Environment, Development and Sustainability (2022) 24:3334–3355
https://doi.org/10.1007/s10668-021-01568-w

Does tourism promote or reduce environmental pollution? Evidence from major tourist arrival countries

Chien-Ming Wang[1] · **Tsung-Pao Wu**[2]

Received: 21 December 2020 / Accepted: 4 June 2021 / Published online: 19 June 2021

Abstract
This study aims to investigate the impact of the inbound tourism development on the environment in the top five important tourist arrival countries from 1995 to 2018. This paper studies the newly developed cointegration test that is applied to the bootstrap autoregressive distributed lag framework in order to investigate the long-run relationship. Evidence of the long-run relationship was found when carbon emissions served as dependent variables in France, the USA, and China. In the short-run relationship, the empirical results confirm that the development of China's tourism industry and economic growth is mutually reinforcing, and there is a bidirectional impact on the economic growth and CO2 emissions. Further findings show a unidirectional impact on tourism development and CO2 emissions in the USA and Italy. The continued growth of tourism has played a vital role in the economic growth of France and China. It appears that tourism development has promoted environmental sustainability. The findings have valuable policy implications so that a sustainable tourism investment or a low-carbon economic investment can reduce CO2 emissions in the USA, France, and Italy but China must implement a sustainable tourism environmental development policy more effectively in order to reduce environmental pollution caused by tourism.

Keywords Tourism development · Carbon emissions · Economic growth · Bootstrap ARDL test

1 Introduction

Over the past 2 decades, the statistics of the World Tourism Organization's annual report indicate that many countries have observed a significant growth in tourism as these countries have adopted tourism promotion policies. In 2018, the number of international tourists increased by 5%, exceeding the 1.4 billion mark. The export revenue of the tourism industry has grown to 1.7 trillion US dollars, which is achieved two years ahead of the prediction of the United Nations World Tourism Organization. Tourism development

✉ Chien-Ming Wang
cmwang8@gmail.com

[1] Department of International Business, Ming Chuan University, Taipei, Taiwan

[2] School of Accounting and Finance, Beijing Institute of Technology, Zhuhai, China

creates more job opportunities and becomes a catalyst for innovation and entrepreneurship, which in turn promotes global power for economic growth and development (World Tourism Organization (UNWTO), 2019). The emergence of a tourism-led growth hypothesis has found that the inbound tourism development may have a mutual impact on the gross domestic product (GDP) (Balaguer & Cantavella-Jorda, 2002). Inbound tourism plays the role of an important determinant in the long-term GDP growth (Adnan Hye & Ali Khan, 2013; Brida et al., 2016; Dogru & Bulut, 2018; Hatemi et al., 2014, 2018; Katircioglu, 2009; Nowak et al., 2007). For the governments of the major inbound tourism countries, determining the effectiveness of tourism companies is of utmost importance. Optimizing the allocation of resources to promote the development of tourism thereby takes advantage of the multiple policies of tourism.

Although tourism development shows a significant positive impact on the GDP, it may have an adverse impact on the environment. Many tourist activities require large amounts of electricity generated from fossil fuels or coal, natural gas, or oil. Even the logistics business is generated during the travel process, and special logistics services and transportation-related logistics infrastructure cause serious environmental problems due to poor logistics infrastructure (Khan et al., 2019; Khan et al., 2020b; Rehman Khan & Yu, 2020). Therefore, a large amount of CO2 is emitted. For example, in 2016, the global transport and freight on CO2 emissions were estimated to a total of 7.23 billion tons, of which the passenger transport generated 64% of carbon dioxide (World Tourism Organization (UNWTO) & International Transport Forum, 2019). Transportation, accommodation, and other tourism-related activities can have serious adverse effects on the environment (Jones & Munday, 2007). However, with changes in travel policies and methods, CO2 emissions can be significantly reduced with the sustainable development of the environment (Scott, 2011).

After the United Nations Climate Change Conference (UNCCC) in Denmark, the low-carbon economy may become the "fourth industrial revolution." The new direction of the tourism policy is implemented with a low-carbon economy or a new low-emission technology, which helps reduce CO2 emissions and continues to increase the number of tourists (Tang et al., 2011a). The low-carbon economy or the sustainable development of the environment requires the use of renewable energy in order to replace non-renewable energy because renewable energy can effectively reduce environmental pollution (Khan et al., 2020a; Khan et al., 2020a, b, c; Nathaniel & Khan, 2020). Effective air control and more energy-efficient restrictions on the number of flights or policies can reduce CO2 emissions. Depending on the development of a low-carbon economy, there may be an uncertain relationship between tourism and carbon dioxide.

The relationship between tourism and carbon emissions in the top five countries (France, Spain, United States, China, and Italy) with the most inbound tourism is presented herein. Since the top five countries with the highest number of inbound tourists receive 1/4 of worldwide arrivals as ranked by the World Tourism Organization as of 2018 (UNWTO, 2019), they earn 444 billion US Dollars in the same year. Especially, France, Spain, United States, China, and Italy are also the top countries that emit carbon dioxide from fossil fuels. For example, the USA, China, France, and Spain are the countries that contribute to the highest carbon dioxide fossil fuel emissions. It is more practical to investigate the relationship between tourism development and carbon emissions in these countries. The tourism environmental policies of countries with a large tourist population show a more profound and influential impact on the global tourism environment. Figure 1 shows an increase in the number of inbound tourists from the top five inbound tourism countries. The trend of the inbound population growth in France

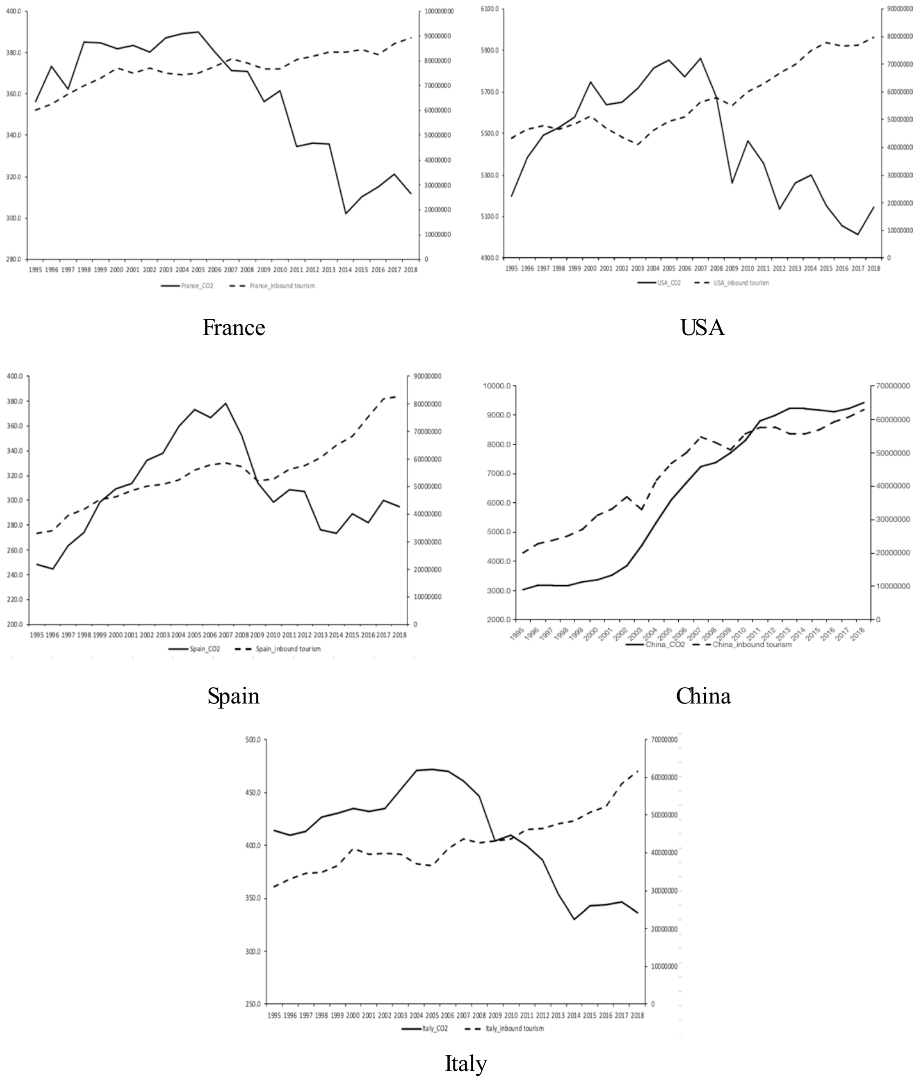

Fig. 1 CO2 emissions and tourism of top five countries

is relatively flat, and the inbound population growth in the USA, Spain, China, and Italy has grown significantly. However, in countries other than China, inverse U-shaped carbon emissions can be observed, which first increase and then decrease. Among the top five countries, only in China, the long-term trend is the same as that of the inbound growth. It can be observed that the changes in the tourism industry and the sustainable development of the environment may vary between different countries and policies, and it is considered an important issue that requires to be further examined.

Most of the studies consider multi-country research and generally use the technique of penal data for analysis (Akadiri & Akadiri, 2019; Dogan et al., 2017; Fethi & Senyucel, 2020; Koçak et al., 2020; Lee & Brahmasrene, 2013; Paramati et al., 2017; Saha

& Yap, 2014; Zaman et al., 2016). In the research of macroeconomic variables with small sample attributes, the panel analysis is usually used for solving the drawbacks. This research focuses on the country-specific studies with time-series data in order to examine the relationship between tourism and CO2 emissions so that considering the bootstrapping procedure in the ARDL model has a larger size and more power properties with small sample than the ARDL-bound test proposed by Pesaran et al. (2001). Therefore, this research explores the country-specific studies that show the relationship between inbound tourism and the economy and considers the role of CO2 emissions in various countries. The key objectives of this research are the following. (1) To examine the sustainable impact of inbound tourism on different environmental qualities and economic growth because the top five major tourism countries guide global sustainable tourism policies. (2) To find the long-run relationship among CO2 emissions, inbound tourism development, and economic growth by using a specific bootstrap ARDL model developed by McNown et al. (2018), as well as the short-run relationship. This is the first application of the newly proposed econometric research method that investigates the relationship between inbound tourism development, economic growth, and carbon dioxide emissions. (3) To propose the corresponding policy enlightenment according to the difference.

This paper is organized as follows. In Sect. 2, we focus on the critical reviews of the relationship between CO2 emissions from tourism and the economic growth in the literature. In Sect. 3, we introduce data and framework models. In Sect. 4, we discuss the results and findings. Finally, in Sect. 5, we present conclusions and discuss the future course of action.

2 Literature review

So far, given the potential connection, the relationship between socioeconomic factors such as the environment and tourism development has provided useful suggestions for scholars and policymakers. Therefore, in order to understand the role of this study in past studies, the literature discusses the tri-variate relationship among tourism development, CO2 emissions, and economic growth.

2.1 CO2 emissions and economic growth

In the past, most research studies in this area have focused on how the environment impacts economic growth and on the reverse impact. It primarily analyzes the Environmental Kuznets Curve (EKC) hypothesis, in which the relationship between the environment and economic growth demonstrates an inverse U shape. Akadiri et al. (2019) and Grossman and Krueger (1995) first proposed that the initial income of a country's economy is positively correlated with environmental pollution, but when income grew to a certain threshold, pollution begins to decrease. Many research works showed the existence of the EKC hypothesis (Akbostancı et al., 2009; Bimonte, 2002; Lise, 2006). Selden and Song (1994) have examined the EKC hypothesis by using the penal data analysis that provides consistent results.

The economic growth and energy consumption affect the cointegration and causality of CO2 emissions by using the bootstrap ARDL test for G7 countries. Cai et al. (2018) reexamined and found that the economic growth in France, Italy, and the USA shows no significant long-run and short-run relationships with CO2 emissions and vice versa. The study investigated the role of energy, real income, and globalization in assessing the environment and found that increasing globalization reduced per capita carbon dioxide emissions in Italy (Saint Akadiri et al., 2019a, b, c). The report on China using the ARDL-bound test indicates that the economic growth shows a positive correlation and significant CO2 emissions in the cointegration and error correction method (Alam et al., 2016). The existence of nonlinear relationships shows the inverted U-shaped curve linkage between CO2 emissions and income in Spain (Esteve & Tamarit, 2012). However, in other countries, the report of Turkey using the ARDL-bound test shows a two-way causal relationship between income and CO2 emissions (Halicioglu, 2009). By supporting an inverted U-shaped curve in the EKC hypothesis for Malaysia (Saboori et al., 2012; Jebli et al., 2016) establish long- and short-run relationships between CO2 emissions and economic growth and verify the EKC hypothesis for OECD countries. It is clear that there is a distinct functional relationship between economic factors and environmental changes as compared to the previous literature.

2.2 Tourism development and economic growth

In the past, many studies have shown that the inbound tourism development shows a long-run and stable impact on the region's economic growth (Chatziantoniou et al., 2013; Crouch, 1994; Ghartey, 2013; Husein & Kara, 2011). The inbound tourism development, which represents the source of income and consumption, is considered a non-standard type of export (Balaguer & Cantavella-Jorda, 2002). Previously, several researchers have studied the correlation between economic growth and tourism development (Cortes-Jimenez et al., 2011; Durbarry, 2004; Oh, 2005). These results show a tourism-led growth hypothesis. Balaguer and Cantavella-Jorda (2002) observed that a cointegration relationship exists in the development of inbound tourism and economic growth in Spain from 1975 to 1997. Income from tourism shows a positive impact on the economic growth of Spain. In contrast to the research of Balaguer and Cantavella-Jordá (2002) and Oh (2005) indicated that there was no long-run relationship between these two variables. He further reported that the one-way cause and effect relationship shows the short-run impact on the economic growth and the development of tourism, but the tourism-led economic growth was not experienced in South Korea. Examining the relationship between tourism and economic growth in the small island developing states, the empirical results show that tourism promotes economic growth (Roudi et al., 2019). Deng et al. (2014) adopted the panel data analysis in 30 provinces of China from 1987 to 2010 and indicated that there had been a slow reverse impact of the tourism-led growth in that period. Their results further showed that tourism activity decreased economic growth by forcing out human capital. In addition to the above economic indicators, the non-economic indicators, such as terrorism, regional situations, and geopolitical risk index, affect tourism and economic growth (Alola et al., 2020; Araña & León, 2008; Saha & Yap, 2014; Saint Akadiri et al., 2020; Uzuner et al., 2020). These past studies have proved that the development of inbound tourism shows different relations with different countries, such as the long-run and short-run economic growth relations.

Tourism development may also show a negative impact on regional development trends. Some studies have observed that more inbound tourism development may remove traditional local industries, such as fisheries, agriculture, and industry, and thus impact the national economic growth, which will turn human resources into tourism (Adams & Parmenter, 1995; McCool & Martin, 1994). Overtourism may have more serious consequences. The destruction of natural landscapes and cultural heritage may develop anti-tourism phenomena, thus resulting in a negative impact on the tourism industry (Kuščer & Mihalič, 2019; Seraphin et al., 2018).

2.3 Tourism development and CO2 emissions

Inbound tourism involves a lot of transportation, accommodation, and activities that depend on fossil fuels. However, fossil fuels have a great dependence on carbon emissions. Solarin (2014) reported a bidirectional impact on CO2 emissions and inbound tourism, and a positive impact was observed on CO2 emissions from the development of inbound tourism in Malaysia. The development of inbound tourism can cause serious pollution problems to the environment quality in less developed and developing countries (León et al., 2014). Similar results were observed in Turkey (Eyuboglu & Uzar, 2019) and Cyprus (Katircioglu et al., 2014). The Organization for Economic Co-operation and Development (OECD) investigated that environmental pollution will become a more serious problem because of tourism development (Dogan et al., 2017) and also reported the same results in EU and candidate countries (Dogan & Aslan, 2017). Bano et al. (2021) supported the tourism-led emission hypothesis for Pakistan. Most of the top 50 tourist countries should pay attention to environmental pollution caused by tourism. Countries such as Turkey, Thailand, Russia, Greece, Saudi Arabia, Macao, Indonesia, Brazil, Dominica, Philippines, Bulgaria, Tunisia, Egypt, Iran, Georgia, Hong Kong, India, and Malaysia must reduce carbon emissions and develop a sustainable environment (Fethi & Senyucel, 2020). Shi et al. (2019) explored different results in tourism development and CO2 emission because of different incomes in the countries. They adopted the panel data analysis for five different income groups that showed causality from inbound tourism to CO2 emission (Haseeb & Azam, 2020). A large number of international tourism countries show an important correlation with the degree of globalization. The globalization–tourism-induced EKC hypothesis has been proposed and proved to be significantly related to the environment. Therefore, the impact of globalization and international tourism contributes to environmental pollutions that are more internal (Akadiri, et al., 2020a, b; Uzuner et al., 2020; Saint Akadiri et al., 2019a, b, c; Saint Akadiri et al., 2019a, b, c). The results show that the impact of inbound tourism on CO2 emissions was positive and significant.

In contrast, this study investigates the relationship between inbound tourism and CO2 emissions from the panel data analysis of the European Union. The results show a cointegration (long-run) relationship between CO2 emissions, tourism, FDI, and economic growth, and the inbound tourism development shows a negative and significant impact on CO2 emissions (Lee & Brahmasrene, 2013). Katircioğlu (2014) examined how the inbound tourism development affects the CO2 emissions in long and short runs from the period 1971 to 2010. The results show that the impact of the development of inbound tourism on CO2 emissions is negative and significant in Singapore. Similar results indicate that in China inbound tourism shows a negative impact on CO2 emissions by using panel causality tests (Zhang & Gao, 2016). Ahmad et al. (2019) investigated the influence of tourism on environmental pollution in the low- and middle-income countries, namely, Indonesia, the Philippines, and Vietnam. The results further confirm that the development of inbound tourism shows a negative impact on environmental pollution in Vietnam; however, tourism development reduces the environmental quality of Indonesia and the Philippines.

The existing literature confirms that the improved environmental quality shows the contribution of a country to the environment and its economic progress. The study primarily showed that the environmental degradation caused by a large number of tourists increases carbon dioxide emissions. However, the current research results do not completely agree with the fact that tourism causes environmental pollution. On the contrary, there is evidence that tourism promotes environmental quality. Tourism development strategies provide different results in different countries.

3 Data and empirical

3.1 Data

Annual data are collected from the period 1995 to 2018 and included five countries. The countries considered were France, the USA, Spain, China, and Italy because these countries were the top five destinations of international tourist arrivals in the world (UNWTO, 2018). CO2 emissions (million tons of carbon dioxide), tourism development (international tourism and number of arrivals), and economic growth (real GDP and current US dollars) were derived from the World Bank Open Data and BP Statistical Review of the World Energy. A natural logarithm form of the three variables was necessary to reduce the heteroscedasticity. The summary statistics of CO2 emissions, economic growth, and tourism development are presented in Table 1.

Our empirical model examines the cointegration between three series in the top five tourist arrival countries (Akadiri et al., 2019; Balli et al., 2019; Eyuboglu & Uzar, 2019; Lee & Brahmasrene, 2013), which can be defined as follows:

$$\ln CO2_t = f\left(\ln \text{GDP}_t,\ \ln \text{TOU}_t\right) \tag{1}$$

Table 1 Summary statistics

Country	Variables	Mean	Max	Min	SD	Skew	Kurt
France	GDP	23.843	24.108	23.500	0.193	− 0.454	1.827
	CO2	5.876	5.966	5.711	0.083	− 0.671	2.109
	Tourism	18.156	18.308	17.910	0.097	− 0.943	3.646
USA	GDP	25.669	25.908	25.349	0.157	− 0.479	2.297
	CO2	8.604	8.876	8.520	0.049	− 0.110	1.698
	Tourism	17.842	18.194	17.534	0.214	0.373	1.734
Spain	GDP	23.179	23.522	22.802	0.228	− 0.373	1.706
	CO2	5.724	5.937	5.499	0.123	0.084	2.268
	Tourism	17.799	18.232	17.311	0.236	− 0.166	2.897
China	GDP	24.493	25.559	23.336	0.755	− 0.021	1.511
	CO2	8.670	9.152	8.016	0.448	− 0.347	1.412
	Tourism	17.556	17.957	16.813	0.366	− 0.697	2.016
Italy	GDP	23.647	23.920	23.374	0.150	− 0.157	2.151
	CO2	6.008	6.158	5.799	0.115	− 0.523	2.019
	Tourism	17.560	17.936	17.251	0.172	0.331	2.649

***Significance at the 1% level

where TOU_t represents the number of tourists in the country in year t, GDP_t represents the real GDP, and CO_{2t} represents carbon emissions in tons in year t. The environmental changes caused by economic development and tourism development require a lot of attention, especially the impact of tourism as the development of the aviation industry has reached a new level in recent years. The examination of the impact of the above function (formula 1) on important tourism arrival countries shows the outcome of a good tourism policy.

3.2 Econometric methodology

Inbound tourism development, carbon dioxide and economic growth are the target variables of this study, and examine the cointegration relationship between them is being applied in our empirical method, which is termed as bootstrap auto regressive distributed lag (bootstrap ARDL) model McNown et al., (2018) for examining dynamics relationship. However, the ARDL model can be specified as follows:

$$\begin{aligned} \ln CO2_t = \alpha_0 + \sum_{i=1}^{n} \alpha_{1,i} \ln CO_{2t-1} + \sum_{i=0}^{n} \alpha_{2,i} \ln GDP_{t-1} \\ + \sum_{i=0}^{n} \alpha_{3,i} \ln TOU_{t-1} + \sum_{j=0}^{m} \beta_j D_{t,j} + e_t \end{aligned} \tag{2}$$

where t denotes the time period $t = 1, 2, \ldots, T$, and i and j are index of lags $i = 1, 2, \ldots, n$; $j = 1, 2, \ldots, m$; $D_{t,l}$ is a dummy variable and β is the coefficient of shot break variable. α_1, α_2, and α_3 represents parameters for the coefficients of the lag of $\ln CO2_t$, $\ln GDP_t$ and $\ln TOU_t$; e_t represents the normal distributed error term. This starting model was generated in an error correction from as follows:

$$\begin{aligned} \Delta \ln CO2_t = \alpha + \delta \ln CO2_{t-1} + \theta \ln GDP_{t-1} + \gamma \ln TOU_{t-1} \\ + \sum_{i=1}^{n} \psi_i \Delta \ln CO2_{t-i} + \sum_{i=1}^{n} \varphi_i \Delta \ln GDP_{t-i} + \sum_{i=1}^{n} \eta_i \Delta \ln TOU_{t-1} + \varepsilon_t \end{aligned} \tag{3}$$

where $\delta = 1 - \sum_{i=0}^{n} \alpha_{1,i}$; $\theta = \sum_{i=0}^{n} \alpha_{2,i}$ and $\gamma = \sum_{i=0}^{n} \alpha_{3,i}$. ψ_i, φ_i and η_i are function parameters in Eq. (2).

Pesaran et al. (2001) explain that there is a rejection of the null hypothesis, that is, has a cointegration relationship between variables that adopting F test (F_x) $H_0: \delta = \theta = \gamma = 0$ and t test (t) $H_0: \delta = 0$. Pesaran et al. (2001) ARDL-bound test chart critical values for F_x and t tests. There are the upper bound and lower bound computing in critical value, if the estimated value from the ARDL-bound model is greater than the upper threshold or less than the lower threshold, it indicates that they have cointegration in the model. McNown et al. (2018) suggest to add a new F test (F_y) $H_0: \theta = \gamma = 0$ to complement the cointegration relationship and estimate critical value for F_x, t and F_y test using Monte Carlo simulations. Thus, the bootstrapping procedure has a more size and power properties.

The bootstrap ARDL test can define cointegration, non-cointegration, case 1 and case 2 by the results of F_x, t and F_y:

- *Cointegration*: The all three null hypothesis was rejected in F test (F_x) $H_0: \delta = \theta = \gamma = 0$, t test (t) $H_0: \delta = 0$, and F test (F_y) $H_0: \theta = \gamma = 0$
- *Non-cointegration*: Do not reject the null hypotheses F test (F_x), t test (t) or F test (F_y).

- *Case 1*: Degenerate Case 1 have to reject the null hypotheses F test (F_x) and F test (F_y) but no reject the null hypotheses t test (t).
- *Case 2*: Degenerate Case 2 have to reject the null hypotheses F test (F_x) and t test (t) but no reject the null hypotheses F test (F_y).

Non-cointegration, case 1 and case 2 mean that they are no cointegration among the three variables. Pesaran et al. did not show for case 1 in the critical value, because they omitted to test F test (F_y). In fact, bootstrap ARDL has been applied in many studies, such as: energy economy (Alhodiry et al., 2021; Ghazouani et al., 2020; Goh et al., 2017a, b; Pata & Aydin, 2020; Tong et al., 2020), environmental economy (Lin et al., 2018; Meirun et al., 2021; Pata, 2019; Wang et al., 2019; Yilanci et al., 2020), and international trade issues (Goh et al., 2017a, b; Nawaz et al., 2019; Saleem & Shabbir, 2020; Wu et al., 2020).

The running of the short-run relationship can be proposed by Granger causality, after directing for the cointegration estimating the bootstrap ARDL. When this test has existed cointegration among the variables, the short-run causality test has impact of GDP and inbound tourism development to CO2 emissions have to include the lagged level of the two independent variable and lagged differences on GDP and tourism development; that is, we estimate whether $\theta = 0$ and $\varphi_i = 0$ or $\gamma = 0$ and $\eta_i = 0$. However, if there is not existing cointegration from GDP and tourism development to CO2 emissions, then the Granger causality test only estimate whether $\varphi_i = 0$ or $\eta_i = 0$.

4 Main results and discussion

4.1 The unit root

The traditional ARDL shows that the all series the inclusion of both I (0) or I (1) time series in cointegration relationship. The bootstrap ARDL test also allows the modeling of variables with the 1 or less order of integration. In other words, at least, all series have to stationary after first differential. We then carefully checked the integration order which contains three variables for each country to understand the properties of each time series. To better understand how to check the unit root properties of three variables that the augmented Dickey–Fuller (Dickey & Fuller, 1981) (ADF) has used to test for with and without structural breaks. Table 2 shows ADF with intercept and trend unit root test results at level and first difference values for CO2 emissions, real GDP, and tourism development. Most, but not all, we indicated non-stationary conclusions in the level column. However, this shows that three variables are I (1) process, because these variables turn stationary in the first difference column. Table 2 shows the ADF unit roots with structural breaks, taking into account the unit breaks in the series of unit root tests. To this end, we introduced the ADF unit root test of Kim and Perron (2009), which contains an unknown structural break of the three series. Thus, it was suitable to report to examine the existence of cointegration among CO2 emissions, inbound tourism development, and economic growth.

4.2 Bootstrap ARDL model with structural breaks

After the integration order of the three variables is determined and tested, this paper applies the bootstrap ARDL model in order to examine whether there is a long-run effect on CO2 emissions, tourism development, and economic growth. The development of the bootstrap

Table 2 Univariate unit root tests

Country	Variables	At level			At first differences		
		ADF (intercept)	ADF (trend and intercept)	ADF (break year)	ADF (intercept)	ADF (trend and intercept)	ADF (break year)
France	GDP	− 0.957 (0)	− 1.515 (0)	− 4.201 (2002)*	− 3.513 (0)**	− 3.422 (0)*	− 4.149 (2003)
	CO2	− 0.370 (0)	− 2.595 (0)	− 3.616 (2010)	− 6.346 (0)***	− 6.677 (0)***	7.814 (2014)***
	Tourism	− 1.258 (3)	− 3.099 (0)	− 3.755 (2010)	− 3.399 (2)**	− 3.076 (2)	− 4.897 (2000)**
US	GDP	− 2.654 (0)*	− 2.836 (1)	− 3.618 (2012)	− 2.624 (0)	− 2.706 (0)	− 4.741 (2009)*
	CO2	− 1.239 (0)	− 2.654 (0)	− 4.419 (2008)*	− 2.179 (2)*	− 4.811 (1)***	− 6.439 (2009)***
	Tourism	− 0.054 (0)	− 2.285 (1)	− 2.112 (2003)	− 3.730 (0)**	− 3.793 (0)**	− 5.929 (2010)***
Spain	GDP	− 1.215 (1)	− 3.303 (5)*	− 4.219 (2002)*	− 3.269 (0)**	− 3.180 (0)*	− 3.909 (2003)
	CO2	− 2.719 (5)*	− 1.590 (0)	− 2.928 (2012)	− 3.349 (0)**	− 3.864 (0)**	− 4.569 (2005)**
	Tourism	− 1.415 (1)	− 2.294 (3)	− 4.630 (2015)**	− 3.064 (0)**	− 3.025 (0)	− 4.267 (2009)*
China	GDP	− 0.692 (1)	− 3.079 (3)	− 5.124 (2005)***	− 3.227 (7)**	− 4.456 (9)**	− 2.537 (2014)
	CO2	− 3.162 (5)**	− 0.521 (5)	− 9.937 (2002)***	− 2.170 (4)	− 3.880 (4)**	− 5.506 (2011)***
	Tourism	− 2.325 (0)	− 1.422 (0)	− 3.721 (2003)	− 5.025 (0)***	− 5.641 (0)***	− 6.048 (2006)***
Italy	GDP	− 1.373 (0)	− 1.323 (0)	− 4.599 (2002)**	− 3.702 (0)**	− 3.573 (0)*	4.412 (2003)*
	CO2	0.149 (0)	− 1.346 (0)	− 2.954 (2011)	− 3.172 (0)**	− 3.577 (0)*	− 4.265 (2009)*
	Tourism	− 0.011 (0)	− 1.658 (0)	− 1.467 (2015)	− 4.097 (0)***	− 4.098 (0)**	− 4.570 (2004)**

***, **, *Significant are the1%, 5%, and 10% levels, respectively. The figure in the parenthesis is the optimal lag structure for ADF tests as determined by the Schwert (1989) formula

ARDL test has more advantages than the ARDL-bound test because the bootstrap ARDL testing approach discusses F_x, t, or F_y. Table 2 presents the results of the bootstrap ARDL model that accommodated structural breaks by using dummy variables.

From Table 2, we find that the existence of the cointegration relationship in the model rejected the hypothesis of the F_y test, F_x test, and t test because both economic growth and tourism development are considered independent variables. The main results of these three tests show the presence of the bootstrap ARDL testing of cointegration at a significance level of 10%.

The significant empirical results are obtained for three critical valued tests when the GDP growth and tourism development are used as independent variables in the CO2 emission function in France, the USA, and China. Besides, we only find evidence of cointegration results in the USA when the economic growth is considered as a dependent variable. However, when CO2 is the dependent variable, we have failed to find cointegrated results for Spain and Italy.

The results of long-run coefficients are presented in Table 4. When the economic growth and tourism development increase by 1%, CO2 emissions decrease by 0.06% and 0.355% in the long run in France (Dogan & Aslan, 2017; Shi et al., 2019). In the long run, there is no growth-led emission because more wealth and income make people pay more attention to environmental protection in France. In China, we find that the effect of tourism development is positive and significant to CO2 emissions by 0.416%. It is evident from Zhang and Gao (2016) that support to tourism development would harm the environment in China. However, the empirical results have been confirmed by Eyuboglu and Uzar (2019), Katircioglu et al. (2014), and Shi et al. (2019). Tourism development indicating a statistically significant and positive effect on the environment proves that it has a crucial impact in the long term. This indicates that economic growth positively affects CO2 emissions with a coefficient of 0.212% in the USA, and tourism development negatively affects CO2 emissions (Lee & Brahmasrene, 2013; Shakouri et al., 2017; Shi et al., 2019; Zhang & Gao, 2016). In the USA, when the economic growth is considered as a dependent variable, we find the long-run relationship between CO2 emissions and tourism development as they show a negative and significant impact on the economic growth by 0.423% and 0.122%. These results have also been reported by Lee and Brahmasrene (2013).

Applying the cumulative sums of the recursive residuals (CUSUM test) and squares of recursive residuals (CUSUM of square tests), the robustness of the cointegration tests is studied (Brown et al., 1975), which is based on two different residual tests. The results of the CUSUM and CUSUM of square tests are found stable at a significance level of 5%, as shown in Table 3.

4.3 Short-run causality test

Furthermore, we also estimated the Granger causality based on ARDL model, as shown in Table 4. Our research shows that the development of inbound tourism stimulates the consumption of the inbound country and the commercial development of tourism. This shows a positive impact on the domestic economic growth and is found statistically significant, which supports the growth hypothesis of tourism dominated by France and China. However, in the USA, inbound tourism development shows a negative and significant impact on economic growth. In China, the impact of CO2 emissions is positively associated with economic growth, but it is negatively and significantly associated with the economic growth in Italy. The economic growth increases while increasing CO2 emissions in the USA, but

Table 3 Bootstrap ARDL model cointegration test results

	Variable	Break year	F_x	F_x*	F_y	F_y*	t	t*	Result	CUSUM	CUSUMsq
France	GDP = f(CO2, Tourism)	2004	1.431	4.704	− 0.862	− 3.025	0.778	5.754	NO	Stable	Stable
	CO2 = f(GDP, Tourism)	2011,2014	***5.732***	3.339	***− 3.067***	− 1.990	***8.589***	3.635	**Cointegration**	Stable	Stable
	Tourism = f(GDP, CO2)	1999, 2011	0.853	4.128	− 0.997	− 2.692	1.251	4.613	NO	Stable	Stable
US	GDP = f(CO2, Tourism)	1999, 2004, 2013	***6.554***	3.713	***1.449***	− 1.989	***9.245***	4.132	**Cointegration**	Stable	Stable
	CO2 = f(GDP, Tourism)	1999, 2009	***4.107***	3.309	***− 3.036***	− 2.075	***6.053***	3.856	**Cointegration**	Stable	Stable
	Tourism = f(GDP, CO2)	2006、2010	3.912	4.959	− 2.918	− 2.705	5.863	6.192	NO	Stable	Stable
Spain	GDP = f(CO2, Tourism)	2004	2.488	4.206	− 2.002	− 2.554	3.644	5.091	NO	Stable	Stable
	CO2 = f(GDP, Tourism)	1999, 2004, 2009	2.544	3.954	0.299	− 2.236	2.927	4.282	NO	Stable	Stable
	Tourism = f(GDP, CO2)	1998, 2002, 2014	0.155	2.897	− 0.199	− 1.721	0.146	3.206	NO	Stable	Stable
China	GDP = f(CO2, Tourism)	2007	23.20	5.405	***− 3.852***	− 0.327	***7.729***	3.578	NO	Stable	Stable
	CO2 = f(GDP, Tourism)	2002, 2005, 2010	***5.479***	4.878	***− 1.864***	− 1.353	***4.750***	4.021	**Cointegration**	Stable	Stable
	Tourism = f(GDP, CO2)	2000, 2004, 2007	0.934	3.243	− 0.779	− 1.589	1.017	3.189	NO	Stable	Stable
Italy	GDP = f(CO2, Tourism)	2004, 2015	1.784	4.797	− 2.102	− 3.023	1.022	5.800	NO	Stable	Stable
	CO2 = f(GDP, Tourism)	2003, 2009, 2013	1.147	3.009	− 0.949	− 1.837	1.567	3.081	NO	Stable	Stable
	Tourism = f(GDP, CO2)	1999, 2007, 2015	1.347	3.251	− 0.399	− 1.530	1.677	3.523	NO	Stable	Stable

[.] is optimal lag by AIC. 1999 means a dummy variable for the year 1999; other years are 0. F is the F-statistics for the coefficients of y_{t-1} and x_{t-1}; t_dep is the t-statistics for the dependent variable, and t_indep is the t-statistics for the independent variable. F_x*, F_y*, and T_{indep}* are the critical value at the 10% significance level, generated from the bootstrap program

Table 4 Long-run coefficient results

Country	France	China	USA	USA
Dependent Variables	lnCO2	lnCO2	lnCO2	lnGDP
lnCO2				– 0.4235*** (0.1002)
lnGDP	– 0.0605* (0.0330)	– 0.0241 (0.1439)	0.2121** (0.0827)	
lnTOU	– 0.3551*** (0.1047)	0.4163** (0.1623)	– 0.0453* (0.0254)	– 0.1222*** (0.0379)
C	9.5110*** (2.3360)	– 3.6792** (1.5148)	– 2.2737 (2.3832)	4.4295*** (1.0351)
R-squared	0.9104	0.9018	0.9953	0.7430

***, **, *Significance at the 1%, 5% and 10% levels, respectively

CO2 emission is significantly reduced in China. We observed that the effect of the inbound tourism development could reduce CO2 emissions in the USA and Italy. In Spain, China, and Italy, the economic growth shows a negative and significant impact on the inbound tourism development. The relationship between CO2 emissions and inbound tourism development is positive and statistically significant in France.

4.4 Empirical discussion

This section examines the top five inbound tourism countries through the bootstrap ARDL model with structural breaks, analyzes the cointegration relationship between CO2 emissions, economic growth, and tourism development, and explains the short-run Granger causality. The long-run result shows that the economic growth and inbound tourism development are negative and the most significant contributors to CO2 emissions in France. It indicates that tourism development in France has promoted environmental sustainability (Bella, 2018). A low-carbon economy has developed in the tourism industry in order to reduce CO2 emissions (Lee & Brahmasrene, 2013).

The United Nations Climate Agreement monitors international flights by using carbon offset and the modification of the aircraft design in order to improve the fuel efficiency, route planning, development of biomass fuels, etc., at the COP 21 in Paris. The blueprint of French policymakers for the tourism industry encourages tourist groups to protect and understand the environment quality. The hotel industry in tourism can propose eco-certified services, such as wastewater and waste recycling, in order to encourage tourists to support green transportation and enhance the effectiveness of transportation, such as mass transportation instead of self-driving or car sharing. It also provides a green passport to promote tourists in order to collectively protect ecological diversity (Bella, 2018). The French government implements the United Nations sustainable development goals (SDGs), including 17 goals and 169 targets after 2014. Among them, policies are formulated and implemented in the tourism industry in order to monitor the impact of sustainable development on the creation of employment and the promotion of the sustainable tourism of local culture and products. Its objective is to ensure a sustainable consumption and production model.

When the economic growth of France exceeds the threshold, the economic growth leads to high environmental quality that is associated with the Environmental Kuznets Curve (EKC) hypothesis (Dogan & Aslan, 2017) in the long-run relationship. However, we observed a unidirectional relationship between the inbound tourism development and economic growth and CO2 emissions and inbound tourism development in the short-run relationship in France. The presence of the tourism-led growth (TLG) hypothesis is supported by many research studies, including our study. The TLG hypothesis is validated for France (Dritsakis, 2012).

The USA is the world's second largest contributor to CO2 emissions, accounting for 14% of the total global CO2 emissions. The main sources of carbon emissions in the USA are transportation sectors (accounting for 38.1% of the total domestic energy consumption), residential sectors (16.2%), industrial sectors (15.8%), and service providers (13.4%) (Muntean et al., 2018). The transportation sector proposes many energy-saving and carbon-reducing policy measures, such as a new generation of air transportation systems, other low-emission aviation, highway, and railway programs, road greenhouse gas assessment tools, renewable fuel standard programs, smart road transportation partnerships, light vehicle fuel economy and environmental labels, the National Clean Diesel Campaign, advanced technology automobile manufacturing loan programs, fuel efficiency and renewable fuel measures, national and alternative fuel supplier fleet programs, and other measures (Salari et al., 2021). Many important tourist locations in the USA have improved the public transportation system, thereby reduced the dependence of tourists on private vehicles. In order to reduce the number of cars, they added new buses, and about half of them use compressed natural gas to operate. In addition to the transportation sector, many hotels used different ways to operate under low carbon. For example, the use of power plants powered by clean burning natural gas can provide more than 50% of the electricity required for nearly 2000 rooms of a hotel and thus can reduce carbon emissions by more than 30%.

In the USA, tourism development is not considered a useful policy for promoting economic growth, and therefore the US government focuses on other sectors such as the export sector (export-led growth) or the manufacturing sector that sets up a healthy fiscal or monetary policy in order to promote the economic growth. In the USA, there is a two-way relationship between economic growth and CO2 emissions in cointegration (in the long run), whereas, in the short term, there is a one-way Granger causality between the economic growth and CO2 emissions. The empirical results of the bootstrap ARDL model in the USA show the growth-led emissions when the impact of the economic growth on the environment quality is statistically significant.

The findings of this research reveal that the inbound tourism development does not affect CO2 emissions in Spain. Instead, it is different from the result of Fethi and Senyucel (2020). However, Spain has also implemented the "National Climate Change Adaptation Plan" in recent years by using assessment tools and testing methods in order to measure the impact of Spain's ecosystem on climate change and the environmental impact of different socioeconomic sectors (Cantos & Rebollo, 2016). This further increases the participation of all agencies in different sectors and systems so that climate change policies can be implemented into appropriate sectors that are required to be developed. Among them, Spain has also formulated plans and strategies to adapt to climate change. In each autonomous region, in order to improve the sustainable development and environmental protection of tourism activities, each region initiated some actions, such as water and electricity saving incentives, personnel environmental awareness, and customer training in tourist facilities, which provide a lot of information on sustainable tourism. Although Spain has initiated many actions in order to reduce environmental pollution, the impact of international tourism on Spain's carbon emissions is found to be limited and has no significant effect.

In Italy, however, we do not observe tourism-led growth, but the impact of CO2 emissions on the economic growth and the impact of the inbound tourism development on CO2 emissions are negative and significant. As a member of the European Union, Italy has pledged in its Intended Nationally Determined Contributions (INDCs) to the United Nations Framework Convention on Climate Change (UNFCCC) and the European Union as a whole, by 2030, to reduce at least 40% of the EU's greenhouse gas emissions as compared to 1990. This plan includes a variety of industries such as energy, industrial processes, agriculture, garbage disposal, and urban land planning, including the transportation sector. Italy has put great efforts in reducing emissions, such as the "Clean Skies" program. As Italy is a member of the European Civil Aviation Organization (ECA), its main objective is to reduce carbon emissions caused by the aviation sector (Saint Akadiri et al., 2019a, b, c). The establishment of the Italian National Energy Strategy (INES) is primarily transformed into a low-carbon economy as a long-term goal (Malinauskaite et al., 2019; Sarrica et al., 2018). The development of a low-carbon economy in the tourism industry can sustain environmental resources, which reduces CO2 emissions and can indirectly improve economic growth. Classical churches, historical museums, and a large number of Roman monuments are still the main tourist attractions of Italy. However, Italy began to tout the expansive natural tourism areas and rural scenery guided tours. Strengthening sustainable tourism promotes the development of new tourist attractions, provides more hotel accommodations in natural attractions, and can also increase the image of the agricultural tourism, which is considered suitable for decentralized tourism in order to create the off-season tourism growth. The Bank of Italy proposed recommendations on the theme of the "green investment" policy in the report to improve the tourism waste recycling system, increase the use of energy efficiency, promote the protection of biodiversity and cultural heritage environment, and develop a sustainable tourism map. In turn, it provides a diversified tourism experience and encourages the development of low-polluting sectors in Italy.

In China, the two most important contributors of CO2 emissions are the tourism-related transportation and accommodation sub-sectors in the tourism industry (Meng et al., 2016). In order to fulfill its emission reduction commitments, the Chinese government has issued tourism-related documents, namely the "Opinions of the State Council on Accelerating the Development of the Tourism Industry" and "Guiding Opinions on Further Promoting the Tourism Industry." In recent years, China's tourism industry has introduced low-carbon transportation, low-carbon buildings, and the construction of smart landscape systems. Eliminating old transportation systems with high-carbon emissions and high air pollution and promoting the use of public buses and hybrid vehicles can help reduce carbon dioxide emissions in the tourism industry (Zha et al., 2020). If implemented effectively, it can significantly protect the environment, but the carbon emissions caused by advanced transportation technology can still seriously pollute the environment in China. From the perspective of China's inbound tourism, it pollutes the environment in the long run (Zhang & Zhang, 2020).

Furthermore, a bidirectional causality is observed between the economic growth and CO2 emissions. The economic growth led to tourism, and tourism led to the economic growth are supported by the existing literature (Dogan et al., 2017). In China, where manufacturing is the main economic driver, the increase in carbon emissions can effectively promote economic development, as shown in Table 5. We observed that the short-run economic growth shows a positive impact on the environment and a negative impact on CO2

Table 5 Short-run Granger causality test based on ARDL model

	Independent variable	GDP equation F-statistics (*p* value) (sign)	CO2 equation F-statistics (*p* value) (sign)	Tourism equation F-statistics (*p* value) (sign)
	GDP	–	0.179 (0.908) (−)	1.537 (0.267) (−)
France [2]	CO2	1.046 (0.386) (+)	–	**6.164 (0.021)** (+)**
	Tourism	**6.438 (0.016)** (+)**	0.758 (0.546) (+)	–
	GDP	–	**3.363 (0.066)* (+)**	− 0.402 (0.694) (−)
US [1]	CO2	0.944 (0.411) (+)	–	0.272 (0.789) (+)
	Tourism	**5.473 (0.016)** (−)**	**6.304 (0.012)** (−)**	–
	GDP	–	0.253 (0.783) (+)	**9.321 (0.008)*** (−)**
Spain [2]	CO2	0.126 (0.883) (+)	–	0.659 (0.543) (−)
	Tourism	1.443 (0.282) (−)	2.236 (0.169) (+)	–
	GDP	–	**3.512 (0.069)* (−)**	**3.377 (0.086)* (+)**
China [2]	CO2	**36.887 (0.000)*** (+)**	–	2.037 (0.193) (+)
	Tourism	**7.706 (0.009)*** (+)**	0.293 (0.829) (−)	–
	GDP	–	2.887 (0.114) (+)	**4.367 (0.052)* (−)**
Italy [2]	CO2	**4.621 (0.042)** (−)**	–	1.718 (0.239) (+)
	Tourism	0.955 (0.421) (−)	**3.604 (0.077)* (−)**	–

***, ** and *Significance at the 1%, 5% and 10% levels, respectively. Additionally, (.) are *p* value and sign for the coefficients. The case of non-cointegration and its causality test involved only lagged differenced variables

emissions, which also exist in the long-run relationship. However, the low-carbon economy reduces CO2 emissions and maintains the sustained economic growth associated with the Environmental Kuznets Curve (EKC) hypothesis (Dogan & Aslan, 2017) in the short-run relationship in China.

5 Conclusions

This paper examines and analyzes the long-run equilibrium and the short-run Granger causality dynamics of the top five inbound tourists from 1995 to 2018, including CO2 emissions, inbound tourism development, and the economic growth of the bootstrap ARDL test with structural breaks.

This study explores a long-run equilibrium relationship among the three variables, which indicates that tourism development and the levels of statistically significant economic growth impact CO2 emissions in China, the USA, and France. Therefore, in the long run, in order to reduce CO2 emissions, tourism development plays a key role in France and the USA. The main finding for the USA and Italy shows a negative association between the inbound tourism development and environmental quality, which indicates that the tourism industry can improve pollution emissions in the short run. In Italy, the long-run association was never observed, but a short-run effect was found between CO2 emissions and inbound tourism development. In the USA, the coefficient of economic growth is found to be significant and positive for CO2 emissions, considering the EKC hypothesis. Consequently, the energy consumption and the utilization of the domestic industrial sector have increased environmental pollution in the USA. Nevertheless, the economic growth improves environmental quality in China by reducing CO2 emissions with the low-carbon economy. Thus, the economic development does not depend on a large number of polluting industries but on the policy of low-pollution and environmentally friendly sustainable operations in China.

5.1 Policy implications

The findings of our research reveal, first, aspects of the economic growth and inbound tourism development relationships in France, the USA, and China. The positive impact of the inbound tourism development on economic growth has proved the results of past literature in France and China. The development of tourism infrastructure and supporting facilities can further promote the tourism industry. Therefore, the tourism industry should implement the national industrial layout to help find opportunities and plans for long-term tourism goals in the country and assist decision-makers in achieving fast development. However, the inbound tourism development shows a negative and significant impact on the economic growth of the USA. Tourism development has replaced the resource allocation of other efficient industries (Shahbaz et al., 2018); that is, increasing the resource allocation of the tourism industry in the USA does not effectively improve the economy, but instead, it is counterproductive.

Second, in the long run, in order to reduce CO2 emissions, tourism development plays a key role in establishing and developing low-carbon tourism or sustainable tourist attractions in France and the USA. The more efficient energy consumption of air and road transportation and the development of better renewable energy is considered the key factors in reducing carbon emissions caused by tourism in France and the USA. The application of renewable energy in the tourism industry should be implemented more actively.

However, in China, we recommended increasing the use of renewable energy in the tourism industry and not keeping it limited to the use of traditional fossil energy. China should pay more attention to energy consumption and CO2 emissions caused by tourism in order to promote the low-carbon transition of the tourism industry (Zhang & Zhang, 2020). China should also use sustainable tourism, for example, forest resources and wetland park protection, low pollution, and low energy consumption (Tang et al., 2011) to improve environmental quality.

Despite certain limitations, the results of this study emphasize policy implications for countries with large tourist populations. Future research should be extended to different fields and countries, which can provide more plans for the development of sustainable tourism policies in specific regions. Moreover, for example, renewable energy, sustainable tourism investment, and low-carbon economic investment can be used as important variables for future research and analysis. Investment in sustainable tourism can effectively reduce the carbon dioxide emissions caused by transportation used in the tourism industry and can also increase the income generated by tourism. Therefore, the environmental impact model should consider more tourism investment so that the association between the environment and tourism can be further improved.

Author contributions Chien-Ming Wang designed the research, performed the experiments, and wrote the paper. Tsung-Pao Wu collected the data.

Funding Hubei Provincial Department of Education (Grant No. Q20192205).

Declaration

Conflict of interest Both authors declare that they have no conflict of interest.

References

Adams, P. D., & Parmenter, B. R. (1995). An applied general equilibrium analysis of the economic effects of tourism in a quite small, quite open economy. *Applied Economics, 27*(10), 985–994.

Adnan Hye, Q. M., & Ali Khan, R. E. (2013). Tourism-led growth hypothesis: A case study of Pakistan. *Asia Pacific Journal of Tourism Research, 18*(4), 303–313.

Ahmad, F., Draz, M. U., Su, L., & Rauf, A. (2019). Taking the bad with the good: The nexus between tourism and environmental degradation in the lower middle-income Southeast Asian economies. *Journal of Cleaner Production, 233*, 1240–1249.

Akadiri, S. S., & Akadiri, A. C. (2019). Examining the causal relationship between tourism, exchange rate, and economic growth in tourism island states: Evidence from second-generation panel. *International Journal of Hospitality and Tourism Administration*. https://doi.org/10.1080/15256480.2019.1598912

Akadiri, S. S., Akadiri, A. C., & Alola, U. V. (2019). Is there growth impact of tourism? Evidence from selected small island states. *Current Issues in Tourism, 22*(12), 1480–1498.

Akadiri, S. S., Lasisi, T. T., Uzuner, G., & Akadiri, A. C. (2020a). Examining the causal impacts of tourism, globalization, economic growth and carbon emissions in tourism island territories: Bootstrap panel Granger causality analysis. *Current Issues in Tourism, 23*(4), 470–484.

Akadiri, S. S., Uzuner, G., Akadiri, A. C., & Lasisi, T. T. (2020). Environmental Kuznets curve hypothesis in the case of tourism island states: The moderating role of globalization. *International Journal of Finance and Economics*. https://doi.org/10.1002/ijfe.1938

Akbostancı, E., Türüt-Aşık, S., & Tunç, G. İ. (2009). The relationship between income and environment in Turkey: Is there an environmental Kuznets curve? *Energy Policy, 37*(3), 861–867.

Alam, M. M., Murad, M. W., Noman, A. H. M., & Ozturk, I. (2016). Relationships among carbon emissions, economic growth, energy consumption and population growth: Testing Environmental Kuznets Curve hypothesis for Brazil, China, India and Indonesia. *Ecological Indicators, 70*, 466–479.

Alhodiry, A., Rjoub, H., & Samour, A. (2021). Impact of oil prices, the US interest rates on Turkey's real estate market. New evidence from combined co-integration and bootstrap ARDL tests. *Plos One, 16*(1), e0242672.

Alola, A. A., Uzuner, G., & Akadiri, S. S. (2020). Modeling tourism and fear nexus in G4 countries. *Current Issues in Tourism*. https://doi.org/10.1080/13683500.2020.1750574

Araña, J. E., & León, C. J. (2008). The impact of terrorism on tourism demand. *Annals of Tourism Research, 35*(2), 299–315.

Balaguer, J., & Cantavella-Jorda, M. (2002). Tourism as a long-run economic growth factor: The Spanish case. *Applied Economics, 34*(7), 877–884.

Balli, E., Sigeze, C., Manga, M., Birdir, S., & Birdir, K. (2019). The relationship between tourism, CO2 emissions and economic growth: A case of Mediterranean countries. *Asia Pacific Journal of Tourism Research, 24*(3), 219–232.

Bano, S., Alam, M., Khan, A., & Liu, L. (2021). The nexus of tourism, renewable energy, income, and environmental quality: An empirical analysis of Pakistan. *Environment, Development and Sustainability*. https://doi.org/10.1007/s10668-021-01275-6

Bella, G. (2018). Estimating the tourism induced environmental Kuznets curve in France. *Journal of Sustainable Tourism, 26*(12), 2043–2052.

Bimonte, S. (2002). Information access, income distribution, and the Environmental Kuznets Curve. *Ecological Economics, 41*(1), 145–156.

Brida, J. G., Cortes-Jimenez, I., & Pulina, M. (2016). Has the tourism-led growth hypothesis been validated? A literature review. *Current Issues in Tourism, 19*(5), 394–430.

Brown, R. L., Durbin, J., & Evans, J. M. (1975). Techniques for testing the constancy of regression relationships over time. *Journal of the Royal Statistical Society: Series B (methodological), 37*(2), 149–163.

Cai, Y., Sam, C. Y., & Chang, T. (2018). Nexus between clean energy consumption, economic growth and CO2 emissions. *Journal of Cleaner Production, 182*, 1001–1011.

Cantos, J. O., & Rebollo, F. V. (2016). Climate change and tourism policy in Spain: Diagnosis in the Spanish Mediterranean coast. *Cuadernos De Turismo, 38*, 565.

Chatziantoniou, I., Filis, G., Eeckels, B., & Apostolakis, A. (2013). Oil prices, tourism income and economic growth: A structural VAR approach for European Mediterranean countries. *Tourism Management, 36*, 331–341.

Cortes-Jimenez, I., Nowak, J.-J., & Sahli, M. (2011). Mass beach tourism and economic growth: Lessons from Tunisia. *Tourism Economics, 17*(3), 531–547.

Crouch, G. I. (1994). The study of international tourism demand: A review of findings. *Journal of Travel Research, 33*(1), 12–23.

Deng, T., Ma, M., & Cao, J. (2014). Tourism resource development and long-term economic growth: A resource curse hypothesis approach. *Tourism Economics, 20*(5), 923–938.

Dickey, D. A., & Fuller, W. A. (1981). Likelihood ratio statistics for autoregressive time series with a unit root. *Econometrica: Journal of the Econometric Society, 49*, 1057–1072.

Dogan, E., & Aslan, A. (2017). Exploring the relationship among CO2 emissions, real GDP, energy consumption and tourism in the EU and candidate countries: Evidence from panel models robust to heterogeneity and cross-sectional dependence. *Renewable and Sustainable Energy Reviews, 77*, 239–245.

Dogan, E., Seker, F., & Bulbul, S. (2017). Investigating the impacts of energy consumption, real GDP, tourism and trade on CO2 emissions by accounting for cross-sectional dependence: A panel study of OECD countries. *Current Issues in Tourism, 20*(16), 1701–1719.

Dogru, T., & Bulut, U. (2018). Is tourism an engine for economic recovery? Theory and empirical evidence. *Tourism Management, 67*, 425–434.

Dritsakis, N. (2012). Tourism development and economic growth in seven Mediterranean countries: A panel data approach. *Tourism Economics, 18*(4), 801–816.

Durbarry, R. (2004). Tourism and economic growth: The case of Mauritius. *Tourism Economics, 10*(4), 389–401.

World Tourism Organization (UNWTO) (Ed.). (2019). *International Tourism Highlights, 2019 Edition*. World Tourism Organization (UNWTO). https://doi.org/10.18111/9789284421152

Esteve, V., & Tamarit, C. (2012). Threshold cointegration and nonlinear adjustment between CO2 and income: The environmental Kuznets curve in Spain, 1857–2007. *Energy Economics, 34*(6), 2148–2156.

Eyuboglu, K., & Uzar, U. (2019). The impact of tourism on CO2 emission in Turkey. *Current Issues in Tourism, 1*, 1–1. https://doi.org/10.1080/13683500.2019.1636006

Fethi, S., & Senyucel, E. (2020). The role of tourism development on CO2 emission reduction in an extended version of the environmental Kuznets curve: Evidence from top 50 tourist destination countries. *Environment, Development and Sustainability, 23*, 1499–1524.

Ghartey, E. E. (2013). Effects of tourism, economic growth, real exchange rate, structural changes and hurricanes in Jamaica. *Tourism Economics, 19*(4), 919–942.

Ghazouani, T., Boukhatem, J., & Sam, C. Y. (2020). Causal interactions between trade openness, renewable electricity consumption, and economic growth in Asia-Pacific countries: Fresh evidence from a bootstrap ARDL approach. *Renewable and Sustainable Energy Reviews, 133*, 110094.

Goh, S. K., Sam, C. Y., & McNown, R. (2017a). Re-examining foreign direct investment, exports, and economic growth in Asian economies using a bootstrap ARDL test for cointegration. *Journal of Asian Economics, 51*, 12–22.

Goh, S. K., Yong, J. Y., Lau, C. C., & Tang, T. C. (2017b). Bootstrap ARDL on energy-growth relationship for 22 OECD countries. *Applied Economics Letters, 24*(20), 1464–1467.

Grossman, G. M., & Krueger, A. B. (1995). Economic growth and the environment. *The Quarterly Journal of Economics, 110*(2), 353–377.

Halicioglu, F. (2009). An econometric study of CO2 emissions, energy consumption, income and foreign trade in Turkey. *Energy Policy, 37*(3), 1156–1164.

Haseeb, M., & Azam, M. (2020). Dynamic nexus among tourism, corruption, democracy and environmental degradation: A panel data investigation. *Environment, Development and Sustainability, 23*, 1–19.

Hatemi-J, A., Gupta, R., Kasongo, A., Mboweni, T., & Netshitenzhe, N. (2018). Does tourism cause growth asymmetrically in a panel of G-7 countries? A Short Note. *Empirica, 45*(1), 49–57.

Hatemi-J, A., Gupta, R., Ksango, A., Mboweni, T., & Netshitenzhe, N. (2014). Are there asymmetric causal relationships between tourism and economic growth in a panel of G-7 countries. *University of Pretoria, Department of Economics Working Paper*, *76*, 18.

Husein, J., & Kara, S. M. (2011). Research note: Re-examining the tourism-led growth hypothesis for Turkey. *Tourism Economics, 17*(4), 917–924.

Jebli, M. B., Youssef, S. B., & Ozturk, I. (2016). Testing environmental Kuznets curve hypothesis: The role of renewable and non-renewable energy consumption and trade in OECD countries. *Ecological Indicators, 60*, 824–831.

Jones, C., & Munday, M. (2007). Exploring the environmental consequences of tourism: A satellite account approach. *Journal of Travel Research, 46*(2), 164–172.

Katircioglu, S. (2009). Testing the tourism-led growth hypothesis: The case of Malta. *Acta Oeconomica, 59*(3), 331–343.

Katircioğlu, S. T. (2014). Testing the tourism-induced EKC hypothesis: The case of Singapore. *Economic Modelling, 41*, 383–391.

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*, 634–640.

Khan, S. A. R., Sharif, A., Golpîra, H., & Kumar, A. (2019). A green ideology in Asian emerging economies: From environmental policy and sustainable development. *Sustainable Development, 27*(6), 1063–1075.

Khan, S. A. R., Yu, Z., Belhadi, A., & Mardani, A. (2020). Investigating the effects of renewable energy on international trade and environmental quality. *Journal of Environmental Management, 272*, 111089.

Khan, S. A. R., Yu, Z., Golpîra, H., Sharif, A., & Mardani, A. (2020). A state-of-the-art review and meta-analysis on sustainable supply chain management: Future research directions. *Journal of Cleaner Production, 278*, 123357.

Khan, S. A. R., Yu, Z., Sharif, A., & Golpîra, H. (2020c). Determinants of economic growth and environmental sustainability in South Asian Association for Regional Cooperation: Evidence from panel ARDL. *Environmental Science and Pollution Research, 27*(36), 45675–45687.

Kim, D., & Perron, P. (2009). Unit root tests allowing for a break in the trend function at an unknown time under both the null and alternative hypotheses. *Journal of Econometrics, 148*(1), 1–13.

Koçak, E., Ulucak, R., & Ulucak, Z. Ş. (2020). The impact of tourism developments on CO2 emissions: An advanced panel data estimation. *Tourism Management Perspectives, 33*, 100611.

Kuščer, K., & Mihalič, T. (2019). Residents' attitudes towards overtourism from the perspective of tourism impacts and cooperation—The case of ljubljana. *Sustainability, 11*(6), 1823.

Lee, J. W., & Brahmasrene, T. (2013). Investigating the influence of tourism on economic growth and carbon emissions: Evidence from panel analysis of the European Union. *Tourism Management, 38*, 69–76.

León, C. J., Arana, J. E., & Hernández Alemán, A. (2014). CO2 Emissions and tourism in developed and less developed countries. *Applied Economics Letters, 21*(16), 1169–1173.

Lin, F.-L., Inglesi-Lotz, R., & Chang, T. (2018). Revisit coal consumption, CO2 emissions and economic growth nexus in China and India using a newly developed bootstrap ARDL bound test. *Energy Exploration and Exploitation, 36*(3), 450–463.

Lise, W. (2006). Decomposition of CO2 emissions over 1980–2003 in Turkey. *Energy Policy, 34*(14), 1841–1852.

Malinauskaite, J., Jouhara, H., Ahmad, L., Milani, M., Montorsi, L., & Venturelli, M. (2019). Energy efficiency in industry: EU and national policies in Italy and the UK. *Energy, 172*, 255–269.

McCool, S. F., & Martin, S. R. (1994). Community attachment and attitudes toward tourism development. *Journal of Travel Research, 32*(3), 29–34.

McNown, R., Sam, C. Y., & Goh, S. K. (2018). Bootstrapping the autoregressive distributed lag test for cointegration. *Applied Economics, 50*(13), 1509–1521.

Meirun, T., Mihardjo, L. W., Haseeb, M., Khan, S. A. R., & Jermsittiparsert, K. (2021). The dynamics effect of green technology innovation on economic growth and CO 2 emission in Singapore: New evidence from bootstrap ARDL approach. *Environmental Science and Pollution Research, 28*(4), 4184–4194.

Meng, W., Xu, L., Hu, B., Zhou, J., & Wang, Z. (2016). Quantifying direct and indirect carbon dioxide emissions of the Chinese tourism industry. *Journal of Cleaner Production, 126*, 586–594.

Muntean, M., Guizzardi, D., Schaaf, E., Crippa, M., Solazzo, E., Olivier, J., & Vignati, E. (2018). *Fossil CO2 emissions of all world countries*. Publications Office of the European Union.

Nathaniel, S., & Khan, S. A. R. (2020). The nexus between urbanization, renewable energy, trade, and ecological footprint in ASEAN countries. *Journal of Cleaner Production, 272*, 122709.

Nawaz, K., Lahiani, A., & Roubaud, D. (2019). Natural resources as blessings and finance-growth nexus: A bootstrap ARDL approach in an emerging economy. *Resources Policy, 60*, 277–287.

Nowak, J.-J., Sahli, M., & Cortés-Jiménez, I. (2007). Tourism, capital good imports and economic growth: Theory and evidence for Spain. *Tourism Economics, 13*(4), 515–536.

Oh, C.-O. (2005). The contribution of tourism development to economic growth in the Korean economy. *Tourism Management, 26*(1), 39–44.

Paramati, S. R., Alam, M. S., & Chen, C.-F. (2017). The effects of tourism on economic growth and CO2 emissions: A comparison between developed and developing economies. *Journal of Travel Research, 56*(6), 712–724.

Pata, U. K. (2019). Environmental Kuznets curve and trade openness in Turkey: Bootstrap ARDL approach with a structural break. *Environmental Science and Pollution Research, 26*(20), 20264–20276.

Pata, U. K., & Aydin, M. (2020). Testing the EKC hypothesis for the top six hydropower energy-consuming countries: Evidence from Fourier Bootstrap ARDL procedure. *Journal of Cleaner Production, 264*, 121699.

Pesaran, M. H., Shin, Y., & Smith, R. J. (2001). Bounds testing approaches to the analysis of level relationships. *Journal of Applied Econometrics, 16*(3), 289–326.

Rehman Khan, S. A., & Yu, Z. (2020). Assessing the eco-environmental performance: An PLS-SEM approach with practice-based view. *International Journal of Logistics Research and Applications, 24*, 303–321.

Roudi, S., Arasli, H., & Akadiri, S. S. (2019). New insights into an old issue–examining the influence of tourism on economic growth: Evidence from selected small island developing states. *Current Issues in Tourism, 22*(11), 1280–1300.

Saboori, B., Sulaiman, J., & Mohd, S. (2012). Economic growth and CO2 emissions in Malaysia: A cointegration analysis of the environmental Kuznets curve. *Energy Policy, 51*, 184–191.

Saha, S., & Yap, G. (2014). The moderation effects of political instability and terrorism on tourism development: A cross-country panel analysis. *Journal of Travel Research, 53*(4), 509–521.

Saint Akadiri, S., Alkawfi, M. M., Uğural, S., & Akadiri, A. C. (2019a). Towards achieving environmental sustainability target in Italy. The role of energy, real income and globalization. *Science of the Total Environment, 671*, 1293–1301.

Saint Akadiri, S., Alola, A. A., & Akadiri, A. C. (2019b). The role of globalization, real income, tourism in environmental sustainability target. Evidence from Turkey. *Science of the Total Environment, 687*, 423–432.

Saint Akadiri, S., Eluwole, K. K., Akadiri, A. C., & Avci, T. (2020). Does causality between geopolitical risk, tourism and economic growth matter? Evidence from Turkey. *Journal of Hospitality and Tourism Management, 43*, 273–277.

Saint Akadiri, S., Lasisi, T. T., Uzuner, G., & Akadiri, A. C. (2019c). Examining the impact of globalization in the environmental Kuznets curve hypothesis: The case of tourist destination states. *Environmental Science and Pollution Research, 26*(12), 12605–12615.

Salari, M., Javid, R. J., & Noghanibehambari, H. (2021). The nexus between CO2 emissions, energy consumption, and economic growth in the US. *Economic Analysis and Policy, 69*, 182–194.

Saleem, H., & Shabbir, M. S. (2020). The short-run and long-run dynamics among FDI, trade openness and economic growth: Using a bootstrap ARDL test for co-integration in selected South Asian countries. *South Asian Journal of Business Studies*. https://doi.org/10.1108/SAJBS-07-2019-0124

Sarrica, M., Biddau, F., Brondi, S., Cottone, P., & Mazzara, B. M. (2018). A multi-scale examination of public discourse on energy sustainability in Italy: Empirical evidence and policy implications. *Energy Policy, 114*, 444–454.

Scott, D. (2011). Why sustainable tourism must address climate change. *Journal of Sustainable Tourism, 19*(1), 17–34.

Selden, T. M., & Song, D. (1994). Environmental quality and development: Is there a Kuznets curve for air pollution emissions? *Journal of Environmental Economics and Management, 27*(2), 147–162.

Seraphin, H., Sheeran, P., & Pilato, M. (2018). Over-tourism and the fall of Venice as a destination. *Journal of Destination Marketing and Management, 9*, 374–376.

Shahbaz, M., Ferrer, R., Shahzad, S. J. H., & Haouas, I. (2018). Is the tourism–economic growth nexus time-varying? Bootstrap rolling-window causality analysis for the top 10 tourist destinations. *Applied Economics, 50*(24), 2677–2697.

Shakouri, B., Khoshnevis Yazdi, S., & Ghorchebigi, E. (2017). Does tourism development promote CO2 emissions? *Anatolia, 28*(3), 444–452.

Shi, H., Li, X., Zhang, H., Liu, X., Li, T., & Zhong, Z. (2019). Global difference in the relationships between tourism, economic growth, CO2 emissions, and primary energy consumption. *Current Issues in Tourism, 23*, 1–16.

Solarin, S. A. (2014). Tourist arrivals and macroeconomic determinants of CO2 emissions in Malaysia. *Anatolia, 25*(2), 228–241.

Tang, Z., Shi, C. B., & Liu, Z. (2011). Sustainable development of tourism industry in China under the low-carbon economy. *Energy Procedia, 5*, 1303–1307.

Tong, T., Ortiz, J., Xu, C., & Li, F. (2020). Economic growth, energy consumption, and carbon dioxide emissions in the E7 countries: A bootstrap ARDL bound test. *Energy, Sustainability and Society, 10*, 1–17.

UNWTO. (2019). *UNWTO Annual Report 2019*. https://doi.org/10.18111/9789284421152

Uzuner, G., Akadiri, S. S., & Alola, A. A. (2020). Tourist arrivals in four major economies: Another side of economic policy uncertainty and fear. *Environmental Science and Pollution Research, 27*, 29659–29665.

Wang, C.-M., Hsueh, H.-P., Li, F., & Wu, C.-F. (2019). Bootstrap ARDL on health expenditure, CO2 emissions, and GDP growth relationship for 18 OECD countries. *Frontiers in Public Health, 7*, 324.

World Tourism Organization (UNWTO), & International Transport Forum (Eds.). (2019). *Transport-related CO2 Emissions of the Tourism Sector—Modelling Results*. World Tourism Organization (UNWTO). https://doi.org/10.18111/9789284416660

Wu, C.-F., Huang, S.-C., Chang, T., Chiou, C.-C., & Hsueh, H.-P. (2020). The nexus of financial development and economic growth across major Asian economies: Evidence from bootstrap ARDL testing and machine learning approach. *Journal of Computational and Applied Mathematics, 372*, 112660.

Yilanci, V., Bozoklu, S., & Gorus, M. S. (2020). Are BRICS countries pollution havens? Evidence from a bootstrap ARDL bounds testing approach with a Fourier function. *Sustainable Cities and Society, 55*, 102035.

Zaman, K., Shahbaz, M., Loganathan, N., & Raza, S. A. (2016). Tourism development, energy consumption and Environmental Kuznets Curve: Trivariate analysis in the panel of developed and developing countries. *Tourism Management, 54*, 275–283.

Zha, J., Tan, T., Yuan, W., Yang, X., & Zhu, Y. (2020). Decomposition analysis of tourism CO2 emissions for sustainable development: A case study of China. *Sustainable Development, 28*(1), 169–186.

Zhang, J., & Zhang, Y. (2020). Tourism, economic growth, energy consumption, and CO2 emissions in China. *Tourism Economics*. https://doi.org/10.1177/1354816620918458

Zhang, L., & Gao, J. (2016). Exploring the effects of international tourism on China's economic growth, energy consumption and environmental pollution: Evidence from a regional panel analysis. *Renewable and Sustainable Energy Reviews, 53*, 225–234.