Green finance and tourism-led economic growth

Asian Journal of Economics and Banking

Mumtaz Ali
Department of Banking and Finance, Near East University, Nicosia, Cyprus
Prashanth Beleya
INTI International University, Nilai, Malaysia
Peter Oluwasegun Igunnu
Department of Banking and Finance, Near East University, Nicosia, Cyprus
Mehdi Seraj
Department of Economics, Near East University, Nicosia, Cyprus, and
Turgut Tursoy
Department of Banking and Finance, Near East University, Nicosia, Cyprus

Received 21 February 2026
Revised 31 March 2026
29 April 2026
26 May 2026
8 June 2026
21 June 2026
22 June 2026
Accepted 3 July 2026

Abstract

Purpose – This study analyzes the effects of tourism (TOR), green finance (GF), carbon emissions (CO_2) and foreign direct investment (FDI) on economic growth (EG) in leading tourist economies.
Design/methodology/approach – This study employs the Residual Augmented Least Squares Engle-Granger (RALS-EG) cointegration approach to test the long-run relationship, followed by the Method of Moments Quantiles Regression (MMQR) to capture heterogeneous effects across different quantiles of EG.
Findings – The finding of the RALS-EG cointegration confirms the existence of a long-run relationship between TOR, GF, CO_2, FDI and EG in leading tourist economies. Furthermore, the MMQR findings reveal that TOR and CO_2 exert positive and statistically significant effects on EG across all quantiles, while GF positively influences EG across most quantiles (q2 to q9). Moreover, FDI contributes positively to EG, particularly in the upper quantile (q6 to q9), suggesting that its growth-enhancing benefits are more pronounced in economies with greater economic capacity and investment absorption potential
Research limitations/implications – This study enhances the existing literature in three significant aspects: First, it integrates TOR, GF, and EG within a unified framework; second, it employs RALS-EG and MMQR methods to capture long-run and heterogeneous effects; and third, it provides evidence on the role of GF in supporting sustainable tourism-led growth.
Originality/value – The findings suggest that leading tourist economies should allocate resources towards the TOR sector, advance sustainable finance and attract FDI to decouple EG from environmental stressors while strengthening environmental sustainability.

Keywords Tourism, Green finance, Economic growth, MMQR, RALS-EG cointegration, Sustainable development goals

Paper type Research article

1. Introduction

Economic growth (EG) is essential as it drives progress and fosters prosperity (Alexander and Gleeson, 2018; Ali *et al.*, 2021). However, the reliance on carbon-based fuels in the pursuit of EG has adversely affected economies and the environment (Hantoko *et al.*, 2024; Rauf *et al.*, 2023). In many cases, economic development continues to depend heavily on fossil fuels and other environmentally harmful energy sources (Loredana *et al.*, 2024), leading to the

JEL Classification — O44, E44

Asian Journal of Economics and Banking
Emerald Publishing Limited
e-ISSN: 2633-7991
p-ISSN: 2615-9821
DOI 10.1108/AJEB-02-2026-0032

degradation of environmental quality. The total heating caused by harmful energy sources has left the environment devastated, depleted resources (Zavala *et al.*, 2023), created land-related problems (Lungarska and Chakir, 2024) and caused overall environmental deterioration, issues that have now become global concerns requiring immediate attention (Ali *et al.*, 2025a, b). The continued reliance on hazardous energy sources has also constrained economic development in leading tourist destinations, causing several of these economies to face persistent environmental pressures, including rising CO_2 emissions from transport and hospitality sectors, increased waste generation linked to high tourist inflows, coastal ecosystem degradation and intensified energy demand during peak tourism seasons. The environmental burden is specifically pronounced in major Mediterranean tourism destinations, where tourism activity has been associated with higher carbon intensity and escalating ecological stress. As a result, sustainable tourism practices and green financing have been proposed as viable solutions to mitigate these environmental pressures.

Sustainable tourism practices have emerged as a prominent and rapidly growing sector worldwide (Annamalah *et al.*, 2023), as tourism is a key contributor to the Sustainable Development Goals (SDGs) agenda, supporting environmental, social and economic sustainability. According to the World Travel and Tourism Council (2023), it has accounted for 9.1% of global GDP, up 23% from 2022 but still 4.1% below 2019. It has also increased the workforce, with 27 million new jobs worldwide, a 9.1% increase from 2022, though still 1.4% below pre-pandemic employment. Furthermore, the literature suggests that tourism positively influences host countries' economic growth by increasing their gross domestic product (Vanhove, 2022), job creation (Purwono *et al.*, 2024) and expanding the diversity of exported goods, among other factors, and, as such, tourism development should be regarded as a vital contributor to economic prosperity. Globally, travel is considered a key driver of EG (Katircioglu *et al.*, 2014), and environmentally responsible tourism is increasingly viewed as an effective approach to mitigating global warming (Shang *et al.*, 2023). Additionally, green financing contributes to reducing CO_2 emissions, improving environmental standards and boosting economic growth by supporting the production of energy efficient goods and services with low CO_2 emissions, thereby addressing climate change (Sharif *et al.*, 2022). Several studies have demonstrated that green funds help mitigate climate change, making them a significant instrument in the global environmental agenda (Ali and Seraj, 2022). Furthermore, developments in clean energy mitigate reliance on energy sources that are responsible for producing excess CO_2, thereby supporting a sustainable economy (Hassan *et al.*, 2022).

Though the literature on tourism-led-growth has expanded significantly, several critical gaps remain unaddressed (Igunnu and Ali, 2025; Zheng *et al.*, 2023). First, from an empirical perspective, prior studies have largely examined TOR, GF, CO_2 and foreign direct investment (FDI) separately, with limited attention given to their integrated effects on EG within leading tourist economies. Existing studies predominantly focus on either the tourism-growth nexus or the environment-growth relationship in isolation, thereby providing fragmented evidence regarding the interaction between tourism expansion, sustainable finance and environmental sustainability. Second, from a theoretical perspective, previous studies have generally relied on single theoretical frameworks, such as the tourism-led growth hypothesis or endogenous growth theory, without integrating environmental sustainability considerations into a unified analytical framework. Consequently, insufficient attention has been devoted to understanding how TOR, GF, CO_2 and FDI jointly shape sustainable EG dynamics in tourism-dependent economies. Third, from a methodological perspective, much of the existing literature has employed conventional mean-based estimators, including OLS, fixed effects and standard panel regression approaches but these methods might fail to capture heterogeneous effects across different levels of EG and may produce biased estimates in the presence of cross-sectional dependence, slope heterogeneity and distributional asymmetry. Therefore, there remains a need for more robust econometric techniques capable of identifying conditional and quantile-specific relationships among the variables. Figure 1 shows the map of the top tourist nations investigated in this study.

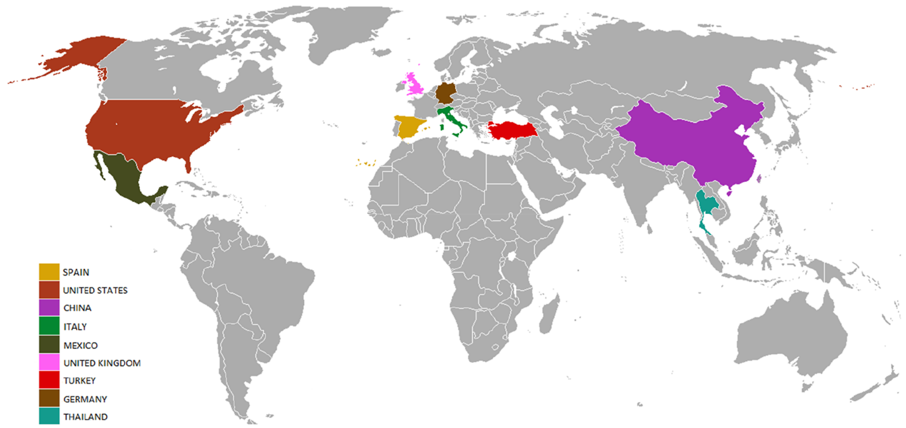

Figure 1. Top tourist nations [1]

Against this background, this study investigates the impacts of TOR, GF, CO_2 and FDI on EG in leading tourist economies, namely Spain, the United States, China, Italy, Turkey, Mexico, Thailand, Germany and the United Kingdom. To achieve this objective, the RALS-EG cointegration approach and the MMQR estimator to capture long-run and heterogeneous relationships across different quantiles of EG have been employed.

This study makes three contributions to existing literature. First, **theoretically**, it integrates the tourism-led growth hypothesis, green growth theory and endogenous growth into a cohesive framework to clarify the dynamics between TOR, GF, CO_2 and EG. Second, **empirically**, the study provides novel evidence on the tourism-finance-growth nexus in leading tourist economies using the MMQR approach. Unlike previous studies that focus on the average effects, the findings reveal heterogeneous effects across different levels of economic growth, specifically, the empirical findings expose: 1) the preliminary tests outcomes confirm the evidence of cross-sectional dependence among the variables, while unit root confirms a mixed order of integration; 2) the MMQR findings demonstrate that TOR and CO_2 exert a positive and statistically significant influence of EG across all quantiles. In addition, GF positively promotes economic growth across most of the quantiles, whereas FDI exhibits a stronger growth enhancing effect in higher quantiles, suggesting greater benefits in leading tourist economies; 3) the robustness analysis largely confirms the baseline findings; and 4) causality testing indicates the unidirectional causality running from TOR to EG and from EG to FDI, while directional causal relationships exist between GF and EG, as well as between CO_2 and EG. Third, **methodologically**, by utilizing the RALS-EG and MMQR approaches, the study accounts for cross-sectional dependence, slope heterogeneity and distributional heterogeneity, thereby providing more robust and reliable estimates compared to conventional means-based estimators (Ali *et al.*, 2022). Figure 2 shows the trends and characteristics of the indicators used in the study.

The paper is structured as follows: Section 2 reviews literature; Section 3 describes the methodology; Section 4 presents findings and discussion; and Section 5 concludes with policy recommendations.

2. Literature review

2.1 Economic theoretical base

An integrated approach to the theoretical foundation of this study combines the Tourism-Led Growth Hypothesis (TLGH), green growth theory and endogenous growth theory, providing

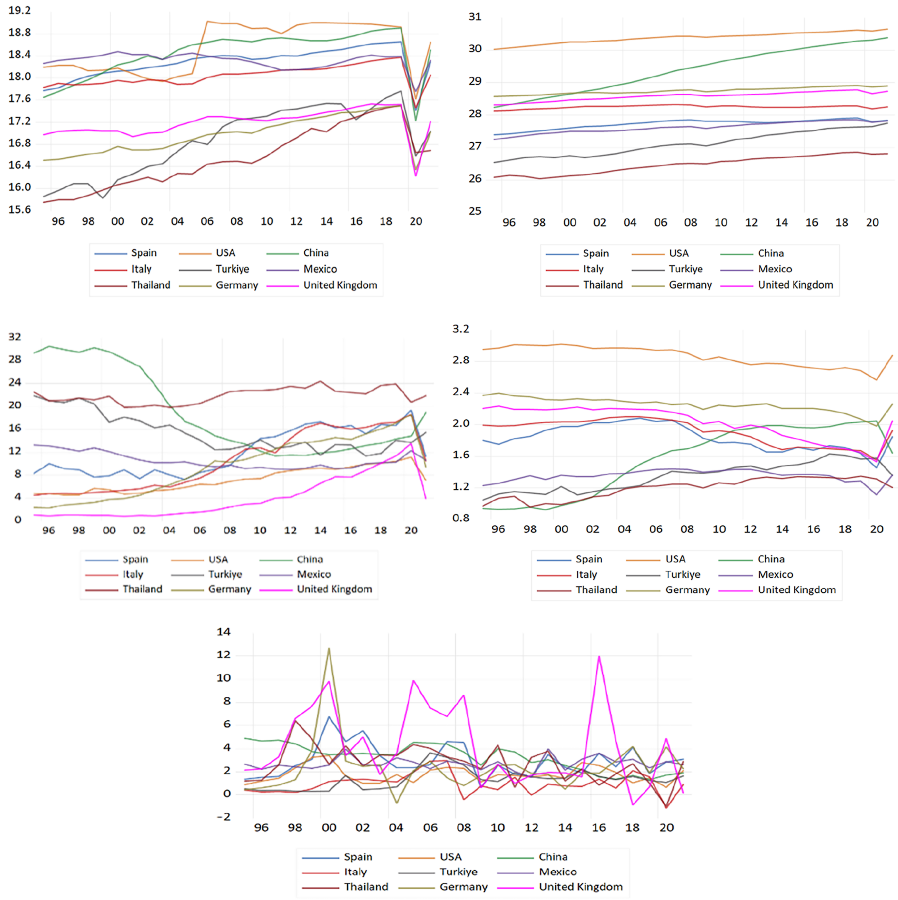

Figure 2. Trends of the variables

an explanation for the reciprocal relationships among TOR, GF, environmental quality and EG. Synthesizing these perspectives, rather than considering them in isolation, offers a stronger justification for the empirical model and the expected relationship among the variables. The TLGH posits that TOR development is a significant catalyst for EG by generating foreign exchange, creating employment opportunities and promoting infrastructure development that facilitates wider economic progress (Balaguer and Cantavella-Jordá, 2002). In this context, TOR is expected to contribute positively to EG, thus, $\beta_1 > 0$ is expected. Additionally, Popp (2012) explained that green growth theory adds more dimensions by arguing that the economy can grow while staying within the ecosystem's boundaries through its resources and eco-positive financial mechanisms. In this regard, GF promotes productive investment that also generates environmental benefits by supporting eco-friendly technologies and the development of sustainable business. Hence, GF is anticipated to yield positive EG, that is, $\beta_2 > 0$.

Nonetheless, CO_2 emissions represent a significant constraint on EG. While some strands of the literature suggest emissions may rise during the early stages of development due to industrialization and expanding economic activity, such growth is not sustainable in the long run. This is largely because environmental degradation imposes sustainable economic costs, including adverse health effects, increased regulatory burdens and resource depletion. From the perspective of environment-growth theory, CO_2 emissions are therefore considered economically counterproductive, meaning $\beta_3 < 0$. In addition, endogenous growth theory explains the positive impacts of FDI as a channel for technological diffusion, as well as capital and human resources accumulation (Baldwin *et al.*, 2005). FDI contributes to increased productivity and enhances the competitiveness of the host economy, and is therefore expected to have a positive impact on EG; thus, $\beta_4 > 0$ is anticipated.

The integration of these theories depicts a coherent framework. Within this context, TOR serves as the primary growth engine, while GF facilitates investment in both the TOR sector and broader economy. Moreover, the CO_2 emissions gauge the environmental-economic and tourism growth trade-off, while at the same time, FDI supports technological advancement, which may either mitigate or exacerbate environmental impacts depending on the nature of the technology adopted. Therefore, the empirical framework conceptualizes EG as a function of TOR, GF, the environmental condition and FDI.

The integration of these theories provides a more comprehensive explanation of the interconnected relationships among TOR, GF, CO_2, FDI and EG. Within this framework, TOR acts as a major driver of economic expansion, while GF supports environmentally sustainable investment and cleaner production activities. At the same time, CO_2 emissions capture the environmental costs associated with economic and tourism expansion, whereas FDI facilitates technological spillovers, capital accumulation and productivity enhancement. Consequently, sustainable economic growth depends on the interaction between tourism development, environmental sustainability policies, financial systems and external investment flows.

2.2 Empirical assessment

2.2.1 Tourism leading economic growth. It is widely recognized that TOR drives EG in many countries and the relationship between the two is widely studied in contemporary literature, such as Zheng *et al.* (2023) in BRICS, who found that TOR has a crucial role in promoting EG. Similarly, further studies in New Zealand (Jaforullah, 2015), Morocco (Huseynli, 2022), South Africa (Huseynli, 2022) and Hong Kong (Wang *et al.*, 2022) asserted that TOR had a potentially beneficial impact on the economic development of the countries, although Wang *et al.* (2022) also highlighted a bidirectional causal link between TOR and EG. On the contrary, Alhowaish (2016) conducted a study in the Gulf Cooperation Council (GCC) nations from 1995 to 2012, the outcome of which differed from prior studies where panel Granger Causality methodology was utilized and determined that there is no causal connection between TOR and economic development in GCC nations. Moreover, research conducted by Nosheen *et al.* (2021) on Asian economies affirmed that TOR boosts EG at the cost of the environment. Likewise, Katircioglu *et al.* (2014) revealed a direct connection between the influx of visitors and the substantial increase in CO_2 emissions into the atmosphere and found that TOR contributes to EG but pollutes the environment. Hence, to state that TOR boosts the economy while lowering environmental stressors is inconclusive and there is a need for further investigation into how TOR creates a balance between EG and the environment.

H1. TOR is directly associated with EG in leading tourist economies.

2.2.2 Green finance leading economic growth. Extensive research has delved into the diverse facets and efficacy of GF, with two notions observed in the literature, the first being that GF boosts economic growth. For example, Falcone (2020) and Zhang *et al.* (2021) discovered that GF substantially enhances economic development by assisting enterprises causing pollution with their transition into environmentally sustainable practices within the context of current investment and financing. Likewise, in China, Yin and Xu (2022) claimed that GF gadgets have the potential to act as catalysts for EG and development, while Xu *et al.*

(2023) found that green technological innovation and environmental regulation significantly support net-zero emission targets in G20 economies. Similarly, Ali and Sultanuzzaman (2026) showed that green transition policies and governance quality promote renewable energy penetration in the Next Eleven economies, although FDI and industrial growth intensified carbon-intensive production structures. Moreover, Tolliver *et al.* (2021) and Tan *et al.* (2023) concluded that GF can further bolster EG and green productivity, while, on the other hand, Sarwar *et al.* (2021) used the two-step system GMM estimator and found that finance and human capital positively contribute to EG in emerging economies. Tiba and Belaid (2020) revealed the bi-causal connection between CO_2 and economic openness. Likewise, Nguyen Thi Truc and Le Thanh (2025) reported that climate-related financial policies reduce financial risks in economies with strong regulatory systems, although transitional challenges remain evident in developing economies.

H2. GF is directly associated with EG in leading tourist economies.

2.2.3 Carbon emissions leading economic growth. Historically, CO_2 and EG have been closely linked (Ali *et al.*, 2024a, b; Igunnu and Ali, 2025). As nations become wealthier, their energy consumption tends to rise, often driven by fossil fuels (Hussain *et al.*, 2021), leading to increased CO_2 emissions. However, there has been a notable shift in recent years, with scholars consistently debating the notion of economic advancement invariably leading to environmental degradation. Recent scientific evidence suggests a significant positive connection between CO_2 and EG (Wang *et al.*, 2022; Abbas *et al.*, 2022; Wen *et al.*, 2022). For instance, in 147 economies (Li *et al.*, 2021), 26 European Union nations (Ren *et al.*, 2021) and in Bangladesh, India, Nepal, Pakistan and Sri Lanka (Khan *et al.*, 2022), scholars have illustrated the positive and substantial link in both factors and activities of an individual economy can have a favorable impact on the amount of CO_2 emissions, particularly in both China and India (Wang and Zhou, 2020) and Bangladesh (Karim *et al.*, 2026). In India, various studies consistently indicated a positive link between CO_2 and EG (Raihan and Tuspekova, 2022) and Peter *et al.* (2026) observed that incremental rises in EG lead to an increase in environmental degradation in Nigeria, specifying that resources that aided economic growth and development have also led to the deterioration of environmental quality. Using the Driscoll–Kraay estimator for Asian economies, Tran *et al.* (2026) identified a U-shaped relationship between EG and CO_2 emissions, thereby challenging the Environmental Kuznets Curve hypothesis. Their findings suggest that industrialization and energy-intensive activities contribute to rising emissions at higher levels of economic development, indicating that the growth-environment relationship differs across economies and development stages.

H3. CO_2 is indirectly associated with EG in leading tourist economies.

2.2.4 FDI leading economic growth. The relationship between FDI and EG has attracted significant interest from researchers worldwide (Vo *et al.*, 2019) and has been thoroughly examined using data from individual countries as well as cross-country samples in the literature, despite unanimous agreement on empirical findings not yet being reached. Iamsiraroj and Ulubaşoğlu (2015) evaluated the connection between FDI and economic development in 140 nations and found that FDI accelerates EG. Concurrently, it was concluded that in Eurozone countries (Pegkas, 2015) as well as 124 other nations worldwide (Iamsiraroj, 2016), FDI contributes to economic development. Using Augmented Mean Group (AMG) and Common Correlated Effects Mean Group (CCEMG) estimators, Ali *et al.* (2023) found FDI, trade openness, EG and research and development expenditures significantly promoted technological innovation in BRICS economies, and confirmed the existence of long-run causality between FDI and innovation activities, supporting the argument that FDI enhances technological spillovers and productivity growth.

H4. FDI is directly associated with EG in leading tourist economies.

3. Methodology

3.1 Data

This study investigates the effects of TOR, GT and FDI as environmental buffers and CO_2 emissions as environmental stressors on EG. The fundamental econometric framework is delineated below:

$$EG_{it} = \beta_0 + \beta_1 TOR_{it} + \beta_2 GF_{it} + \beta_3 CO_{2it} + \beta_4 FDI_{it} + \mu_{it} \quad (1)$$

In Equation (1), EG_{it} refers to economic growth (Kyara *et al.*, 2021), TOR_{it} denotes tourism (Balsalobre-Lorente *et al.*, 2023), GF_{it} refers to green finance (Ali *et al.*, 2024a, b), CO_{2it} denotes carbon emissions (Ren *et al.*, 2021) and FDI_{it} refers to foreign direct investment (Iamsiraroj, 2016). Moreover, β_0, $\beta_1, \beta_2, \beta_3$, and β_4 represent intercepts and coefficients of TOR, GF, CO_2 and FDI, while the i, t and μ_{it} denote the leading tourist economies, study period (2000–2023) and error term, respectively. The summary of variables is presented in Table 1 and Figure 3 presents the graph of kernel density.

3.2 Estimation procedure

3.2.1 Preliminary tests. First, this study employs the CD test to assess the cross-sectional dependency and to determine which stationary test to utilize. Without conducting the CD test, the study's conclusions may exhibit inconsistency, unreliability and subjectivity, potentially leading to biased, skewed and less robust findings (Ali and Seraj, 2022). The equation form of the CD test is:

$$\mathrm{CD} = \left\{ \frac{\mathrm{KN}(\mathrm{N}-1)^{\frac{1}{2}-\tau}}{2} \right\} \quad (2)$$

Second, based on the evidence from the CD test outcomes, the use of first-generation unit root tests may lead to estimation inefficiency. Therefore, this study employs the Cross-sectionally Augmented Dicky Fuller (CADF) and Cross-sectionally Augmented IPS (CIPS) tests, which are second-generation unit root tests designed to address cross-sectional dependence. The formula employed for the CADF and CIPS are presented in Equations (6) and (8), respectively, as shown below:

$$\Delta\gamma_{it} = \Delta\vartheta_{it} + \beta_i \mathrm{X}_{it} + \delta_{it} + \sum_{j=1}^{n} \varnothing_{ij} \Delta \mathrm{X}_{\mathrm{i,t-j}} + \propto_{it} \quad (3)$$

$$CIPS = N^{-1} \sum_{I=1}^{N} CADF_I \quad (4)$$

Table 1. Variables information

Variables	Abs	Measurement unit	Source
Green Finance	GF	Climate mitigation and adoption finance	OECD
Carbon Emissions	CO_2	CO_2 emissions (metric tons per capita)	WB
Foreign Direct Investment	FDI	Foreign direct investment, net inflows (% of GDP)	
Tourism	TOR	International tourism, number of arrivals	
Economic Growth	EG	GDP per capita (constant 2015 US$)	

Note(s): OECD = Organization of economic coordination and development https://data.oecd.org/, and WB = World Bank https://databank.worldbank.org/reports.aspx?source=World-Development-Indicators

Source(s): Authors' compilation

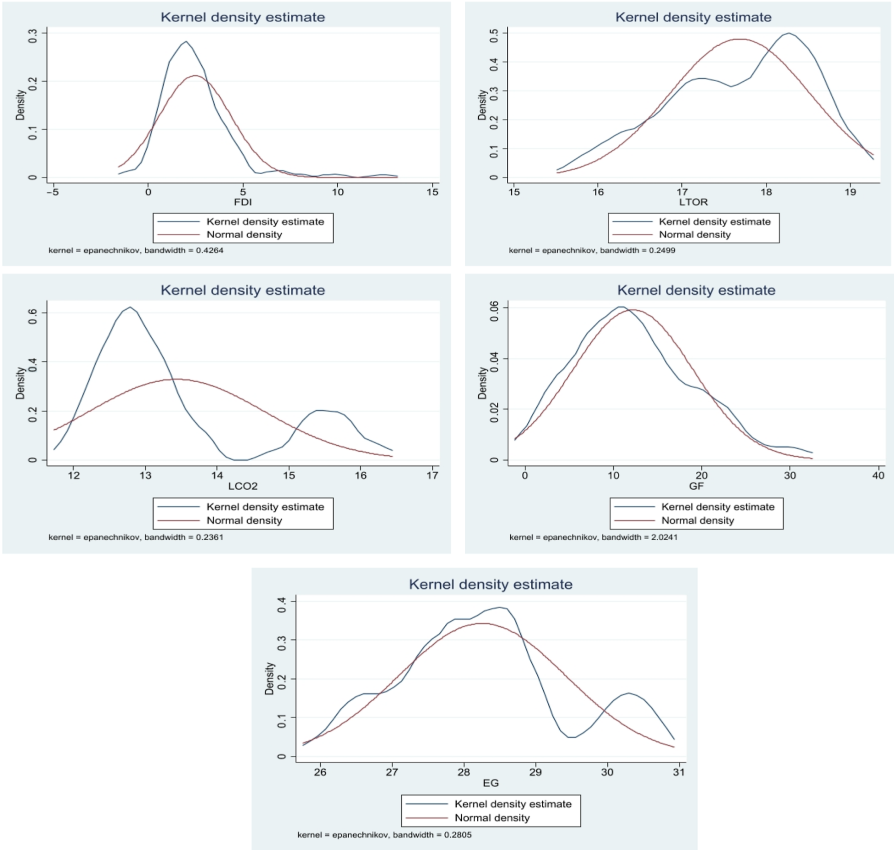

Figure 3. Kernel density graph

In Equation (4), $\Delta\vartheta_{it}$ represents the intercept, while, X_{it}, denotes TOR, GF, CO_2 and FDI, Δ shows the difference operator, T denotes the time dimension and $\propto_{it}$ is the stochastic error term.

Third, the Slope Heterogeneity (SH) analysis is utilized to evaluate the changes in slope of coefficients. Ignoring the SH test could potentially lead to the misinterpretation of regression results, resulting in inaccurate hypothesis testing. Mathematically, SH is denoted as under:

$$\widehat{v} = \sum_{i=1}^{N}\left(\widehat{\alpha} - \overline{\alpha}_{WFE}\right)\frac{x_i M_T x_i}{\varnothing_i^2}\left(\widehat{\alpha} - \overline{\alpha}_{WFE}\right) \quad (5)$$

$$\check{\Delta} = \sqrt{N}\left[\frac{N^{-1}\,\check{\varsigma} - \Sigma}{\sqrt{2K}}\right] \quad (6)$$

Also, the equation for the adjusted delta in the SH test is as under:

$$\check{\Delta}\text{adj} = \sqrt{N}\left[\frac{N^{-1}\,\check{\text{S}} - \text{E}\left(\overline{Z_{iT}}\right)}{\sqrt{VAR\left(\overline{Z_{iT}}\right)}}\right] \tag{7}$$

Finally, the RALS-EG econometric technique developed by Lee *et al.* (2015) is employed to investigate cointegration among research variables, followed by Khalid *et al.* (2024) and Ali *et al.* (2024a, b). The RALS-EG offers several advantages, including reducing power loss, producing robust and efficient estimates, and improving least squares estimations under non-normal error distributions.

The Engle-Granger (EG) Test is a two-step cointegration procedure based on a residual-based framework and conventional t-statistics. In the first step, the stationarity properties and variable order of integration are examined using unit root tests to ensure the variables are integrated of the same order, typically I(1).

$$y_t = \beta z_t + \mu_t \tag{8}$$

The ADF test is used to evaluate the level of integration after acquiring the residuals (ût).

$$\Delta\hat{\text{u}}_t = \Phi_0 + \Phi_1\hat{\text{u}}_{t-1} + \sum_{i-1}^{q}\Phi_{i+1}\,\Delta\hat{\text{u}}_{t-1} + \vartheta_t \tag{9}$$

When the error distribution of the test equation is non-normal, higher-order residual moments indicate deviations from normality. In such a case, the RALS approach can generate more robust, reliable and efficient estimates. To implement the RALS procedures, Equation (9) is modified as follows:

$$\hat{\text{y}}_\text{t} = q(\hat{\text{u}}_\text{t}) - \hat{\text{E}} - \hat{\text{u}}_\text{t}\hat{\text{O}}_\text{t}$$

Whilst (ût) signifies white noise,

$$q(\hat{\text{u}}_\text{t}) = \left[\hat{\text{u}}_\text{t}^2, \hat{\text{u}}_\text{t}^3\right], \hat{\text{E}} = \frac{1}{\text{T}}\sum_{\text{i}=1}^{\text{T}} q(\hat{\text{u}}_\text{t}),\ \hat{\text{O}}_\text{t} = \frac{1}{\text{T}}\sum_{\text{i}=1}^{\text{T}} q(\hat{\text{u}}_\text{t})$$

Furthermore, the following formula illustrates the RALS proposed by Meng *et al.* (2017).

$$\hat{\text{y}}_t = \left[\hat{\text{u}}_t^2 - \text{m}_2, \hat{\text{u}}_t^2 - \text{m}_3 - 3\text{m}_2\hat{\text{u}}_t\right] \tag{10}$$

in which, $\text{m}_\text{i} = \text{T}^{-1}\sum_{i=1}^{T}\hat{\ }u_t^j$. Subsequently, by adding $\hat{w}_t$ in Equation (9), RALS is formulated in Equation (11) as detailed below

$$\Delta\hat{\text{u}}_t = \Phi_1\hat{\text{u}}_{t-1} + \sum_{i-1}^{q}\Phi_{i+1}\,\Delta\hat{\text{u}}_{t-1} + \hat{\text{w}}_t\gamma + \vartheta_t \tag{11}$$

Furthermore, Equation (12) is employed to ascertain the three exponentially varying ranges of t-statistics

$$t^{*} = q.t + \sqrt{1} - q^{2}.Z \tag{12}$$

3.2.2 Model selection. Based on the outcomes of the preliminary tests, this study utilizes the MMQR analyzer proposed by Machado and Silva (2019) to capture the conditional heterogeneity of the explained variable. Unlike standard quantile regression approaches, MMQR addresses unobserved variation and yields more reliable estimates when cross-sectional dependence and distributional asymmetries are present (Khalid *et al.*, 2026). This renders it especially appropriate for panel data analysis, where the influence of explanatory variables is heterogeneous through many aspects of the conditional distribution (Ali *et al.*, 2025a, b).

$$\mathrm{Z_{it}} = \partial_{\mathrm{i}} + Y_{it}\, a + (A_i + V_{it}\sigma)\, \varepsilon_{it} 0.75\, em \tag{13}$$

The model's fixed influence and $\mathrm{V_{it}}$ are represented by ∂_{i} and A_i, denoting the differentiable transformation of the m vector of Y. The following is the mathematical presentation

$$S_c = S_c(Y), c = 1, 2, 3 \ldots\ldots., m \tag{14}$$

Furthermore, in the context of quantiles, estimations are derived utilizing the following procedure

$$V_y\left(T/_{Y_{it}}\right) = (\partial_i + A_i(q(T)) + Y_{it}a + V_{it}\sigma_q(T) \tag{15}$$

Y_{it} represents the predictor facets vector in Equation (15), encompassing TOR, GF, CO and FDI. The dependent quantile spread of the internal aspect in Equation (15) is situated on the left. The distinguishing feature of the individual effects estimate methodology, in contrast to other LS-fixed effects methodologies, is the absence of an intercept term. The variables are supposed to exhibit time-invariance, indicating that the disparities between the units are presumed to remain constant. The subsequent solution is optimized to derive the quantiles of the collected data.

$$min_q \sum\nolimits_i \sum\nolimits_t \sqsubseteq_T \left(Z_{it} - \left(B_i + Q_{it}\sigma_q\right) q\right) \tag{16}$$

3.2.3 Robustness check. This study uses the FGLS method to determine the connection among the variables and to assess the robustness of MMQR estimations. The FGLS is considered effective due to its ability to address potential serial correlations, heteroscedasticity and cross-sectional dependence (Bai *et al.*, 2021), and the Dumitrescu-Hurlin (DH) test is used to examine the direction of causality among the study variables with the overall methodological framework presented in Figure 4.

4. Results

4.1 Preliminary outcomes

Table 2 presents descriptive statistics of the data. It is observed that all variables exhibit positive mean values, with EG recording the highest mean (28.255). In terms of the range, EG shows the highest values, whereas FDI records the lowest. Furthermore, Table 3 reports the outcomes of the CD, CIPS, CADF and RALS-ADF tests and shows the findings indicate the variables exhibit cross-sectional dependence and mixed order of integration.

Moreover, Table 4 reports the findings of the SH test, where both delta and adjusted delta statistics are at the 1% level which is significant as it provides evidence of slope heterogeneity. Cointegration is then assessed using the RALS-EG estimator, with results presented in Table 5 and the t-statistic (−5.49253) below the critical value (−4.80), confirming the presence of a long-run cointegration relationship among the variables.

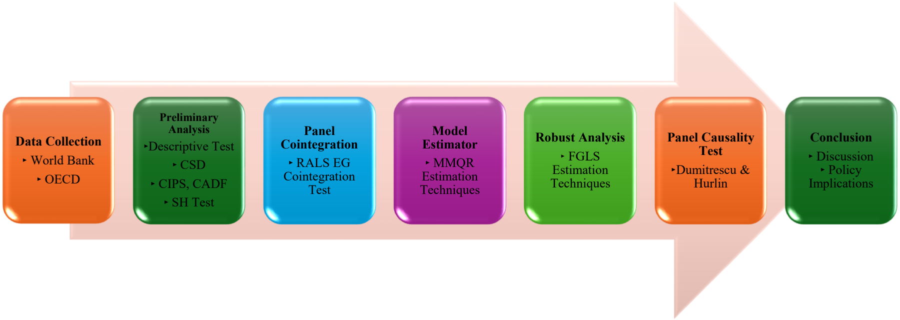

Figure 4. Methodological flow

Table 2. Descriptive statistics

Variables	EG	TOR	GF	CO_2	FDI
Mean	28.255	17.687	12.217	7.164	2.468
Median	28.256	17.885	11.47	5.893	2.225
Maximum	30.653	19.026	30.54	20.47	12.732
Minimum	26.035	15.755	0.85	2.517	−1.164
Std. Dev	1.165	0.833	6.747	4.401	1.89

Source(s): Authors' compilation

4.2 MMQR estimation outcomes

The findings of the MMQR estimation are reported in Table 6. The findings indicate the coefficients of TOR across all quantiles (q1 to q9) are positive and statistically significant, suggesting a robust positive relationship between TOR and EG. Moreover, the magnitude of the coefficient exhibits an increasing trend across higher quantiles, implying that economies experiencing higher levels of growth derive greater benefits from TOR over time. These outcomes support the tourism-led-growth hypothesis, affirming that TOR substantially contributes to EG. These results are consistent with Razzaq *et al.* (2023), who argue that promoting TOR boosts EG in the top ten GDP nations. However, the findings are in contrast with those of Nyasha *et al.* (2021), who could not find any connection between TOR and EG in low- and middle-income African nations. The stronger positive effects of TOR across higher quantiles may reflect the greater capacity of high-growth tourist economies to efficiently utilize TOR revenues through advanced infrastructure, diversified service industries and stronger institutional support. In leading tourist nations, such as Spain, the United States and the United Kingdom, TOR contributes through direct revenue generation as well as employment creation, transportation development, hospitality expansion and spillover effects across related sectors.

Furthermore, the MMQR findings indicate that GF exerts a positive and statistically substantial effect on EG across the most quantiles (q2 to q9), which suggests that an increase in GF contributes to an increase in the EG in leading tourist nations. Moreover, the magnitude of the coefficients from q2 to q9 increases gradually, implying GF plays a stronger role in promoting EG at higher levels of economic development. The findings are consistent with prior studies by Tan *et al.* (2023) and Yin and Xu (2022), which highlight that promoting the adoption of environmentally sustainable investment practices in investment policies substantially supports economic development. In addition, the results are consistent with the green growth strategy, which emphasizes the need for governments to harmonize economic

Table 3. CSD, CIPS, CADF and RALS-ADF test outcomes

Variables	CSD	*p*-value	CIPS I (0)	I (1)	CADF I (0)	I (1)	RALS-ADF I (0)	I (1)
EG	25.99**	0.040	−1.14	−3.035***	−1.14	−3.035***	−14.450	
TOR	21.58***	0.000	−3.405***		−2.607***		−2.052	−12.769
GF	3.09***	0.000	−1.185	−4.417***	−1.185	−4.417***	−2.859	−6.368
CO_2	0.95***	0.000	−0.937	−4.049***	−0.937	−4.049***	1.411	−7.894
FDI	5.52***	0.002	−3.645***		−3.645***		9.027	−12.959

Note(s): *** means significant at the 1% level

Table 4. Heterogeneity slope test

Δ	*p*-value	Δ Adj	*p*-value
12.698***	0.000	14.398***	0.000

Note(s): *** means significant at the 1% level

Table 5. RALS-EG cointegration

Method	K	*t* Test	Rho
EG	0	0.999997	
RALS-EG	0	−5.49253	0.587181

Note(s): K shows the optimum lag length found using recursive statistics; the 1%, 5%, and 10% critical values for the EG test are −5.02, −4.32, and −3.98, respectively; the 1%, 5%, and 10% critical values for the RALS-EG test are −4.80, −4.19, and −3.88, respectively

expansion with environmental sustainability. This may be accomplished by strengthening the eco-efficiency of economic development and optimizing the synergistic relationship between the environment and the economy. However, insignificant effects observed at the lowest quantile suggest the effectiveness of GF may be constrained by structural and institutional limitations in lower growth economies, where financial systems and environmental investment are developing.

Furthermore, the MMQR findings demonstrate that CO_2 positively influences EG across all quantiles. However, the magnitude of the coefficients declines progressively from q1 to q9, suggesting that the growth-enhancing effect of CO_2 emissions weakens at higher levels of economic development. This may reflect the gradual transition from fossil fuel dependence toward cleaner and renewable energy sources, supported by increasing investment in GF. These findings are consistent with Khan *et al.* (2022) and Muhammad (2019), who found that CO_2 emissions contribute to EG despite their adverse environmental consequences. Similarly, industrial and tourism-related activities in leading tourist economies have supported economic expansion while simultaneously increasing energy demand and CO_2 (McGee and York, 2018; Zhang *et al.*, 2017). However, this positive relationship reflects a clear growth-environment trade-off, where EG is partly achieved at the expense of environmental sustainability. Therefore, governments should strengthen environmental regulations, promote cleaner technologies and encourage sustainable production systems to reduce long-run environmental risks.

Finally, the MMQR findings confirm FDI favorably influences EG across upper quantiles (q6 to q9) which demonstrates FDI contributes to greater economic performance at higher levels of economic development. Meanwhile, at lower and middle quantiles (q1 to q5), FDI has no meaningful influence on EG. However, these findings confirm the hypothesis that higher FDI would lead to better economic performance, findings in line with those of Hong Hiep *et al.* (2023) and Tran *et al.* (2023), who found FDI has a positive effect on provincial EG in Vietnam, which underscores how important FDI is in fostering growth among selected countries. In addition, findings support the endogenous growth theory, which posits that FDI fosters economic development by augmenting both capital accumulation and productivity. Consequently, governments must encourage FDI inflows for technologies, quality management approaches and access to international markets, which ultimately boosts economic development through increasing efficiency and expanding production capacity.

Table 6. Outcomes of MMQR assessment

Variable	q1	q2	q3	q4	q5	q6	q7	q8	q9
TOR	0.249***	0.298***	0.345***	0.366***	0.419***	0.463***	0.534***	0.596***	0.675***
	(0.075)	(0.062)	(0.059)	(0.060)	(0.066)	(0.076)	(0.094)	(0.111)	(0.139)
GF	0.091	0.120**	0.148***	0.161***	0.193***	0.219***	0.262***	0.298***	0.346***
	(0.068)	(0.060)	(0.057)	(0.057)	(0.063)	(0.072)	(0.090)	(0.108)	(0.134)
CO_2	1.881***	1.830***	1.780***	1.758***	1.701***	1.654***	1.579***	1.513***	1.430***
	(0.132)	(0.114)	(0.109)	(0.110)	(0.121)	(0.138)	(0.172)	(0.206)	(0.256)
FDI	−0.039	−0.011	0.017	0.029	0.060	0.086*	0.127**	0.163**	0.209**
	(0.132)	(0.037)	(0.035)	(0.036)	(0.040)	(0.045)	(0.057)	(0.067)	(0.084)

Source(s): Authors' compilation

4.3 Robustness analysis

To further strengthen the robustness of the findings, additional analyses were conducted by incorporating global shock variables and heterogeneity-based estimations, as presented in Table 7. Specifically, dummy variables capturing the global financial crisis and the COVID-19 pandemic were introduced into the baseline model to account for potential structural disruptions and global economic shocks affecting tourism-led economies. The findings reveal the COVID-19 shock exerted a positive and statistically significant effect on EG, whereas the global financial crisis variable remained statistically insignificant. Furthermore, the sample was divided into large and small tourist economies based on GDP levels to capture cross-country heterogeneity. The results indicated TOR maintains a positive and significant effect on EG across both groups, although the magnitude was stronger among small economies and that GF positively contributes to growth in large economies but becomes insignificant in smaller economies, suggesting differences in financial market development and absorptive capacity. In addition, CO_2 emissions remain positively associated with EG across all models, reinforcing the existence of a growth-environment trade-off. Finally, the Driscoll–Kraay estimation was employed to further address cross-sectional dependence, heteroskedasticity and autocorrelation, with the outcomes remaining broadly consistent with the baseline estimations, thereby confirming the robustness and reliability of the main findings.

4.4 Dumitrescu-Hurlin panel causality tests

To enhance the robustness of the empirical analysis, this study further employs the Dumitrescu-Hurlin panel causality test to determine the direction of causality among the variables, as reported in Table 8. The findings reveal two unidirectional and two bidirectional causal relationships, with specific evidence of unidirectional causality running from FDI to EG, as well as from TOR to EG. Additionally, bidirectional causality is found between GF and EG and between CO_2 and EG.

Table 7. Empirical estimates and heterogeneity scale adjustments

	(1) Model_ Baseline	(2) Model_ Large	(3) Model_ Small	(4) Model_ Driscoll
TOR	0.067***	0.012	0.166***	0.230***
	(0.026)	(0.016)	(0.034)	(0.050)
GF	0.107***	0.139***	−0.047	−0.431***
	(0.036)	(0.021)	(0.110)	(0.043)
CO_2	0.756***	0.575***	0.530***	0.733***
	(0.038)	(0.038)	(0.126)	(0.024)
FDI	0.001	0.001	0.004	−0.056**
	(0.003)	(0.002)	(0.007)	(0.022)
Shock (global financial crises)	0.003			
	(0.019)			
Shock (COVID-19)	0.093***			
	(0.035)			
Constant	16.688***	20.486***	17.807***	15.461***
	(0.645)	(0.526)	(1.727)	(0.664)
Observations	243.000	135.000	108.000	243.000

Note(s): Standard errors in parentheses
Model 1–3 estimated using FGLS with Panel-Specific Heteroskedasticity and AR (1) autocorrelation corrections
Model 4 calculated via Driscoll–Kraay Robust Matrix at Lag 1
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 8. Outcomes of DH causality test

Null hypothesis	W-Stat	Zbar-Stat	Prob	Causality direction
TOR ≠ EG	8.322	7.365	0.000	→
EG ≠ TOR	1.512	−0.858	0.391	
GF ≠ EG	4.777	3.085	0.002	↔
EG ≠ GF	16.917	17.743	0.000	
CO_2 ≠ EG	5.287	3.701	0.000	↔
EG ≠ CO_2	24.794	27.255	0.000	
FDI ≠ EG	1.503	−0.868	0.385	→
EG ≠ FDI	4.467	2.71	0.007	

Source(s): Authors' compilation

5. Conclusion

The study examines the effects of TOR, GF, CO_2 and FDI on EG in leading tourist economies by employing the MMQR model to capture the heterogeneous effects across different quantiles and the FGLS estimator to ensure the robustness and reliability of the results.

The outcomes suggest that TOR promotes EG, thereby supporting the tourism-led-growth hypothesis. Furthermore, CO_2 emissions exhibit a concerning pattern across all quantiles. Industrial and manufacturing expansions, which has driven EG in leading tourist economies over the recent decades, have also increased demand for energy, thereby contributing to CO_2 emissions. In addition, the results show that GF plays a dual role by reducing CO_2 emissions while simultaneously promoting EG. Thus, GF helps alleviate the adverse environmental impacts associated with CO_2 emissions while enhancing EG. Finally, FDI is observed to have a positive effect on EG, particularly in the upper quantiles, indicating its stronger effect in the long run.

5.1 Practical implications

Based on the findings, several practical policy implications are proposed. First, since TOR is found to promote EG, governments should consider TOR as an effective policy instrument for fostering economic expansion. To attract international tourists, it is essential to preserve and sustainably manage indigenous TOR destinations and ensure the safety and security of international visitors, which requires the effective implementation of relevant regulations and policies. Governments may also introduce TOR certification programs, invest in eco-friendly infrastructure and adopt digital TOR promotion strategies to enhance competitiveness and ensure the long-term resilience of the TOR sector.

Second, many challenges affecting the environment caused by the world's leading tourist countries can be tackled by channeling the economy toward sustainability, since GF is effective in fostering sustainable EG. Therefore, governments of the world's leading tourist countries have a responsibility to promote green financing and sustain EG by offering tax incentives and subsidies for investment in renewable energy and sustainable infrastructure. It should also be considered that governments need to support these initiatives by expanding green bond markets, establishing sustainability-linked financing frameworks and enforcing environmental standards within tourism-related investments to ensure alignment with long-term sustainability objectives.

Third, governments should create a framework for attracting FDI by strengthening local infrastructure and supporting political, economic and legal stability, which will create better conditions for local businesses, pushing them to improve a country's economy. Alongside this, targeted policies, such as investment facilitation programs, sector-specific incentives for sustainable industries and streamlined regulatory frameworks, should be implemented to attract high-quality and environmentally responsible FDIs. Finally, countries that attract a large percentage of global tourists should work on improving their economic structures and consumption behavior so environmental degradation caused by EG is minimized.

5.2 Theoretical implications

This study contributes to existing literature on the effect of TOR, GF, CO_2 emissions FDI on EG in leading economies. It also extends prior research by integrating the tourism-led-growth hypothesis, green growth theory and the endogenous growth model into a unified framework, thereby providing a stronger theoretical foundation for explaining growth environment dynamics.

5.3 Limitations and future direction

Though the study presents useful empirical insight, it has some constraints that must be addressed. First, it focuses on nine tourist economies due to the data availability for the given timeframe, which could influence the findings. Second, although the study has utilized a sophisticated econometric framework to advance the estimates in quantile form, further research may apply CS-ARDL, AMG and CCEMG models to analyze the long-run data. Furthermore, the sample can be enlarged by considering more countries and recent data to take a more extensive global overview of the association among the parameters. Prospective scholars can also consider a country-focused analysis to investigate the heterogeneous effect at a more disaggregated level, such as a state or city. Finally, further studies can be performed by employing time-varying parameter models with structural breaks to better capture the effects of dynamic heterogeneity and transition over time across economies in the sample.

Note

1. The information is retrieved from Wikimedia Commons, on 06/05/2024. For more details see File: World's Top 10 Tourism Destinations.png - Wikimedia Commons

References

Abbas, S., Gui, P., Chen, A. and Ali, N. (2022), "The effect of renewable energy development, market regulation, and environmental innovation on CO_2 emissions in BRICS countries", *Environmental Science and Pollution Research*, Vol. 29 No. 39, pp. 59483-59501, doi: 10.1007/s11356-022-20013-7.

Alexander, S. and Gleeson, B. (2018), *Degrowth in the Suburbs: A Radical Urban Imaginary*, Springer.

Alhowaish, A.K. (2016), "Is tourism development a sustainable economic growth strategy in the long run? Evidence from GCC countries", *Sustainability*, Vol. 8 No. 7, p. 605, doi: 10.3390/su8070605.

Ali, M. and Seraj, M. (2022), "Nexus between energy consumption and carbon dioxide emission: evidence from 10 highest fossil fuel and 10 highest renewable energy-using economies", *Environmental Science and Pollution Research*, Vol. 29 No. 58, pp. 87901-87922l, doi: 10.1007/s11356-022-21900-9.

Ali, N. and Sultanuzzaman, M.R. (2026), "Determinants of green energy penetration in N-11 countries: a machine learning analysis", *Energies*, Vol. 19 No. 2, p. 541, doi: 10.3390/en19020541.

Ali, N., Hu, X., Hussain, J. and Nilofar, M. (2021), "Assessing the environmental impacts of COVID-19: a review", *Polish Journal of Environmental Studies*, Vol. 30 No. 5, pp. 4401-4403, doi: 10.15244/pjoes/130337.

Ali, N., Phoungthong, K., Khan, A., Abbas, S., Dilanchiev, A., Tariq, S. and Sadiq, M.N. (2023), "Does FDI foster technological innovations? Empirical evidence from BRICS economies", *PLoS One*, Vol. 18 No. 3, e0282498, doi: 10.1371/journal.pone.0282498.

Ali, M., Igunnu, P.O. and Tursoy, T. (2024a), "Do green finance and energy prices unlock environmental sustainability in Pakistan? Fresh evidence from RALS-EG cointegration", *OPEC Energy Review*, Vol. 48 No. 4, pp. 370-390, doi: 10.1111/opec.12319.

Ali, M., Seraj, M., Turuc, F., Tursoy, T. and Uktamov, K.F. (2024b), "Green finance investment and climate change mitigation in OECD-15 European countries: RALS and QARDL evidence", *Environment, Development and Sustainability*, Vol. 26 No. 11, pp. 27409-27429, doi: 10.1007/s10668-023-03765-1.

Ali, M., Igunnu, P.O., Seraj, M. and Raza, A. (2025a), "Effect of green finance and institutional quality on economic growth: evidence from novel MMQR approach", *SN Business and Economics*, Vol. 5 No. 10, p. 136, doi: 10.1007/s43546-025-00911-x.

Ali, M., Samour, A., Soomro, S.A., Khalid, W. and Tursoy, T. (2025b), "A step towards a sustainable environment in top-10 nuclear energy consumer countries: the role of financial globalization and nuclear energy", *Nuclear Engineering and Technology*, Vol. 57 No. 1, 103142, doi: 10.1016/j.net.2024.08.011.

Ali, N., Phoungthong, K., Techato, K., Ali, W., Abbas, S., Dhanraj, J.A. and Khan, A. (2022), "FDI, green innovation and environmental quality nexus: new insights from BRICS economies", *Sustainability*, Vol. 14 No. 4, p. 2181, doi: 10.3390/su14042181.

Annamalah, S., Paraman, P., Ahmed, S., Dass, R., Sentosa, I., Pertheban, T.R., Shamsudin, F., Kadir, B., Aravindan, K.L., Raman, M., Hoo, W.C. and Singh, P. (2023), "The role of open innovation and a normalizing mechanism of social capital in the tourism industry", *Journal of Open Innovation: Technology, Market, and Complexity*, Vol. 9 No. 2, 100056, doi: 10.1016/j.joitmc.2023.100056.

Bai, J., Choi, S.H. and Liao, Y. (2021), "Feasible generalized least squares for panel data with cross-sectional and serial correlations", *Empirical Economics*, Vol. 60 No. 1, pp. 309-326, doi: 10.1007/s00181-020-01977-2.

Balaguer, J. and Cantavella-Jorda, M. (2002), "Tourism as a long-run economic growth factor: the Spanish case", *Applied Economics*, Vol. 34 No. 7, pp. 877-884, doi: 10.1080/00036840110058923.

Baldwin, R., Braconier, H. and Forslid, R. (2005), "Multinationals, endogenous growth, and technological spillovers: theory and evidence", *Review of International Economics*, Vol. 13 No. 5, pp. 945-963, doi: 10.1111/j.1467-9396.2005.00546.x.

Balsalobre-Lorente, D., Abbas, J., He, C., Pilař, L. and Shah, S.A.R. (2023), "Tourism, urbanization and natural resources rents matter for environmental sustainability: the leading role of AI and ICT on sustainable development goals in the digital era", *Resources Policy*, Vol. 82, 103445, doi: 10.1016/j.resourpol.2023.103445.

Falcone, P.M. (2020), "Environmental regulation and green investments: the role of green finance", *International Journal of Green Economics*, Vol. 14 No. 2, pp. 159-173, doi: 10.1504/ijge.2020.109735.

Hantoko, D., Khan, W.U., Osman, A.I., Nasr, M., Rashwan, A.K., Gambo, Y., Hossain, M.M. and Chandrasekar, S. (2024), "Carbon–neutral hydrogen production by catalytic methane decomposition: a review", *Environmental Chemistry Letters*, Vol. 22 No. 4, pp. 1-41, doi: 10.1007/s10311-024-01732-4.

Hassan, S.T., Batool, B., Zhu, B. and Khan, I. (2022), "Environmental complexity of globalization, education, and income inequalities: new insights of energy poverty", *Journal of Cleaner Production*, Vol. 340, 130735, doi: 10.1016/j.jclepro.2022.130735.

Huseynli, N. (2022), "Econometric analysis of the relationship between tourism revenues, inflation and economic growth: the case of Morocco and South Africa", *African Journal of Hospitality, Tourism and Leisure*, Vol. 11 No. 1, pp. 135-146, doi: 10.46222/ajhtl.19770720.216.

Hussain, J., Zhou, K., Muhammad, F., Khan, D., Khan, A., Ali, N. and Akhtar, R. (2021), "Renewable energy investment and governance in countries along the Belt and Road Initiative: does trade openness matter?", *Renewable Energy*, Vol. 180, pp. 1278-1289.

Hong Hiep, H., Quang, B.N. and Minh, H.C. (2023), "The impact of FDI and regional factors on economic growth in Vietnamese provinces: a spatial econometric analysis", *Post-communist Economies*, Vol. 35 No. 5, pp. 454-474, doi: 10.1080/14631377.2023.2196869.

Iamsiraroj, S. (2016), "The foreign direct investment–economic growth nexus", *International Review of Economics and Finance*, Vol. 42, pp. 116-133, doi: 10.1016/j.iref.2015.10.044.

Iamsiraroj, S. and Ulubaşoğlu, M.A. (2015), "Foreign direct investment and economic growth: a real relationship or wishful thinking?", *Economic Modelling*, Vol. 51, pp. 200-213, doi: 10.1016/j.econmod.2015.08.009.

Igunnu, P.O. and Ali, M. (2025), "Drivers of carbon emissions in Turkey and Indonesia: the roles of energy use, natural disasters, and technological change", *New Energy Exploitation and Application*, Vol. 4 No. 2, pp. 47-64, doi: 10.54963/neea.v4i2.1365.

Jaforullah, M. (2015), "International tourism and economic growth in New Zealand", *Tourism Analysis*, Vol. 20 No. 4, pp. 413-418, doi: 10.3727/108354215x14400815080523.

Karim, R., Hoque, M.A., Mahmood, R., Bhowmik, R.C., Islam, S. and Ramachandaran, S.D. (2026), "Unveiling the roles of green tax, financial development, banking development, fintech adoption, and economic growth on sustainable development in Bangladesh", *World Development Sustainability*, Vol. 8, 100277, doi: 10.1016/j.wds.2026.100277.

Katircioglu, S.T., Feridun, M. and Kilinc, C. (2014), "Estimating tourism-induced energy consumption and CO_2 emissions: the case of Cyprus", *Renewable and Sustainable Energy Reviews*", Vol. 29, pp. 634-640, doi: 10.1016/j.rser.2013.09.004

Khalid, W., Seraj, M., Khalid, K. and Özdeşer, H. (2024), "The impact of renewable and non-renewable energy consumption on aggregate output in Pakistan: robust evidence from the RALS cointegration test", *Environmental Science and Pollution Research*, Vol. 31 No. 45, pp. 56621-56644, doi: 10.1007/s11356-024-34804-7.

Khalid, W., Aybudak, H.G., Rafay, A., Seraj, M. and Hassan, M. (2026), "Environmental sustainability in G-7 countries: do technological Innovation, renewable energy and stringent environmental policies matter?", *Economic Change and Restructuring*, Vol. 59 No. 1, p. 11, doi: 10.1007/s10644-025-09943-7.

Khan, M.B., Saleem, H., Shabbir, M.S. and Huobao, X. (2022), "The effects of globalization, energy consumption and economic growth on carbon dioxide emissions in South Asian countries", *Energy and Environment*, Vol. 33 No. 1, pp. 107-134, doi: 10.1177/0958305x20986896.

Kyara, V.C., Rahman, M.M. and Khanam, R. (2021), "Tourism expansion and economic growth in Tanzania: a causality analysis", *Heliyon*, Vol. 7 No. 5, e06966, doi: 10.1016/j.heliyon.2021.e06966.

Lee, H., Lee, J. and Im, K. (2015), "More powerful cointegration tests with non-normal errors", *Studies in Nonlinear Dynamics and Econometrics*, Vol. 19 No. 4, pp. 397-413, doi: 10.1515/snde-2013-0060.

Li, R., Wang, Q., Liu, Y. and Jiang, R. (2021), "Per-capita carbon emissions in 147 countries: the effect of economic, energy, social, and trade structural changes", *Sustainable Production and Consumption*, Vol. 27, pp. 1149-1164, doi: 10.1016/j.spc.2021.02.031.

Loredana, C., Rehman, A., Mirabela, F.I.M., Pinzon, S. and Cismaş, L.M. (2024), "What implications do primary energy use, urban population agglomeration, and economic development rendered to Romania's environmental sustainability?", *Energy Strategy Reviews*, Vol. 53, 101399, doi: 10.1016/j.esr.2024.101399.

Lungarska, A. and Chakir, R. (2024), "Projections of climate change impacts on ecosystem services and the role of land use adaptation in France", *Environmental and Sustainability Indicators*, Vol. 22, 100369, doi: 10.1016/j.indic.2024.100369.

Machado, J.A. and Silva, J.S. (2019), "Quantiles via moments", *Journal of Econometrics*, Vol. 213 No. 1, pp. 145-173, doi: 10.1016/j.jeconom.2019.04.009.

McGee, J.A. and York, R. (2018), "Asymmetric relationship of urbanization and CO_2 emissions in less developed countries", *PLoS One*, Vol. 13 No. 12, e0208388, doi: 10.1371/journal.pone.0208388.

Meng, M., Lee, J. and Payne, J.E. (2017), "RALS-LM unit root test with trend breaks and non-normal errors: aApplication to the Prebisch-Singer hypothesis", *Studies in Nonlinear Dynamics and Econometrics*, Vol. 21 No. 1, pp. 31-45, doi: 10.1515/snde-2016-0050.

Muhammad, B. (2019), "Energy consumption, CO_2 emissions and economic growth in developed, emerging and Middle East and North Africa countries", *Energy*, Vol. 179, pp. 232-245, doi: 10.1016/j.energy.2019.03.126.

Nosheen, M., Iqbal, J. and Khan, H.U. (2021), "Analyzing the linkage among CO2 emissions, economic growth, tourism, and energy consumption in the Asian economies", *Environmental Science and Pollution Research*, Vol. 28 No. 13, pp. 16707-16719, doi: 10.1007/s11356-020-11759-z.

Nyasha, S., Odhiambo, N.M. and Asongu, S.A. (2021), "The impact of tourism development on economic growth in Sub-Saharan Africa", *European Journal of Development Research*, Vol. 33 No. 6, pp. 1514-1535, doi: 10.1057/s41287-020-00298-5.

Nguyen Thi Truc, A. and Le Thanh, H. (2025), "Climate-related financial policies and bank risks: do environmental sustainability factors matter?", *Asian Journal of Economics and Banking*, Vol. 9 No. 3, pp. 418-436, doi: 10.1108/ajeb-04-2025-0037.

Pegkas, P. (2015), "The impact of FDI on economic growth in Eurozone countries", *The Journal of Economic Asymmetries*, Vol. 12 No. 2, pp. 124-132, doi: 10.1016/j.jeca.2015.05.001.

Peter, O.I., Oluwatoyin, A.S. and Huseyin, O. (2026), "Assessing the role of renewable energy, environmental taxes, and energy use in shaping greenhouse gas emissions in Nigeria", *Clean Energy and Sustainability*, Vol. 4 No. 2, p. 10007, doi: 10.70322/ces.2026.10007.

Popp, D. (2012), "The role of technological change in green growth", (NBER Working Paper No. 18506), National Bureau of Economic Research, available at: https://www.nber.org/papers/w18506

Purwono, R., Esquivias, M.A., Sugiharti, L. and Rojas, O. (2024), "Tourism destination performance and competitiveness: the impact on revenues, jobs, the economy, and growth", *Journal of tourism and services*, Vol. 15 No. 28, pp. 161-187, doi: 10.29036/jots.v15i28.629.

Raihan, A. and Tuspekova, A. (2022), "Nexus between emission reduction factors and anthropogenic carbon emissions in India", *Anthropocene Science*, Vol. 1 No. 2, pp. 295-310, doi: 10.1007/s44177-022-00028-y.

Rauf, A., Ali, N., Sadiq, M.N., Abid, S., Kayani, S.A. and Hussain, A. (2023), "Foreign direct investment, technological innovations, energy use, economic growth, and environmental sustainability nexus: new perspectives in BRICS economies", *Sustainability*, Vol. 15 No. 18, 14013, doi: 10.3390/su151814013.

Razzaq, A., Fatima, T. and Murshed, M. (2023), "Asymmetric effects of tourism development and green innovation on economic growth and carbon emissions in Top 10 GDP Countries", *Journal of Environmental Planning and Management*, Vol. 66 No. 3, pp. 471-500, doi: 10.1080/09640568.2021.1990029.

Ren, X., Cheng, C., Wang, Z. and Yan, C. (2021), "Spillover and dynamic effects of energy transition and economic growth on carbon dioxide emissions for the European Union: a dynamic spatial panel model", *Sustainable Development*, Vol. 29 No. 1, pp. 228-242, doi: 10.1002/sd.2144.

Sarwar, A., Khan, M.A., Sarwar, Z. and Khan, W. (2021), "Financial development, human capital and its impact on economic growth of emerging countries", *Asian Journal of Economics and Banking*, Vol. 5 No. 1, pp. 86-100, doi: 10.1108/ajeb-06-2020-0015.

Shang, Y., Zhu, L., Qian, F. and Xie, Y. (2023), "Role of green finance in renewable energy development in the tourism sector", *Renewable Energy*, Vol. 206, pp. 890-896, doi: 10.1016/j.renene.2023.02.124.

Sharif, A., Saqib, N., Dong, K. and Khan, S.A.R. (2022), "Nexus between green technology innovation, green financing, and CO_2 emissions in the G7 countries: the moderating role of social globalisation", *Sustainable Development*, Vol. 30 No. 6, pp. 1934-1946, doi: 10.1002/sd.2360.

Tan, J., Su, X. and Wang, R. (2023), "The impact of natural resource dependence and green finance on green economic growth in the context of COP26", *Resources Policy*, Vol. 81, 103351, doi: 10.1016/j.resourpol.2023.103351.

Tiba, S. and Belaid, F. (2020), "The pollution concern in the era of globalization: do the contribution of foreign direct investment and trade openness matter?", *Energy Economics*, Vol. 92, 104966, doi: 10.1016/j.eneco.2020.104966.

Tolliver, C., Fujii, H., Keeley, A.R. and Managi, S. (2021), "Green innovation and finance in Asia", *Asian Economic Policy Review*, Vol. 16 No. 1, pp. 67-87, doi: 10.1111/aepr.12320.

Tran, O.K.T., Mai, D.B., Chu, T.T.T. and Van Nguyen, D. (2023), "Do FDI and institutional quality affect the economic growth of local governments across Vietnam? Insights from bayesian modeling", *Scientific Papers of the University of Pardubice, Series D: Faculty of Economics and Administration*, Vol. 31 No. 2, doi: 10.46585/sp31021689.

Tran, T.T.T., Tran, H.T. and Duong, K.D. (2026), "The non-linear relationship between economic development and air pollution: evidence from panel data analysis", *Asian Journal of Economics and Banking*, Vol. 10 No. 1, pp. 81-95, doi: 10.1108/ajeb-09-2024-0112.

Vanhove, N. (2022), *The Economics of Tourism Destinations: Theory and Practice*, Routledge.

Vo, D.H., Vo, A.T. and Zhang, Z. (2019), "Exchange rate volatility and disaggregated manufacturing exports: evidence from an emerging country", *Journal of Risk and Financial Management*, Vol. 12 No. 1, p. 12, doi: 10.3390/jrfm12010012.

Wang, Q. and Zhou, Y. (2020), "Evolution and drivers of production-based carbon emissions in China and India: differences and similarities", *Journal of Cleaner Production*, Vol. 277, 123958, doi: 10.1016/j.jclepro.2020.123958.

Wang, Y., Wang, L. and Pan, C. (2022), "Tourism–growth nexus in the presence of instability", *Sustainability*, Vol. 14 No. 4, p. 2170, doi: 10.3390/su14042170.

Wen, J., Ali, W., Hussain, J., Khan, N.A., Hussain, H., Ali, N. and Akhtar, R. (2022), "Dynamics between green innovation and environmental quality: new insights into South Asian economies", *Economia Politica*, Vol. 39 No. 2, pp. 543-565, doi: 10.1007/s40888-021-00248-2.

World Travel & Tourism Council (2023), *Travel and Tourism Economic Impact, World Travel & Tourism Council (WTTC)*, available at: https://assets-global.website-files.com/6329bc97af73223b575983ac/647e0115aa2037c6a78f1158_EIR2023-OIC.pdf (accessed 6 May 2024).

Xu, D., Abbas, S., Rafique, K. and Ali, N. (2023), "The race to net-zero emissions: can green technological innovation and environmental regulation be the potential pathway to net-zero emissions?", *Technology in Society*, Vol. 75, 102364, doi: 10.1016/j.techsoc.2023.102364.

Yin, X. and Xu, Z. (2022), "An empirical analysis of the coupling and coordinative development of China's green finance and economic growth", *Resources Policy*, Vol. 75, 102476, doi: 10.1016/j.resourpol.2021.102476.

Zavala, C., Babonneau, F. and Homem-de-Mello, T. (2023), "Measuring the impact of regional climate change on heating and cooling demand for the Chilean energy transition", *Journal of Cleaner Production*, Vol. 428, 139390, doi: 10.1016/j.jclepro.2023.139390.

Zhang, S., Liu, X. and Bae, J. (2017), "Does trade openness affect CO_2 emissions: evidence from ten newly industrialized countries?", *Environmental Science and Pollution Research*, Vol. 24 No. 21, pp. 17616-17625, doi: 10.1007/s11356-017-9392-8.

Zhang, D., Mohsin, M., Rasheed, A.K., Chang, Y. and Taghizadeh-Hesary, F. (2021), "Public spending and green economic growth in BRI region: mediating role of green finance", *Energy Policy*, Vol. 153, 112256, doi: 10.1016/j.enpol.2021.112256.

Zheng, C., Wu, S., Teng, Y.P., Wu, S. and Wang, Z. (2023), "Natural resources, tourism resources and economic growth: a new direction to natural resources perspective and investment", *Resources Policy*, Vol. 86, 104134, doi: 10.1016/j.resourpol.2023.104134.

Corresponding author
Mumtaz Ali can be contacted at: mumtaz.ali@neu.edu.tr