

Does sustainability uncertainty matter for tourism development?

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Abstract

Purpose – The study examines the impact of the Sustainability Uncertainty Index on county tourism development. It also examines this relationship across countries with low and high levels of tourism development.

Design/methodology/approach – Using a sample of 23 countries over an 18-year period (2003–2020), the study employs a two-way fixed-effects regression and conducts various robustness checks to validate its results.

Findings – The study found that, for the sample countries, the Sustainability Uncertainty Index has a negative but statistically insignificant effect on tourism development, as measured by both receipts and arrivals. Analysis across tourism development levels also shows that, from the lower to the upper quartile, the Sustainability Uncertainty Index has no significant impact on tourism development receipts and arrivals. Additionally, in the sample countries, both low- and high-tourism-development countries showed a negative impact of Sustainability Uncertainty on their tourism development receipts and arrivals, but the effect was insignificant.

Originality/value – This study contributes to the literature by helping to understand the impact of the sustainability uncertainty index on the countries' tourism development.

Keywords Tourism development, Sustainability uncertainty,

Two-way fixed-effect regression and robust analysis

Paper type Research article

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1. Introduction

Sustainability practices related to ESG (Environmental, Social, and Governance) standards, policies, and disclosure expectations within a country can significantly influence the development of its tourism industry (Hassan and Meyer, 2025; Kumar, 2025; Wang and Jia, 2025; Wen *et al.*, 2026). As sustainability practices encourage countries to address climate risk exposure, promote good environmental practices by firms and individuals, ensure compliance with local and international environmental agreements, and provide other benefits (Opuni-Frimpong, 2025; Shin *et al.*, 2026; Zhang *et al.*, 2025).

Sustainability practices related to ESG performance in a country address or promote ESG factors, advancing environmental, social, and governance factors (Hluszko *et al.*, 2024; Padilla-Rivera *et al.*, 2025). This supports the enactment of sound regulations that benefit businesses and economic activities in a country, promote transparency in reporting, reduce risk exposure in businesses and economic activities in a country, reduce climate risk exposure, help reduce carbon dioxide emissions, support biodiversity protection, ensure gender equity, promote good governance, and ensure effective resource utilization, providing other benefits that impact various industries within a country (Handoyo and Anas, 2024; Opuni-Frimpong, 2025; UNDP, 2024), including the tourism industry. This would indeed impact the tourism industry, where businesses are closely linked to the environment and local communities (Hassan and Meyer, 2025; UN tourism, 2024).

Therefore, a country's ESG performance can help its tourism industry reduce operational risk exposure, implement effective governance regulations to support its development, and serve as a valuable resource to attract customers and investors and gain other competitive advantages in tourism-related business activities (UN tourism, 2024; Zhang *et al.*, 2025). Thus, from the theoretical perspectives of risk reduction theory, the resource-based view, and institutional theory, a country with a strong ESG framework can help reduce risk exposure for businesses, serve as a valuable resource to promote growth, implement sound regulations to guide businesses, and mitigate sustainability uncertainty across various industries, including the tourism industry.



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However, ESG uncertainty, characterized by unpredictable or inconsistent ESG practice frameworks within a country, would result in unclear or inconsistent ESG sustainability practices, unclear policies on ESG practices, reporting, and operational expectations, and other issues. These factors would reasonably create unclear climate risk-mitigation policies, inconsistent disclosure standards for ESG practices, and other detrimental impacts across industries in a country, including the tourism industry. This would reasonably cause the tourism industry to miss out on the benefits associated with a country's strong ESG performance. Thus, all things being equal, it would make it difficult for the tourism industry to attract customer loyalty, reduce carbon footprints, support biodiversity protection, ensure sustainable financing, attract environmentally conscious investors, ensure transparent reporting and regulatory compliance, and address other challenges related to their operational risk exposures. So, uncertainty around sustainability, including future ESG trends, policy shifts, changing social norms, or inconsistent disclosure standards, can affect a country's environmental performance and climate risk exposure, and can considerably influence TOD in that country.

Sustainability uncertainty (SUN) stems from evolving ESG regulatory frameworks, inconsistent standards, and contested societal values (Alalmaee, 2026; Ongan *et al.*, 2025). These factors create unclear climate policies, inconsistent disclosure standards, and hinder countries' financial growth (Alalmaee, 2026), including the development of the tourism industry. In fact, the growth of the tourism industry is shaped by sustainability practices related to climate mitigation measures, adherence to good ESG practices and regulations established within a country, and the promotion of social equality (Dias *et al.*, 2026; Shin *et al.*, 2026; Siripipathanakul *et al.*, 2026). Therefore, these factors foster an environment that encourages the development of the tourism industry.

Indeed, previous studies have emphasized the influence of uncertainties and other variables on the growth of the tourism industry, including economic, political, and default risk uncertainties, as well as sustainability disclosures (Altinay *et al.*, 2005; Chisadza *et al.*, 2022; Nguyen *et al.*, 2022; Tiwari and Sharif, 2026). Although earlier research has improved understanding of factors affecting TOD, such as economic and political uncertainty, default risk, and sustainability disclosures, less attention has been paid to the effects of uncertainty in ESG standards and regulations, as well as regulatory expectations, which can hinder the industry's progress. Therefore, ambiguity surrounding ESG policies, disclosure frameworks, and regulatory expectations may negatively impact a country's tourism growth, yet little is known about this issue. This highlights the need to address the identified research gap.

Therefore, the study aims to investigate the impact of sustainability-related uncertainty on TOD. It also explores this relationship across high- and low-developed tourism countries. Specifically, the study examines 23 countries from 2003 to 2020. Using two-way fixed-effects regression and several robustness tests, it assesses the impact of the ESG-based SUN index on the TOD of these countries.

The significance of this study lies in providing empirical evidence on how the ESG-based SUN index influences TOD. Additionally, it offers new insights into the impact of SUN in both high- and low-developed tourism countries. It also responds to the recent call for research on tourism, sustainable environmental practices, and environmental issues, an area that prior studies largely overlooked (e.g. Wen *et al.*, 2026). Furthermore, the research supports the theoretical frameworks of risk reduction, resource-based view, and institutional theories. The results will assist governments, tourism organizations, and international agencies in understanding the impact of SUN on TOD, thereby improving their policies and decision-making.

2. Theoretical background and literature review

2.1 The risk -reduction theory, resource-based view, and institutional theory

Examining the impact of sustainability uncertainty on tourism development, the study draws on Risk-Reduction Theory, the Resource-Based View, and Institutional Theory. Sustainability

practices aligned with ESG frameworks support risk management, strengthen consumer loyalty, reduce carbon footprints, protect biodiversity, ensure sustainable financing, attract environmentally conscious investors, promote transparent reporting, ensure regulatory compliance, and deliver other benefits within the tourism industry, where businesses are closely linked to the environment and local communities. Thus, unclear or inconsistent sustainability practices related to ESG frameworks in a country, all else being equal, would make it more difficult to manage risk exposure, attract customer loyalty, reduce carbon footprints, protect biodiversity, ensure sustainable financing, attract environmentally conscious investors, promote transparent reporting and ensure regulatory compliance, and address other challenges within the tourism industry. Therefore, the research relies on the Risk-Reduction Theory, the Resource-Based View, and Institutional Theory to better understand the relationship between sustainability uncertainty and tourism development, which are elaborated on as follows:

Risk-Reduction Theory suggests that active ESG engagement helps reduce the impact of external shocks (Khorilov and Kim, 2024; Kumar, 2025). Therefore, countries that promote or ensure ESG practices and implement ESG regulations can help the tourism industry adopt sustainable practices, such as optimizing resource use—energy, food, and water—and managing waste (Zhang *et al.*, 2025). These efforts, all other factors being equal, can help the tourism industry mitigate the negative effects of climate change uncertainties on its operations and support its development (Ali *et al.*, 2023). In examining how SUN affects TOD, countries that address these issues by aligning ESG regulations with current practices, establishing consistent standards, and promoting societal values can help the tourism industry avoid climate risks, comply with environmental regulations, and embed sustainable tourism practices. This can help the tourism industry reduce risk exposure and positively influence its development. Additional studies grounded in Risk-Reduction Theory have also explored how ESG factors affect TOD (He *et al.*, 2024; Kumar, 2024, 2025; Shin *et al.*, 2026).

The resource-based view theory also supports this study. It explains that ESG practices or integration can serve as a key resource for gaining a competitive advantage (Bhandari *et al.*, 2022; dos Reis Cardillo and Basso, 2025). Therefore, countries promoting ESG practices, ensuring up-to-date ESG regulations, maintaining consistent ESG standards aligned with international best practices, and valuing societal values would foster a favourable environment that provides their tourism industry with a competitive edge and aids in its development (dos Reis Cardillo and Basso, 2025; Shin *et al.*, 2026; Yadav *et al.*, 2025). These measures would reduce CO₂ emissions, promote biodiversity protection, ensure community engagement and transparent governance, and all enhance the tourism industry. So, within the framework of studying the impact of SUN on TOD, countries addressing SUN by promoting ESG practices, ensuring current ESG regulations, maintaining consistent ESG standards aligned with international best practices, and valuing societal values would help their tourism industries gain a competitive advantage over others, thereby supporting their development. Indeed, other studies within the resource-based view framework have explored how ESG factors influence TOD (dos Reis Cardillo and Basso, 2025; Kumar, 2024; Shin *et al.*, 2026).

Additionally, the study draws on Institutional Theory, which suggests that norms, societal values, regulations, and other factors influence the behaviour of firms and individuals, thereby driving development (Soares *et al.*, 2021). Therefore, countries that promote and implement ESG regulations and practices, are attentive to climate risk mitigation, address environmental degradation and pollution, and are concerned with societal values, can positively impact their tourism industry by influencing them in incorporating sustainable practices into their operations (Hassan and Meyer, 2025; Shin *et al.*, 2026). Thus, in examining SUN in tourism-dependent countries, enacting good regulations and policies to address climate risk exposure and environmental degradation, and ensuring social justice in addressing sustainability concerns would likely influence these countries' tourism industries and support their development. Other studies within the scope of Institutional Theory have also explored how ESG regulations and related factors influence TOD (Rahman *et al.*, 2025).

Thus, the study suggests that these theories complement each other in explaining that addressing SUN can help improve a country's tourism industry, and SUN can act as a constraint on its development.

2.2 TOR and SUN

Prior studies have paid less attention to the impact of SUN on TOD but have focused extensively on other external uncertainties, such as economic, political, energy, and pandemic-related factors (e.g. [Hassan and Meyer, 2025](#); [Kumar, 2025](#); [Rahman et al., 2025](#); [Shin et al., 2026](#)). Because sustainability uncertainty, relating to unclear policies on ESG practices, reporting, and operational expectations in a country, and the absence of good governance regulations for the tourism industry can make it difficult for the tourism industry to attract customer loyalty, reduce carbon footprints, support biodiversity protection, ensure sustainable financing, attract environmentally conscious investors, ensure transparent reporting and regulatory compliance, and address other challenges related to their operational risk exposures, the relevant literature is reviewed to develop the hypotheses for the study.

Recently, within the resource-based view theory, [Shin et al. \(2026\)](#) explained that the external environment in ESG decision-making is considered in most tourism activities and studies. This highlights that SUN regarding ESG in a country would affect its tourism industry. [Kumar \(2025\)](#), within risk reduction theory, found that ESG disclosures mitigate the adverse effects of political and climate change uncertainties on the total and systematic risks faced by tourism firms. The study also examines the relationship between ESG disclosures and firm risk, as well as the connection between uncertainties and firm risk, to demonstrate the validity of both risk-reduction theory and stakeholder theory. They discovered that the amount of ESG disclosures plays a key role in moderating the relationship between uncertainties and the risks faced by different industries of the tourism industry (Recreation and Entertainment, Transportation, and Hospitality and Restaurants). The author concluded that active involvement of tourism companies in sustainability efforts can help them better manage risks and reduce the effects of uncertainties more efficiently.

This highlights that countries' ESG-related sustainability uncertainties can have a lesser impact on their tourism industries and development. From a theoretical risk-reduction perspective, examine the effect of hotel firms' ESG performance in the United States on their cost of debt. They found that, in general, hotel firms with higher ESG scores are significantly associated with lower debt costs. Furthermore, the study has observed that the relationship between hotels' ESG scores and their debt costs has become statistically significant since 2014, suggesting that lenders have placed greater value on ESG in recent years ([He et al., 2024](#)). This clearly shows that a country's SUN would affect the cost of debt for its tourism industry, which, in turn, would influence its development. [Rahman et al. \(2025\)](#) in the context of institutional theory, examine how ESG-driven sustainable tourism management in small and medium-sized enterprises. In analyzing 760 SMEs, they found that indeed institutions influence the adoption of ESG practices by SMEs in the tourism industry, which would impact the industry's development. This indicates that countries' SUN would also influence the sustainable practices of their SME businesses, which would impact their tourism industry.

[Hassan and Meyer \(2025\)](#) investigated the key determinants of international tourism in the Czech Republic, Hungary, Poland, and Slovakia over the period 1995–2019. They found that, in addition to economic factors, international tourists' perception of ESG risk is another key determinant of international tourism demand in these countries. Then it can be deduced that tourists' perceptions or knowledge of SUN in a country would influence tourism demand there, which in turn impacts the country's TOD. In the context of institutional theory, [Kim et al. \(2024\)](#) found that government and industry regulations affect sustainability performance among Korean companies. This shows that a country's SUN, as it relates to ESG issues in government policies and regulations, can influence its tourism firms. This would influence the development of the tourism industry. [Kumar \(2024\)](#), within the risk reduction and the

resource-based view theories, investigated the role of corporate sustainability disclosures in moderating the link between country-level uncertainties (economic policy uncertainty, political uncertainty, and uncertainty due to climate change) and firms' risks (total risk, market risk, and default risk) in the worldwide tourism firms. Using the volume of ESG activities disclosures by the firms as a proxy of corporate sustainability disclosures, they found that sustainability initiatives play a vital role in reducing the default risk of tourism businesses. The study also highlights the significant impact external uncertainties have in increasing the default risk of tourism businesses.

Additionally, the author shows that sustainability initiatives mitigate the effects of uncertainty on default risk by examining two periods of heightened uncertainty (the COVID-19 outbreak and the global financial crisis) and demonstrating how they reduce the impact of such uncertainty on default risk in the tourism industry. This indicates that a country's SUN can increase default risk in the tourism industry, negatively affecting its development. Within resource-based view theories, the external environment in ESG decision-making is considered in most tourism activities and studies (Shin *et al.*, 2026). This highlights that SUN regarding ESG in a country would affect its tourism industry. In China, examining the causal effect of ESG disclosure on A-Share-listed tourism firms for the period 2012–2020, they found that ESG disclosure has significantly increased the value of tourism corporations by alleviating financing constraints, reducing financial risks, attracting green investors, and promoting the development of the industry, which thrives on brand loyalty and market competitiveness (Atay *et al.*, 2026; Jalali *et al.*, 2026; Wang and Jia, 2025). This could mean that countries' sustainability uncertainty, considering the positive impacts of ESG disclosures on the tourism industry, would have less impact on their tourism industry.

Other studies have also hinted at the impact of sustainability on the tourism industry. Kumar (2023) investigated the impact of national-level economic and political uncertainties on the quantity of environmental, social, and governance (ESG) sustainability disclosures by the tourism industry firms from the stakeholder theory perspective. The findings indicate that, as economic and political uncertainties increase, tourism firms make greater use of sustainability disclosures, mainly to build strong relationships with stakeholders and to spread positive word-of-mouth about the firm's contributions to social welfare and environmental conservation. The author also found that sustainability disclosures moderate the impact of economic uncertainty on firm value during the COVID-19 pandemic and the global financial crisis. This suggests that a country's SUN can prompt its tourism industry to promote sustainability practices and disclosures to build good relationships with various stakeholders regarding its contributions to environmental issues and social welfare, thereby helping the industry's development.

Nguyen *et al.* (2022) Using the framework of the theory of reasoned action, the study examined the influence of economic uncertainty on tourism across a global sample of 124 countries from 1996–2017. They found that an increase in economic uncertainty encourages domestic tourism while reducing outbound tourism in the global sample. Notably, their findings were consistent across upper-middle-income economies: an increase in uncertainty had a positive impact on both domestic and outbound tourism, whereas in lower-middle-income economies it had a negative impact on both. SUN poses a challenge to the development of the tourism industry due to difficulties in implementing sustainable practices, changing consumer behaviour, and external factors such as pandemics, which affect competitiveness and require new strategies for sustainable tourism destinations (Streimikiene *et al.*, 2021). Dima (2020) stressed that the sustainable development of tourism in the long term can only be achieved by eliminating the negative impact on the ecosystem. Thus, countries addressing SUN would promote sustainable tourism practices, thereby supporting its development.

Ghosh (2019) explores the causal associations between political and economic uncertainty and tourism, as well as other macroeconomic variables, for France, Greece, and the United States for the period 1995 to 2016. Political uncertainty is proxied by the terrorism index, and economic uncertainty is explained by the Economic Policy Index. The author found that

Uncertainty adversely affects TOD in the long run. In other related study, [Kocourková et al. \(2024\)](#), examined the impact of energy uncertainty on international tourism receipts in 11 European countries, namely Belgium, Croatia, Denmark, France, Germany, Greece, Ireland, Italy, the Netherlands, Spain, and Sweden. They found that a 1% increase in energy uncertainty results in a 0.08% decrease in international tourism receipts in Europe. Consequently, it is reasonable to conclude that SUN would also decrease a country's TOD. [Streimikiene et al. \(2021\)](#) emphasized that the theoretical definition of sustainable tourism involves economic, social, and environmental protection dimensions. Then it can be argued that countries' sustainable uncertainty regarding ESG-related uncertainty would negatively impact their TOD.

Building on previous research that highlights sustainability's influence on the tourism industry, this study utilizes the risk reduction, resource-based view, and institutional theory to suggest that countries' SUN, specifically, ESG-related uncertainty, may not help the tourism industry reduce its risk exposure. It may also fail to provide a competitive advantage and have less influence on promoting sustainable tourism practices. Therefore, SUN could negatively affect a country's tourism industry development. Consequently, the study aims to test the hypothesis that:

H1. SUN negatively impacts countries' TOD.

2.3 Additional review

Given that sustainability practices in the tourism industry benefit both highly developed and low-developed tourism countries ([UN tourism, 2005](#); [Zhang et al., 2025](#)). Then, SUN, that is, ESG-related uncertainty, acts regarding ESG policies, disclosure frameworks, and regulatory expectations, can impede the tourism industry's growth, irrespective of the nature of the TOD in countries. Therefore, the study also explores how SUN impacts countries' TOD in both high- and low-tourism developed nations.

Therefore, based on the above discussion, the study proposes a conceptual framework, as shown in [Figure 1](#).

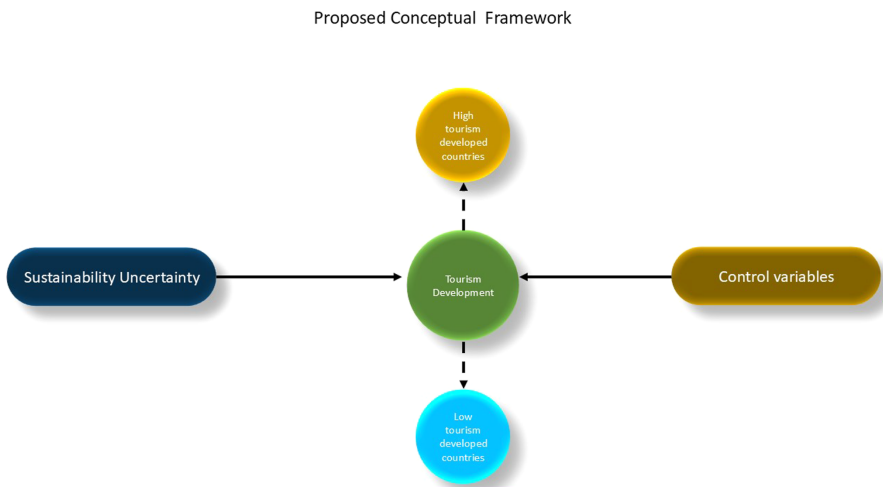


Figure 1. Proposes a conceptual framework. Source: Author's own work

3. Methodology

3.1 Sample selection

The study initially considers all 25 countries having data on sustainability uncertainty developed by [Ongan et al. \(2025\)](#). However, as Spain and the UK do not have tourism receipts data from the United Nations World Tourism Organization at the time of the research, they are excluded from the sample, resulting in a final sample of 23 countries for the study. Thus, the study focuses on 23 countries for the period 2003 to 2020. The years 2003 and 2020 are the start and end points because the primary independent variable, the SUN, begins in 2003, with the primary dependent variable, TOD, measured by international tourism receipts and tourism arrivals data from the United Nations World Tourism Organization, also concluding within this timeframe. Additionally, this period saw significant changes in TOD, with international visits doubling. Therefore, it is an ideal interval to explore the relationship between SUN and TOD.

Data on TOD, proxied by international tourism receipts (TOR) and tourism arrivals (TOA), are sourced from the United Nations World Tourism Organization. SUN is sourced from the economic policy uncertainty <https://www.policyuncertainty.com/> and developed by [Ongan et al. \(2025\)](#). While the control variables were also sourced from the World Bank. The study used Power Query and Stata 15 to extract and analyse data. The countries included in the study are listed in [Table 1](#), Panel A.

3.2 Measurement of variables

TOD is measured using the proxy variables of the log of international tourism receipts (TOR) and the log of tourism arrivals (TOA), following ([Beha et al., 2024](#); [Dzitac et al., 2025](#); [Hassan and Meyer, 2025](#)).

Following prior studies (e.g. [Alalmaee, 2026](#)), the SUN is measured using the ESG-based SUN index developed by [Ongan et al. \(2025\)](#). The ESG-based sustainability index is a country-level, text-based index developed using text-mining techniques on economic and country reports. It is concerned with the frequency with which terms related to ESG issues co-occur with expressions of uncertainty. So, the index focuses explicitly on sustainability and ESG-related sources of uncertainty.

Considering previous studies ([Beha et al., 2024](#); [Hassan and Meyer, 2025](#); [Kumar, 2025](#)), the theories underlying the study, measurement validity, data availability, and the need to improve research model estimation, the study includes the following control variables: Trade openness (TRO), measured as total trade as a percentage of GDP. Trading activities can improve tourism attractions and their development. Urbanization (URB) is measured as the share of the urban population. Urbanization can help to improve the TOD in a country. GDP growth (GDPG) is measured by the GDP (annual % growth). GDP, serving as an economic indicator, can also influence the development of the tourism industry. GDP per Capita (GDPP) is measured as the log of GDP per capita (constant 2015 US\$). As an indicator of the standard of living, which can affect the TOD. Considering climate risk factors, the Renewable Energy (REN), measured as the Share of renewables in total energy Consumption, is controlled for. Renewable energy consumption can help reduce the country's climate risk exposure, promote sustainable tourism practices, and influence its development. The COVID-19 pandemic, which had detrimental impacts on countries and businesses ([Opuni-Frimpong, 2026](#); [Opuni-Frimpong et al., 2024, 2025](#)), is controlled for using a Dummy variable equal to 1 for the pandemic period and 0 otherwise.

For robust analysis, the study includes additional control variables. Government Effectiveness (GE) is measured using the Government Effectiveness Index, which ranges from approximately -2.5 to 2.5, with higher values indicating better governance. Infrastructure (INFR) is measured using the log of the total number of passengers carried by air transport. Improving infrastructure can enhance tourism and development in a country.

Table 1. A sample of countries, variables definition, descriptive statistics, and Pearson correlation matrix

Sample countries, variables definition, descriptive statistics and pearson correlation matrix

Panel A: Sample Countries

Australia, Belgium, Brazil, Canada, Chile, China, Colombia, France, Germany, Greece, India, Ireland, Italy, Japan, Mexico, Netherlands, Pakistan, Russia, Singapore, South Korea, Sweden, US, Vietnam

Variable	Measurement	Sources
<i>Panel B: Variables definitions</i>		
<i>Dependent variables</i>		
International tourism receipts (TOR)	The log of international tourism, receipts	United Nations World Tourism Organization
Tourism Arrivals (TOA)	The log of international tourism, number of arrivals	United Nations World Tourism Organization
<i>Independent variable</i>		
Sustainability Uncertainty Index (SUN)	ESG-based sustainability uncertainty index	Economic Policy Uncertainty (Ongan et al., 2025)
<i>Control variables</i>		
Trade openness (TRO)	Total trade as a percentage of GDP	World Development Indicators
Renewable Energy (REN)	Share of renewables in total energy Consumption	World Development Indicators
Urbanization (URB)	Share of urban population	World Development Indicators
GDP growth (GDPG)	GDP (annual % growth)	World Development Indicators
GDP per Capita (GDPP)	Log value of GDP per capita (constant 2015 US\$)	World Development Indicators
Covid 19 Pandemic (COV)	Dummy variable of 1 for the pandemic period, otherwise 0	World Health Organization
<i>Additional control variables for robust analysis</i>		
Infrastructure (INFR)	Total number of passengers carried by air transport	World Development Indicators
Government Effective (GE)	Good governance, as measured by the Government Effectiveness Index, ranges from approximately –2.5 to 2.5, with higher values indicating better governance	World Governance Indicators

Variable	Obs	Mean	Std. Dev	Min	Max
<i>Panel C: Descriptive statistics</i>					
TOR	414	23.327	1.135	20.245	26.212
TOA	414	16.487	1.387	13.124	19.199
SUN	414	26.807	8.278	7.419	56.119
TRO	414	84.217	75.545	21.326	437.327

(continued)

Table 1. Continued

Variable	Obs	Mean	Std. Dev	Min	Max
REN	414	17.949	15.223	0.500	57.800
URB	414	73.578	18.651	26.175	100.000
GDPG	414	2.758	3.766	-9.877	24.624
GGDPP	414	9.756	1.197	6.735	11.301
COV	414	0.056	0.229	0.000	1.000

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	VIF
<i>Panel D: Pearson correlation matrix</i>										
(1) TOR	1.000									
(2) TOA	0.812*	1.000								
(3) SUN	0.059	-0.008	1.000							1.143
(4) TRO	-0.065	-0.092*	0.099*	1.000						1.261
(5) REN	-0.566*	-0.487*	0.016	-0.311*	1.000					1.734
(6) URB	0.294*	0.164*	0.209*	0.212*	-0.453*	1.000				2.775
(7) GDPG	-0.176*	-0.093*	-0.069	0.164*	0.129*	-0.372*	1.000			1.586
(8) GGDPP	0.579*	0.362*	0.262*	0.301*	-0.606*	0.790*	-0.338*	1.000		3.724
(9) COV	-0.083*	-0.117*	0.060	0.005	0.036	0.027	-0.398*	0.022	1.000	1.246
Mean VIF										1.924

Note(s): Note to Panel D: * indicate 1%, 5% and 10% significance levels. VIF represents the Variance Inflation Factor

Source(s): Author's own

3.3 Research model

Building on prior studies on tourism (Beha *et al.*, 2024; Hassan and Meyer, 2025; Sun *et al.*, 2025), this research investigates how SUN impacts countries' TOD. It employs a two-way fixed-effects panel model that considers unobserved country-specific factors and global shocks over time. The baseline model for the study is as follows:

$$TOD_{it} = \beta_0 + \beta_1 SUN_{it} + \sum \beta_k Controls_{it} + Country\ Fixed\ Effect + Year\ Fixed\ Effect + \varepsilon_{it}$$

where subscript *i* is for country *i* and subscript *t* is for year *t*. TOD is the tourism development representing either tourism receipts (TOR) or tourism arrivals (TOA). SUN is the Sustainability Uncertainty Index, an ESG-based sustainability uncertainty index. Controls are the control variables. ε is the residual error term. All the continuous variables are winsorized at the 1st and 99th percentiles to enhance model estimation.

The fixed-effects model is justified because it controls for unobserved country-specific traits that are time-invariant but may affect TOD. By focusing on within-country variation over time, the model reduces omitted-variable bias from time-invariant factors such as economic structure, geography, culture, and institutional history. This makes fixed effects especially suitable for this study involving countries, where heterogeneity across nations can influence the estimated relationship between SUN and TOD. Furthermore, the fixed-effects model enhances the accuracy of causal inference by focusing on how changes in the study's explanatory variables over time affect each country individually.

Given the study's focus on only 23 countries and the difficulty of addressing potential sample selection bias, several robustness checks are conducted to validate the findings. For

example, the Driscoll-Kraay model, additional control variables, two-stage regression, and the two-step system general method of moments are used to validate the study's findings. Furthermore, quantile regression is estimated to better understand the relationship between SUN and TOD. The study employs the fixed-effects regression model and further validates the results through multiple robustness analyses, making it preferable to alternative statistical estimations.

4. Results

4.1 Descriptive statistics and correlation matrix

[Table 1](#), panel C, provides descriptive statistics for the study variables. TOR has an average of 23.327 and a standard deviation of 1.135, ranging from 20.245 to 26.212, showing low variability across countries. TOA's mean is 16.487 with a standard deviation of 1.387, also indicating low variability. SUN has a mean of 26.807 and a standard deviation of 8.278, suggesting moderate variability in SUN across the sample countries. For brevity purposes, the control variables are not elaborated on.

[Table 1](#), panel D, presents Pearson's correlation matrix, showing that SUN is positively correlated with TOR but negatively correlated with TOA, and both correlations are statistically insignificant. The correlations among the independent variables are all below 0.8, suggesting no multicollinearity issues according to standard statistical thresholds. The variance inflation factors (VIFs) for the independent variables in the main model are also below 10. These results confirm that multicollinearity does not affect the regression models in this study.

4.2 Regression analysis, robustness, endogeneity analysis, and additional quantile analysis

4.2.1 TOR, TOA, and SUN. [Table 2](#), Panel A, column (1) and column (7) show that the estimated coefficients on SUN are negative 0.003 and insignificant for both the TOR and TOA models, respectively. This does not support [H1](#). This means that the study, by justifying the use of the two-way fixed-effects regression model, finding no serial correlation or cross-country dependence among the sample countries, and addressing heteroscedasticity and autocorrelation, as reported in its diagnostic tests, found that countries' sustainability uncertainty negatively impacts their tourism development, but it is insignificant. The insignificant impact of SUN on TOR could be due to ESG integration within the industry, which relies heavily on brand, physical attractions, and market competitiveness. This aligns with previous studies that found that active involvement of tourism firms, which thrive on brand, physical attractions, and market competitiveness, in sustainability efforts helps them better manage risks, reduce the effects of uncertainties more effectively, enhance their value, and improve their reputation ([Kumar, 2025](#); [Wang and Jia, 2025](#); [Zhang et al., 2025](#)). This also supports the risk-reduction and resource-based views, suggesting that ESG integration within the country's tourism industry helps mitigate negative impacts associated with ESG-related uncertainty ([dos Reis Cardillo and Basso, 2025](#); [He et al., 2024](#); [Kumar, 2025, 2024](#); [Shin et al., 2026](#)). For brevity purposes, the control variables are not elaborated on.

To assess the robustness of the findings, several analyses were performed. The first was the Driscoll-Kraay regression model, which tests for cross-sectional dependence among countries. [Table 2](#), Panel A, columns (2) and (8) show the results, indicating that for both the TOR and TOA models, respectively, the estimated coefficients on SUN are 0.003 and are insignificant. This confirms the baseline findings. Second, the study re-estimated the baseline regression model, replacing the SUN variable with its natural logarithm. Natural logarithm values are useful for model estimation. [Table 2](#), Panel A, columns (3) and (9) present the results, again showing that for both the TOR and TOA models, respectively, the estimated coefficients on SUN are negative 0.002 and 0.037, respectively, and they remain insignificant. Third, in untabulated results, infrastructure development within the tourism industry was added to the baseline regression models for both TOR and TOA, and the results still confirm

Table 2. Regression analysis

Variable	Tourism receipts model						Tourism arrival model					
	Two-way Fixed effect Baseline Model (1) TOR	Driscoll- Kraay Model (2) TOR	Two-way Fixed effect Log value of SUN (3) TOR	Two stage Regression First stage (4) SUN	Second stage (5) TOR	Two-step System GMM (6) TOR	Two-way Fixed effect Baseline Model (7) TOA	Driscoll- Kraay Model (8) TOA	Two-way Fixed effect Log value of SUN (9) TOA	Two stage Regression First stage (10) SUN	Second stage (11) TOA	Two-step System GMM (12) TOA
<i>Panel A: Regression, robust, and endogeneity analyses</i>												
SUN	−0.003 (0.002)	−0.003 (0.002)	−0.002 (0.042)		−0.005 (0.004)	−0.002 (0.002) 0.877*** (0.033)	−0.003 (0.002)	−0.003 (0.002)	−0.037 (0.055)		−0.002 (0.005)	−0.002 (0.001) 0.971*** (0.014)
L.TOR/L.TO												
L.SUN				0.461*** (0.047)						0.461*** (0.047)		
TRO	0.003*** (0.001)	0.003 (0.002)	0.000 (0.001)	0.010 (0.023)	0.000 (0.001)	−0.001 (0.000)	0.003*** (0.001)	0.003 (0.002)	0.003** (0.001)	0.010 (0.023)	0.003** (0.001)	−0.000 (0.000)
REN	−0.013** (0.005)	−0.013** (0.006)	−0.016*** (0.004)	0.330*** (0.118)	−0.011** (0.005)	−0.004*** (0.001)	−0.013** (0.005)	−0.013** (0.006)	−0.013** (0.005)	0.330*** (0.118)	−0.012** (0.006)	0.000 (0.002)
URB	−0.018* (0.009)	−0.018*** (0.005)	−0.058*** (0.007)	−0.046 (0.219)	−0.055*** (0.008)	−0.003* (0.002)	−0.018* (0.009)	−0.018*** (0.005)	−0.019** (0.009)	−0.046 (0.219)	−0.020** (0.010)	−0.001 (0.001)
GDPG	−0.008 (0.006)	−0.008 (0.006)	0.000 (0.005)	−0.157 (0.134)	0.000 (0.005)	0.013* (0.005)	−0.008 (0.006)	−0.008 (0.006)	−0.008 (0.006)	−0.157 (0.134)	−0.009 (0.006)	0.008** (0.003)
GGDPP	0.446*** (0.170)	0.446*** (0.121)	0.772*** (0.131)	1.717 (3.865)	0.770 (0.138)	0.104** (0.042)	0.446*** (0.170)	0.446*** (0.121)	0.447*** (0.170)	1.717 (3.865)	0.455** (0.177)	0.015 (0.021)
COV	−0.406*** (0.109)	−0.406*** (0.054)	0.251*** (0.084)	−0.160 (2.395)	0.049 (0.086)	−0.633*** (0.159)	−0.406*** (0.109)	−0.406*** (0.054)	−0.399*** (0.109)	−0.160 (2.395)	−0.479*** (0.110)	−1.118*** (0.134)
_cons	12.092*** (1.627)	13.267*** (1.013)	20.216*** (1.259)	−6.497 (36.540)	20.312*** (1.307)	2.210*** (0.724)	12.092*** (1.627)	13.267*** (1.013)	12.169*** (1.638)	−6.497 (36.540)	12.231*** (1.677)	0.368 (0.324)
Obs	414	414	414	391	391	391	414	414	414	391	391	391
R-squared	0.970	0.5817	0.974	0.619	0.974		0.970	0.5817	0.970	0.619	0.972	
Country FE	Yes		Yes	Yes	Yes		Yes		Yes	Yes	Yes	
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

(continued)

Table 2. Continued

	Tourism receipts model						Tourism arrival model					
	Two-way		Two -way	Two stage			Two-way		Two stage			
	Fixed	Driscoll-	Fixed	Regression		Two-step	Fixed	Driscoll-	Fixed	Regression		Two-step
	effect	Kraay	effect	Log value	First	Second	effect	Kraay	effect	Log value	First	Second
	Baseline	Model	Log value	stage	stage	System	Baseline	Model	Log value	stage	stage	System
	Model	Model	of SUN	stage	stage	GMM	Model	Model	of SUN	stage	stage	GMM
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Variable	TOR	TOR	TOR	SUN	TOR	TOR	TOA	TOA	TOA	SUN	TOA	TOA
<i>p</i> -value	0.000	0.000	0.000				0.000	0.000	0.000			
F-Statistic				12.80***	296.62***					12.80***	270.46***	
AR (1)						0.004						0.008
AR (2)						0.109						0.425
Sargan test						0.038						0.067
Hansen test						0.974						0.552
No of Instruments/ Group						21/23						21/23
Countries	23	23	23	23	23	23	23	23	23	23	23	23
	Tourism receipts model					Tourism arrival model						
	(1)	(2)	(3)	(4)	(5)	(1)	(2)	(3)	(4)	(5)		
Variable	TOR	TOR	TOR	TOR	TOR	TOA	TOA	TOA	TOA	TOA		
<i>Panel B: Quantile regression</i>												
	0.10	0.30	0.50	0.70	0.90	0.10	0.30	0.50	0.70	0.90		
SUN	−0.000	0.001	0.001	−0.001	−0.000	−0.000	−0.000	−0.004	−0.001	0.000		
	(0.001)	(0.002)	(0.002)	(0.002)	(0.001)	(0.002)	(0.002)	(0.003)	(0.003)	(0.002)		
TRO	0.001	0.000	0.002**	0.001	0.001	0.002**	−0.000	−0.000	0.001	0.003***		
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)	(0.001)		
REN	−0.026***	−0.020***	−0.025***	−0.014**	−0.001	−0.005	−0.011*	−0.010	−0.004	−0.017***		
	(0.003)	(0.005)	(0.005)	(0.006)	(0.003)	(0.004)	(0.006)	(0.007)	(0.008)	(0.004)		
URB	−0.044***	−0.059***	−0.064***	−0.061***	−0.058***	−0.030***	−0.017*	−0.030**	0.002	0.002		
	(0.006)	(0.010)	(0.009)	(0.010)	(0.006)	(0.007)	(0.010)	(0.013)	(0.015)	(0.007)		

(continued)

Table 2. Continued

Variable	Tourism receipts model					Tourism arrival model				
	(1) TOR	(2) TOR	(3) TOR	(4) TOR	(5) TOR	(1) TOA	(2) TOA	(3) TOA	(4) TOA	(5) TOA
GDPG	0.003 (0.004)	−0.001 (0.007)	−0.002 (0.006)	−0.002 (0.007)	−0.007* (0.004)	−0.002 (0.005)	−0.002 (0.007)	−0.004 (0.008)	−0.003 (0.010)	−0.006 (0.005)
GDPP	0.839*** (0.112)	0.996*** (0.181)	0.785*** (0.161)	0.754*** (0.182)	0.917*** (0.107)	0.253* (0.130)	0.399** (0.186)	0.383* (0.229)	0.385 (0.279)	0.332* (0.130)
COV	−0.171** (0.072)	0.161 (0.116)	0.301*** (0.103)	0.314*** (0.117)	0.305*** (0.069)	−0.559*** (0.083)	−0.487*** (0.119)	−0.324** (0.147)	−0.389** (0.179)	−0.232*** (0.083)
_cons	18.228*** (1.071)	17.820*** (1.732)	20.638*** (1.541)	20.874*** (1.745)	18.802*** (1.024)	14.798*** (1.242)	12.385*** (1.780)	13.933*** (2.196)	11.145*** (2.675)	11.798*** (1.244)
Observations	414	414	414	414	414	414	414	414	414	414
Pseudo R ²	0.8930	0.8598	0.8469	0.8503	0.8819	0.8823	0.8517	0.8535	0.8623	0.8823
Country FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Variable	Tourism receipts High developed Tourism countries Two-way Fixed effect Baseline Model (1) TOR		Low Developed Tourism Countries Two-way Fixed effect Baseline Model (2) TOR		Tourism arrivals High developed Tourism countries Two-way Fixed effect Baseline Model (3) TOA		Low Developed Tourism Countries Two-way Fixed effect Baseline Model (4) TOA	

Panel C: High and low-developed tourism countries

SUN	−0.001 (0.002)	−0.000 (0.002)	−0.001 (0.004)	−0.001 (0.003)
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(continued)

Table 2. Continued

Variable	Tourism receipts High developed Tourism countries Two-way Fixed effect Baseline Model (1) TOR	Low Developed Tourism Countries Two-way Fixed effect Baseline Model (2) TOR	Tourism arrivals High developed Tourism countries Two-way Fixed effect Baseline Model (3) TOA	Low Developed Tourism Countries Two-way Fixed effect Baseline Model (4) TOA
TRO	0.008*** (0.002)	−0.001 (0.001)	0.013*** (0.004)	−0.002 (0.001)
REN	−0.031*** (0.009)	−0.010* (0.006)	−0.004 (0.015)	0.010 (0.007)
URB	−0.066*** (0.010)	−0.016 (0.020)	−0.043*** (0.016)	0.108*** (0.023)
GDPG	−0.010 (0.008)	−0.005 (0.007)	−0.021 (0.014)	−0.011 (0.008)
GGDPP	0.727*** (0.248)	1.583*** (0.243)	0.843** (0.407)	1.452*** (0.285)
COV	0.243* (0.141)	−0.093 (0.170)	−0.699*** (0.231)	−1.103*** (0.199)
_cons	21.369*** (2.297)	7.651** (3.311)	9.519** (3.772)	−8.333** (3.881)
Observations	198	216	198	216
Pseudo R ²	0.8384	0.8073	0.8831	0.8132
Country FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes

Note(s): *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$ indicate significance at the 1%, 5%, and 10% levels, respectively. Standard errors are in parentheses and are clustered at the country level. p -values are reported for AR (1), AR (2), the Hansen test, and the Sargan test

Source(s): Author's own

that the estimated coefficients on SUN remain insignificant. Finally, in untabulated results, government effectiveness was also included in the baseline regression models for both TOR and TOA, and the results still show that the estimated coefficients on SUN remain insignificant.

Considering that the country's sustainability uncertainty may influence its tourism development, and vice versa, tourism development might also affect sustainability uncertainty. Additionally, addressing omitted variable bias and potential measurement errors is important, as these could lead to endogeneity. Therefore, the study employs a two-stage regression to address endogeneity by using lagged SUN values as an instrumental variable, following prior studies (e.g. [Alalmaee, 2026](#)). Since historical values of SUN are likely to impact current SUN values but are less likely to influence current tourism development, [Table 2](#), Panel A, columns (4) and (10) show that the first stage regression for TOR and TOA respectively confirms that the estimated coefficients on the lagged SUN suggest that historical SUN can influence current SUN. The F values of the models, which exceed the standard acceptable level of 10, validate the instrument. The second stage regressions, reported in columns (5) and (11), also show that the estimated coefficients on SUN are negative 0.005 and 0.002, respectively, and they are insignificant. This confirms that the baseline results are free of endogeneity. Finally, considering that the two-step system GMM model can also address endogeneity ([Ullah et al., 2018](#)), it was estimated. [Table 2](#), Panel A, columns (6) and (12) show that for both TOR and TOA, respectively, the estimated coefficients on SUN are negative 0.002 and insignificant. This again confirms the robustness of the baseline results.

4.2.2 Quantile regression. To better understand the relationship between TOD and SUN, quantile regression is used to evaluate the effect of SUN on TOR and TOA at various levels of tourism development outcomes. Therefore, quantile regression is performed at the 0.10, 0.30, 0.50, 0.70, and 0.90 quantiles for the TOR and TOA models. [Table 2](#), Panel B, shows that for both TOR and TOA, columns (1) to (10) indicate that the estimated coefficients on SUN are not significant. This also supports the baseline findings.

4.3 Additional analysis

In valuating SUN impacts on countries' TOD in both high- and low-tourism developed nations. TOR and TOA are used to split the sample into low- and high-tourism developing countries, based on their median values. For the TOR, the estimated coefficients on SUN for high- and low-tourism developed countries are -0.001 and -0.000 , respectively, and remain insignificant, as shown in [Table 2](#), Panel C, columns (1) and (2). Also, for TOA models, the estimated coefficients on SUN for high- and low-tourism developed countries are negative and insignificant at 0.001, as shown in [Table 2](#), Panel C, columns (3) and (4). This suggests that the study, relying on a two-way fixed-effects regression model, reports no serial correlation or cross-country dependence among the sample countries and addresses heteroscedasticity and autocorrelation, as indicated by its diagnostic tests. It finds that, for both low- and high-tourism developing countries, sustainability uncertainty negatively affects tourism development, but the effect is statistically insignificant.

This indicates that, across all countries in the study, the integration of ESG practices into their tourism industries, along with their industries' focus on branding, physical attractions, and market competitiveness, may explain this outcome. This is consistent with prior studies that have highlighted these benefits associated with the tourism industry, helping to mitigate the negative impact of uncertainty ([Kumar, 2025](#); [Wang and Jia, 2025](#)). This aligns with the risk-reduction and resource-based perspectives, emphasizing the benefits of ESG integration in the country's tourism industry in reducing the negative impacts of ESG-related uncertainty ([dos Reis Cardillo and Basso, 2025](#); [He et al., 2024](#); [Kumar, 2025, 2024](#); [Shin et al., 2026](#)). For brevity, the control variables are not elaborated on for the low- and high-developed tourism regression models.

4.4 Diagnostic test

Table 3 presents the Chow test for country fixed effects and the Wald/*F*-test for time fixed effects. The *p*-values for the baseline regression model across all countries, as well as for high- and low-developed tourism countries, are below 0.05, indicating that the two-way fixed-effects regression model is appropriate. The Jochmans' portmanteau test was also performed, with *p*-values greater than 0.05 and equal to 1, implying no serial correlation. Additionally, the Pesaran test for cross-sectional independence across all countries, as well as for high- and low-developed tourism countries, shows that the baseline regression models exhibit no cross-country dependence. To mitigate heteroscedasticity and autocorrelation, the models employ clustered standard errors for all baseline regression estimates.

5. Conclusion and implications

Sustainability practices within the tourism industry promote healthier ecosystems, cleaner air, increased tourist attractions, improved landscapes, and reduced climate risks. However, a country's sustainability uncertainty regarding ESG-related activities can negatively affect its tourism industry. Against this background, the study investigates the impact of sustainability uncertainty on the country's tourism development. Using data from 23 countries from 2003 to 2020, along with a two-way fixed-effects regression and robustness tests, the findings show that SUN has a negative, insignificant effect on its TOD for both receipts and arrivals. Analysis across tourism development levels shows that, from the lower to the upper quartile, the Sustainability Uncertainty Index has no significant impact on tourism development receipts and arrivals. Additionally, for the sample countries with low and high tourism development, the results show that the impact of SUN is negative on their TOD receipts and arrivals, but it is insignificant. Figure 2 summarizes the main results underlying the study.

The findings may be attributed to several reasons, some of which are elaborated on as follows: The negative impact of SUN on TOD, but its insignificant impact could be attributed to some plausible reason that: the development of tourism in these countries, often linked to ESG practices and the promotion of sustainable tourism, may explain why the tourism industry is negatively impacted by their sustainability uncertainty, but it is having an insignificant impact. Additionally, the tourism industry's focus on ESG practices, physical attractions, branding, and market competitiveness may explain why countries' sustainability uncertainty negatively impacts the tourism industry but has an insignificant impact. These ESG practices, physical attractions, branding, and market competitiveness help the industry mitigate the negative effects of the countries' sustainability-related uncertainties. Thus, sustainable practices within countries' tourism industries, coupled with the enactment of sound regulations, benefit the industry (UN tourism, 2024; Zhang *et al.*, 2025) and could offset the negative impact of SUN on countries' TOD, making its impact insignificant.

Sustainable tourism practices ensure transparency in reporting, reduce risk exposure, including climate risk, lower carbon dioxide emissions, support biodiversity protection, promote good governance, and ensure effective resource utilization, providing additional benefits for the tourism industry (UN tourism, 2024; Zhang *et al.*, 2025). Thus, when coupled with sound regulations for the tourism industry, sustainable tourism practices serve as a valuable resource for reducing operational risk exposure and mitigating the negative impacts of sustainability uncertainty within a country's tourism industry. Also, the industry's market competitiveness, which encourages tourism firms to build brand loyalty and increase customer satisfaction, attracting a growing market of eco-conscious consumers, promoting job creation, ensuring the preservation of historical ruins and cultural traditions, and the integration of technologies helping in resource consumption, may explain why the country's sustainability uncertainty is having a negative impact but its insignificant impact on the industry's development.

So, sustainability uncertainty in a country relating to unclear policies on climate issues, or inconsistent ESG policies and regulations, the study found that it has a negative impact on the

Table 3. Diagnostic tests

Test	Problem	All countries Baseline regression Model		High developed Tourism countries Baseline regression Model		Low developed Tourism countries Baseline regression Model		Conclusion
		Tourism Receipts Model	Tourism Arrival Model	Tourism Receipts Model	Tourism ArrivaL Model	Tourism receipts model	Tourism arrival model	
Chow test for fixed Effect	Deciding whether country fixed effects are jointly significant	$p = 0.001$, as $p < 0.05$	$p = 0.005$, as $p < 0.05$	$p = 0.004$, as $p < 0.05$	$p = 0.007$, as $p < 0.05$	$p = 0.004$, as $p < 0.05$	$p = 0.009$, as $p < 0.05$	Emphasize the significance of Country fixed effects and the justification of the two-way fixed effect
Time fixed effects Wald/F-test	Deciding whether year fixed effects are jointly significant	$p = 0.006$, as $p < 0.05$	$p = 0.008$, as $p < 0.05$	$p = 0.004$, as $p < 0.05$	$p = 0.007$, as $p < 0.05$	$p = 0.005$, as $p < 0.05$	$p = 0.002$, as $p < 0.05$	Emphasize the significance of time effects and the justification of the two-way fixed effect
Jochmans portmanteau test	Serial correlation	Chi-squared p -value = 1	Chi-squared p -value = 1	Chi-squared p -value = 1	Chi-squared p -value = 1	Chi-squared p -value = 1	Chi-squared p -value = 1	No serial correlation issue
Pesaran’s test of cross-sectional independence	Cross-sectional independence	p -value = 0.95100	p -value = 0.823	p -value = 0.78142	p -value = 0.6982	p -value = 0.6850	p -value = 0.9482	No Cross-sectional dependence
Cluster Standard Error at Country level vce (cluster country)	Heteroscedasticity And Autocorrelation	Cluster Standard Error is used for all the regression estimation						Cluster Standard Error corrects for it
Source(s): Author’s own								



Figure 2. Summary of results. Source: Author’s own work

tourism industry development, but it had an insignificant impact, which could be attributed to the industry striving on ESG integration, digitalization, and brand loyalty, market competitiveness and good governance regulations, which may explain these findings. This is consistent with prior studies that emphasize these benefits within the tourism industry (dos Reis Cardillo and Basso, 2025; He *et al.*, 2024; Jalali *et al.*, 2026; Kumar, 2025, 2024; Shin *et al.*, 2026). This study contributes to the literature by analysing how countries’ sustainability uncertainty affects their tourism development. The study found a negative impact of sustainability uncertainty on the countries’ tourism development, but it is insignificant, adding to the existing literature on tourism development and sustainability, an area that has received comparatively less attention in earlier studies (e.g. dos Reis Cardillo and Basso, 2025; He *et al.*, 2024; Jalali *et al.*, 2026; Kumar, 2025, 2024; Shin *et al.*, 2026).

5.1 Theoretical contributions

The study’s findings on the negative impact of a country’s sustainability uncertainty on its tourism development, and its insignificant impact, can be attributed to the integration of ESG and sustainable practices, technology adoption, efforts to strengthen brand and customer loyalty, and enhanced market competitiveness, coupled with good regulations, which support the tourism industry. These factors help mitigate the negative effects of sustainability uncertainty on countries’ TOD and support risk-reduction, resource-based view, and institutional theories by emphasizing the benefits of sustainable tourism practices and sound regulations within the tourism industry. This is similar to prior studies, which, within the risk-reduction, institutional and the resource-based view theories framework, observed that sustainability practices within the tourism industry, the promotion of branding, physical attractions associated with the tourism industry, and market competitiveness within the tourism industry and good regulations supporting the tourism industry serve as valuable resources to help reduce the effects of uncertainties, help the tourism industry manage risks, and enhance the industry’s value and reputation (e.g. Hassan and Meyer, 2025; Kumar, 2025; Shin *et al.*, 2026; Wang and Jia, 2025; Zhang *et al.*, 2025).

Also, the study’s findings, from the theoretical perspectives of risk reduction and the resource-based view, are consistent with Kumar (2023), who shows that as economic and political uncertainties increase, the tourism industry makes greater use of sustainability disclosures to build strong relationships with stakeholders and spread positive word-of-mouth about the industry’s contributions to social welfare and environmental conservation. Thus, the findings emphasize that sustainable practices within the tourism industry, coupled with

effective regulations, can be a key resource for mitigating the negative impacts of sustainability uncertainty. So, the study provides theoretical support for the risk reduction, resource-based view, and institutional theory underlying it.

5.2 Implications

The study's findings have several implications for governments, tourism organizations, and other stakeholders involved in tourism development. The fact that sustainability uncertainty does not affect the country's tourism industry, due to ESG practices, technology use, efforts to enhance brand and customer loyalty, and improved market competitiveness, underscores the importance of promoting these elements. This would help the industry to continuously mitigate the negative impacts of sustainability uncertainty. For instance, to maintain these benefits, countries should continuously develop ESG strategies at corporate, local, national, and global levels to meet Sustainable Development Goals within their tourism industry, support the shift toward low-carbon, climate-resilient tourism models, and encourage integrated AI frameworks for analytics and monitoring to advance ESG practices within the tourism industry. In addition, tourism firms and their stakeholders should promote sustainable tourism practices, which will help mitigate the negative impacts of climate risk exposure (Opuni-Frimpong, 2024) environmental degradation and pollution in the industry. This would help the industry to sustain its mitigation of sustainability uncertainty.

5.3 Limitations and concluding remarks

This study's limitations include, first, its focus on 23 countries regarding the impact of sustainability uncertainty on tourism development. Future research could expand the sample to gain a broader perspective. Thus, the narrow country sample, country-level operationalization, and the negative, insignificant impact of SUN on TOD, restrict the study's generalizability and contribution. Second, Future work might investigate nonlinear effects and the mediating and moderating roles of other variables. The research is based on risk reduction, resource-based, and institutional theories, but exploring alternative perspectives, such as the Legitimacy Theory, green growth theory, and Signaling Theory, could offer additional insights. Additionally, future studies evaluating the impact of individual countries would help better understand the relationship between sustainability uncertainty and tourism development. Lastly, a comparative study across continents could provide further insights into the relationships among sustainability uncertainty and tourism development.

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