in energy use.

The results of this study confirm the positive impact of tourism growth in energy consumption. This finding raises crucial economic policy implications: In order to avoid environmental degradations that started to be a significant concern in the last few decades, countries need to pay attention to the usage of alternative energies rather than fuel oil and petroleum consumption patterns. If this positive effect is due to traditional energy usage like fuel oil, this means that tourism growth in the countries would result in environmental pollution while it would result in environmental quality improvement in those where energy usage source comes from alternative and environmentally friendly energy systems. Thus, the significant finding of this study that tourism exerts positive effects on energy consumption implies that countries need to divert their investment projects with alternative energy usage sources. Further research directions are also available to investigate the other drivers of energy consumption in countries other than tourism for comparison and policy purposes.

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