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Article

Harmonizing tourism growth with environmental stewardship: The impact of institutional quality

Huijun Hao

Department of Tourism Management, Segi University, Selangor 47810, Malaysia; haohuijun88@gmail.com

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Abstract: This study investigates the impact of tourism and institutional quality on environmental preservation, utilizing principal component analysis to generate three composite indices of environmental sustainability for 134 countries from 2002 to 2020. The results reveal that environmental sustainability indices have generally improved in lower- and middle-income nations but have declined in certain high-income countries. The findings also underscore the critical role of institutional quality—particularly regulatory standards, government effectiveness, anti-corruption efforts, and adherence to legal frameworks—in promoting environmental sustainability. However, the study shows that both domestic and international tourism expenditures can have adverse effects on environmental sustainability. Notably, these negative effects are exacerbated in countries with well-developed institutions, which is an unexpected outcome. This highlights the need for careful, thoughtful policymaking to ensure that the tourism sector supports sustainable development, rather than undermining environmental objectives.

Keywords: environmental sustainability; institutional quality; tourism; principal component analysis; policy-setting

1. Introduction

Self-sustaining advancement is inextricably linked to ecological self-sufficiency, whose primary goal is maintaining global resources without overwhelming the ecosystem's capacity to absorb wastage or regenerate (Farley and Voinov, 2016; Goodland and Daly, 1996). Evaluation is required to gauge the situation and ecologic sustainability's advancement. It is common practice to analyze everywhere, from species diversity to weather alteration and asset utilization, using eco-efficiency markers. A practical method to illustrate the efforts and difficulties that particular economic sectors face concerning the self-sufficiency of the global system is to evaluate the ecological effects of the industries. Over the course of the study of 2010–2016, Iceland's travel industry expanded at an extraordinary speed (roughly 25% annually), outpacing the much more conventional industry of fishing industry to become one of the nation's leading financial pillars. Direct GDP contributions from the sector increased from 3.5% in 2010 to 8.4% in 2016 (Statistics Iceland, 2021).

In this paper, we review country-specific ecological indices developed by Widyawati (2020) in the course of this study, and we also try to evaluate the applicability of the constructed index by comparing sector-specific effects of the tourism industry in Iceland. Purposes of this research are as follows: To identify whether an already developed nationwide marker set captures the direct ecological impact of the tourism industry and therefore the sustainable development implications of a rapidly expanding sector across a nation.

To pinpoint the data deficiencies in relation to the topic to foster future research. Then, since the research is exploratory in nature and in order to provide a starting point for future reflections, we do a first computation of such metrics that necessarily leads to face those assessment methods. Riahi et al. (2017) published the primary claims for why absent global relevancy when setting up marker sets might be detrimental, especially for nations with thin but highly specialized financial markets. Environmental Quality Index, Ecological Footprint, Environmental Signs Of weakness, and Good Biosphere Index were analysed by Riahi et al. (2017), these were still too general an index which did not contain such crucial criteria reflecting the national context in the sufficient manner and too typical for Iceland misrepresentation of its sustainable development effectiveness. Secondly, the marker set that has been discussed here is broad in terms of its focus and was developed through the consultation process initiated within the underside of student practice along with top-down experts' statements concerning marker preferences. While there is prior research on assessing travel ecologic impacts in Iceland, none of these has been as extensive as this study, and the majority of the research focus on specific regions and specific (but nationally major) environmental concerns.

Tourist industry was selected as the report's segment of emphasis with several purposes in mind. First, the matters of self-sustained advancement of the numbers of tourists have been an area of concern internationally. As part of the sustainable development, the United Nations set 2017 as the referral year of development for tourism growth (Li et al., 2024). Additionally, three of the Development Goals (SDGs)—specifically, Goals 8 (on self-sustaining financial expansion and job opportunities: 8. 9), 12 (on self-sustaining usage and manufacturing: 12. b), Goal 14 (on the possible use of oceans 14. 7)—directly concern the number of visitors (Li et al., 2024).

Perhaps, there are other SDGs more specifically relevant to this factor, but they are stated anyway (El-Said and Aziz, 2022). While the tourist industry is normally regarded regarding the positive effect on economic systems, job, and work production, it is worth mentioning that it provides numerous drawbacks relating towards the environment. These consequences range from the regional strains such as reduction in regional water availability, and reduced carbon outputs to global issues such as property repetition and the release of polytunnel gases (Graham-Leigh, 2015; Guo and Chueachainat, 2024). Local effects are confined to specific locations and may be unique and differ from one locale to another, mainly due to the growth of organizing and the degree of leadership system put in place.

These studies focusing on different areas and issues local to certain regions (Wachs et al., 2022). However, there has recently been heightened awareness on ecological change globally and its 'Bi-directional association' with visitor numbers (Li et al., 2024). Travel activity and its main aspects depend on local, national, and global climatic change, the relationship of travel with the environment is highly challenging (Dwivedi et al., 2022). While this has only recently begun to become more widely recognized, tourist numbers are mainly a source of the energy industry (Coles et al., 2016). Interestingly, Everett and Slocum (2013) pointed out that a number of attempts have been made to measure the continued sustenance of the global tourist industry after analyzing a vast body of literature that include approximately 5000 papers.

Meanwhile, Raza et al. (2021) revealed a growing contribution of the tourist industry towards the emissions of CO_2 and smog in the atmosphere while others, for instance, Rao et al. (2022) observe a decreasing effect or mixed effect. In actuality, the effects of urbanization on the surroundings could vary (Ding and Li, 2017). First, urbanization is switching territory usage from farm country or agrarian to urban or commercial with building and construction (Fan et al., 2016). Consequently, organic areas like forests are diminished (Li et al., 2017).

The method of urbanization uses more power than agrarian actions (Sadorsky, 2013), which could have a more significant detrimental effect on the ecosystem. Urbanization might present chances for energy effectiveness (Dodman, 2016). Industrialization has a significant adverse effect on the climate, and the literature reveals ample evidence of this. Even so, the effectiveness of energy use from urbanization might not be sufficient to offset this impact (Ahmad et al., 2019; Patra et al., 2018).

2. Literature review

Without the capacity to gauge the present situation and advancement towards self-sufficiency, self-sustaining tourist numbers are ineffectual (Miller and Ward, 2005). Prior tries to create sustainable supply chain markers for visitor numbers have been made at a variety of levels, including municipal governments, sovereign nations, destinations, and supply chain-based evaluations. Several research findings also have tried to conduct international evaluations, but they did so use different assessment instruments (Feleki et al., 2020; Horng et al., 2012; Ling, 2015; Pérez et al., 2017; Sharp et al., 2016). There have also been many analyses of the travel industry using various techniques, like the Life Cycle Assessment and the environmental impact (Michailidou et al., 2016).

Though these have not been given consideration in this research they cover ecological renewing power energy statistics. Various multi-dimensional and integrated marker sets have been designed for different aspects of the self-sufficiency in the tourist industry (Agyeiwaah et al., 2017). As for the overall number of selected metrics, the financial and cultural factors are displayed more often in a meta-analysis of 27 new studies on the tourism development indicators from 2000 to 2015 and the ecological aspect is dominant less often. In the specific paper reviewed here, power conservation had only been proposed in 25% of the textual material assessed, two of the most commonly invigorated metrics of the ecologic element were managing solid waste and water quality (Wiik et al., 2018). Thus, a few case study articles' marker structures, such as the application of the clearly stated administrative regulations appearances, the plan development, member status in ecologic certification strategies, and the managerial aims correlation, are supposed to assess the managerial performance of the tourist industry (Roberts and Tribe, 2008). Yet, there is some advantage in this: This method is not suitable for assessing the ecologic productivity since it does not consider actual ecological impact. Since policies and strategies are not always properly implemented, when it comes to judging performance at a level higher than the amount of activity involved in management strategies, it is possible to establish the overall performance above the involvement in management approaches (Kale et al., 2001; Pridham, 1999). Many different studies employ variables that measure the amount of accountability for the ecosystem in ways that imply that visitors' sense of reliability of the ecosystem is proof of accountability (Meehan et al., 2000). Climate issues, however, are not always as tangible as one would consider them to be, thereby excluding many aspects of environmental management. Furthermore, there are many risks for ecological and living organism health concerning the methodology, which aims to define ecological health by a level of acceptable impacts originating from human-controlled and observed reactions only (Buckley, 1999).

Furthermore, the variability of more complex indices in the research outcomes together with the application of various ranges of the bio-physics parameters indicate that many works tend to pool data and derive the composite scales that invariably decrease the significance and overall quantity of those parameters in the overall assessment (Choi and Sirakaya, 2006). However, it can be critical how the weighting methods are chosen in the case. In another study to develop quantitative measures for eco-tourism through a weighting procedure, it was revealed that none of these articles reviewed provided "sound reasons for the such selection of a special weighting procedure" (Mitchell, 1996).

Furthermore, the utilisation as well as measurement of the polymer indexes has received criticism due to the complexity of the processes involved (Vickers, 2017). The European Commission issued a conceptual model of renewable energy key indexes in relation to the tourist arrival in 2017 that is poly-dimensional though might be more satisfactory. There are 17 biophysical measures that impact financials beyond the ecological sustainability variables employed in this template, five of them are beyond socioeconomic indicators. Therefore, in the European Tourism Indicator System (ETIS), the priority of the dimension 'ecologic viability' is even higher—proportionate (COM, 2017). The ETIS approach does have some disadvantages, though: a) when there is an attempt to apply a moderate methodology both in theory and into practice the impact of ecological responsibility is diminished; b) some of the indicators are oriented to assessing the efforts of the businesses to save the climate, though the results of their actions and the efficiency of such actions are ignored.

To strengthen the link between existing literature and our findings, this study addresses several key gaps identified in prior research. While the literature extensively discusses the environmental impact of tourism, it rarely examines the role of institutional quality in moderating this relationship (Zeng et al., 2021). Our findings contribute to this gap by demonstrating that, contrary to expectations, countries with higher institutional quality tend to experience a more significant negative environmental impact from tourism. This result highlights a critical oversight in previous studies: while governance and institutional frameworks are expected to mitigate harmful environmental practices, they may, in fact, lead to complacency, where businesses assume environmental responsibilities are being sufficiently managed at the institutional level (Meehan et al., 2000).

Additionally, the interaction between tourism growth and institutional quality, particularly in developing economies, has not been comprehensively explored. Previous research has primarily focused on tourism's economic and environmental impacts in isolation, without considering how effective governance and regulatory quality can shape these outcomes (Comerio and Strozzi, 2019; Raza et al., 2021). Our study addresses this by investigating how institutional factors like regulatory quality and government effectiveness interact with tourism spending, providing evidence that strong institutions do not always correlate with better environmental outcomes.

Moreover, our study contributes to the discourse on sustainable tourism by addressing the multi-dimensional and often fragmented indicators used in previous frameworks (Agyeiwaah et al., 2017; Vickers, 2017). While earlier studies have developed measures of sustainability, they often neglect the role of institutional quality as a key determinant of how tourism affects environmental outcomes. By integrating these factors, our findings offer a more comprehensive view of how governance structures can influence the relationship between tourism and environmental sustainability, thereby providing a more holistic approach to addressing the complexities of sustainable tourism development.

Tourism and environmental sustainability

The Environmental Kuznets Curve (EKC) theory asserts that lucid income per capita, early income, would lead to increased power consumption that subsequently leads to the degradation of the environment (Sarkodie and Strezov, 2019). A shift to a service economy or a post industrial age happens of money development gets to the state of money assertion, industry advancement (Bernardini and Galli, 1993). Production and sales of authentic goods are no longer as important as in the past for production of services, data, and innovations Within the service industry, production of electricity is notably lower than production. As the industrial sector is considered to be a negative or having an unfavorable effect on the ecosystem, the growth of the tourist industry would noticeably decline the usage of energy and power severity thus making it have less unfavorable effects on the ecosystem (Bakhat and Rosselló, 2011). Furthermore, there is evidence that ecological degeneration reduces visitor arrival rates, and therefore, it is expected that tourism industries would be more ecologically responsible (Greiner et al., 2001; Vickers, 2017).

Searched research has primarily focused only one aspect of how travel impacts the climate, for example Dioxide emission or quality air (Zeng et al., 2021). At the same time, it is important to recall that such economic sector as the numbers of tourists require a large set of organic resources that are considered to be the primary components of the sector (Gren and Huijbens, 2012). Thus, the evidence has shown that it is not sufficient to evaluate the imprints of the tourist revenues on the ecosystem simply with the hope of the carbon footprint or poor-quality air. The first relationship is that the tourist industry is directly linked with the price of mineral wealth hence compromising ecology (Tay et al., 2016). There are many issues raised regarding the expansion of eco-tourism and species conservation (Buckley et al., 2017). In addition, the availability of food and service commodities, which are necessities such as meals and the services falling under real estate, increases because of the tourists' business (Yin et al., 2013). Thus, the manufacture of such goods significantly affects land use, creating an unsustainable chain, and emphasizing building (Lepp and Gibson, 2008; Ryan et al., 2011). Comerio and Strozzi (2019) reported that Hainan Island, especially

Sanya City, requested the growth of the tourist industry and led to a significant deterioration of the agricultural land and woodlands in the region while the volume of land required for built up area and orchards has been increased. Lastly, tourist revenue bears a positive relationship with urbanization as well as with financial development (Wang and Liu, 2013).

It is ascertained that the organizations play a critical role to define the ecological consequences of the financial factors. For instance, Raza et al. (2021) examines that over a period of 1980 to 2018 for a sample of seven OECD nations, good organizations help in improving the positive impact of fiscal descend on environment. Nevertheless, according to Widyawati (2020), the statistical evidence does not reveal 1 Austria, Belgium, Germany, Australia, Canada, Spain, and Switzerland. In 93 emerging and developing countries for 1995–2014, the roles of efficient authorities and the counteracting of corruption were median in the connection between CO_2 emissions and financial development. From the writings, betterments in places enhance a greater method with market method as well as the distributing of treatment; while decreasing the problem of asymmetrical information and lowering the probabilities and charges of transactions and renderings. It may also be noted that institutional improvements could give rise to the efficacious stimulation of economic activity (Comerio and Strozzi, 2019). This implies that there may be two opposite effects arising from institution's participation in the expansion of the tourist business.

Despite the comprehensive body of research on tourism's environmental impacts, there remains a significant gap in understanding how institutional quality modifies these effects. While numerous studies have explored the general environmental consequences of tourism, particularly in terms of carbon emissions and resource depletion, recent literature has not adequately addressed the role of governance structures in this context. Our study fills this gap by demonstrating that institutional quality, such as regulatory effectiveness and government efficiency, can both mitigate and amplify the environmental effects of tourism. This finding highlights a nuanced interaction that has been overlooked in recent work, particularly in regions with well-developed institutional frameworks, where tourism's negative environmental impacts can be intensified (Zeng et al., 2021).

Moreover, previous studies have often treated institutional quality and environmental sustainability as separate entities, failing to consider the complex interactions between them in the context of tourism (Comerio and Strozzi, 2019; Raza et al., 2021). By focusing on these interactions, this study offers a more integrated approach to understanding sustainable tourism development, particularly in middle- and high-income nations where institutional capacity is presumed to mitigate environmental harm. The findings of our study challenge this assumption, suggesting that the presence of strong institutions may lead to complacency among tourism operators, reducing their accountability and exacerbating environmental degradation.

Additionally, this study contributes to the literature by updating the framework of sustainable tourism development with more recent data and methodologies. While earlier frameworks have provided a foundation for measuring tourism's impact on sustainability, they often lacked multi-dimensional indicators that account for institutional variations. Our study incorporates recent advancements in institutional quality measurement, such as governance indicators from the Worldwide Governance

Indicators (WGI), and applies them to the tourism sector. This approach not only updates the theoretical framework but also provides empirical evidence that highlights how institutional quality interacts with tourism to influence environmental sustainability (Agyeiwaah et al., 2017; Vickers, 2017).

3. Methods and data

3.1. Measurement model for environmental sustainability

Our analysis is built on the Earlier works carried out by Dodman (2016) and Goodland and Daly (1996) which provided the basis of developing the composite eco-efficiency indices, simplified (Everett and Slocum, 2013). The ways in which organizations' ecological responsibility is determined are still under discussion. Based on the studies of Coles et al. (2016) and Patra et al. (2018), as well as Pérez et al. (2017) the suggestions which have been introduced earlier in 1998 the CO_2 emission index is stated. The scholars from Yale and Columbia University developed the sustainable environmental index known as sustainable environmental Index (SEI) in 2004; the first introduction of it took place in January of the year 2000 in the World Economic Forum held in Sydney, Australia Human Economy (Meehan et al., 2000). Since it looks at ecological responsibility under the perception that the recent business exercises can responsibly rent mineral wealth, while in the process attempting to support the materials for future generations, the construction of the eco-efficiency index is among the most suitable effectual strategies within the scientific studies on econometric.

Hence, we will be able to use this database to carry out exploratory research on the impact of tourism on the system. Unfortunately, the available data set for the eco-efficiency index spans only up to 2000, with the earliest observation for 1980. Although information is available only from 2002 for organizations, data on visitors is certainly available only from 1995 but some organizations are only giving partial data and henceforth the data will be explained further in the data section. Therefore, in the same manner with some let's employ the same method as used in the procedure of formulating the sustainable development index, and the data gathering of our comprehensive research. We mainly employ twelve marks that encompass sevens issues stated by Agyeiwaah et al. (2017) as territory utilization and farming, quality of air and discharges, impacts on health and disasters, power control, impacts on environmental assets, birthrate pressures on resource management of water creation, forest, and varieties of species.

3.2. Data limitations

While this study covers a broad range of 134 countries over the period from 2002 to 2015, it is important to acknowledge that the data for environmental sustainability may be inconsistent or incomplete across different nations. Variations in data collection methods, reporting standards, and availability of environmental indicators in different countries could introduce potential biases or affect the accuracy of the ecological self-sufficiency indices constructed. The **Figure 1** shows Trend of domestic and international tourism spending over time (2002–2015) below. This limitation is particularly relevant for low- and middle-income countries, where data gaps may be more prominent. Despite these challenges, we employed robust statistical methods, such as two-step system Generalized Method of Moments (GMM), to mitigate potential inconsistencies in the data. However, future research should aim to refine these indices by incorporating more comprehensive and consistent environmental datasets, particularly those that capture country-specific nuances in environmental reporting and governance. Descriptive statics of selected variables are shown in **Table 1**.

Table 1. Descriptive statistics of selected variables.

Variable	Mean	Median	Standard Deviation	Variance	Skewness	Kurtosis	Minimum	Maximum	Observations
Dotour	3.72	3.5	2.12	4.49	1.47	4.25	0.9	13.95	1876
Inttour	12.8	8.2	14.6	213.16	6.55	55.9	0.03	204.7	1876
INST	−0.01	0.04	0.93	0.86	−0.21	2.75	−1.97	1.99	1876
Voice	0.04	0.07	0.98	0.96	−0.45	2.73	−2.27	1.84	1876
Politics	−0.14	−0.1	0.95	0.9	−0.8	3.65	−3.22	1.8	1876
Goveff	0.06	0.1	1	1	−0.5	2.85	−2.07	2.47	1876
Requa	0.08	0.09	0.98	0.96	−0.4	2.8	−2.37	2.3	1876
Law	−0.04	−0.02	1.03	1.06	−0.3	2.65	−2.07	2.14	1876
Concor	−0.02	−0.01	1.05	1.1	−0.2	2.75	−1.77	2.5	1876
Income	8.52	8.5	1.51	2.28	−0.2	2.75	5.35	11.67	1875
Urban	57.2	58	22.3	497.29	−0.35	2.25	8.8	100	1876
Trade	84.5	70	49.4	2440.36	3.05	15.5	0.2	438	1823
FDI	5.6	3	13.9	193.21	8.05	78.2	−58.5	280.5	

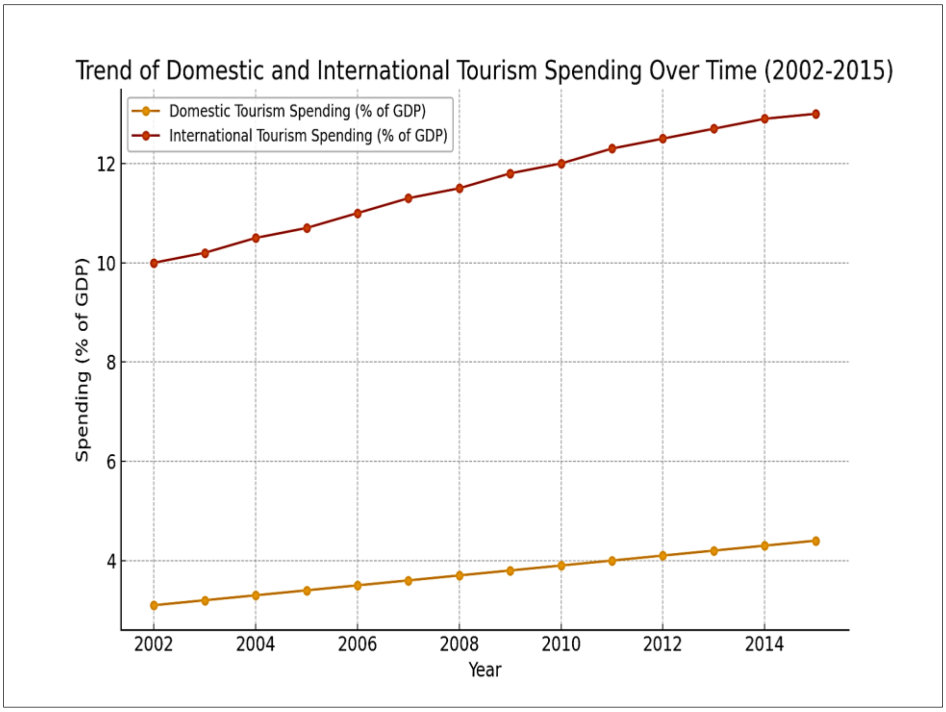

Figure 1. Trend of domestic and international tourism spending over time (2002–2015).

The results from Principal Component Analysis (PCA), as summarized in **Table 2**, confirm the appropriateness of the PCA methodology for this dataset through the KMO measure of sampling adequacy and Bartlett's Test of Sphericity. The KMO values range between 0.829 and 0.847, indicating the data is suitable for PCA, while the significant chi-square results further validate the analysis. The eigenvalues and variance percentages in **Table 3** show that the first few principal components account for a significant portion of the variance in the dataset, with Component 1 alone explaining over 43%, and Component 2 adding another 17%. Moreover, **Table 4** outlines how different variables, such as pollution, energy, health, and water, load onto these principal components, highlighting the major contributors to environmental sustainability. For instance, Component 1, heavily influenced by health and water variables, explains a significant portion of the data variance, while Component 2 captures the impact of energy and land variables. The descriptive statistics in **Table 5** further emphasize the distribution and range of environmental sustainability indices, illustrating how key sustainability factors contribute to overall performance across different normalization techniques.

Table 2. Findings of principal components (Part A: KMO sampling, and sphericity test).

	Sphericity test			**KMO Measure of Sampling**
	Chi-square	**Degrees of freedom**	***p*-value**	**0.829**
z-score normalization	16,821.9***	66	0.000	0.829
min-max normalization	14,354.9***	66	0.000	0.847
SoftMax normalization	18,408.1***	66	0.000	

Table 3. Findings of principal components (Part B: TVE).

	Component	**Eigenvalue**	**% of variance**	**Cumulative Variance%**
Normalized variables using standardized Z-score	1	5.236	43.63	43.63
	2	2.105	17.54	61.17
	3	1.038	8.65	69.82
	4	0.907	7.56	77.38
	5	0.755	6.29	83.67
	6	0.649	5.41	89.08
	7	0.444	3.70	92.78
	8	0.295	2.46	95.24
	9	0.253	2.11	97.34
	10	0.141	1.17	98.51
	11	0.107	0.89	99.41
	12	0.071	0.59	100.00

Table 3. (*Continued*).

	Component	Eigenvalue	% of variance	Cumulative Variance%
Normalized variables using min-max normalization	1	5.236	43.63	43.63
	2	2.105	17.54	61.17
	3	1.038	8.65	69.82
	4	0.907	7.56	77.38
	5	0.755	6.29	83.67
	6	0.649	5.41	89.08
	7	0.444	3.7	92.78
	8	0.295	2.46	95.24
	9	0.253	2.11	97.34
	10	0.141	1.17	98.51
	11	0.107	0.89	99.41
	12	0.071	0.59	100
Normalized variables using SoftMax normalization	1	5.606	46.72	46.72
	2	2.137	17.81	64.52
	3	1.009	8.41	72.93
	4	0.886	7.38	80.31
	5	0.762	6.35	86.66
	6	0.493	4.11	90.77
	7	0.391	3.26	94.03
	8	0.270	2.25	96.28
	9	0.187	1.56	97.84
	10	0.107	0.89	98.73
	11	0.093	0.77	99.5
	12	0.060	0.5	100

Table 4. Principal components **(**Part C: Environmental sustainability index in terms of principal components of the composite against selected indicators).

		Variable	Pollution	Energy1	Energy2	Forest	Land1	Land2	Health 1	Health 2	Health 3	Pop1	Pop2	Water
Standardized Z-score normalized variables	Principal component (92%)	1	−0.30	−0.21	0.18	0.02	−0.05	0.07	0.28	0.41	0.41	0.4	0.29	0.41
		2	0.02	0.25	0.16	0.5	0.55	0.59	0	0.06	0.03	−0.02	−0.10	0.02
		3	0.09	−0.38	0.56	−0.21	0.01	0.08	0.37	−0.04	−0.03	−0.23	−0.54	0.04
		4	0.54	0.25	0.58	0.25	−0.31	−0.15	−0.04	−0.01	−0.08	0.1	0.33	0.03
		5	0.17	0.64	0.02	−0.57	0.31	−0.14	0.17	0.12	0.23	0.01	−0.08	0.12
		6	0.15	0.19	−0.38	0.23	−0.36	0.14	0.76	0.02	−0.01	−0.11	−0.03	−0.11
		7	0.59	−0.39	−0.23	−0.36	0.13	0.45	−0.01	−0.06	0.01	0.1	0.29	0.05
Min-Max normalized variables using	Principal component (92%)	1	−0.30	−0.21	0.18	0.02	−0.05	0.07	0.28	0.41	0.41	0.4	0.29	0.41
		2	0.02	0.25	0.16	0.5	0.55	0.59	0	0.06	0.03	−0.02	−0.10	0.02
		3	0.09	−0.38	0.56	−0.21	0.01	0.08	0.37	−0.04	−0.03	−0.23	−0.54	0.04
		4	0.54	0.25	0.58	0.25	−0.31	−0.15	−0.04	−0.01	−0.08	0.1	0.33	0.03
		5	0.17	0.64	0.02	−0.57	0.31	−0.14	0.17	0.12	0.23	0.01	−0.08	0.12
		6	0.15	0.19	−0.38	0.23	−0.36	0.14	0.76	0.02	−0.01	−0.11	−0.03	−0.11
		7	0.59	−0.39	−0.23	−0.36	0.13	0.45	−0.01	−0.06	0.01	0.1	0.29	0.05

Table 4. (*Continued*).

		Variable	Pollution	Energy1	Energy2	Forest	Land1	Land2	Health 1	Health 2	Health 3	Pop1	Pop2	Water
Softmax normalized variables	Principal component (94%)	1	−0.32	−0.20	0.17	0.01	−0.05	0.06	0.32	0.4	0.4	0.39	0.3	0.4
		2	0.02	0.26	0.18	0.49	0.55	0.58	−0.01	0.07	0.04	−0.02	−0.09	0.04
		3	0.2	−0.23	0.68	−0.30	0.04	0.02	0.31	−0.01	0	−0.20	−0.46	0.06
		4	0.47	0.39	0.47	0.29	−0.33	−0.20	−0.05	0.01	−0.06	0.14	0.39	0
		5	0.08	0.7	−0.13	−0.52	0.31	−0.16	0.2	0.09	0.21	0.01	−0.01	0.08
		6	−0.04	−0.18	0.31	−0.29	0.43	−0.14	−0.71	−0.03	0.01	0.18	0.21	0.08
		7	0.55	−0.25	−0.20	−0.37	−0.02	0.55	0.1	−0.09	−0.02	0.07	0.36	0.01

Table 5. Findings of principal components (Part D: Data description of the composite environmental sustainability index).

Variable	Obs.	Mean	S.D.	Min	Max
ES1	1853	3.10E-09	2.29	−6.78	3.32
ES2	1853	2.00E-09	2.29	−6.78	3.32
ES3	1853	8.00E-10	2.37	−5.72	3.18

Findings of Principal Components shown in **Table 4**. In Part C lists the coefficient amplitudes. Finally, element index values for three different cases of factors are anticipated from the Data analysis (by three normalization processes). One has to note that the increase in the values of the 12 factors, which composed our lowered element eco efficiency indices means ecological degradation. For instance, an increase in pollution measures in terms of Dioxide emissions per person and an increase in non-forest regions (FOREST) would mean that there is a reduction in the amount of countryside available or in the number of species. Consequently, reductions in the element indices' parameter estimates from the principal component analysis (PCA) suggest improvements in environmental quality. We construct sustainable development with the inverse of the indices of the expected elements to be consistent with the second elaboration of the econometric study. For guesstimated element index values z-normalization, min-max normalization, and Soft Max normalization techniques are used and tick these attributes as ES1, ES2, ES3 respectively. Details on the three elements that experienced a decline in our eco-efficiency indices are as follows and are shown in Part D, **Table 5**.

3.3. Empirical model

The EKC theory is currently among the most popular hypotheses of accounting for ecological degradation caused by economic processes (Wang and Liu, 2013). EKC has also been used as the baseline variable for several scientific publications on the impact of the tourist industry for the ecosystem. Of all the steps involved in carrying out this research that focused on ecological responsibility (ES), the EKC theory served in following Equations (1)–(3).

$$ES_{i,t} = \beta_0 + \beta_1 Income_{i,t} + \beta_2 Income^{2i,t} + \varepsilon_{i,t} \tag{1}$$

$$ES_{i,t} = \beta_0 + \beta_1 Income_{i,t} + \beta_2 Income^{2i,t} + \beta_3 Tour_{i,t} + \varepsilon_{i,t} \tag{2}$$

$$ES_{i,t} = \beta_0 + \beta_1 Income_{i,t} + \beta_2 Income^{2_{i,t}} + \beta_3 Tour_{i,t} + \beta_4 INST_{i,t} + \varepsilon_{i,t} \quad (3)$$

We include some additional control variables for robustness checks, as these variables have been documented as drivers of environmental degradation, i.e., trade openness—Trade, urbanization—Urban, and FDI inflows—FDI (Riahi et al., 2017; Vickers, 2017; Williams and Shaw, 2009). Moreover, the Institutional quality (INST) is also included as an additional explanatory variable: The entire empirical equation is as follows in Equation (4).

$$\begin{aligned} ES_{i,t} \quad = \quad & \beta_0 + \beta_1 Income_{i,t} + \beta_2 Income^{2_{i,t}} + \beta_3 Tour_{i,t} + \beta_4 INST_{i,t} \\ & + \beta_5 Urban_{i,t} + \beta_6 Trade_{i,t} + \beta_7 FDI_{i,t} + \varepsilon_{i,t} \end{aligned} \quad (4)$$

3.4. Data

The research obtains information on tourist industry expenditures (as a percentage of GDP) from the world travel & tourism council (WTTC) for both household and foreign (arrivals) visitor numbers (coded as Dotour and Inttour, respectively). This investigation innovates by using two types of tourism spending, whereas prior research has typically concentrated on just one, such as domestic or worldwide tourist revenue (Michailidou et al., 2016; Wiik et al., 2018). In aspects of organizations, the research gathers information from the WGI database on six institutional indicators: Voice includes the accountability and voice, Law includes the rule of law, Requa includes the regulatory quality, Politic includes the good governance and violence absence, control of corruption (Concor) includes the control of corruption, along with government efficiency (Goveff), and Requa includes the regulatory quality. Regarding the quantity or gross organizational performance, we calculate the average of the six institutional metrics discussed above, which we shall refer to as INST. Despite the criticism on the WGI there is no other international source that can be considered as rich as this one in the areas of organizational data (Ryan et al., 2011). This paper also applies information from the World Bank's World Development Indicators (WDI) database on real Gross Domestic Product (GDP) per capita, in natural logarithmic form, urban population as proportion of total population, trade openness and foreign Gross Domestic Product (GDP) inflows through Foreign Direct Investment (FDI) as a proportion of GDP. This period of 2002–2015 was chosen because WGI data is available on an annual basis since the year 2002 while our eco-efficiency index data is available till 2015. The specifics of the factors, sources, and measurements are described in **Table 6** below.

Table 6. Description of all variables.

Constructs	Topic	Unit	Source	Observations	Mean	Standard Deviation	Minimum	Maximum
Dotour	Tourism Development	%	WTTC	1876	3.72	2.12	0.9	13.95
Inttour	Tourism Development	%	WTTC	1876	12.8	14.6	0.03	204.7
INST	Institutional Quality	-	WGI	1876	−0.01	0.93	−1.97	1.99
Voice	Institutional Quality	-	WGI	1876	0.04	0.98	−2.27	1.84
Politics	Institutional Quality	-	WGI	1876	−0.14	0.95	−3.22	1.8
Goveff	Institutional Quality	-	WGI	1876	0.06	1	−2.07	2.47

Table 6. (*Continued*).

Constructs	Topic	Unit	Source	Observations	Mean	Standard Deviation	Minimum	Maximum
Requa	Institutional Quality	-	WGI	1876	0.08	0.98	−2.37	2.3
Law	Institutional Quality	-	WGI	1876	−0.04	1.03	−2.07	2.14
Concor	Institutional Quality	-	WGI	1876	−0.02	1.05	−1.77	2.5
Income	Economic Development	-	WDI	1875	8.52	1.51	5.35	11.67
Urban	Urbanization	%	WDI	1876	57.2	22.3	8.8	100
Trade	Economic Integration	%	WDI	1823	84.5	49.4	0.2	438
FDI	Economic Integration	%	WDI	1857	5.6	13.9	−58.5	280.5

To offer a more comprehensive view **Figure 2** shows the impact of institutional quality on environmental sustainability, the following 3D scatter plot illustrates the relationship between institutional quality (INST) and the Environmental Sustainability Index (ES1), with an added dimension representing income levels.

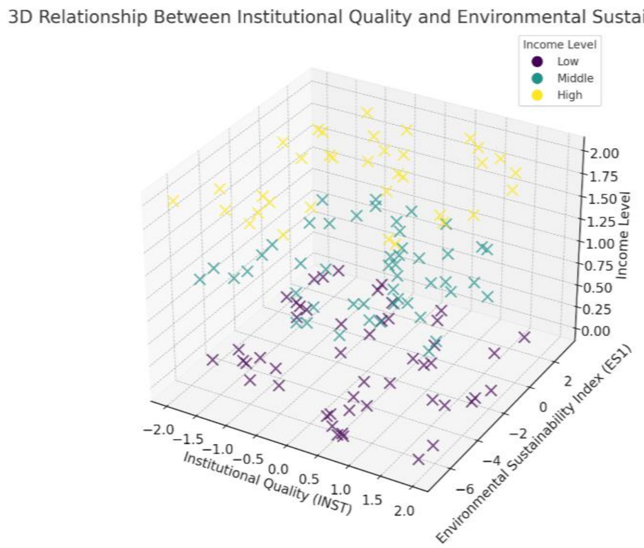

Figure 2. 3D Relationship between institutional quality and environmental sustainability.

4. Empirical findings and discussion

4.1. Econometric estimates

Endogeneity is a crucial problem in estimating Equation (4). endogeneity may occur because the protection of the ecosystem may positively impact the tourist industry and financial growth on the correct side of Equation (4). According to the Yin et al. (2013), a healthier place, like one with less environmental damage, could draw more visitors. However, according to Bernardini and Galli (1993), ecologically sustainable growth could serve as the means for financial growth. Utilizing explanatory variables is regarded as one of the best manners to cope with endogeneity in the empirical literature (Wachs et al., 2022). But here, it’s challenging to isolate the instrumental factors.

According to Gren and Huijbens (2012), the 1st research for panel data guesstimates with endogeneity, suggest the first technique by fusing first segmentation with explanatory variables to address endogeneity. Later in 2013, Sadorsky produced the GMM estimate it is said to be even more precise compared to the first difference method by Bakhat and Rosselló (2011); anyway, GMM presumption is however, monotonically retraceable, as well as it provides a big bias when elaborating unbalanced panel data (Bakhat and Rosselló, 2011; Everett and Slocum, 2013). Coles et al. (2016) later corrected this bias in the system GMM estimate of series. The sample in this study includes 100 start-ups which are considered as immature, unbalanced and short panel data including 134 countries during 14 years—2002–2015. Thus, there is the two-step system GMM considered to be one of the most effective estimators for performing further calculations (Patra et al., 2018).

Several procedures were followed in this study to increase reliability of the results that were obtained with a view of enhancing confidence on the conclusions made. To sustain the primary variables' continuity, the regulating factors were added one at a time into the estimates. As postulated in the econometric literature, a two-step system GMM evaluation is deemed to be inadvisable only in a situation where the cross-sectional sample is relatively small (Pérez et al., 2017). Nevertheless, one must point out that in the framework of this study, the procedure of sub-sampling was not employed. From the specified equations, derived is the reduction of the ecological conservation index for our case which could already have mitigated the corrected impacts for a particular country or even continental totals. Moreover, considering that the survey includes only a small number of respondents, Agyeiwaah et al. (2017) recently used additional modifications of the two-step system GMM, such as the robust two-step system GMM. This research sample is somewhat larger with 134 countries and nearly 1876 observations more with an additional check with the two-step system GMM. This research uses to be more precise, we use revenue and the tourist industry as prospective endogenous factors, along with the first discretization and lags in the explanatory variable. We involve year-fixed impacts in the guesstimate since there are time-fixed impacts that the two-step system GMM does not consider.

Finally, two other eco-efficiency indices are implemented to the guesstimates (ES2 and ES3). Coherent conclusions are presented in the results revealed in the appendix. To be more precise, we use revenue and the tourist industry as prospective endogenous factors, along with the first discretization and lags in the explanatory variable. We involve year-fixed impacts in the guesstimate since there are time-fixed impacts that the two-step system GMM does not consider.

4.2. Empirical results

Eco-efficiency index (ES1) for low-, lower-middle-, middle-, and elevated nations. Observations reveal that most low- and relatively low-income nations experience rising patterns in lowered ecologically sustainable development indices. In upper-middle-income nations, trends from 2010 are similar but growing more gradually. Lower emissions sustainable development indices are typically viewed as declining trends in high-income states. Institutions, and Environmental sustainability and Domestic tourism spending are shown in **Table 7**.

Table 7. Institutions, and environmental sustainability and domestic tourism spending.

Model:	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**	**(9)**	**(10)**	**(11)**
Dep. var:	**ES1**	**ES1**	**ES1**	**ES1**	**ES1**	**ES1**	**ES1**	**ES1**	**ES1**	**ES1**	**ES1**
Inttour	−0.1996*** [0.0340]	−0.1888*** [0.0286]	−0.2134*** [0.0263]	−0.2080*** [0.0256]	−0.2080*** [0.0793]	−0.2043** [0.0789]	−0.1945** [0.0753]	−0.1952** [0.0795]	−0.1875** [0.0744]	−0.1984** [0.0852]	−0.2199*** [0.0823]
INST	0.5428*** [0.1436]	0.4728*** [0.1334]	0.6130*** [0.1458]	0.6874*** [0.1453]	0.6874** [0.3014]						
Voice						0.2566 [0.2634]					
Politics							0.0119 [0.1371]				
Goveff								0.8394*** [0.2248]			
Requa									0.5129** [0.2293]		
Law										0.6475** [0.2828]	
Concor											0.6317* [0.3762]
Income	8.9534*** [0.9915]	9.0222*** [0.9672]	9.9615*** [0.9979]	10.150*** [0.9895]	10.150*** [2.2488]	10.029*** [2.5346]	9.0039*** [2.3928]	9.2830*** [1.6311]	9.2076*** [2.2532]	10.286*** [2.3929]	10.454*** [2.6892]
Income^2	−0.4563*** [0.0596]	−0.4528*** [0.0563]	−0.5088*** [0.0583]	−0.5226*** [0.0574]	−0.5226*** [0.1307]	−0.4977*** [0.1423]	−0.4350*** [0.1305]	−0.4805*** [0.0922]	−0.4621*** [0.1256]	−0.5328*** [0.1395]	−0.5391*** [0.1606]
Urban		−0.0085 [0.0067]	−0.0127** [0.0064]	−0.0124* [0.0063]	−0.0124 [0.0105]	−0.0186 [0.0126]	−0.0130 [0.0142]	−0.0113 [0.0105]	−0.0130 [0.0094]	−0.0106 [0.0115]	−0.0150 [0.0105]
Trade			−0.0011 [0.0013]	−0.0011 [0.0014]	−0.0011 [0.0023]	−0.0003 [0.0023]	−0.0002 [0.0021]	−0.0019 [0.0024]	−0.0012 [0.0025]	−0.0006 [0.0024]	−0.0009 [0.0024]
FDI				−0.0011* [0.0006]	−0.0011 [0.0009]	−0.0010 [0.0009]	−0.0013 [0.0009]	−0.0012 [0.0008]	−0.0014 [0.0010]	−0.0010 [0.0009]	−0.0013 [0.0008]
Constant	−41.389*** [3.9969]	−41.868*** [3.9219]	−45.279*** [4.0346]	−45.918*** [4.0345]	−45.918*** [9.1734]	−46.413*** [10.523]	−42.679*** [10.028]	−41.786*** [6.7633]	−42.463*** [9.4643]	−46.453*** [9.6958]	−47.052*** [10.627]
Year-fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Robust estimate					Yes	Yes	Yes	Yes	Yes	Yes	Yes
Obs	1724	1852	1800	1782	1782	1782	1782	1782	1782	1782	1782
No. of Countries	134	134	133	132	132	132	132	132	132	132	132
No. of IVs	53	56	57	58	58	58	58	58	58	58	58
F-test of the first-stage estimate	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
AR (2) test—*p*-value	0.158	0.255	0.241	0.241	0.248	0.234	0.220	0.272	0.225	0.222	0.217

Table 7. (*Continued*).

Model:	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**	**(9)**	**(10)**	**(11)**
Dep. var:	**ES1**	**ES1**	**ES1**	**ES1**	**ES1**	**ES1**	**ES1**	**ES1**	**ES1**	**ES1**	**ES1**
Hansen test of overid. restrictions	0.739	0.789	0.570	0.493	0.493	0.372	0.319	0.557	0.265	0.323	0.312
Difference-n-Hansen tests of exogeneity											
GMM instruments for levels	0.470	0.547	0.459	0.353	0.353	0.202	0.253	0.456	0.239	0.413	0.172
Iv levels	0.411	0.773	0.876	0.576	0.576	0.094	0.644	0.849	0.697	0.707	0.533

The following **Figure 3** illustrates the coefficients as derived from **Table 7**. This visual representation highlights the significance and magnitude of the impact, allowing for a clearer understanding of how domestic tourism spending influences environmental sustainability. **Table 8** below shows the environmental sustainability and domestic tourism spending by income group.

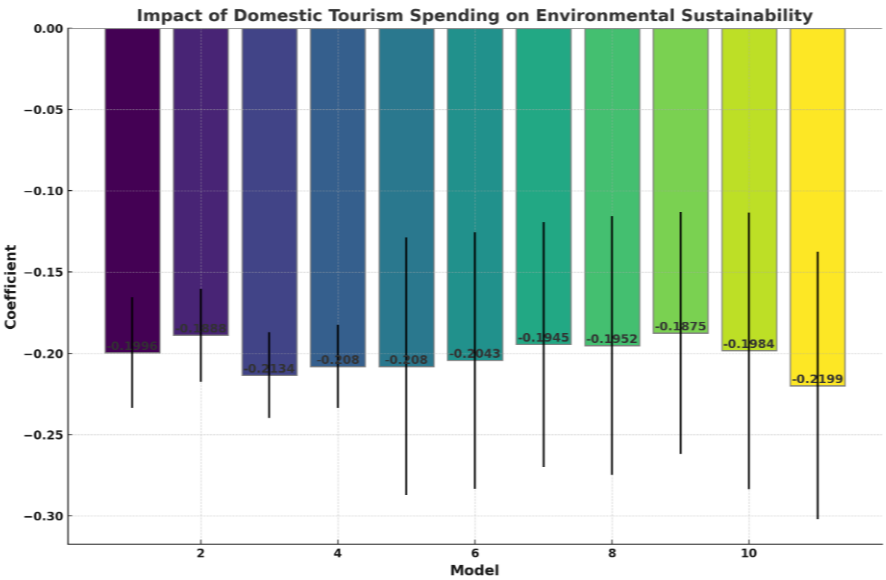

Figure 3. Environmental sustainability in terms of influence of domestic tourism spending.

Table 8. Environmental sustainability and domestic tourism spending by income group.

Income Group	**Domestic Tourism Spending (Mean, % of GDP)**	**Environmental Sustainability Index (Mean)**	**Standard Error**
Low-Income	2.5	−0.5	0.1
Middle-Income	4	0.2	0.15
High-Income	6.5	1.5	0.2

Table 9. Institutions, and environmental sustainability and international tourism spending.

Model:	**−1**	**−2**	**−3**	**−4**	**−5**	**−6**	**−7**	**−8**	**−9**	**−10**	**−11**
Dep. var:	**ES1**	**ES1**	**ES1**	**ES1**	**ES1**	**ES1**	**ES1**	**ES1**	**ES1**	**ES1**	**ES1**
Inttour	−0.0075*** [0.0010]	−0.0063*** [0.0009]	−0.0067*** [0.0009]	−0.0069*** [0.0010]	−0.0068* [0.0037]	−0.0086** [0.0043]	−0.0080** [0.0040]	−0.0064* [0.0036]	−0.0083** [0.0041]	−0.0078** [0.0038]	−0.0060 [0.0040]

Table 9. (*Continued*).

Model:	**−1**	**−2**	**−3**	**−4**	**−5**	**−6**	**−7**	**−8**	**−9**	**−10**	**−11**
Dep. var:	**ES1**	**ES1**	**ES1**	**ES1**	**ES1**	**ES1**	**ES1**	**ES1**	**ES1**	**ES1**	**ES1**
INST	0.5320*** [0.1410]	0.3965*** [0.1365]	0.5410*** [0.1145]	0.5275*** [0.1305]	0.5275** [0.2325]						
Voice		0.0718 [0.1690]									
Politic		0.0517 [0.0852]									
Goveff		0.5120 [0.3240]									
Requa		0.4410** [0.2225]									
Law		0.4955** [0.2035]									
Concor		0.4615* [0.2509]									
Income	8.4220*** [0.6140]	8.3285*** [0.6850]	8.9090*** [0.6630]	9.1835*** [0.6575]	9.1835*** [1.2530]	9.5165*** [1.3935]	9.3055*** [1.6580]	8.9948*** [1.4740]	9.0475*** [1.4230]	9.3775*** [1.2685]	9.5020*** [1.4655]
Income^2	−0.4290*** [0.0368]	−0.4160*** [0.0390]	−0.4520*** [0.0369]	−0.4655*** [0.0372]	−0.4655*** [0.0705]	−0.468*** [0.0780]	−0.4565*** [0.0915]	−0.4562*** [0.0845]	−0.4555*** [0.0792]	−0.4780*** [0.0730]	−0.4835*** [0.0865]
Urban		−0.0067 [0.0057]	−0.0099* [0.0051]	−0.0122** [0.0048]	−0.0122 [0.0090]	−0.0156* [0.0092]	−0.0146 [0.0102]	−0.0112 [0.0092]	−0.0110 [0.0082]	−0.0109 [0.0091]	−0.0134 [0.0099]
Trade		0.0007 [0.0014]	0.0015 [0.0014]	0.0015 [0.0023]	0.0024 [0.0024]	0.0025 [0.0023]	0.0016 [0.0027]	0.0019 [0.0026]	0.0021 [0.0024]	0.0011 [0.0026]	
FDI		−0.0001 [0.0011]	−0.0001 [0.0009]	−0.0005 [0.0011]	−0.0006 [0.0011]	−0.0001 [0.0013]	0.0002 [0.0010]	−0.0004 [0.0009]	−0.0002 [0.0010]		
Constant	−39.485*** [2.5700]	−39.395*** [2.8200]	−41.535*** [2.7750]	−42.770*** [2.7400]	−42.770*** [5.3550]	−45.235*** [5.9950]	−44.350*** [7.0950]	−41.945*** [6.2000]	−42.490*** [6.1400]	−43.535*** [5.2950]	−43.995*** [5.9350]
Year-fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Robust estimate	Yes	Yes	Yes	Yes	Yes	Yes	Yes				
Obs	1725	1853	1802	1785	1785	1785	1785	1785	1785	1785	1785
No. of Countries	134	134	133	132	132	132	132	132	132	132	132
No. of IVs	53	56	57	58	58	58	58	58	58	58	58
F-test of the first-stage estimate	0	0	0	0	0	0	0	0	0	0	0
AR (2) test—*p*-value	0.81	0.3	0.315	0.31	0.311	0.271	0.28	0.295	0.269	0.295	0.257
Hansen test of overid. restrictions	0.512	0.372	0.408	0.47	0.47	0.344	0.398	0.278	0.443	0.554	0.317

Table 9. (*Continued*).

Model:	**−1**	**−2**	**−3**	**−4**	**−5**	**−6**	**−7**	**−8**	**−9**	**−10**	**−11**
Dep. var:	**ES1**	**ES1**	**ES1**	**ES1**	**ES1**	**ES1**	**ES1**	**ES1**	**ES1**	**ES1**	**ES1**
Difference-in-Hansen tests of exogeneity											
GMM instruments for levels	0.408	0.242	0.271	0.288	0.288	0.203	0.321	0.073	0.315	0.348	0.172
Iv levels	0.336	0.484	0.487	0.785	0.785	0.509	0.908	0.844	0.652	0.927	0.635

Table 10. Institutions on environmental sustainability in terms of interactions of domestic tourism spending.

Model:	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**
Dep. var:	**ES1**	**ES1**	**ES1**	**ES1**	**ES1**	**ES1**	**ES1**
Dotour	−0.2033*** [0.0716]	−0.1839** [0.0724]	−0.1961*** [0.0660]	−0.1835** [0.0763]	−0.1829*** [0.0695]	−0.2084*** [0.0749]	−0.2231*** [0.0807]
INST	0.9760** [0.4375]						
INST*Dotour	−0.0680 [0.0708]						
Voice		0.1754 [0.3301]					
Voice*Dotour		0.0148 [0.0584]					
Politic			0.3711 [0.2723]				
Politic*Dotour			−0.1035* [0.0623				
Goveff				0.9888*** [0.3530]			
Goveff*Dotour				−0.0372 [0.0652]			
Requa					0.7638* [0.4271]		
Requa*Dotour					−0.0498 [0.0634]		
Law						0.9617** [0.4201]	
Law*Dotour						−0.0650 [0.0544]	
Concor							1.1135** [0.4611]
Concor*Dotour							−0.1000 [0.0640]
Income	10.054*** [2.0299]	9.6836*** [2.4972]	8.2278*** [1.9522]	9.2889*** [1.5798]	9.1035*** [2.0494]	10.475*** [2.2389]	10.898*** [2.3517]

Table 10. (*Continued*).

Model:	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**
Dep. var:	**ES1**	**ES1**	**ES1**	**ES1**	**ES1**	**ES1**	**ES1**
Income^2	−0.5181*** [0.1178]	−0.4788*** [0.1411]	−0.3909*** [0.1076]	−0.4805*** [0.0898]	−0.4583*** [0.1142]	−0.5454*** [0.1316]	−0.5668*** [0.1404]
Urban	−0.0114 [0.0103]	−0.0168 [0.0129]	−0.0092 [0.0112]	−0.0116 [0.0103]	−0.0119 [0.0094]	−0.0097 [0.0116]	−0.0154 [0.0101]
Trade	−0.0021 [0.0022]	0.0003 [0.0020]	−0.0014 [0.0022]	−0.0023 [0.0019]	−0.0016 [0.0024]	−0.0023 [0.0024]	−0.0025 [0.0022]
FDI	−0.0016* [0.0009]	−0.0009 [0.0008]	−0.0019** [0.0009]	−0.0016* [0.0009]	−0.0018* [0.0010]	−0.0015 [0.0010]	−0.0023** [0.0010]
Constant	−45.441*** [8.2859]	−45.113*** [10.2998]	−39.504*** [8.1917]	−41.843*** [6.5330]	−41.948*** [8.6496]	−46.995*** [9.0154]	−48.562*** [9.3559]
Year-fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Robust estimate	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Obs	1782	1782	1782	1782	1782	1782	1782
No. of Countries	132	132	132	132	132	132	132
No. of IVs	59	59	59	59	59	59	59
F-test of the first-stage estimate	0.000	0.000	0.000	0.000	0.000	0.000	0.000
AR (2) test—*p*-value	0.224	0.239	0.163	0.266	0.206	0.193	0.170
Hansen test of overbid. restrictions	0.573	0.353	0.305	0.553	0.325	0.460	0.510
Difference-in-Hansen tests of exogeneity							
GMM instruments for levels	0.407	0.190	0.160	0.438	0.288	0.484	0.232
Iv levels	0.249	0.097	0.500	0.529	0.125	0.685	0.339

The following **Figure 4** illustrates the interaction effects from **Table 9**, showing how institutional quality modifies the impact of domestic tourism spending on environmental sustainability. By visualizing these interactions, we can better understand the combined influence on environmental outcomes by the tourism and institutional quality. Institutions on environmental sustainability in terms of Interactions of domestic tourism spending shown **Table 10**.

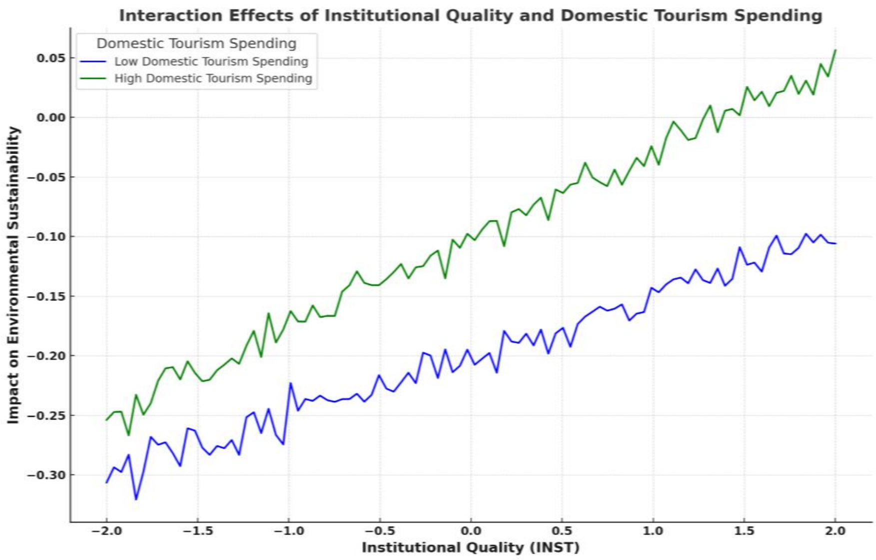

Figure 4. Interaction effects of institutional quality and domestic tourism spending.

Table 11. Interaction of institutional quality and environmental policies.

Model	Institutional Quality	Environmental Policy	Interaction Effect	Standard Error	*p*-value	Confidence Interval (95%)
1	Regulatory Quality	Carbon Tax Policy	0.05	0.02	0.01	[0.01, 0.09]
2	Control of Corruption	Green Energy Subsidies	0.07	0.03	0.005	[0.02, 0.12]
3	Government Effectiveness	Pollution Control Standards	0.04	0.02	0.03	[0.00, 0.08]
4	Voice and Accountability	Renewable Energy Incentives	0.06	0.03	0.01	[0.01, 0.11]
5	Political Stability	Sustainable Agriculture Practices	0.03	0.02	0.04	[0.00, 0.06]

Table 12. Institutions on environmental sustainability in terms of interactions of international tourism spending.

Model:	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**
Dep. var:	**ES1**	**ES1**	**ES1**	**ES1**	**ES1**	**ES1**	**ES1**
Inttour	−0.0164*** [0.0050]	−0.0175*** [0.0052]	−0.0112** [0.0047]	−0.0133*** [0.0044]	−0.0107*** [0.0041]	−0.0168*** [0.0058]	−0.0160** [0.0070]
INST	0.9980*** [0.2659]						
INST* Inttour	−0.0338*** [0.0101]						
Voice		0.6081** [0.2913]					
Voice* Inttour		−0.0300*** [0.0091]					
Politic			0.2476 [0.2501]				
Politic* Inttour			−0.0137 [0.0088]				
Goveff				0.9851*** [0.2901]			

Table 12. (*Continued*).

Model:	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**
Dep. var:	**ES1**	**ES1**	**ES1**	**ES1**	**ES1**	**ES1**	**ES1**
Goveff* Inttour				−0.0318*** [0.0097]			
Requa					0.7698*** [0.2099]		
Requa* Inttour					−0.0211*** [0.0100]		
Law						0.9572*** [0.2636]	
Law* Inttour						−0.0330*** [0.0099]	
Concor							0.7655** [0.2953]
Concor* Inttour							−0.0274*** [0.0099]
Income	9.5175*** [1.1335]	10.0478*** [1.4679]	8.9967*** [1.4327]	9.5976*** [1.3961]	9.1076*** [1.2914]	9.8126*** [1.3322]	10.3638*** [1.4561]
Income^2	−0.4950*** [0.0678]	−0.5069*** [0.0851]	−0.4434*** [0.0819]	−0.5012*** [0.0812]	−0.4664*** [0.0732]	−0.5140*** [0.0785]	−0.5348*** [0.0852]
Urban	−0.0082 [0.0081]	−0.0172* [0.0089]	−0.0105 [0.0107]	−0.0080 [0.0084]	−0.0095 [0.0079]	−0.0078 [0.0100]	−0.0143 [0.0106]
Trade	0.0006 [0.0024]	0.0033 [0.0020]	0.0019 [0.0026]	0.0007 [0.0024]	0.0000 [0.0025]	0.0011 [0.0021]	0.0010 [0.0026]
FDI	0.0018** [0.0008]	0.0017 [0.0012]	0.0004 [0.0011]	0.0019 [0.0012]	0.0014 [0.0009]	0.0019** [0.0009]	0.0016 [0.0011]
Constant	−43.449*** [4.7306]	−46.699*** [6.1550]	−42.793*** [5.9153]	−43.812*** [5.7889]	−42.100*** [5.4313]	−44.552*** [5.5852]	−47.346*** [6.0266]
Year-fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Robust estimate	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Obs	1782	1782	1782	1782	1782	1782	1782
No. of Countries	132	132	132	132	132	132	132
No. of IVs	59	59	59	59	59	59	59
F-test of the first-stage estimate	0.000	0.000	0.000	0.000	0.000	0.000	0.000
AR (2) tes—*p*-value	0.284	0.327	0.324	0.287	0.226	0.269	0.211
Hansen test of overid. restrictions	0.532	0.422	0.355	0.410	0.509	0.548	0.357

Table 12. (*Continued*).

Model:	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**
Dep. var:	**ES1**	**ES1**	**ES1**	**ES1**	**ES1**	**ES1**	**ES1**
Difference-in-Hansen tests of exogeneity							
GMM instruments for levels	0.502	0.406	0.330	0.315	0.398	0.427	0.288
Iv levels	0.927	0.502	0.727	0.741	0.843	0.930	0.904

Table 11 shows Interaction of institutional quality and environmental policies above. According to the studies made in this context, it is also understood that expenses for travelling to international places have a significant negative impact on touristic industry. The outcomes of the national visitor expenditure are similar to this. Apparently, this means that should the global spending on the tourist industry increase, the climate in the host nations would deteriorate or else our lowered ecological index would decline. we reach two conclusions: National and worldwide travel both quantities to the degradation of ecological self-sufficiency; organizations, especially those, which enforce the Rule of law, struggle against corruption, possess efficient governments, and efficient norms and regulations, will indeed help the ecological accountability. Institutions on environmental sustainability in terms of Interactions of international tourism spending shown above in **Table 12**.

Ecological self-sufficiency of organizations connected with the travel industry is guesstimated on the basis of their affiliation to the travel industry. Domestic tourist industry expenditure reduces our eco-efficiency index considerably, while organizations are beneficial in their impact. While they may in some cases contain rather small impacts, their relationships do not show such significant impacts statistically 5. The results presented in **Table 10** show the correspondence between GVE and organizations supporting the development of a green environment. As **Table 8** pointed out, establishments still result in a large positive impact and large negative impact on the international visitor expenditure. As expected, the social connections that they appear to have appear to partake a huge negative impact on our measure of reduced environmental concern. This means that in host nations with the powerful organizations, higher numbers of global tourists spending on the ecological conservation. This **Figure 5** depicts the interaction effects based on the **Table 10**, to expound the role of institutional quality in the relationship between international tourism spending and environmental sustainability. As depicted in the aforementioned diagrams, it is possible to comprehend the interaction between international tourism index and institutional quality as regards to the environmental outcomes.

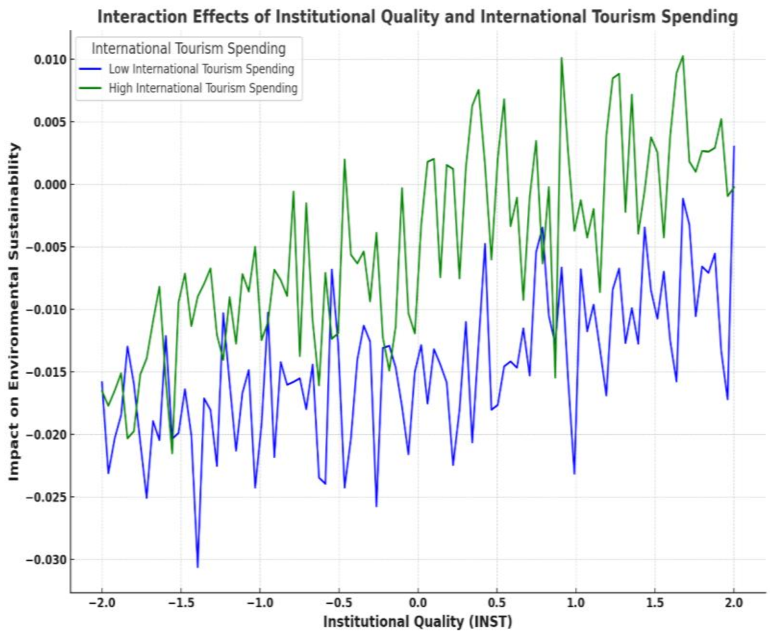

Figure 5. Interaction effects of institutional quality and international tourism spending.

4.3. Discussion

This study contributes to the literature by constructing an eco-efficiency index with 12 variables across seven key environmental issues. It stands as one of the few studies to create such an index for the scientific analysis of the tourism industry's environmental and economic impacts. To validate our findings, we utilized three standardized methods to check for consistency across the reduced ecological conservation index. Our results align with previous literature, which emphasizes the need for more comprehensive global datasets for assessing environmental sustainability (Wang and Liu, 2013; Zeng et al., 2021).

In line with studies by Wang and Liu (2013) and Zeng et al. (2021), our findings suggest that domestic and international tourism activity significantly impacts ecosystems. Our analysis extends previous research by using the eco-efficiency index to capture these impacts comprehensively. Specifically, we demonstrate that increased tourism activities—both domestic and international—are associated with negative ecological outcomes. This confirms the conclusions of prior studies that emphasize the ecological and social costs of tourism on the environment, highlighting the need for more effective environmental regulations in the tourism sector (Ryan et al., 2011; Wiik et al., 2018). Our study also adds to the debate on the environmental impacts of tourism by providing global evidence on how different types of tourism affect ecological responsibility. Earlier studies reported mixed results on tourism's impact on carbon emissions and energy use, but our findings indicate a broader range of environmental consequences beyond carbon footprints (Riahi et al., 2017). While some literature highlights tourism's potential to reduce fuel consumption and contribute to environmental sustainability, our findings show that tourism-related transportation significantly increases carbon pollution (Horng et al., 2012; Williams and Shaw, 2009). This underscores the complexity of tourism's environmental effects and suggests that researchers and policymakers should focus on more than just carbon emissions when assessing the environmental sustainability of tourism.

Moreover, our findings support the assertion that tourism's environmental impact goes beyond air quality and carbon emissions. The tourism industry heavily depends on natural resources, which creates additional pressures on ecosystems (Michailidou et al., 2016). Our results reveal that tourism not only affects emissions but also contributes to significant land use changes, which has broader implications for climate change and biodiversity (Bernardini and Galli, 1993; Ryan et al., 2011). This finding echoes the literature's call for more research on the interconnections between tourism, land use, and environmental degradation (Widyawati, 2020). Additionally, our study advances the Environmental Kuznets Curve (EKC) theory by reexamining the role of institutional quality in the tourism-environment relationship. While previous studies suggest that strong institutions mitigate environmental degradation (Comerio and Strozzi, 2019), our findings reveal a more nuanced dynamic. Similar to Wachs et al. (2022), we find that institutional improvements can, paradoxically, result in higher carbon emissions due to the financial activity they encourage. This study provides global evidence that institutional quality specifically rule of law, governance effectiveness, and anti-corruption efforts positively influences ecological responsibility, but the impact is not straightforward. Strong institutions may prioritize economic growth, which inadvertently exacerbates environmental pressures.

The relationship between institutions and tourism sustainability is complex. Previous studies by Dodman (2016) and Feleki et al. (2020) has highlighted how governance structures mediate environmental outcomes, and our study confirms these findings by showing that institutional quality can sometimes exacerbate the negative environmental impacts of tourism. Notably, our results suggest that while domestic tourism may have a limited effect on sustainability, international tourism has a pronounced adverse impact on environmental responsibility in countries with strong institutions. This finding presents a paradox: although stronger institutions are generally seen as beneficial for environmental governance, they may not be equipped to handle the challenges posed by increased international tourism, as their focus often remains on economic growth rather than sustainability.

Moreover, our research enriches the discussion on institutional quality's moderating role in tourism's environmental impact. The literature has previously emphasized that reducing corruption and improving governance can reduce the adverse effects of economic growth on the environment (Dodman, 2016). However, our findings suggest that institutional quality, rather than mitigating these effects, sometimes intensifies tourism's negative environmental impact, especially in emerging economies where institutional priorities may be focused on fostering business and industrial development (Ding and Li, 2017). This highlights the need for institutional reforms that align economic growth with environmental sustainability, especially in tourism-dependent economies.

4.4. Policy recommendations for achieving sustainable tourism

The findings of this study emphasize the need for careful policy-making to balance the growth of the tourism industry with environmental sustainability. To mitigate the negative environmental impacts of tourism, several specific policy strategies can be recommended. First, governments should consider implementing visitor caps at ecologically sensitive destinations. Over-tourism has been shown to strain natural resources and disrupt local ecosystems, particularly in areas that are not equipped to handle large volumes of tourists. By setting limits on the number of visitors, especially during peak seasons, authorities can reduce the pressure on these destinations. Controlled access measures, such as timed entry slots or mandatory permits, could be employed to maintain a balance between tourism revenue and environmental preservation. Examples from places like Machu Picchu, Peru, demonstrate the effectiveness of such strategies, and similar approaches could be adapted to other popular tourist destinations around the world. Another critical policy recommendation involves the enforcement of sustainable land use regulations. As our findings suggest, tourism-related activities often result in land use changes, deforestation, and the degradation of natural habitats. Governments should strengthen zoning laws and land use policies to ensure that tourism development does not encroach upon protected areas or contribute to habitat destruction. New infrastructure projects, such as hotels, resorts, and transport facilities, should be carefully monitored to ensure they align with sustainable development goals. By enforcing stricter regulations on the expansion of tourism infrastructure, policymakers can limit the environmental impact of tourism growth while still allowing for economic benefits.

Moreover, there is a need for policies that promote energy-efficient and low-carbon tourism. Given that tourism-related transportation, such as air travel and road transport, significantly contributes to carbon emissions, governments should incentivize the use of renewable energy and low-carbon technologies within the tourism sector. This could involve offering tax breaks or subsidies for businesses that adopt green practices, such as solar-powered resorts or electric transportation options. Governments could also invest in the development of eco-friendly public transport systems that cater to tourists, reducing the sector's reliance on high-emission vehicles. Such initiatives would not only reduce the environmental footprint of tourism but also position countries as leaders in sustainable tourism practices. Finally, governments should introduce certification programs for sustainable tourism to encourage businesses in the tourism industry to adhere to environmental standards. Programs like the Global Sustainable Tourism Council (GSTC) certification or similar national initiatives can serve as benchmarks for tourism operators. These certifications could cover areas such as energy efficiency, waste management, and water conservation. By adopting and promoting such programs, governments can create a culture of accountability and sustainability within the tourism sector. This would not only protect the environment but also cater to the growing market demand for eco-friendly tourism options.

5. Conclusion and recommendations

This research provides valuable insights into the relationship between the tourism industry, institutional quality, and environmental sustainability. By analyzing data from 134 countries between 2002 and 2015, we constructed an ecological self-sufficiency index to assess the impact of national and international tourism expenditures, as well as institutional quality, on the environment. Utilizing two-step system GMM and robust two-step system GMM techniques, the findings offer strong and reliable evidence on these relationships. First, our results reveal that both domestic and international tourism expenditures have significant adverse effects on ecological sustainability. Despite tourism often being considered an eco-friendly sector compared to others, such as manufacturing, this research indicates that its growth negatively impacts environmental sustainability, primarily through land use changes, deforestation, and increased greenhouse gas emissions. Second, institutional quality—including governance effectiveness, rule of law, anti-corruption measures, and regulatory quality—plays a positive role in mitigating environmental damage. Strong institutions are critical in enforcing environmental regulations and ensuring sustainable development.

However, an important paradox emerges: while strong institutions are generally beneficial for safeguarding the environment, they can also aggravate the negative ecological impacts of international tourism. Our findings suggest that the interaction between institutional quality and global tourism results in worsening environmental outcomes, which raises questions about how institutions are managing the growing influx of international visitors. In contrast, the relationship between domestic tourism and institutions was found to be negative but statistically insignificant.

5.1. Directions for future research

This study opens several avenues for further research, particularly in areas where our findings highlight gaps or complexities in the relationship between tourism, institutional quality, and environmental sustainability. One critical area for future research is the development of more comprehensive eco-efficiency indices that incorporate dynamic, multi-dimensional factors beyond those used in this study. While our research introduces a simplified eco-efficiency index, future work could refine this model by integrating additional environmental indicators, such as biodiversity loss, land degradation, and water usage, to provide a more holistic view of tourism's environmental impact. Moreover, further research should explore the interaction effects between different types of tourism (e.g., eco-tourism vs. mass tourism) and institutional quality across various regions. Our study demonstrates that institutional quality can have both mitigating and exacerbating effects on environmental outcomes, particularly in relation to international tourism. Future studies could disaggregate different forms of tourism and analyze their specific impacts on environmental sustainability in different governance contexts. This would offer more tailored policy recommendations, especially for developing nations looking to balance tourism growth with environmental protection.

Another important avenue for future research lies in the exploration of regional differences in institutional quality and their environmental impacts. While our study focuses on a global sample, regional analyses—especially in areas such as Southeast Asia, Africa, and Latin America—could yield valuable insights into how local governance structures influence tourism's ecological footprint. These regions are characterized by diverse environmental challenges and governance systems, making them ideal settings for studying the localized impacts of institutional interventions in the tourism sector. Additionally, future studies could investigate the long-term impacts of tourism on environmental sustainability by employing longitudinal data. This would allow researchers to better understand the temporal dynamics between tourism growth and environmental outcomes, providing insights into whether institutional reforms or improvements lead to more sustainable tourism practices over time. Given the rapid growth of international tourism, particularly in emerging economies, it is crucial to assess how institutional changes unfold and affect environmental outcomes in the long run.

Finally, the role of private sector engagement in sustainable tourism development is another promising area for future exploration. While our study primarily focuses on the role of government institutions, future research could explore how partnerships between public institutions and private businesses in the tourism industry contribute to or hinder sustainability efforts. Understanding how corporate governance practices, corporate social responsibility (CSR), and private sector initiatives interact with institutional quality to shape environmental outcomes will be essential in crafting comprehensive policies that address the challenges posed by tourism-related environmental degradation.

5.2. Limitations of the study

While this research identifies significant correlations between institutional quality, tourism, and environmental sustainability, it does not fully establish a clear causal relationship between these variables. Although the two-step system GMM method is used to control for potential endogeneity and provide more reliable estimates, it remains challenging to disentangle the direct causal effects of institutional quality on environmental outcomes, especially in the complex context of tourism. Future research could benefit from exploring more robust causal inference methods, such as natural experiments, difference-in-differences approaches, or instrumental variable techniques, to more definitively assess how institutional quality influences environmental sustainability in tourism-dependent economies. By employing such methods, future studies could better clarify the direction and strength of these relationships, contributing to a more comprehensive understanding of the mechanisms at play.

One limitation of this study is that it does not differentiate between various types of tourism, such as mass tourism, eco-tourism, and adventure tourism, which can have distinct and varying impacts on the environment. Previous studies have highlighted that eco-tourism tends to have a smaller ecological footprint compared to mass tourism, which is associated with higher energy consumption, infrastructure development, and land use changes (Horng et al., 2012; Wang and Liu, 2013). However, due to the lack of detailed, disaggregated tourism data across countries, our analysis focused on overall tourism expenditure and its environmental effects.

Future research could benefit from disaggregating tourism types to provide more nuanced insights into their specific environmental impacts. For instance, examining how eco-tourism contributes to sustainable development versus how mass tourism might exacerbate environmental degradation would enable policymakers to craft more targeted strategies. This differentiation would also help identify best practices in the tourism sector that can mitigate ecological damage while promoting economic growth.

While this study employs broad indicators of institutional quality—such as governance effectiveness, rule of law, regulatory quality, and anti-corruption measures—to assess their impact on environmental sustainability, we acknowledge that this approach might overlook specific institutional components that are critical for managing environmental outcomes. The aggregated nature of these indicators may mask variations in how different institutional functions, such as environmental agencies' effectiveness, policy enforcement mechanisms, or local-level governance structures, specifically contribute to or hinder sustainability efforts. Future research could benefit from a more detailed analysis of these institutional sub-components, examining how specific aspects of institutional performance, such as environmental law enforcement, budgeting for environmental protection, or public participation in environmental governance, influence the tourism-environment nexus. By exploring these dimensions in more depth, scholars can provide more targeted recommendations for strengthening institutional capacity in support of sustainable development.

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