International Journal of Applied Economics, Finance and Accounting
ISSN 2577-767X
Vol. 18, No. 1, pp. 43-52
2024
DOI: 10.33094/ijaefa.v18i1.1286


# Quality of life: The role of tourism and renewable energy

**Pavlos Stamatiou**

*Department of Economic Sciences, International Hellenic University, Terma Magnesias Str., zip: 62124, Serres, Greece.*
*Email: p.stamatiou@es.ihu.gr*



**Keywords:**
*Panel data*
*Quality of life*
*Renewable energy*
*Tourism.*

**JEL Classification:**
*C31; C33; C51; Q43; Q56; F60.*

**Received:** *16 May 2023*
**Revised:** *21 August 2023*
**Accepted:** *13 November 2023*
**Published:** *8 December 2023*

## Abstract

The present research examines the effects of tourism (TOUR) and renewable energy consumption (REC) on quality of life (QoL) using a multivariate panel regression model. The model incorporates trade openness (TO) and urbanization (URB) as additional variables. The analysis focuses on the top 10 nations that receive the highest number of international visitors. The data sample used is comprised of annual observations during the period from 1995-2018. This paper adopts the assumption of cross-sectional independence and addresses cross-sectional heterogeneity by employing the second-generation econometric approach for panel data analysis. The results indicate that all variables exhibit long-run integration. The variables TOUR, REC, TO, and URB exhibit a statistically significant impact on the quality of life (QoL). The outcome clearly claims that TOUR, REC, TO, and URB have the potential to improve QoL. Findings also support bidirectional causalities between tourism and quality of life, renewable energy consumption and quality of life, trade openness and quality of life, urbanisation and quality of life, urbanisation and trade openness, as well as urbanisation and tourism. Moreover, the analysis reveals the presence of unidirectional causal relationships originating from the variable REC and directed towards the variables TOUR, TO, REC, and URB. The outcome is useful for policymakers in order to develop better energy-tourism plans for long-term economic success, which in turn will enhance life quality. The results could potentially be restricted by the QoL index. In this study, the QoL index is measured according to human development indicators, including life expectancy. Alternative measurements include access to knowledge and the purchasing power of the people. With a focus on the 10 most-visited countries in the world, this paper aims to contribute to the existing literature on the macroeconomic determinants of economic growth and its implications for life quality, with a specific focus on the 10 most-visited nations globally.

**Funding:** This study received no specific financial support.
**Institutional Review Board Statement:** Not applicable.
**Transparency:** The author confirms that the manuscript is an honest, accurate, and transparent account of the study; that no vital features of the study have been omitted; and that any discrepancies from the study as planned have been explained. This study followed all ethical practices during writing.
**Data Availability Statement:** Pavlos Stamatiou may provide study data upon reasonable request.
**Competing Interests:** The author declares that there are no conflicts of interests regarding the publication of this paper.

## 1. Introduction

The concept of improving QoL appeared in the second half of the 20th century; however, its origins may be traced back to 1920, when Arthur Cecil Pigou (an English economist) first suggested the idea. Its widespread use began in the 1950s. Generally, there is not a sole definition regarding QoL since it includes several contexts such as healthcare, employment, international development, and politics. The World Health Organization (WHO) incorporates various standard indicators into the measurement of QoL. These indicators encompass

domains such as well-being and health, freedom, education, employment, religious beliefs, ideas, the environment, and wealth (but see also Nussbaum and Sen (1993)).

The tourism industry is considered one of the most significant economic sectors in the worldwide economy. Tourism affects the QoL of the nation in various ways, such as enhancing employment, increasing the levels of local activity and growth, improving investments in public infrastructure (e.g., roads and energy networks), and improving services of public interest (Theobald, 2005). In the year 2020, before the onset of the COVID-19 pandemic, the global tourism industry saw a significant economic impact, equivalent to around 4.7 trillion US dollars (Statista, 2022).

Economic growth is a prominent determinant that directly influences energy consumption, hence affecting the tourism sector. Therefore, the rise of tourism is closely related to the rise of energy demand. In modern economies, tourism and energy are considered integral components. Energy is required for sustainable and high living standards (Sarpong, Bein, Gyamfi, & Sarkodie, 2020). The tourism sector is engaging in overuse of natural resources, whether they are renewable or non-renewable in nature. Based on recent research findings, it is projected that the carbon dioxide emissions attributed to the tourism sector will exceed 25% of the levels recorded in 2016 by the year 2030.

The primary reason for the rise in $CO_2$ emissions is linked to the rise in energy consumption, especially coal, oil, and gas (Rahman, 2017). Carbon dioxide emissions, which are considered the most harmful anthropogenic greenhouse gas (GHG), are responsible for more than 60% of the greenhouse effect (IPCC, 2019). According to the IEA report from (2019), it was seen that global energy consumption had a growth of over 2% in 2017, which can be compared to a 0.9% increase in 2016. Furthermore, the average annual increase during the period of 2012-2016 was nearly 0.9%.

Environmental degradation is a common occurrence in nations where tourism's financial contribution facilitates revenue growth (Tugcu & Topcu, 2018). Renewable energy (e.g., solar, biomass, geothermal, hydropower, and wind power) is inevitable in order to fulfil the continuously increasing energy demand and increase the economy without damaging the environment (Sebri & Ben-Salha, 2014). Kokkhangplu, Onlamai, Chokpreedapanich, and Phikul (2023) reported the ability of $CO_2$ emissions reduction in the tourism sector due to the willingness of tourists to cover costs for activities associated with eco-friendly technologies. Investment in green power has been demonstrated to generate significant returns within a short period of time.

Low-income countries should invest resources in the adoption of renewable energy sources in order to enhance the economic growth and improve their quality of life. This can be achieved by leveraging renewable energy for irrigation in agriculture, diversified cropping practices, and modernized construction projects. On the other hand, developed countries expand their agriculture industries and economic growth rates through increased energy utilization, thereby leading to an elevated standard of living (Sarpong et al., 2020).

On December 11, 1997, the signature parties to the Kyoto Protocol reached an agreement to attain a state of stabilization in GHG emissions within the atmosphere. This would be achieved through the implementation of measures. This would be achieved by the implementation of measures such as the integration of renewable energy sources to replace fossil fuels and the supply of technological assistance for eco-friendly projects in economically less developed economies. The basic policy employed to achieve this objective involved reducing the reliance of an economy on imported energy resources. During the Paris agreement on December 12, 2015, negotiators governments successfully achieved a historic agreement regarding the mitigation of global warming. The negotiators have expressed their commitment to restricting the increase in the world's average temperature to a level much below 2°C in relation to the preindustrial period (preferably to minimize the rise to 1.5°C). It is imperative to reduce carbon dioxide emissions by 50% until 2030 and further improve upon this reduction over the remainder of the twenty-first century. The utilization of efficient types of renewable energy will help countries achieve climate change objectives while simultaneously yielding economic advantages that contribute to the sustenance and augmentation of growth prospects.

According to Eurostat, European Union (EU) has increased the share of renewable energy from 12.6% in 2009 to 18% in 2018, achieving the objective of attaining a renewable energy share of 20% in relation to the overall final energy consumption. There are countries that already go beyond these goals (e.g., Finland, Sweden, and Denmark), and a few others that are trying to achieve them (e.g., France, Germany, and Spain). European nations exhibit substantial variations in terms of geographical size, the structure of the economy, resources, and population.

The electricity-generating industry is the primary domain in which renewable energy sources are able to effectively compete with nonrenewable sources while maintaining growth expectations. According to IEA (2019), in Europe, 32% and 65% of overall energy usage will derive directly from clean energy, around 2030 and 2040, respectively.

This paper aims to explore the effect of tourism sector and sustainable energy usage on QoL within the framework of economic openness and urban concentration. The analysis focuses on the top 10 countries that are visited the most globally. The sample dataset consists of annual observations spanning from 1995-2018. This research seeks to add to the literature in a number of ways:

i) It augments the literature with empirical proofs related to the links among tourism, renewable energy, and quality of life within the setting of the top 10 most visited nations across the world. These are the countries with the largest contribution to economic growth and development through tourism. The

research paper contributes to the existing literature on the macroeconomic determinants of economic growth and, therefore life quality.

ii) In accordance with the authors' best knowledge, except Pasten and Santamarina (2012); Ridderstaat, Croes, and Nijkamp (2016); Croes, Ridderstaat, and van Niekerk (2018); and Sarpong et al. (2020), no other research has been conducted to investigate the links between tourism, renewable energy, and quality of life. The majority of the literature focuses on the energy-quality of life nexus.

iii) In addition, there is no literature using panel data analysis in this context.

iv) Another difference is that, in the current analysis (in contrast to the existing studies), we investigate not only the causal relations among the examined variables but also the potential of long- and short term relations among tourism development, renewable energy sources, trade openness, and urbanization, as well as the consequences to QoL.

v) The research methodology applied in the research process is based on recent data and utilize the latest modeling and economic frameworks.

vi) Finally, the study presents some conclusions and policy implications that may serve as a debate for further investigation.

The remainder of the research is structured into four sections: The next section presents a review of the literature. Section 3 shows the data and methodology. Empirical analysis is presented in section 4. Concluding remarks are given in the final section.

## 2. Literature Review

For the last two decades, QoL has been an important issue in the tourism literature. A number of published studies claim that tourist revenues play an important role in long term development by facilitating the expansion of industry, generating employment opportunities, and enhancing the quality of life for both hosts and visitors. International trade, infrastructure, renewable energy, and globalization are crucial factors for tourism development (see also Köksal (2021)).

Dolnicar, Lazarevski, and Yanamandram (2013) examined the association between QoL and tourism, utilizing a data set from 1000 Australian adults. The results of their study show that vacations are considered a core aspect of QoL for 11% of respondents, while 59% of the sample perceives vacations as a means of improving their overall well-being. Authors argue that people who report that vacations improve their QoL, have a good QoL overall. Individuals who perceive vacations as an essential component of their existence are more inclined to own a higher salary and attribute significant value to their occupation. A similar study by Gondos (2014) suggests that tourists who are satisfied and gain a lot of experiences will be more content and happy with their lives . As a result, they will travel more in the future in order to gain more positive experiences.

Andereck and Vogt (2000), analyzed the relationship between residents' attitudes towards tourism and their level of support for various tourist development alternatives, such as parks, outdoor recreation possibilities, and restaurants, throughout the state of Arizona. They argued that tourism has a beneficial impact on the QoL within a town.

Regarding the triangular nexus among tourism development, economic growth, and QoL, Ridderstaat, Croes, and Nijkamp (2014) supported a two-way direct relationship between tourism development and QoL for Aruba (a small island destination). The importance of understanding the impact of tourism development on all aspects of life and recognizing the function of QoL in the context of tourist development is emphasized by scholars. A study conducted by Croes et al. (2018) explored similar studies in the context of Malta. The findings of the analysis reveal a limited association between tourism specialization and both QoL and economic development. Authors concluded that tourism specialization has a positive impact on the QoL of host's communities, but only temporarily.On the other hand, Köksal (2021) did not manage to prove any significant relation between the tourism sector and QoL in Turkey, using a dataset covering the period 1990-2019. Although Turkey is widely recognized as a prominent tourist destination on the global stage, the impact of the tourism industry on the overall well-being of the local population remains limited. Other factors, such as international trade and Gini index (which serves as a metric for assessing wealth distribution within a country) have been identified as significant influences influencing the quality of life inside a country.

Furthermore, the existing body of literature includes another category of studies that examine the relationship between the environment and tourism development. Tourism-related transportation, whether through air or land vehicles, imposes a burden on the ecosystem by introducing carbon dioxide emissions and influencing air quality. Gauche (2017) proved that the increase in tourist stays is associated with environmental degradation through urbanization and increased pressure on natural resources.

In a landmark study, Gössling and Peeters (2015) examine five important factors related to environmental changes associated with leisure- activities,arriving at the conclusion that travel has significant environmental ramifications. Furthermore, it highlights that individuals residing in developing nations are likely to have the greatest burden resulting from these adverse effects.

Katircioglu, Feridun, and Kilinc (2014), analyzed the nexus among energy consumption, tourist arrivals and environmental pollution for Cyprus, spanning from 1970-2009. The major finding of the analysis is that international tourism servesas a catalyst for energyconsumption, thereby contributing to the phenomenon of

global warming. The authors reached the conclusion that a thorough evaluation of the tourist business is necessary when policy makers establish metrics to mitigate global warming.

Finally, an additional category of studies focuses on the energy-QoL nexus. Pasten and Santamarina (2012), argued that there is a significant link between power usage and a variety of QoL indicators. Energy is required in order to keep and improve living standards (Hall, Tharakan, Hallock, Cleveland, & Jefferson, 2003).

Alam, Bala, Huq, and Matin (1991) supported the existence of a significant correlation between energy usage and QoL. Authors conclude that this correlation is even stronger between physical quality of life indicators and renewable energy usage.

Clean energy consumption is an essential part of the energy plan since it produces low to no harmful emissions to the environment.Sustainable performance along with the utilisation of renewable energy sources are prerequisites for raising living standards and advancing human growth (Smil & Knowland, 1980).

In a recent study conducted by Sarpong et al. (2020), the researchers examined the links among tourism, clean energy use, and QoL in the Southern African region. The study spanned from 1995 to 2017. The results prove a significant relationship between the tourism sector and QoL, and they also demonstrate that the tourism sector has the ability to enhance all aspects of QoL in this region.

## 3. Methodology

### *3.1. Model & Data*

According to Katircioglu (2009), the tourism sector plays an important role in human development metrics. Furthermore, the utilization of renewable energy, the promotion of economic openness, and the concentration of metropolitan areas are significant factors that contribute to the overall quality of life.
So, we specify the following model, as shown in Equation 1(Sarpong et al., 2020):

$$QoL_{i_t} = \alpha + \beta TOUR_{it} + \gamma REC_{it} + \delta TO_{it} + \zeta URB_{it} + \varepsilon_{it} \quad (1)$$

where $QoL$ stands for quality of life of a country (measured according to human development indicators, including life expectancy), $TOUR$ represents international tourist arrivals, $REC$ stands for renewable energy consumption (measured as the share of final energy consumption), $To$ represents trade openness (measured as the sum of imports plus exports as a percentage of Gross Domestic Product (GDP)), $URB$ represents urban population (measured as the percentage of the total population in urban areas), $\varepsilon_{it}$ shows the error term, $I$ represents the number of individual members, and $t$ represents the number of observations over time. In Equation 1, the logarithmic transformation of all variables has been performed, so the estimated coefficients ($\beta$, $\gamma$, $\delta$, $\zeta$) will provide us with relatively precise estimates of the long-run flexibility.

### *3.2. Sample*

Our analysis utilizes panel data for the group of 10 countries that are visited the most globally (in millions tourists) :France (89.4 mm), Spain (82.7 mm), United States (79.6 mm), China (62.9 mm), Italy (62.1 mm), Turkey (45.7 mm), Mexico (41.4 mm), Germany (38.8 mm), Thailand (38.2 mm) and United Kingdom (36.3 mm). The data is obtained from the World Development Indicators (WDI, 2022) provided by the World Bank, covering the period from 1995 to 2018. The sample was selected based on the availability of data. The panel data technique is utilized in conducting empirical investigations. One of the advantages of utilizing panel data is that it yields more dependable estimates for parameters when compared to single-country data. Additionally, panel data analysis offers greater efficiency, variability, and information compared to time series or cross-sectional research.

### *3.3. Methodology*

#### *3.3.1 Cross-Sectional Dependence (CD) Test*

The empirical analysis commences by using various cross-sectional dependence statistics, which are proposed by Breusch and Pagan (1980) (Lagrange Multiplier (LM)statistic), Pesaran (2004) (Scaled Lagrange Multiplier ($LM_s$) statistic and Cross-Sectional Dependence ($CD_p$) statistic), as well as Baltagi, Feng, and Kao (2012) (Bias Corrected Scaled Lagrange Multiplier ($LM_{BC}$) statistic). Equations 2-5 present the above-mentioned four CD statistics:

$$LM = T(\sum_{i=1}^{N-1}\sum_{j=i+1}^{N}\hat{\rho}_{ij}{}^2) \rightarrow X^2 \text{ with } \frac{N(N-1)}{2} \text{ df} \quad (2)$$

$$LM_s = \sqrt{\frac{1}{N(N-1)}}\sum_{i=1}^{N-1}\sum_{j=i+1}^{N}(T_{ij}\hat{\rho}_{ij}{}^2 - 1) \rightarrow N(0,1) \quad (3)$$

$$CD_p = \sqrt{\frac{2}{N(N-1)}}\sum_{i=1}^{N-1}\sum_{j=i+1}^{N}(T_{ij}\,\hat{\rho}_{ij}^2) \rightarrow N(0,1) \quad (4)$$

$$LM_{BC} = \sqrt{\frac{1}{N(N-1)}}\sum_{i=1}^{N-1}\sum_{j=i+1}^{N}(T_{ij}\,\hat{\rho}_{ij}^2 - 1) - \frac{N}{2(T-1)} \rightarrow N(0,1) \quad (5)$$

$\hat{\rho}_{ij}{}^2$i indicates the pair wise correlation coefficient among the units, $T$ denotes time-interval and $N$ the number of units.

### 3.3.2. Panel Unit Root Test

We proceed with the recently developed CIPS (Cross Sectionally Augmented Im-Pesaran-Shin (IPS)) statistic, by Pesaran (2007). The procedure begins with the next CADF (Cross Sectional Augmented Dickey-Fuller (ADF)) regression:

$$\Delta y_{it} = \alpha_i + \rho_i y_{i,t-1} + \delta_i \bar{y}_{t-1} + \sum_{j=0}^{k} \delta_{ij} \Delta \bar{y}_{i,t-j} + \sum_{j=0}^{k} \Delta y_{i,t-j} + \varepsilon_{it} \quad (6)$$

$$\bar{y}_{i,t-1} = \left(\frac{1}{N}\right) \sum_{i=1}^{N} y_{i,t-1} \text{ and } \Delta \bar{y}_t = \left(\frac{1}{N}\right) \sum_{i=1}^{N} y_{i,t}$$

The CIPS statistic is as follows:

$$CIPS = \left(\frac{\sum_{i=1}^{N} CADF_i}{N}\right) \quad (7)$$

### 3.3.3. Panel Cointegration Analysis

Panel co-integration methodology is employed for the analysis of the long-run equilibrium connection among the variables of interest. Pedroni (1999) developed seven co-integration tests, consisting of both panel and group statistics. Panel statistics are derived using the within-dimension method. Group statistics are derived using the between-dimensions approach. Pedroni co-integration methodology takes into consideration the heterogeneity of the parameters that may differ among the units. In statistical analysis, the null hypothesis $H_0$ is commonly tested to determine the presence or absence of co-integration between the series. Westerlund (2007) has introduced a new panel co-integration methodology that enhancing robustness to cross-sectional dependence (see also Chang (2004)), and avoids the problem of common factor restrictions. Westerlund (2007) introduced four panel co-integration statistics: $P_t$ and $P_a$ panel statistics, as well as $G_t$ and $G_a$ group mean statistics. The computation of $P_t$ and $G_t$ involves the utilization of standard errors derived from the error correction process. On the other hand, the calculation of $P_a$ and $G_a$ is based on the application of Newey and West (1994), adjusted standard errors, which account for autocorrelation and -Heteroskedasticity corrections. The $H_0$ of no co-integration is tested against the alternative. The panel statistics test is conducted to examine the hypothesis $H_1$ which posits that the entire panel exhibits co-integration. In contrast, group mean statistics are utilized to assess the alternative hypothesis $H_1$ which posits that there exists co-integration among at least one of the cross-sectional units.

### 3.3.4. Panel Model Estimation Approach

The FM-OLS (Fully modified OLS) methodology by Pedroni (1999) and Pedroni (2001) is employed for the estimation of the long-run equilibrium. This method allows the incorporation of heterogeneity and serial-correlation in the co-integrating vector by using a non-parametric method.

In addition, the D-OLS (Dynamic OLS) estimator proposed by Kao and Chiang (2000), as well as Mark and Sul (2002), is used to test the resilience of the long-term relationship. The D-OLS technique is a comprehensive parametric approach that addresses the issue of auto correlation by incorporating lagged and leading independent variables. Both methods (FM-OLS and D-OLS) enable more flexibility in the case of heterogeneity in long-run equations (Pedroni, 2000; Pedroni, 2004) and produce consistent parameters that can be used for postulation.

### 3.3.5. Dumitrescu-Hurlin Panel Causality Test

The causality approach built by Dumitrescu and Hurlin (2012) is tested in order to discover the causality links between our model's variables. This is an enhanced iteration of the concept of non-causality in Granger causality analysis, wherein regressions are performed on individual cross-sections independently. It is based on a block bootstrapping approach to correct the critical test values.There are several benefits associated with this technique. i) consider sheer to geneity as well as cross-sectional dependence. ii) The relative size of units and the time dimension are irrelevant to one another, iii) It provides reliable findings in unbalanced panels. iv) it can be utilized irrespective of the existence of co-integration.

Dumitrescu and Hurlin (2012), proposed a linear equation to detect causality:

$$y_{it} = a_i + \sum_{k=1}^{K} \gamma_i^{(k)} y_{i,t-k} + \sum_{k=1}^{K} \beta_i^{(k)} x_{i,t-k} + e_{i,t} \quad (8)$$

$x$ and $y$ represent each variable of the model, $a_i$ = individual fixed effects, $\beta_i = (\beta_i^{(1)}, \ldots, \beta_i^{(k)})'$, $\gamma_i^{(k)}$ = lag parameter, $\beta_i^{(k)}$ = slope parameter, $K$ = optimal lag-length, and the $H_0$ is "x does not Granger cause y".

Null hypothesis ($H_0$) and alternative hypotheisis ($H_1$) are shown below:

$H_0: \beta_i = 0 \forall i = 1, \ldots, N$ Homogeneous Non-Causality (HNC) Hypothesis

$H_1: \beta_i = 0 \forall i = 1, \ldots, N_1$ Heterogeneous Non-Causality (HENC) Hypothesis

$\beta_i \neq 0 \forall i = N_1 + 1, N_1 + 2, \ldots, N$

$N_1$ is an unknown parameter under $0 \leq N_1/N < 1$.

Dumitrescu and Hurlin (2012), calculated the statistic for the panel average for the HNC as follows:

$$W_{N,T}^{HNC} = \frac{1}{N} \sum_{i=1}^{N} W_{i,T} \quad (9)$$

$W_{i,T}$is the individual statistic of Wald, for the i[th] unit.

## 4. Results

### 4.1. Cross-Sectional Dependence (CD) Results

Cross-sectional dependence (CD) tests are employed in order to identify suitable unit-root, co-integration, and causality approaches. Estimation outputs are tabulated in Table 1.

**Table 1.** CD test results.

| Var. | Breuch pagan LM | | Pesaran scaled LM | | Bias ccorrected scaled LM | | Pesaran CD | |
|---|---|---|---|---|---|---|---|---|
| | Statistic | Prob | Statistic | Prob | Statistic | Prob | Statistic | Prob |
| L QoL | 940.45 *** | 0.00 | 94.38 *** | 0.00 | 94.17 *** | 0.00 | 30.48 *** | 0.00 |
| LTOUR | 631.24 *** | 0.00 | 61.79 *** | 0.00 | 61.57 *** | 0.00 | 19.19 *** | 0.00 |
| LREC | 712.39 *** | 0.00 | 70.34 *** | 0.00 | 70.13 *** | 0.00 | 4.58 *** | 0.00 |
| LTO | 510.32 *** | 0.00 | 49.05 *** | 0.00 | 48.83 *** | 0.00 | 20.88 *** | 0.00 |
| LURB | 1035.50 *** | 0.00 | 104.40 *** | 0.00 | 104.19 *** | 0.00 | 32.17 *** | 0.00 |

**Note:** The $H_0$ is that the panel does not exhibit any cross-sectional dependence, *** shows significant at 1% level, d.f. is 45, letter *L* stands for logarithm transformation of the variables.

According to the above results, the $H_0$ hypothesis of lacking cross-sectional dependence is firmly rejected at a significance level of 1% for the variables being examined (L Qol, LTOUR, LREC, LTO, and LURB).

### 4.2. Panel Unit Root Results

The study of cross-sectional dependence is employed to establish the integration order of each variable using the Pesaran (2007) CIPS test. The findings are presented in the next table.

**Table 2.** Pesaran CIPS results.

| CIPS test – 1st difference | | | | | |
|---|---|---|---|---|---|
| **Variables** | **LQoL** | **LTOUR** | **LREC** | **LTO** | **LURB** |
| Intercept | -2.98*** | -2.90*** | -2.75*** | -3.39*** | -2.41** |
| Intercept andtrend | -3.15*** | -3.27** | -2.92** | -3.97*** | -2.75* |
| Critical values | 1% | | 5% | | 10% |
| Intercept | -2.58 | | -2.33 | | -2.21 |
| Intercept and trend | -3.14 | | -2.87 | | -2.74 |

**Note:** ***, **, * indicate rejection of $H_0$ at 1%, 5% and 10%, critical values obtained from Pesaran (2007), letter *L* stands for logarithm transformation of the variables.

The results presented in Table 2 and the findings at first-order differential support the rejection of the $H_0$. Based on our analysis, it can be inferred that the variables L QoL, LTOUR, LREC, LTO, and LURB are stationary in their initial differences. This finding suggests the possibility of a co-integration relationship among these variables.

### 4.3. Panel Co-integration Analysis Results

Table 3 displays Pedroni (1999) and Pedroni (2004) as well as Westerlund (2007) co-integration methodologies. Both approaches support the $H_1$ (alternative hypothesis of co-integration) can be accepted.

**Table 3.** Panel co-integration analysis results.

| Pedroni test | | Stat | Prob |
|---|---|---|---|
| Panel | V | -1.37* | 0.08 |
| | Rho | 0.08 | 0.53 |
| | PP | -3.44*** | 0.00 |
| | ADF | -2.31*** | 0.00 |
| Group | Rho | -0.85 | 0.80 |
| | PP | -4.39*** | 0.00 |
| | ADF | -3.40*** | 0.00 |

| Westerlund test | | | |
|---|---|---|---|
| Stat | Value | Zvalue | Pvalue |
| Gt | -2.63*** | -5.29*** | 0.00 |
| Ga | -3.70*** | -4.48*** | 0.00 |
| Pt | -14.13*** | -3.50*** | 0.00 |
| Pa | -10.52*** | -3.00*** | 0.00 |

**Note:** All variables (under the $H_0$)~N(0, 1), *** and * denote 1% and 10% significance levels, in Westerlund AICis selected for optimal lag-lead length, *PP* stands for Phillips-Perron, *ADF* for Augmented Dikey-Fuller.

The results of Table 3 indicate the existence of a long-term equilibrium relationship among the variables under examination. Out of seven Pedroni statistics, three homogeneous and two heterogeneous statistics are statistically significant. Furthermore, Westerlunds' statistics are against the $H_0$. These results can be viewed as proof of co-integration.

### 4.4. FM-OLS & D-OLS Results

The estimation outcome generated by FM-OLS and D-OLS techniques is reported in Table 4.

**Table 4.** FM-OLS & D-OLS results.

| | Independent variables | | | |
|---|---|---|---|---|
| **FM-OLS** | **LTOUR** | **LREC** | **LTO** | **LURB** |
| Coef. | 0.05<br>(10.75)*** | 0.01<br>(3.26)** | 0.01<br>(1.81)* | 0.08<br>(5.89)*** |
| $R^2$ | 0.96 | | | |
| Adj. $R^2$ | 0.95 | | | |
| D-OLS | Independent variables | | | |
| | LTOUR | LREC | LTO | LURB |
| Coef. | 0.02<br>(4.25)*** | 0.01<br>(4.21)*** | 0.02<br>(1.80)* | 0.06<br>(5.06)*** |
| $R^2$ | 0.99 | | | |
| Adj. $R^2$ | 0.98 | | | |

**Note:** T-statistic in parentheses, ***, ** and * denote significance levels at 1%, 5% and 10%, in D-OLS lag-lead approach is selected by AIC, letter *L* stands for logarithm transformation of the variables.

The above table presents the long-run estimated parameters of the QoL model. The model supports that all variables cause improvements in QoL. More specifically, the outcome of FM-OLS estimation supports that 1% variation (increase) in TA, REC, TO, and URB leads to improvement in QoL by 0.05%, 0.01%, 0.01%, and 0.08%. Finally, the D-OLS technique, as a robustness test, confirms the results of our FM-OLS estimates.

Research findings are equivalent to those of Andereck, Valentine, Vogt, and Knopf (2007) and Andereck and Nyaupane (2011), who argue that the tourism sector should be utilized in order to help countries and enhance their standard of living (see also Sarpong et al. (2020)). In addition, the results suggest that these countries can rely on renewable energy sources and trade liberalization policies to positively affect human development and thereby raise their standard of living. The results of the study indicate that the establishment of well-planned urban centers is crucial in order to ensure the availability of sufficient social amenities and services, hence contributing to the enhancement of human development (Sarpong et al., 2020).

### 4.5. Panel Causality Analysis Results

The final step in our analysis is to explore the causality links among TA, REC, TO, URB, and QoL. For this purpose, the Dumitrescu and Hurlin (2012) methodology is employed. Table 5 shows the panel causality analysis results.

**Table5.** Panel causality analysis results.

| **Dimitrescu and Hurlin causality analysis** | | | |
|---|---|---|---|
| | **W-stat.** | **Zbar-stat.** | **Direction of causality** |
| LTOUR → LQoL | 8.45*** | 7.55*** | |
| LQoL → LTOUR | 4.68*** | 2.95*** | LTOUR ↔ LQoL |
| LREC → LQoL | 15.02*** | 15.56*** | |
| LQoL → LREC | 7.28*** | 6.11*** | LREC ↔ LQoL |
| LTO → LQoL | 6.59*** | 5.28*** | |
| LQoL → LTO | 7.77*** | 6.71*** | LTO ↔ LQoL |
| LURB → LQoL | 24.35*** | 26.94*** | |
| LQoL → LURB | 11.08*** | 10.76*** | LURB ↔ LQoL |
| LREC → LTOUR | 4.26** | 2.43** | |
| LTOUR → LREC | 3.52 | 1.53 | LREC → LTOUR |
| LTO → LTOUR | 3.01 | 0.91 | |
| LTOUR → LTO | 3.81* | 1.88* | LTOUR → LTO |
| LURB → LTOUR | 5.62*** | 4.10*** | |
| LTOUR → LURB | 3.94** | 2.04** | LURB ↔ LTOUR |
| LTO → LREC | 3.07 | 0.98 | |
| LREC → LTO | 5.85*** | 4.38*** | LREC → LTO |
| LURB → LREC | 7.59*** | 6.50*** | |
| LREC → LURB | 1.91 | -0.42 | LURB → LREC |
| LURB → LTO | 9.31*** | 8.59*** | |
| LTO → LURB | 3.93** | 2.03** | LURB ↔ LTO |

**Note:** ***, ** show 1% and 5% significance levels of causality directions, letter *L* stands for logarithm transformation of the variables.

The outcomes prove the existence of bilateral causal relationship among TOUR and QoL, REC and QoL, TO and QoL, URB and QoL, URB and TO, as well as URB and TOUR. Furthermore, from the above table, we can see that there are unidirectional causality relationships with directions from REC to TOUR, from TOUR to TO, from REC to, and from URB to REC.

In such a way, the current setting is critical for enhancing the energy-tourism-QoL literature. There is a close interrelationship between the use of renewable energy, the tourism sector, and the quality of life (QoL). As a result, researchers and governments ought to think of tourism and energy strategies that are sustainable for long-term development, which in turn will enhance the quality of life.

## 5. Conclusion

The study's objective is to investigate the role of the tourism sector and renewable energy use on quality of life. Within the context of a multivariate panel structure, this study also incorporates the variables of trade openness and urban concentration. The study is based on data from the 10 most popular travel countries, spanning from 1995 to 2018. These are the countries with the largest contribution to economic growth and development through the tourism sector. The exclusion of data prior to the 1995s was necessitated by the absence of a sufficient dataset. The empirical inquiry employs the panel methodology of second-generation econometrics. The long-run estimation results reveal a significant relationship between the examined variables, implying that TOUR, REC, TO, and URB have the potential to improve all the factors that contribute to life quality. The study's findings are in line with those of Andereck et al. (2007) and Andereck and Nyaupane (2011), who support the idea that the tourist industry should be used to assist nations in improving their living standards (see also Sarpong et al. (2020)).

From the causality analysis results, we see that there are bilateral relations among TOUR and QoL, REC and QoL, TO and QoL, URB and QoL, URB and TOUR, as well as URB and TO. Furthermore, this study provides evidence of unidirectional causal relationships, specifically from REC to TOUR, from TOUR to TO, from REC to TO, and from URB to REC. Key recommendations may include identifying and implementing policies that highlight green power for industrial purposes, as well as ensuring activities that boost the tourist sector's percentage in economic development.

The identification of a reciprocal causal relationship between tourism and quality of life suggests that the influx of tourist dollars will lead to increased foreign exchange earnings for the host economy, hence fostering economic growth and development and enhancing the overall standard of living for individuals. Furthermore, considering the immense potential of the tourist business, the governments of these countries should concentrate on alternative concepts, like health, sports, food/congress tourism. Thus, international tourist revenues may grow even more, which would have long-term implications for people's quality of life. Security is an additional crucial aspect that has the potential to enhance tourism in a host country. As a result, it is up to the governments of these nations to implement appropriate security measures to ensure the security and safety of tourists (Sarpong et al., 2020).

The significant finding of a bilateral causal relationship between REC and QoL suggests that policymakers should shift the use of energy from carbon-based materials to substitute green power materials more rapidly because green power seems to be a motivating factor for QoL. Renewable energy sources, including solar, hydrothermal, wind, geothermal ocean, and biomass, possess the potential to significantly influence the trajectory of energy policy. Furthermore, the importance of international trade on quality of life points out the need for liberalised trade policies. It is imperative to enact regulations pertaining to trade that would yield a substantial increase in the influx of foreign investors. The government should emphasise enhancing exports more through the implementation of subsidies for crucial export industries and the maintenance of policies that foster economic growth. The findings of this study suggest that these countries can rely on renewable energy sources and trade liberalisation policies that positively affect human development and thereby raise their standard of living.

Finally, our results agree with the modernization theory, which supports that urban concentration has a positive influence on education and other social elements. The effective development of urban centres with the appropriate plans regarding social amenities and services has the potential to contribute to human development (but see also Sarpong et al. (2020)).

### *5.1. Limitations & Future Work*

Nevertheless, it is important to acknowledge that the current analysis possesses certain shortcomings that could be addressed in further studies: i) there were only 24 available observations for the examined variables. ii) The potential limitations of the study's findings may be attributed to the utilisation of the Quality of Life (QoL) metric. In this study, the QoL index is measured according to human development indicators, including life expectancy. Alternative measurements include access to knowledge and the purchasing power of the people. iii) Additional investigation could be conducted to explore the determinants of various measures of well-being (e.g., community and social wellbeing). iv) finally, comparable analysis focusing on diverse countries or groups could be applied.

## References


Alam, M., Bala, B., Huq, A., & Matin, M. (1991). A model for the quality of life as a function of electrical energy consumption. *Energy*, *16*(4), 739-745. https://doi.org/10.1016/0360-5442(91)90023-f

Andereck, K. L., & Nyaupane, G. P. (2011). Exploring the nature of tourism and quality of life perceptions among residents. *Journal of Travel Research*, *50*(3), 248-260. https://doi.org/10.1177/0047287510362918

Andereck, K. L., Valentine, K. M., Vogt, C. A., & Knopf, R. C. (2007). A cross-cultural analysis of tourism and quality of life perceptions. *Journal of Sustainable Tourism*, *15*(5), 483-502. https://doi.org/10.2167/jost612.0

Andereck, K. L., & Vogt, C. A. (2000). The relationship between residents' attitudes toward tourism and tourism development options. *Journal of Travel Research*, *39*(1), 27-36. https://doi.org/10.1177/004728750003900104

Baltagi, B. H., Feng, Q., & Kao, C. (2012). A lagrange multiplier test for cross-sectional dependence in a fixed effects panel data model. *Journal of Econometrics*, *170*(1), 164-177. https://doi.org/10.1016/j.jeconom.2012.04.004

Breusch, T. S., & Pagan, A. R. (1980). The lagrange multiplier test and its applications to model specification in econometrics. *The Review of Economic Studies*, *47*(1), 239-253. https://doi.org/10.2307/2297111

Chang, Y. (2004). Bootstrap unit root tests in panels with cross-sectional dependency. *Journal of Econometrics*, *120*(2), 263-293. https://doi.org/10.1016/s0304-4076(03)00214-8

Croes, R. (2011). Measuring and explaining competitiveness in the context of small island destinations. *Journal of Travel Research*, *50*(4), 431-442. https://doi.org/10.1177/0047287510368139

Croes, R., Ridderstaat, J., & van Niekerk, M. (2018). Connecting quality of life, tourism specialization, and economic growth in small island destinations: The case of Malta. *Tourism Management*, *65*(C), 212-223. https://doi.org/10.1016/j.tourman.2017.10.010

Dolnicar, S., Lazarevski, K., & Yanamandram, V. (2013). Quality of life and tourism: A conceptual framework and novel segmentation base. *Journal of Business Research*, *66*(6), 724-729. https://doi.org/10.1016/j.jbusres.2011.09.010

Dumitrescu, E.-I., & Hurlin, C. (2012). Testing for granger non-causality in heterogeneous panels. *Economic Modelling*, *29*(4), 1450-1460. https://doi.org/10.1016/j.econmod.2012.02.014

Gauche, M. (2017). *Tourism intensity at a local level: Environmental pressure or preservation factor?, The monitoring and statistics directorate (SOeS): Paris, France.* Retrieved from https://www.statistiques.developpementdurable.gouv.fr/sites/default/files/2018-10/datalab-17-la-fonction-touristique-des-territoires...mars2017-anglais.pdf

Gondos, B. (2014). *Relationship between tourism and quality of life: Researches at lake balaton, human capital without borders: Knowledge and learning for quality of life.* Paper presented at the Proceedings of the Management, Knowledge and Learning International Conference, ToKnowPress.

Gössling, S., & Peeters, P. (2015). Assessing tourism's global environmental impact 1900–2050. *Journal of Sustainable Tourism*, *23*(5), 639-659. https://doi.org/10.1080/09669582.2015.1008500

Hall, C., Tharakan, P., Hallock, J., Cleveland, C., & Jefferson, M. (2003). Hydrocarbons and the evolution of human culture. *Nature*, *426*(6964), 318-322. https://doi.org/10.1038/nature02130

IEA. (2019). *International energy agency*. Paris: Global Energy & CO2 Status Report.

IPCC. (2019). *Refinement to the 2006 IPCC guidelines for national greenhouse gas inventories*. Switzerland: IPCC.

Kao, C., & Chiang, M. H. (2000). On the estimation and inference of a cointegrated regression in panel data. *Advances in Econometrics*, *15*, 179-222. https://doi.org/10.1016/s0731-9053(00)15007-8

Katircioglu, S. T. (2009). Revisiting the tourism-led-growth hypothesis for Turkey using the bounds test and Johansen approach for cointegration. *Tourism Management*, *30*(1), 17-20. https://doi.org/10.1016/j.tourman.2008.04.004

Katircioglu, S. T., Feridun, M., & Kilinc, C. (2014). Estimating tourism-induced energy consumption and CO2 emissions: The case of cyprus. *Renewable and Sustainable Energy Reviews*, *29*(C), 634-640.

Kokkhangplu, A., Onlamai, W., Chokpreedapanich, T., & Phikul, K. (2023). What predicts behavioral intention in eco-friendly hotels? The roles of tourist's perceived value and satisfaction: A case study of Thailand. *Sustainability*, *15*(4), 3219. https://doi.org/10.3390/su15043219

Köksal, C. (2021). The impact of international trade and tourism development on quality of life: Evidence from Turkey. *JOEEP: Journal of Emerging Economies and Policy*, *6*(2), 406-413.

Mark, N. C., & Sul, D. (2002). *Cointegration vector estimation by panel DOLS and long-run money demand.* NBER Working Paper, No. 287.

Newey, W. K., & West, K. D. (1994). Automatic lag selection in covariance matrix estimation. *The Review of Economic Studies*, *61*(4), 631-653. https://doi.org/10.2307/2297912

Nussbaum, M., & Sen, A. (1993). *The quality of life.* Oxford: Clarendon Press.

Pasten, C., & Santamarina, J. C. (2012). Energy and quality of life. *Energy Policy*, *49*(C), 468-476.

Pedroni, P. (1999). Critical values for cointegration tests in heterogeneous panels with multiple regressors. *Oxford Bulletin of Economics and Statistics*, *61*(S1), 653-670. https://doi.org/10.1111/1468-0084.61.s1.14

Pedroni, P. (2000). Fully modified OLS for heterogeneous cointegrated panels. *Advances in Econometrics*, *15*, 93-132. https://doi.org/10.1016/s0731-9053(00)15004-2

Pedroni, P. (2001). Purchasing power parity tests in cointegrated panels. *Review of Economics and Statistics*, *83*(4), 727-731. https://doi.org/10.1162/003465301753237803

Pedroni, P. (2004). Panel cointegration: Asymptotic and finite sample properties of pooled time series tests with an application to the PPP hypothesis. *Econometric Theory*, *20*(3), 597-625. https://doi.org/10.1017/s0266466604203073

Pesaran, M. H. (2004). *General diagnostic tests for cross section dependence in panels*. Cambridge Working Papers in Economics, No. 435.

Pesaran, M. H. (2007). A simple panel unit root test in the presence of cross-section dependence. *Journal of Applied Econometrics*, *22*(2), 265-312. https://doi.org/10.1002/jae.951

Rahman, M. M. (2017). Do population density, economic growth, energy use and exports adversely affect environmental quality in Asian populous countries? *Renewable and Sustainable Energy Reviews*, *77*(C), 506-514. https://doi.org/10.1016/j.rser.2017.04.041

Ridderstaat, J., Croes, R., & Nijkamp, P. (2014). The tourism development–quality of life nexus in a small island destination. *Journal of Travel Research*, *55*(1), 79-94. https://doi.org/10.1177/0047287514532372

Ridderstaat, J., Croes, R., & Nijkamp, P. (2016). A two-way causal chain between tourism development and quality of life in a small island destination: An empirical analysis. *Journal of Sustainable Tourism*, *24*(10), 1461-1479. https://doi.org/10.1080/09669582.2015.1122016

Sarpong, A. Y., Bein, M. A., Gyamfi, B. A., & Sarkodie, S. A. (2020). The impact of tourism arrivals, tourism receipts and renewable energy consumption on quality of life: A panel study of Southern African region. *Heliyon*, *6*(1), e05351. https://doi.org/10.1016/j.heliyon.2020.e05351

Sebri, M., & Ben-Salha, O. (2014). On the causal dynamics between economic growth, renewable energy consumption, CO2 emissions and trade openness: Fresh evidence from BRICS countries. *Renewable and Sustainable Energy Reviews*, *39*, 14-23. https://doi.org/10.1016/j.rser.2014.07.033

Smil, V., & Knowland, W. E. (1980). *Energy in the developing world: The real energy crisis, (eds)*. Oxford:Oxford University Press:

Statista. (2022). *The statistics portal for market data, market research and market studies, hamburg, global tourism industry statistics*. Retrieved from https://www.statista.com/topics/962/global-tourism/

Theobald, W. F. (2005). *Global tourism* (3rd ed.). Burlington: Elsevier Butterworth-Heinemann.

Tugcu, C. T., & Topcu, M. (2018). The impact of carbon dioxide (CO2) emissions on tourism: Does the source of emission matter. *Theoretical and Applied Economics*, *25*(614), 125-136.

WDI. (2022). *World development indicators by the world bank*. Washington DC: WDI Publishing.

Westerlund, J. (2007). Testing for error correction in panel data. *Oxford Bulletin of Economics and Statistics*, *69*(6), 709-748. https://doi.org/10.1111/j.1468-0084.2007.00477.x