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Article

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Impact of environmental efficiency on tourism export under the moderation of inflation: a cross-country analysis

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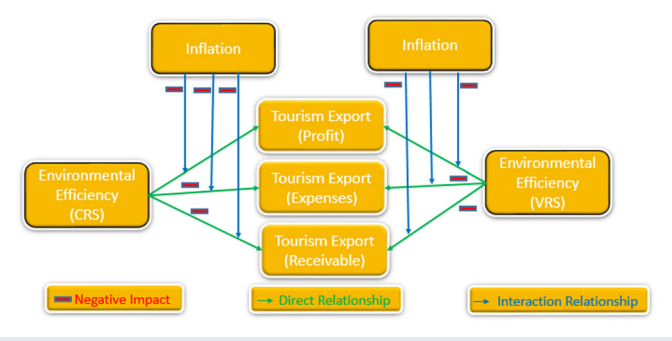
ABSTRACT

A country's tourism sector plays an essential role in the nation's economy and aids in globalization. With the advanced technological establishments, this sector becomes more promising for economic growth. However, the connection of tourism development to environmental effects cannot be denied. Tourism export is also a recent term in this sector that needs to be explored. Therefore, this study aims to determine the impact of environmental efficiency (EE) on tourism export using the cross-country data of 90 countries for the sample period 2011–2020. The panel data is used for the analysis. The findings suggest that EE adversely affects tourism exports. A negative relationship between the two is also observed under the moderating effect of inflation. It means EE reduces tourism exports under higher inflation. This study notably contributes to existing literature through its unique and novel evidence on the EE and tourism export connection. This study recommends that EE be treated as a critical component of tourism policymaking. Figure A presents the graphical abstract.

GRAPHICAL ABSTRACT: FIGURE A



Source: Author's own compilation

IMPACT STATEMENT

We explore in the current research the crucial relationship that exists between environmental sustainability and the booming tourism sector. In light of the worldwide concern for protecting our natural resources, our research investigates how environmental efficiency affects tourism export. Our purpose in analyzing this relationship is to offer insights that will help the tourism industry as well as the larger objective of attaining sustainable development. Our mission is to promote a sustainable equilibrium between economic growth and environmental preservation for the benefit of the tourism sector as well as the earth in the long run.

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1. Introduction

Countries worldwide have witnessed an expanding demand for tourism at the local and global levels. Many countries have developed their infrastructure, like coastlines, mountains, and other sites, to attract more and more tourists (Gössling & Hall, 2006; Gössling, 2013). Hence, it has created a new taste of consumerism to see other places, consume services, and meet other human beings. Therefore, nowadays, tourism is treated as a big business and is considered one of the most promising export products worldwide. Tourism, by definition, is 'the temporary movement of people to destinations outside their normal places of work and residence, the activities undertaken during their stay in those destinations, and the facilities created to cater to their needs' (Mathieson & Wall, 1982). However, by definition, an export brings new money into the local economy from the other country by selling its goods or services to that country. Therefore, tourism also meets this standard when a foreign tourist purchases goods or consumes services in a host country in exchange for some money (Dedkova & Gudkov, 2019; Gunter, 2018). Hence, tourism export is the share of tourism that contributes substantially as non-commodity exports from one country to another (Dedkova & Gudkov, 2019; Gunter, 2018). Tourism export brings revenues and helps develop domestic tourist infrastructure, and environmental resources also attribute it. It forms the market reputation of a country in the world.

The 'environment' as a term has the broadest sense, which incorporates every aspect of human nature, including social, political, cultural, and economic factors. All these aspects affect our lives by interacting with human and non-human worlds (Holden, 2016; Gössling & Hall, 2006). The world has seen faster economic growth in the latter part of the twentieth century (Abbas et al., 2019). This development has significantly strained the earth's natural resources and affected the environmental system, such as ozone depletion and global warming (Balsalobre-Lorente et al., 2023). These are negative environmental changes accelerated mainly through human actions. Environment degradation also gives rise to hazardous health problems for all living beings (Abbas et al., 2022; Micah et al., 2023; Zhou et al., 2021).

Moreover, the urbanization rate is rapidly growing in developed and developing nations, creating an increasing environmental demand to satisfy needs and wants. The urbanization process establishes the distance between people and nature and presents people with a need to define a new notion of the community. The satisfaction of such needs and wants, combined with increasing prosperity, coined a new form of consumerism, 'tourism' (Holden, 2016). According to Holden (2016), in the current century's beginning, over 650 million people travel internationally annually. It may be increased to 1600 million in the next 20 decades. In many developed countries, tourism is now a life necessity. NGASS (Nations General Assembly Special Session (Earth Summit II) in New York in 1997 advocated that tourism is a changing agent for the environment. The changes can both be negative and positive. Foreign Tourist Arrivals worldwide increased to 1.5 billion in 2019 from 827 million in 2007, a high jump in the tourism sector (Tian et al., 2021).

Global tourism has steadily grown in the past few decades and contributed vigorously to economic growth (Dritsakis, 2012; Ohajionu et al., 2022; Wang et al., 2023). It is also evident from the Tourism Led Economic growth [TLEG] theory that tourism has a substantial role in a nation's economic growth. Furthermore, the tourist spending in the host country has created an alternative form of export, 'tourism export'. It helps the countries to improve the balance of payment (BOP) through the inflow of foreign exchange earnings (FEE) from tourism exports (Balaguer & Cantavella-Jordá, 2002; Ohajionu et al., 2022). Furthermore, the tourism sector (as part of economic diversification) also acts as an insurance facility. It can significantly compensate for a downturn in the economy through other sectors (Ohajionu et al., 2022). According to Wang et al. (2023), tourism involves several other sectors in its connection; thus, it creates good employment opportunities in a country and improves economic growth. Tourism development in connection with environmental issues, there exists a popular environment-development theory known as the 'Environment Kuznet Curve (EKC)'. It states that environment and development have a U-shaped connection. First, the increasing environmental degradation gives rise to economic development. However, reaching a threshold reduces economic development (Abbas et al., 2022; Grossman & Krueger, 1995; Usman et al., 2020).

Notwithstanding the importance of tourism, mainly tourism export, the research in this area is significantly less. The concern for environmental issues results from increasing tourism activities involving

tourism exports. Therefore, tourism export needs to be explored more by researchers to provide novel evidence on various dimensions. As tourism export consists of selling goods and services to guest countries, environmental features may attract foreign tourists. Hence, it would be interesting to estimate the impact of EE on tourism exports. The current study steps towards this direction to find the connection between tourism export and the environment.

The tourism industry is complex as it involves transportation (railways, roadways, airways, and waterways), hotels, restaurants, amusement parks, hospitals, and general retail and merchandise stores. Many studies are available on world tourism (Gössling & Hall, 2006; Gössling, 2013). However, many other exciting areas in tourism research are not much explored, for example, tourism export (Dedkova & Gudkov, 2019; Gunter, 2018). Tourism export is not given much attention in research. In addition, tourism export has not yet been investigated about environmental aspects.

Moreover, tourism research is more focused on the impact of increasing tourism on environmental issues. However, researchers have rarely given attention to the direction to investigate how environmental efficiency influences the potential of tourism across the globe. Therefore, the mentioned environmental issues and the existing research gaps related to tourism and the environment are the primary motivations of the current study.

The studies on environment-development aspects are incomplete without exploring the tourism sector (Wang et al., 2023). Therefore, this paper aims to investigate the impact of environmental efficiency on tourism exports. It has mainly two objectives. First, it finds the EE's impact on tourism exports. Second, it investigates their association with the moderating effect of inflation. The study uses the cross-country level data of 90 countries from 2010 to 2019. Different proxies of tourism exports are analyzed to provide robust evidence. The environmental efficiency is also measured using DEA (Data Envelope Analysis), which outlooks a justifiable view of the environment.

The findings imply a significant role of environmental efficiency in tourism export. It shows that EE adversely affects tourism exports. The current paper greatly contributes to the existing knowledge body incorporating environmental and tourism studies through its unique, fresh, and surprising evidence on the interconnection of the environment and tourism. As no such research exists that looks for the connection of EE with tourism export, this study is original and gives noticeable nights on environmental issues and tourism. The study's findings also provide notable policy implications to critically consider the environmental factors to promote tourism export.

The paper is further partitioned into several sections. Section 2 explores the existing literature. Section 3 puts discussion on the employed data and methodology. Sections 4 and 5 explain the results and their discussion, respectively. Section 6 concludes the paper.

2. Literature review

2.1. Tourism and environment

Over the past 150 years, it has been witnessed that the global earth's temperature is ever-changing and significantly influencing people's lives due to environmental changes (Brooke, 2014; Hafeez et al., 2023; Shah et al., 2023). The recent COVID-19 pandemic is a hazardous event that has shaken people's lives (Abbas, 2020; Hafeez et al., 2023; Micah et al.,2023). It has influenced human's mental health (Abbas, 2020). Therefore, environmental concerns have become a key issue, especially concerning the tourism sector, to prevent such a pandemic (Mensah & Boakye, 2023). The nexus between the environment and tourism has been the object of scientific investigation for over 50 years. Tourism's rapid growth has geared up after post-World War II (since 1950). Tourism was mainly spotted as the economic sector has massive potential for the nation's economy (Gössling & Hall, 2006; Ohajionu et al., 2022). It can open up opportunities for economic growth by promoting employment and infrastructure upgradation for the people and the country. However, the environmental role of tourism was realized after 1960 and 1970 when the green movement took place (Mathieson & Wall, 1982).

Mathieson and Wall (1982), Gössling and Hall (2006), and Gössling (2013) have given signals for tourism and environmental connection. However, they have argued that tourism and the environmental connection are debatable as they are positively related in some cases and negatively associated

elsewhere. Moreover, environmental impacts evaluated in existing studies are based on artistic judgments which lack scientific evidence (Gössling & Hall, 2006; Gössling, 2013). Furthermore, the investigations of tourism in existing studies are based on a destination basis. A global perspective is not much explored.

The tourism industry is also complex as it is associated with several sectors. Tourism export is also a vital component of the tourism industry, which is not investigated in the literature. Moreover, the environmental perspective used in the current study is investigated through a Pollutant basis (primarily considering CO2 emission as it is regarded as the primary environmental pollutant (Ohajionu et al., 2022; Paramati et al., 2017; Zhang & Zhang, 2021). However, the aspect of environmental efficiency is not yet investigated as examined in the current study. Thus, there are substantial research gaps in the literature on tourism and the environment, as existing studies do not discuss environmental efficiency and its relationship with tourism export. The current study determines the EE's impact on tourism export to fill existing research gaps. Moreover, inflation plays a key role in an economy. Therefore, this paper also estimates the EE's impact on tourism exports under the influence of inflation.

2.2. Tourism, energy consumption and CO2 emission

Tourism substantially contributes to any nation's economic development in one direction; however, it also has significantly contributed to the increment of a country's carbon dioxide emissions. Development in tourism can cause an increase in CO2 emissions (Ohajionu et al., 2022; Zhang & Zhang, 2021). Several researchers like Katircioglu et al. (2014), Becken (2013), Katircioglu (2014a, 2014b), Gössling (2013), Akadiri et al. (2019), De Vita et al. (2015), Akadiri et al. (2020) and Ohajionu et al. (2022), Opeyemi (2021), have put debates on the upshots of tourism development (TD) on CO2 emissions and climate changes. Katircioglu et al. (2014) find a positive association between energy consumption (EC), CO2 emissions and foreign tourist arrival (FTA) in Cyprus. They claim that foreign tourism increases EC, raising CO2 emissions. Similarly, in their study in Turkey, De Vita et al. (2015) found that FTA in Turkey enhances EC and raises CO2 emissions. Zhang and Zhang (2021) also examined that TD leads to degraded environmental quality due to increased CO2 emission in China.

Nie et al. (2019), Zhang and Zhang (2021), Adedoyin and Bekun (2020), Dogru and Bulut (2018) and Akalpler and Hove (2019), Koçak et al. (2020) also indicate a positive relationship between foreign tourism to EC and CO2 emissions. They have reasoned that tourism contributes positively to the economic development of destinations with the increase in EC. This increase in EC leads to an increment in CO2 emission. Solarin (2014) also observes that Malaysia's energy consumption is increased due to tourist arrivals. Similar evidence is found by Tang et al. (2016) in the Indian context. According to Gössling (2013), several countries have witnessed vulnerabilities regarding energy induced by tourism.

2.3. Theoretical background and hypothesis formation

2.3.1. Tourism and environmental quality

Many studies have recently recognized the connectivity of pollutant emissions (like CO2 emission) to tourism demand (including tourism export). According to De Vita et al. (2015), Katircioglu (2014a, 2014b) and Stern (2004), the proposition of their relationship (environment and tourism) is based on the Environmental Kuznets Curve (EKC) hypothesis. This hypothesis states that global tourism demand raises the energy demand (due to the increasing demand for transportation and accommodation). The rise in energy demand leads to improved environmental quality by exploring better energy sources in the long run (Iorember et al., 2020; Usman et al., 2020). Zhang and Liu (2019), cited in Bano et al. (2021) and Ohajionu et al. (2022), advocate that increasing TD, in the long run, helps in the development of environmental infrastructure in many parts of Asia. Mamirkulova et al. (2020) also indicate that tourism development and quality of life have a positive connection.

Similarly, Ben Jebli et al. (2015), as cited in Khan et al. (2020), find a negative association of energy consumption with tourism demand in Tunisia. They also argue that increasing tourism demand improves environmental quality by reducing CO2 emissions in Tunisia's ecology in the long run. However, there are many other studies which contradict the existing EKC theory. Khan et al. (2020) also support that

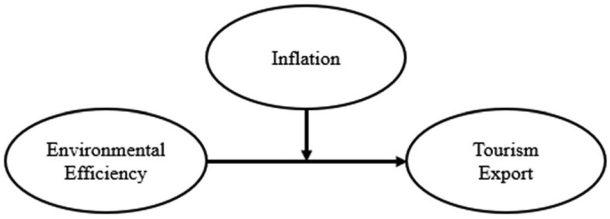

Figure 1. Conceptual model.
Source: Author's own compilation.

tourism demand encourages improving environmental infrastructure, which may reduce pollutant emissions in the long run.

Lei and Jing (2016) and Zhang and Zhang (2021) find a negative association between environmental quality and tourism demand in eastern China. Khan et al. (2020) also provide similar evidence on the relationship between the environment and tourism. However, they also indicate that tourism demand encourages improving the environmental infrastructure, which may reduce CO2 emissions in the long run. Ohajionu et al. (2022), Nie et al. (2019), Adedoyin and Bekun (2020), Dogru and Bulut (2018) and Akalpler and Hove (2019) also indicate a positive relationship between foreign tourism to EC and CO2 emissions. Hence, they indicated that tourism demand has an opposite relationship with environmental quality, as Musa et al. (2021) argued. Tang et al. (2016), in the Indian context, also indicate that tourism demand degrades environmental quality. Therefore, it has been established from the existing literature that there are inconsistent results on the current EKC theory that says tourism growth improves environmental quality in the long run. Therefore, more research must be done to verify the connectivity of the environment and tourism demand having some other reasonable aspect of the environment (for instance, environmental efficiency as discussed in the current paper) for sustainable growth planning. Thus, this paper assumes the following hypotheses in their alternative form as follows:

H_1: *Environmental efficiency positively impacts tourism export*

2.3.2. Tourism, environmental fairness and inflation

Additionally, Hang et al. (2020), Yong (2014), and Naidu et al. (2017) also indicate that tourism demand is affected by inflation pressure. Athari et al. (2021) also indicate that inflation negatively impacts international tourism demand. Khan et al. (2022) state that inflation is essential to environmental quality. It adversely affects environmental quality. While validating the EKC theory, Ahmad et al. (2021) argue that inflation has a significant connection to environmental quality. In earlier studies, inflation is a vital determinant affecting tourism and environmental quality. Nguyen (2022) and Usman et al. (2021) also find that inflation plays a significant role in tourism demand and environmental factors. Hence, looking for environment and tourism connections under inflation pressure will be an exciting investigation. Therefore, this paper assumes the following hypothesis in its alternative form as mentioned below (Figure 1 shows the conceptual model):

H_2: *Environmental efficiency positively impacts tourism export under the moderating effect of inflation.*

3. Data and methodology

3.1. Data and methodology

This paper is a cross-country research to deliver a global prospect on tourism and environmental connectivity. Hence, this study analyses the secondary data of 90 countries worldwide for 2011–2020. The data is collected from the World Bank Tourism, environment, and economic development database. Initially, we procured the data from 140 countries; however, we found the authenticated data and fine-tuned data for 90 countries only to have a balanced panel. These 90 countries involve the world's major nations to cover a substantial portion of the world's economy (please see Appendix for a list of countries). As mentioned earlier, there were 140 countries at the beginning of data collection. However, several countries have missing data. We have removed those countries and finally taken 90 countries in

the sample (Abbas et al., 2023; Rastogi & Kanoujiya, 2022; Shah et al., 2023). The duration of the study is essential as many regulatory reforms are witnessed worldwide during this period (after the 2008 global financial crisis). A detailed note on variables is mentioned in Table 1.

This study is a cross-country investigation based on data from 90 countries for ten years. Hence, the panel data approach (PDA) is the well-suited methodology for data analysis to confirm the validity of the assumed hypotheses. Additionally, the longitudinal study (PDA) has its benefits in providing unbiased results because it attributes both cross-sectional (countries in the current study) and time dimensions (Abbas et al., 2023; Hsiao, 2007; Rastogi & Kanoujiya, 2022; Wooldridge, 2015). The PDA-based regressions give unbiased outcomes even in the presence of endogeneity. This study looks for the environmental impact on tourism export in linear association with the base variable and interaction term (under the moderation of inflation) (Li et al., 2022). Thus, there are 12 models (3x2x2) with three proxies of tourism export, two proxies of environmental efficiency, and two models (base and interaction) for each combination of tourism export and environmental efficiency. We have performed several diagnostics tests to assess the appropriate fitness of the model. Tests such as the multicollinearity, endogeneity, Hausman, Wald, and Wooldridge tests are performed to ensure model fitness (Hsiao, 2007; Rastogi & Kanoujiya, 2022; Wooldridge, 2015). The outcomes of these tests are discussed in the results section (Section 4). The following model specifications are established in this study:

$$TE_{it} = \beta_1 EE_{it} + \beta_2 lnCO2\_emm_{it} + \beta_3 \ln\_Non\_ene\_cons_{it} + u_{it} \quad (1)$$

$$TE_{it} = \beta_1 EE_{it} + \beta_2 lninfl_{it} + \beta_3 INTRm_{it} + \beta_4 lnCO2\_emm_{it} + \beta_5 \ln\_Non\_ene\_cons_{it} + u_{it} \quad (2)$$

where '$uit = \mu it + vit$'

Models 1 to 6 (base models) correspond to Equation (1), and Models 7 to 12 (interaction models) correspond to Equation (2). TE is a dependent variable having three proxies (lnProf_usd, lnExp_pass_t, and lnRec_exp) representing tourism export. The environmental efficiency (EE) is the primary exogenous variable having two variants, lnEnv_eff_crs and lnEnv_eff_vrs. 'ln_Non_ene_cons (non-renewable energy consumption) and 'lnCO2_emm' (CO2 emission) are included as control variables to have the appropriate fit model. Interaction terms (represented as INTR in model specifications) are also introduced, having inflation (lnInfl) as the moderator. The interaction terms are 'i_lnEnv_eff_crs_lnInfl' (=lnEnv_eff_crs**X**lnlfl) and 'i_lnEnv_eff_vrs_lnInfl' (=lnEnv_eff_vrs**X**lnlfl). '*uit*' is error-term which sums up 'μit' (representing individual-effect) and '*vit*' (representing regular-error). The following subsection gives a detailed description of the variables.

3.2. Variables

The primary dependent variable in the current paper is tourism exports (Dedkova & Gudkov, 2019; Gunter, 2018). It has three proxies: receivables from tourism export, expenditure on passenger travel, and profit from foreign tourism. All the proxies of DV are computed in USD. The logarithmic values are taken for these proxies to sustain consistency. The primary exogenous variable is environmental efficiency (Chen & Jia, 2017; Song et al., 2012), which has two proxies, i.e. environmental efficiency at a constant return to scale (lnEnv_eff_crs) and environmental efficiency at a variable return to scale (lnEnv_eff_vrs). These proxies are also treated in their logarithmic values.

The EE is measured using DEA (Data Envelope Analysis). A detailed discussion on environmental efficiency assessment is mentioned in the following subsection. Inflation is another independent variable to include as a moderator for investigating the interaction effect of EE and inflation on tourism exports. Hence, inflation is a moderator in interaction models. As per the World Bank, Inflation is defined as the increase in the rate of prices over a given period (Hang et al., 2020; Yong, 2014). It indicates the increase in the cost of living in a nation.

Furthermore, two independent variables are also included in the model as control variables to identify the sole impact of EE on tourism export. Non-renewable energy consumption is the first control variable measured as the percentage of total energy consumption. The second control variable is CO2 emission estimated in Kiloton (Chen & Jia, 2017; Song et al., 2012).

Table 1. List of variables.

SN	Variable	Symbol	Type	Definition	Citations
1	Tourism export (Profit from tourism export)	lnProf_usd	DV	It is the profit earned from tourism export in USD. It is taken as the proxy for tourism export.	Cortes-Jimenez and Pulina (2010), Lim and Pan (2005), Li et al. (2013), Gunter (2018), Dedkova and Gudkov (2019)
2	Tourism export (Expenses by foreign passenger travel in host country)	lnExp_pass_t	DV	It is the expenses by tourists in host country measured in USD. It also represents tourism export.	Cortes-Jimenez and Pulina (2010), Lim and Pan (2005), Gunter (2018), Dedkova and Gudkov (2019)
3.	Tourism export	lnRec_exp	DV	It is total receivable in USD from tourism export in a host country. It is also taken as a proxy of tourism export.	Cortes-Jimenez and Pulina (2010), Lim and Pan (2005), Gunter (2018), Dedkova and Gudkov (2019)
3	CO2 Emission	lnCO2	CV	It shows environmentaqqualityin form of CO2 emission in metric ton. Higher CO2 emission leads to poor environment quality.	Song et al. (2012), Chen and Jia (2017)
4	Non-renewable energy consumption	lnNon_ene_cons	CV	It is the share of non-renewable energy consumption out of total energy consumption in a country.	Ivanovski et al. (2021), Opeyemi (2021)
5	Inflation	lninf	MV	It shows the rate of increment in price of livelihood in a country. See Section 3.3.	Hang et al. (2020), Yong (2014), and Naidu et al. (2017)
6	Environmental efficiency (at constant return to scale)	crs_env	EV	It represents the environmental efficiency assuming the change in output is proportional to change in inputs at constant rate. Subsection 3.3 explains it.	Song et al. (2012), Chen and Jia (2017)
7	Environmental efficiency (at variable return to scale)	vrs_env	EV	It represents the environmental efficiency assuming the change in output is proportional to change in inputs at varying rate. Subsection 3.3 explains it.	Song et al. (2012), Chen and Jia (2017)

Note. DV, CV, EV, MV represent the dependent, control, exogenous, and moderating variables, respectively.

3.3. DEA analysis and environmental efficiency computation

The DEA analysis is applied to assess environmental efficiency. DEA analysis is a widely used stochastic approach to measure relative efficiency by analyzing multiple inputs and outputs (Thanassoulis, 1993). DEA is a popular tool because it has various benefits over other stochastic approaches. As it is non-parametric, it does not need prior model specifications. Hence, it is easy to implement and establish the most appropriate model to estimate consistent results. A frontier efficiency is set to find relative efficiency (Bevilacqua & Braglia, 2002). DEA analysis should meet some criteria to run the DEA program. Decision-making units [DMUs] (90 countries in this study) should be larger than five times the total number of inputs and outputs ($3 \times 5 = 15$ in this study) (Bevilacqua & Braglia, 2002). Following Guo and Wu (2013) and Li et al. (2013), we use the DEA approach for its consistent output compared to other techniques.

Energy intensity and non-renewable energy consumption are two inputs taken for DEA. Environmental measures are generally undesirable; for instance, CO2 emission should be less for better environmental quality. Hence, CO2 emission is an undesirable output. Unwanted output needs to decrease. CO2 is the major causing pollutant of environmental degradation. Therefore, we have solely taken this output variable. As per Kuo et al. (2014), Li et al. (2013), Wu et al. (2013), and Seiford and Zhu (2002), the inverse value of CO2 emission (i.e. f(CO2)=1/CO2) is taken to deal with undesirable output in DEA. It should be noted that implementing the inverse value is a valid measure to resolve the issue of this undesirable output because the CO2 emission of a country cannot be zero. As suggested by Kuo et al. (2014) and Seiford and Zhu (2002), for running the DEA program, DMUs are more significant than five times the total number of inputs and outputs ($3 \times 5 = 15 < 90$). We have used two variants of DEA efficiency: (1) Constant return to Scale (CRS), assuming output changes with the same proportion as inputs change; and (2) Variable return to scale (VRS), assuming output does not change with the same proportion as inputs change (Kuo et al., 2014; Li et al., 2013).

4. Results

4.1. Descriptive statistics

Table 2 presents the statistical summary of the study variables' data. The mean value of Prof_usd is 1.7709 (billion USD), slightly down towards Min, showing a low average profit from tourism across sample countries. Receivable from tourism export (Rec_exp) shows a mean value of 13.29 (in billion USD), also down towards Min, indicating a low level of receivables. Similarly, expenditure on tourist passengers for tourism export (Exp_pass_t) has a mean value of 1.53 (in billion USD) down towards Min. The Infl with a mean value of 5.29 shows low average inflation in sample countries. The Env_eff_crs and Env_eff_vrs have mean values of 0.50 and 0.62, respectively. The values are approximately at the centre of Min and Max; hence it shows a moderate level of environmental efficiency, on average, in sample countries. The CO2 emission worldwide is alarming, with a high mean value of 380864.6. On average, the non-renewable energy consumption is relatively high, showing a mean value of 75% inclined to Max.

4.2. Multicollinearity and endogeneity

Tables 3 and 4 show the correlation matrix and the results of endogeneity tests. Environmental efficiency variables have the issue of multicollinearity as having a correlation coefficient of more than 0.800.

Table 2. Descriptive statistics.

Variables	Mean	SD	Min	Max
Prof_usd	1.7709	1.1510	−4.7210	8.5910
Rec_exp	13.29338	15.75179	0	93.65199
Exp_pass_t	1.5309	4.5209	100000	5.2810
Infl	5.296396	22.91849	−19.14647	558.56
Env_eff_crs	.5023736	.2128195	.156	1
Env_eff_vrs	.6240934	.1868098	.251	1
Non_ene_cons	75.01033	22.75199	6.82	100
Co2_emm	380864.6	1258963	110	10707220

Note. SD, Mean, Max, Min indicate standard deviation, mean value, maximum, and minimum, respectively.

Table 3. Correlation matrix.

Variables	lnEnv_eff_crs	lnEnv_eff_vrs	lnInfl	i_lnEnv_ eff_crs_lnInfl	i_lnEnv_ eff_vrs_lnInfl	lnNon_ene_cons	lnCo2_emm
lnEnv_eff_crs	1.0000						
lnEnv_eff_vrs	0.9470*	1.0000					
	(0.0000)						
lnInfl	−0.0831*	−0.0822*	1.0000				
	(0.0106)	(0.0114)					
i_lnEnv_eff_crs_lnInfl	0.4915*	0.4847*	−0.8114*	1.0000			
	(0.0000)	(0.0000)	(0.0000)				
i_lnEnv_eff_vrs_lnInfl	0.4859*	0.5162*	−0.7924*	0.9866*	1.0000		
	(0.0000)	(0.0000)	(0.0000)	(0.0000)			
lnNon_ene_cons	−0.5694*	−0.5639*	−0.1083*	−0.2240*	−0.2315*	1.0000	
	(0.0000)	(0.0000)	(0.0008)	(0.0000)	(0.0000)		
lnCo2_emm	−0.7408*	−0.5413*	0.0134	−0.2995*	−0.2379*	0.4787*	1.0000
	(0.0000)	(0.0000)	(0.6816)	(0.0000)	(0.0000)	(0.0000)	

Note. * for significance of correlation coefficient at 0.05.

Therefore, they are not used together in model specifications. In addition, interaction terms have shown a correlation coefficient of more than 0.800. It is treated as structural multicollinearity, permissible in regression analysis with interaction terms (Baltagi & Baltagi, 2008; Wooldridge, 2015). The rest of the variables with significant correlation does not have coefficient value more than 0.800. Hence, they do not feel responsible for multicollinearity issues.

Table 4 shows the results of the Durbin Chi2 and Wu-Hausman tests. These tests examine the endogeneity issues associated with explanatory variables for the dependent variable. Models 1, 2, 5,6, 9, and 10 have insignificant values for these tests. Hence, these models are significantly free from endogeneity issues. However, the rest of the models (Models 3, 4, 7, 8, 11, and 12 have significant values by these tests. Therefore, endogeneity issues exist in these models. Hence, Models with endogeneity problems use Instrument variables regression models (IVreg) for consistent results. The lag3 value of the endogenous variable is used as an instrumental variable for both endogeneity tests and performed IVreg regression (Baltagi & Baltagi, 2008; Wooldridge, 2015).

4.3. Regression outcomes

Table 5 demonstrates the regression results of base models (Models 1 to 6). The Hausman test, showing significant values, confirms models' consistency with fixed effect. Models 1, 2, 4, and 6 have autocorrelation and heteroscedasticity issues because the Wooldridge test for autocorrelation and the Wald test for heteroscedasticity have significant values. Therefore, robust estimates (robust standard errors) are observed for discussing outcomes (Baltagi & Baltagi, 2008; Wooldridge, 2015).

Both environmental efficiency variables (lnEnv_eff_crs and lnEnv_eff_vrs) are found insignificant for tourism export (considering tourism profit [lnProf_usd] as a proxy in Models 1 and 2). In contrast, both environmental efficiency variables are negative and significant at 5% significance in Models 3, 4, 5, and 6. It indicates that the environmental efficiency of a country lowers tourism exports. The control variable 'ln_Non_ene_cons' is to be significant and negative in Models 3, 4, and 5. Another control variable, 'lnCO2_emm', is found to be significant and negative only in Model 5.

In interaction models (see Table 6), the moderator' lnInfl' has significant coefficients only in Models 11 and 12 for tourism export (with proxy 'lnRec_exp'). 'lnEnv_eff_crs' has significant and negative coefficients for 'lnExp_pass_t' (in Model 9) and 'lnRec_exp' (in Model 11). However, 'lnEnv_eff_vrs' is significant in Model 12, having a negative coefficient. The interaction terms' i_lnEnv_eff_vrs_lnInfl' and 'i_lnEnv_eff_crs_lnInfl' are found to have significant and negative coefficients for tourism export (proxied by lnRec_exp) in Models 11 and 12. It means that environmental efficiency is detrimental to tourism exports while inflation is high and vice versa (see Figures 2 and 3). The control variable 'ln_Non_ene_cons' is significant in Models 9,10,11, and 12. However, 'lnCO2_emm' is significant only in Model 12.

4.4. Robustness of outcomes

The study's findings need to be verified for their robustness using different variants of variables (Bhimavarapu et al., 2022; Kanoujiya et al., 2022). Therefore, this study utilizes the multi-models approach,

Table 4. Results of the endogeneity test.

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8	Model 9	Model 10	Model 11	Model 12
Durbin Chi-2	.412017 (0.5209)	.034471 (0.8527)	2.75051 (0.0972)	2.15625 (0.1420)	3.793 (0.0515)	2.41414 (0.1202)	18.1317 (0.0000)	18.9282 (0.0000)	2.3562 (0.1248)	1.18468 (0.2764)	4.76228 (0.0291)	5.90198 (0.0151)
Wu-Hausman test	.407948 (0.5233)	.034103 (0.8536)	2.74214 (0.0982)	2.14796 (0.1432)	3.78661 (0.0521)	2.40545 (0.1214)	18.7446 (0.0000)	19.6116 (0.0000)	2.33777 (0.1268)	1.1731 (0.2792)	4.74375 (0.0298)	5.89069 (0.0155)

Note. p-value is in (). * signals significance at 5%. DV symbolizes the dependent variable.

Table 5. Result (static model).

	Model 1 (base model) robust DV: lnProf_usd		Model 2 (base model) robust DV: lnProf_usd		Model 3 (base model) DV: lnExp_pass_t		Model 4 (base model) robust DV: lnExp_pass_t		Model 5 (base model) DV: lnRec_exp		Model 6 (base model) robust DV: lnRec_exp	
	Coeff	SE	Coeff	SE	Coeff	SE	Coeff	SE	Coeff	SE	Coeff	SE
lnEnv_eff_crs	.31	.41			−3.33*	.84			−3.24*	.66		
lnEnv_eff_vrs			.59	.60			−.72	.29*			−.48*	.21
lnNon_ene_cons	−.44	.23	−.31	.88	−3.89*	.83	−1.74	.70*	−1.07***	.64	−.29	.34
lnCo2_emm	.24	.81	.24	.24	.18	.24	.16	.22	−.87*	.19	−.11	.16
Cons.	20.71*	2.75	20.25*	2.94	31.51*	3.12	24.68	2.46*	13.53*	2.42	4.28*	1.34
BP-test (random effect)	1331.09* (0.0000)		1374.44* (0.0000)		3546.03* (0.0000)		3557.09* (0.0000)		3514.97* (0.0000)		3547.13* (0.0000)	
Hausman test	27.54* (0.0000)		19.90* (0.0000)		65.33* (0.0000)		63.33* (0.0000)		12.99* (0.0047)		14.35* (0.0025)	
Wald test for heteroscedasticity[1]	1.729* (0.0000)		4.629* (0.0000)				8.506* (0.0000)				4.306* (0.0000)	
Chi-square					978016.69* (0.0000)				18868.86* (0.0000)			
F Test	0.93 (0.4297)		1.16 (0.3295)		42.71* (0.0000)		3.05* (0.0319)		32.92* (0.0000)		2.13 (0.1013)	
Wooldridge autocorrelation test[2] AR (1)	13.292* (0.0005)		13.501* (0.0005)				10.599* (0.0015)				7.598* (0.0069)	

Note. Wald test of heteroscedasticity has the null of no heteroscedasticity. Wooldridge test of autocorrelation in panel has the null of no autocorrelation (with 1 lag). Robust estimates are estimated due to significant Heteroscedasticity and Autocorrelation. DV (dependent variable) is lnProf_usd, lnExp_pass_t, lnRec_exp. These are the tourism export proxies. () has p-value. * significance at 5% and *** significant at 10%.

Table 6. Result (interaction model).

	Model 7 (interaction model) DV: lnProf_usd		Model 8 (interaction model) DV: lnProf_usd		Model 9 (interaction model) robust DV: lnExp_pass_t		Model 10 (interaction model) robust DV: lnExp_pass_t		Model 11 (interaction model) DV: lnRec_exp		Model 12 (interaction model) DV: lnRec_exp	
	Coeff	SE	Coeff	SE	Coeff	SE	Coeff	SE	Coeff	SE	Coeff	SE
lnInfl	−.29	.21	−.21	.19	−.00	.04	.00	.04	−.24*	.11	−.22*	.10
lnEnv_eff_crs	.30	.27			−.34*	.20			−.25	.18		
lnEnv_eff_vrs			.57	.58			−.45	.30			−.46*	.27
i_lnEnv_eff_crs_lnInfl	−.38	.38			−.00	.04			−.29*	.14		
i_lnEnv_eff_vrs_lnInfl			−.39	.35			.00	.05			−.40*	.19
lnNon_ene_cons	−.87	1.28	−.64	1.28	−1.90*	.70	−1.92*	.71	.22*	.45	.15*	.45
lnCo2_emm	.13	.43	.09	.43	.35	.21	.35	.21	−.54	.15	−.54*	.15
Cons.	23.74*	3.61	23.26*	3.62	23.51*	2.54	23.52*	2.63	6.84	1.52	7.13*	1.54
BP-test (random effect)	1029.09* (0.0000)		1065.11* (0.0000)		2932.19* (0.0000)		2949.30* (0.0000)		2899.27* (0.0000)		2922.27 (0.0000)*	
Hausman test	19.35* (0.0017)		586.18* (0.0000)		50.97* (0.0000)		48.81* (0.0000)		18.95* (0.0020)		22.88* (0.0004)	
Wald test for heteroscedasticity[1]					5.806* (0.0000)		9.506* (0.0000)					
Chi-square	545343.27* (0.0000)		553482.91* (0.0000)						27231.75* (0.0000)		27076.56* (0.0000)	
F test	29.76* (0.0000)		30.07* (0.0000)		1.91 (0.0994)		1.70 (0.1402)		47.16* (0.0000)		47.06 (0.0000)*	
Wooldridge autocorrelation test[2] AR (1)					9.056* (0.0033)		8.208* (0.0051)					

Note. Wald test of heteroscedasticity has the null of no heteroscedasticity. Wooldridge test of autocorrelation in panel has the null of no autocorrelation (with 1 lag). Robust estimates are estimated due to significant Heteroscedasticity and Autocorrelation. DV (dependent variable) is lnProf_usd, lnExp_pass_t, lnRec_exp. These are the tourism export proxies. () has p-value. * significance at 5% and *** significance at 10%.

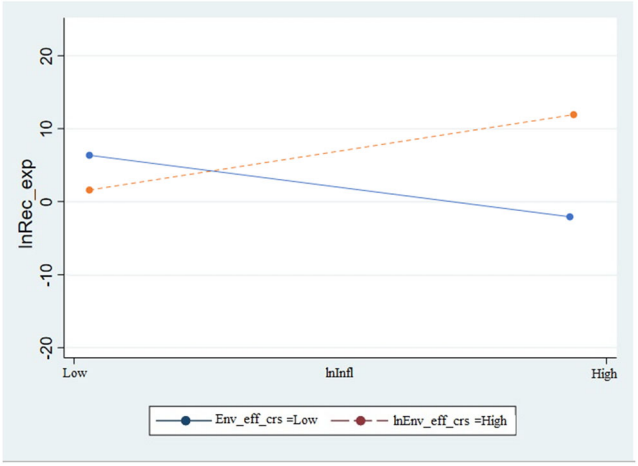

Figure 2. Model 11 (interaction graph).
Source: Author's own compilation.

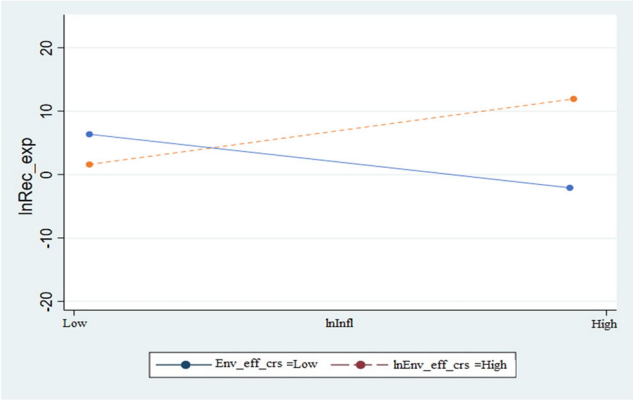

Figure 3. Model 12 (interaction graph).
Source: Author's own compilation.

followed by Kanoujiya et al. (2022) and Rastogi and Kanoujiya (2022), using three proxies of tourism export and two versions of environmental efficiency. We have developed 12 models, i.e. six base models and six interaction models, as discussed in Section 3.2. A significant and negative impact of environmental efficiency on tourism export is found in most of the models. It implies that EE reduces tourism exports. Hence, most models exhibit similarity in outcomes, ensuring the results' robustness. Similar results, even in interaction models (Models 11 and 12), also confirm robustness under the moderating effect of inflation.

5. Discussion

5.1. Hypothesis discussion and comparison with previous studies

The first hypothesis is focused on achieving the study's first objective. H_1 assumes that environmental efficiency adversely impacts tourism exports. This hypothesis has strong evidence in its support in most models. It implies that environmental efficiency significantly reduces tourism exports. The second hypothesis is focused on the second objective. H_2 assumes environmental efficiency adversely impacts tourism export understanding moderating inflation effect. This hypothesis has enough evidence in its support. Therefore, it implies that environmental efficiency reduces tourism exports while inflation increases. Hence, it is found from accomplishing both objectives that EE adversely impacts tourism export worldwide. The current findings contradict the existing EKC theory that has the proposition on the environment and tourism relationship. It states that environmental quality and tourism demand are moving in the same direction. It means tourism development is enhanced with improved environmental

quality. However, it is observed in the current findings that environmental efficiency reduces tourism exports. It might be due to the maintenance of the environmental quality of the host country, which increases the cost of tourism facilities. Hence, inflationary pressure also causes a negative connection between environmental quality and tourism, including other sectors (Zhuang et al., 2022).

No study is observed that examines the impact of environmental efficiency on tourism export, as investigated in the current paper. However, the current findings can be compared with some existing literature on environment and tourism, having its foundation in EKC theory. Several studies have provided evidence on EKC theory, indicating that environment and tourism are positively associated. The findings obtained from accomplishing the current study's objectives contradict the findings of Zhang and Liu (2019), Ben Jebli et al. (2015), Li et al. (2022), and Yu et al. (2022), which supports EKC theory. However, the current findings are in support by many studies, such as Nie et al. (2019), Zhang and Zhang (2021), Adedoyin and Bekun (2020), Dogru and Bulut (2018), Akalpler and Hove (2019), Lei and Jing (2016), and Ohajionu et al. (2022) contradicting EKC theory. These studies argue that environment and tourism demand are negatively associated.

5.2. Contribution

The present study has two main objectives. The first is to determine the EE's impact on tourism export. The second objective is to determine the EE's impact on tourism exports under the moderation of inflation. By achieving both objectives, it is found that EE adversely impacts tourism exports across the world. The current findings contradict the 'Environment Kurzen Curve theory.' These outcomes might be due to environmental efficiency increasing tourism export costs to higher inflation. Environmental concerns and the increasing tourism demand are critical issues in any economy. However, less attention is given towards this direction by the researchers. No study examines environmental efficiency and tourism export and finds evidence for their connection. The findings are unique and novel and significantly contribute to environmental and tourism literature. The study's contributions are manifold to the existing literature. First, it assesses the environmental efficiency of the countries by applying DEA. Second, it highlights the importance of tourism export. Third, it finds novel and unique evidence of the EE's impact on tourism export by achieving the objectives set in the study.

5.3. Implications

The study's outcomes from the current analysis recommend notable suggestions to policymakers. Regarding economic and policy implications, environmental efficiency should be considered a critical issue for policymakers for tourism development. Environmental efficiency should be balanced so that it does not increase tourism costs by rising inflation. Hence, it should be given an important place in regulatory initiatives. Resources like Renewable energy should be involved in cost-cutting energy consumption (Zhuang et al., 2022). Innovation in developing environment-friendly and cost-cutting transportation systems is required to develop sustainable tourism. The suggested recommendations are believed to improve both the environment and tourism arrival across the globe significantly. Policymakers should also focus on adequate city planning for sustainable development, including the tourism sector, at a lower cost (Abbas et al., 2021; Hussain et al., 2019). The notable economic implication of the current finding is environmental efficiency is important for sustainable development in the economy; however, it should be carefully considered as it should not result in inflationary pressure. Otherwise, it can affect the tourism sector adversely in an economy.

6. Conclusion, limitations and future scope

6.1. Conclusion

United Nations World Tourism Organization (UNWTO) reports that the tourism sector greatly contributes to the economic growth of any nation (Ohajionu et al., 2022). Tourism worldwide is substantially related to natural resources (water, lakes, rivers, coast, mountains, forests, oceans, etc.), directly influenced by environmental changes. This study investigates the impact of environmental efficiency on tourism

exports. The current study's findings reveal that environmental efficiency harms tourism exports. In addition, a similar association is also found under the moderating effect of inflation. The present results are in support of many studies, such as Nie et al. (2019), Zhang and Zhang (2021), Adedoyin and Bekun (2020), and Ohajionu et al. (2022) contradicting EKC theory. The findings uniquely contribute to the existing literature on tourism and the environment through their novel evidence on the relationship between environmental efficiency and tourism export.

6.2. Policy implications

Regarding the policy implications, the current outcomes of the analysis recommend that environmental efficiency be critically treated in policy making of tourism development. Alternatives to reduce costs in energy consumption should be given importance as energy resources are the main causes of pollutant emissions. Policymakers should also focus on adequate city planning, having better environmental conditions for sustainable development, including the tourism sector, at a lower cost.

6.3. Limitations

Notwithstanding, the current findings naturally have some limitations: each country has different structural, cultural, and political features which may influence tourism-led economic growth and are connected to environmental aspects. Moreover, some confounding factors such as population, ruling aspects of a country (democracy), and geographical and economic situations that may influence the results.

6.4. Future scope

The above-mentioned factors need to be explored in future studies as these factors may have the potential to provide insights into handling environmental issues in tourism and other sectors. This study does not discuss the impact of the COVID-19 pandemic or its influence on the environment and tourism demand worldwide. Thus, it could be taken as the future scope of the study. Moreover, only CO2 emissions as pollutants are considered for the environmental outcome. Other responsible factors for environmental efficiency should be placed in future studies.

Disclosure statement

No potential conflict of interest was reported by the author(s).

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Appendix. Sample countries

Serial no	Country name
1	Albania
2	United Arab Emirates
3	Argentina
4	Armenia
5	Australia
6	Austria
7	Azerbaijan
8	Belgium
9	Bangladesh
10	Bulgaria
11	Bahrain
12	Belarus
13	Bolivia
14	Brazil
15	Canada
16	Switzerland
17	Chile
18	China
19	Colombia
20	Costa Rica
21	Cuba
22	Cyprus
23	Czech Republic
24	Germany
25	Denmark
26	Dominican Republic
27	Algeria
28	Ecuador
29	Egypt, Arab Rep.
30	Spain
31	Estonia
32	Finland
33	Fiji
34	France

(*continued*)

Appendix. Continued.

Serial no	Country name
35	United Kingdom
36	Georgia
37	Greece
38	Guatemala
39	Hong Kong SAR, China
40	Honduras
41	Croatia
42	Hungary
43	Indonesia
44	India
45	Ireland
46	Iran, Islamic Rep.
47	Iceland
48	Israel
49	Italy
50	Jordan
51	Japan
52	Kazakhstan
53	Kyrgyz Republic
54	Cambodia
55	Korea, Rep.
56	Lao PDR
57	Sri Lanka
58	Lithuania
59	Luxembourg
60	Latvia
61	Macao SAR, China
62	Morocco
63	Moldova
64	Mexico
65	Malta
66	Mauritius
67	Nicaragua
68	Netherlands
69	Norway
70	Nepal
71	New Zealand
72	Oman
73	Panama
74	Peru
75	Philippines
76	Poland
77	Puerto Rico
78	Portugal
79	Paraguay
80	Romania
81	Russian Federation
82	Saudi Arabia
83	Singapore
84	Sierra Leone
85	El Salvador
86	Slovak Republic
87	Slovenia
88	Sweden
89	Eswatini
90	Sint Maarten (Dutch part)

Source: Author's own compilation.