RESEARCH ARTICLE

Analyzing the linkage among CO$_2$ emissions, economic growth, tourism, and energy consumption in the Asian economies

Misbah Nosheen[1] · Javed Iqbal[2] · Hidayat Ullah Khan[3]

Abstract

The study empirically explores the long-run dynamic influence of output, tourism, energy use, trade, financial development, and urbanization on CO$_2$ emissions in the framework of EKC for Asian economies for the time period 1995–2017. In this study, we tackle cross-sectional dependence problem and use CADF and CIPS unit root tests in contrast to conventional unit root tests. Moreover, we employ LM bootstrap panel co-integration test. The results of DOLS show that GDP and GDP squares have opposite signs which shows inverted u-shaped hypothesis between GDP growth and carbon emissions. We find an evidence of EKC proposition in case of Asian economies. Tourism has a vital role in increasing environment degradation of Asian economies as magnitude of coefficient is 0.132. Moreover, energy use, urbanization, trade, and financial development have direct and a profound impact on environmental degradation. The empirical results thus point to the fact that tourism, trade openness, and urbanization have contributed to the environmental degradation in the Asian region. Hence, the counties of the region should harness renewable energy sources along with environment-friendly technologies to support the tourism at a sustainable level that may be conducive to economic growth and environmental quality as well.

Keywords Tourism · Asian countries · Environmental degradation · DOLS

Introduction

The increasing earth temperature is alarming for human beings. Different groups of gases, for example, carbon dioxide, methane, and nitrous oxide, produce climate change and greenhouse gases (Sherafatian-Jahromi et al. 2017). It is evident that the impact of warm weather is harmful for tourism (Hamilton et al. 2005). It tends to affect human health and is responsible for various types of diseases (Reiter 2008; Paul 2008). Moreover, due to these circumstances, the goals of sustainable development are difficult to achieve (Iwata and Okada 2014). Emission of carbon dioxide is not only harmful

for health and global environment, but it also has negative impact on sustainable economic growth. In modern era of globalization, tourism is a potential area in terms of GDP growth in developing nations. It is an important sector of economy as it has contributed 9.5% to global GDP and provides 266 million employment opportunities (Zaman et al. 2017). With the help of effective planning and management, tourism sector may contribute further and significantly to gross domestic product (Ridderstaat et al. 2014). Tourism contributes to the economic development in different ways. It boosts GDP growth such as it is helpful in proper utilization of natural resources and contributes to foreign reserves and creates job opportunities. It helps in developing the infrastructure of the building and roads and is the source of earning tax revenue for economy (Zaman et al. 2017: Dritsakis 2004: Modeste 1995 and Tsui et al. 2018).

The World Tourism Organization (UNWTO 2018) reported that the total number of tourist's arrival is supposed to increase in the coming years at the global level. In year 1950, the number of tourists was 25 million, and it increased to 1326 million by 2017, in which 323.1 million were related to Asian region. The UNWTO also identified that the annual growth rate of number of tourist arrival was 4.2%, in which

✉ Misbah Nosheen
  Misbah@hu.edu.pk

[1] Department of Economics, Hazara University, Mansehra, Pakistan

[2] School of Economics, Quaid Azam University, Islamabad, Pakistan

[3] Department of Economics, Abbottabad University of Science and Technology, Abbottabad, Pakistan

the annual growth rate of tourist related to Asian region was 6.4% by year 2017. The increasing growth rate of international tourists has substantial influence on the national income of emerging developing nations. By 2017, the total revenue collected from tourists was $1340 billion, in which $389.6 billion was related to the Asian region.

The tourists' arrival in a country tends to boost the GDP growth, yet it is also supposed to damage the environmental quality with the use of high energy streaming from fossil fuel (Tsui et al. 2018; Gössling and Peeters 2015). The rising rate of tourism adversely affects the environmental quality in the shape of high use of energy related to transportation, housing facility for tourists, increasing the construction, wood cutting, wood burning, and other tourist activities as well (Becken et al. 2001; Scott et al. 2010; Tsui et al. 2018). Source: World Data Bank (2018)

Figure 1 represents the number of entries of worldwide travelers in the Asian region. In the figure, China, India, Indonesia, Thailand, Malaysia, and Vietnam have high number of international tourists as compared with other Asian countries. Similarly, another factor, responsible for carbon release, is the emanating urbanization pressure in developing economies, in particular in Asian countries [Rafiq et al. 2017; Canning et al. (2008), Majeed et al. (2016), Chikaraishi et al. (2015) and Azam et al. (2019)].

The Asian Pacific region has emerged as one of the much-loved tourism destinations for tourism of all categories. Over the past, the Asia Pacific region has received a drastic increase in international arrivals and receipts as well. The Asian region has got its reputation for being an attractive destination because the region is enriched with natural landscapes and has shown significant progress in necessary infrastructure development for holiday goers and other international different tourists. The increasing tourism activities have been accompanied by growing economic opportunities in the Asian region, and now tourism is an important industry that has a contribution to economic growth of the region (UNWTO 2018, 2019).

In line with the Asia Pacific, Southeast Asia has become a new hub of international tourism which is reflected in the fact that the region shows a momentum in collecting a significant amount of revenue in terms of tourism receipts. Hence tourism industry has turned into one of the major industries of the region to stimulate economic growth. For example, Thailand is destined as a much amorous area and receives millions of tourists each year. In line with these countries, tourism has contributed significantly to the economies of the Philippines, Vietnam, Singapore, Malaysia, and Indonesia in terms of revenue collection and employment generation Dinh et al. (2019). To keep the momentum and influx of tourists in the region, the countries concerned have launched and initiated various programs such as facilitation in visa attainment and low-cost airlines that aims to facilitate both domestic and international tourists. All these developments related to tourism has resulted in growing economic opportunities and has caused to increase the income level of a common person which has been reflected in more spending and growth of the region.

Figure 2 below indicates the classifications of international tourism receipts within the Asian region. It shows that in Northeast Asia, international tourism receipts were 101.2 billion, while in Southeast Asia, it amounted to Rs 53.5 billion in 2009 which increased to 188.4 billion and 142.3 billion by 2018 both in Northeast Asia and Southeast Asia, respectively. Similarly, over this period, South Asia has experienced a growth of 11% over 2009 to 2018 from 14.9 billion to 43.6 billion.

However, the increasing tourism-related activities tend to have implications for increasing environmental degradation in the Asian region. The nexus between tourism activities are supposed

to enhance energy consumption and increase pollution in several ways. First, a rise in the number of global tourists may contribute to the increasing energy consumption thanks to the increasing energy demand that may likely to affect climate change in the form of CO_2 emission. According to the World Summit on Sustainable Development 2002, one of the main energy-using sectors is the tourism sector because of the fact that the hoteling industry and increasing air and road transports are supposed to enhance energy consumption that may further increase carbon emission.

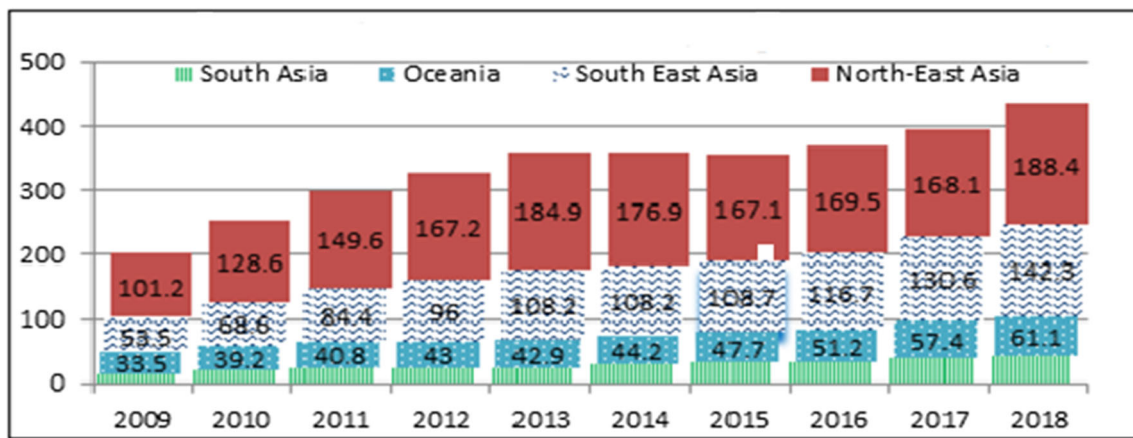**Fig. 1** Tourists arrivals and receipts share (%) Source: (UNWTO) 2018
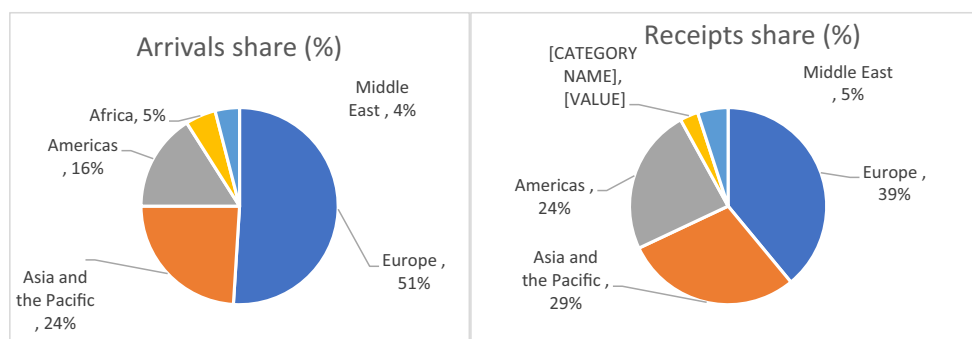
Fig. 2 International tourist's receipts in the Asian region (in billion dollars). Note: Based on WDI data

This can be found in Fig. 3. It shows that on the average an increasing trend in carbon emission can be observed since 1995 and onward. However, within the Asia region, China and India are the two major economies which have contributed to CO_2 emission at an accelerating pace.

Now the question arises that in what way tourism is likely to affect the environment in the Asian region. An increasing economic growth caused by tourism may affect the environment in different ways. If the environmental Kuznets curve hypothesis is valid, then environmental quality may worse off initially and may get improved in later stages when income level rises to a certain level. In line with the environment Kuznets curve hypothesis, tourism may improve environmental quality in the sense that to attract both domestic and international tourists, countries would have to move to a more eco-friendly tourism, where maxim natural beauty is retained by planting more trees by preserving the natural landscapes that may likely to lessen the pressure on environmental degradation and carbon emission as well. However, in the short run, we may expect degradation in the quality of environment with the development of new road infrastructures and other hoteling facilities. The study, therefore, explores the effect of economic growth and tourism on ecological quality for the region of Asia. The empirical results point to the fact that tourism, trade openness, and urbanization have been key factors affecting the environmental quality in the Asian region. The empirical results point to the fact that the counties of the region should harness renewable energy sources along with environment-friendly technologies in order to support the tourism at a sustainable level that may be conducive to economic growth and ecological quality as well.

This study is important as it has a contribution to literature in a variety of ways: first, the association between tourism and CO_2 emission is not discussed earlier in the case of Asian region which is the second highly international tourism arrival region in terms of tourist arrivals of 347 million [UNWTO (2019)]. Second, these countries have significant share in trade urbanization, energy use, and financial development of global GDP and
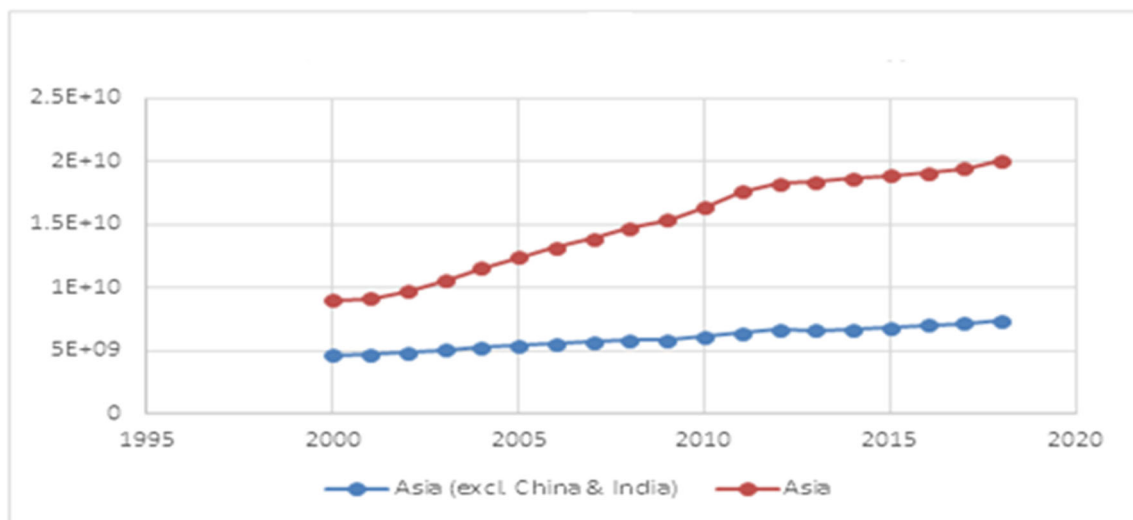

Fig. 3 Trend in CO_2 emissions in the Asian region. Note: Based on WDI data

CO_2 emission. Third, the study employs second-generation unit root tests and LM bootstrap test to tackle cross-sectional dependence problem.

The rest of the study is organized in a way that literature review and data and methodology are reported in Sections 2 and 3, respectively, while Section 4 shows data analysis and results, whereas Section 5 shows conclusion.

Review of literature

In order to present a comprehensive overview of the existing literature, related to this study, we summarize the literature based on the association of CO_2 emissions (CEs) with three major areas, i.e., (i) energy mix (EM) and economic growth (GDP), (ii) tourism industry (TI) and GDP, and (iii) urban growth trends (UGTs). Each of the areas has a subsection comprising a thorough review of the most relevant studies, as we proceed further.

Nexus between energy mix and GDP growth on CO_2 emissions

As mentioned earlier, this subsection summarizes the studies particularly focusing on association among EM, GDP, and CEs. Usman et al. (2020) empirically examine the effect of renewable energy use (REC) and economic growth (GDP), on ecological degradation (ED) in the United States of America. The outcome revealed that the use of REC negatively affects the environmental degradation through its undesirable association with the "ecological footprint." However, the findings disclose that GDP along with BC has an upward while TP has downward push on EF. Hussain et al. (2019) investigate the environmental impacts of energy use (EC) and GDP growth (GDP) for Malaysia. The study shows positive and significant relationship between EC and GDP. Moreover, the study establishes a bidirectional causality between EC and GDP via application of Granger-Causality test. Khan et al. (2019) study the impact of globalization, economic factors, and energy consumption (EC) on CO_2 emissions (CEs) in Pakistan. The study shows that energy use (EC), financial development (FD), foreign direct investment (FDI), trade, and different aspects of globalizations (i.e., economic, social, and political) are positively linked with CEs, whereas urbanization, economic growth (GDP), and innovation have negative relationship to CEs. Moreover, the study finds that EC, urbanization, GDP, FD, and different aspects of globalizations raise the level of CEs, in short run, while trade, innovation, and FDI reduce the level of CEs.

Hammami and Saidi (2015) show significant positive impact of CEs on EC at global level. Furthermore, the study shows GDP has an overall positive relationship with EC but positive and significant at regional level. The findings indicate that GDP, CEs, and EC complement each other. Omri et al. (2014)

confirms a two-way causality for FDI and GDP as well as that for FDI and CEs across the board, apart from Europe and North Asia. Furthermore, the study concludes that across the broad reverse causal association between CEs and GDP, it implies that the higher the level of GDP growth, the higher will be the CEs level. Therefore, the use of greener technology and efficient energy sources is essential for sustaining higher economic growth and limiting CEs levels. Saidi (2017) investigates the association among quality of environment, economic growth (GDP), carbon emissions (CEs), and energy use (EC). The study finds bidirectional causality among GDP and EC as well as that between GDP and CEs for all countries excluding Algeria. Moreover, same findings are confirmed in the case of CEs and EC for all countries except Venezuela, which has unidirectional causality directed from the former to the latter. Besides, there are many studies, for instance, Munir and Khan (2014), Lean and Smyth (2010), Halicioglu (2009), Ang (2007), etc., revealing similar outcomes. Through this subsection, we can sum up that the available EM-GDP-CEs literature has serious issues when it comes to the selection of methodology. In addition to this, the techniques employed for panel estimation do not consider across the countries' heterogeneous effects and cross-sectional dependence may produce biased results suffering from forecast errors.

Effects of tourism industry and GDP growth on CO_2 emissions

It is believed that TI is a key contributor to GDP of a few countries and regions but also to CEs levels, and hence environmental degradations. In this subsection, we attempt to establish this association through reviewing a wide range of studies.

Dogan and Aslan (2017) explore the association among carbon emissions (CEs), output (GDP), energy use (EC), and tourism by using a pool dataset of existing and prospective European Union (EU). The authors claim to apply a unique method of "heterogeneous panel estimation, with cross-sectional dependence." The study confirms long-term association among the key variables. Furthermore, the study finds a direct association between EC, energy use, and CEs, whereas inverse correlation between real GPP and tourism, and CEs. Zaman et al. (2017) investigate how tourism transport can contribute towards economic growth (GDP), energy consumption (EC), and CO_2 emissions (CEs). The study reveals that the greater the GDP per capita, the greater will be the CEs and environmental degradation. Moreover, the study finds that both receipts and payments of international travel raise CEs as well as GDP per capita of the countries. Moreover, the study establishes causal relationship between tourism payments and receipts, GDP per capita, and FDI, among the countries.

Aslan (2016) assesses the effect of various tourism proceeds, on economic growth (GDP) in the long term. The study

employs techniques like "autoregressive distributed lag (ARDL) and causality test" on Turkish dataset covering a period from 2003 to 2012. The study confirms a long-term association between various tourism proceeds (i.e., hosteling and accommodations, transportation, sporting activities and adventures, sightseeing, shopping expenses, etc.) and GDP. Balcilar et al. (2014) investigate causality among tourism proceeds (TPs) and GDP. The study uses South African data covering a period of 1960–2011 and finds no causal relationship between TPs and GDP via Granger test of causality for the whole sample. However, the study predicts that TPs positively contribute towards GDP, via application of time-variant coefficient models through the state space representations, for the entire period except for a time span between 1985 and 1990. Katircioğlu (2014) attempts to establish a relationship between tourism development (TD) and carbon emissions (CEs) through the use of "environmental Kuznets curve (ECK)" for Singapore, which is a hub of tourism, with economy with a good energy mix (EM), greater urbanization, and fast-paced industrial growth. The study establishes long-run (LR) equilibrium between tourism development and CEs, i.e., CEs can potentially converge, via tourism, EM, and GDP, towards equilibrium in LR. On the other hand, the higher the level of tourism, the higher will be the CEs in LR as well as in short run (SR). The study confirms tourism-led ECK, through the establishment of unidirectional causal association from TD to CEs in the LR, for Singapore.

León et al. (2014) examine the association between carbon emissions (CEs) and tourism for developed as well as underdeveloped nations, by applying STIRPAT technique on panel data, of the countries for 1998–2006. The study establishes that tourism sector causes significant rise in the level of CEs for all the nations, but the magnitude of CEs is greater in the case of developed than that of underdeveloped nations. The study identifies a need for sustainable approach with lower levels of CEs for tourism sectors. Lee and Brahmasrene (2013) attempt to find the impact of tourism industry (TI) on GDP growth (GDP) and carbon emissions (CEs). The study analyzes a panel dataset of European Union (EU) nations from a period between 1988 and 2009 by using unit root and co-integration tests. The study concludes direct significant association amid GDP and CEs while the later has negative association between tourism and FDI. To sum up this subsection, a strong association among TI, GDP growth, and CEs level exists. However, it does not answer the questions about a desirable volume of tourism and CEs level, with least environmental degradation, ensuring sustainable GDP growth.

Linkages between CO$_2$ emissions and urban growth trends

It is generally believed that the increasing urban growth trends cause an overall rise in CEs levels, both at regional and global levels, and hence global warming. In this subsection, we attempt to establish this nexus through available literature by reviewing the most relevant studies. Anser et al. (2020) attempt to find the effects of urban and economic growth (GDP) and the rising population on domestic carbon emissions (CEs) in the SAARC region. The outcomes reveal that population growth and per capita GDP are major contributors of CEs in the region. Moreover, the study finds that the association between urban growth and domestic CEs is u-shaped. The study recommends for a curb in urbanization and population rise to reduce domestic CEs in the region. Shahbaz et al. (2016) assess effects of urban growth trends (UGTs) on CO$_2$ emissions (CEs) for Malaysia. The results show that CEs levels rise due to EC and liberal trade policies. Furthermore, the study reveals the "U-shaped" association between UGTs and CEs.

Kasman and Duman (2015) find causality amid energy use (EC), carbon emissions (CEs), GDP growth, trade liberalization (TL), and urban growth trends (UGTs) of existing and potential member nations of EU. The outcomes of the study establish EKC and shows U-shaped association of CEs and GDP for all the countries. Similarly, Wang et al. (2014) confirm two-way and positive long-term association between UGTs, EC, and CEs levels, with varying significance subject to the size of provinces' economies. Shahbaz et al. (2013) show that GDP and EC cause a rise the CEs levels, while FSD and TL can bring it down. Hossain (2012) anticipates a rise in CEs levels and hence decline of the country's atmosphere on account of trade and financial liberalization and economic growth, while Sharma (2011) shows that the high foreign aid and remittances, the lower the CEs, while higher financial sector development (FSD) and GDP per capita increases CEs. To summarize the literature review section, the available literature establishes a strong association among GDP, EC, TI, and CEs, by using different techniques on a variety of datasets of various regions and countries. The existing studies have limitations, however, either based on their conceptual and analytical approaches that need to be complemented by a comprehensive study capable of fulfilling these shortcomings. This study is an attempt towards fulfilling these shortcomings.

Model and methodology

Theoretical background and model specification

In 1980, the nexus of the tourism environment was initially discussed by Pigram. The study indicated that tourism could affect environmental quality in different directions: significantly negative, marginally negative, and positive. Ecotourism or "nature-based tourism" is a part of global tourism. It is the swiftest expanding segment of the global tourism

industry that supports less and non-destructive use of nature. There has been a rising discussion on quality of international tourism over the last 30 years. Therefore, ecotourism appeared as an environmentally important travel destination to areas of remarkable beauty. For underdeveloped rural areas, it is a win-win[1] development strategy.

Damaging tourism-led ecological effects are unavoidable. Most activities related to tourism require fossil fuels' energy use, hence causing a considerable amount of carbon to increase. According to Scott et al. (2010), tourism tends to be major contributing factor to climate change. Up till the last two decades, the link concerning tourism-related activities and carbon releases was comparatively not explored in the studies. However, previous literature mostly discusses the harmful impacts of tourism development on carbon releases. Kuo and Chen (2009) investigated energy use and CO_2 emissions (per tourist per trip), reflecting different features of tourism-linked activities using "life cycle evaluation (LCA)" such as accommodation, transportation, and recreation. Applying the "autoregressive distributed lag model (ARDL) approach," Katircioglu (2014) observes that tourism growth improved energy use and generated considerable ecological pollution in the form of carbon emissions. We can find the same results from Tsai et al. (2014), Tang et al. (2015), Durbarry and Seetanah (2015), and Katircioğlu 2014) for Taiwan, China, Mauritius, and Cyprus, respectively. Still, the link between tourism development and carbon releases is not obvious.

The relationship between tourism growth and the EKC theory is emerging and a debatable topic. In explaining the relation between environmental degradation and tourism, the issue has conventionally been one of the key concerns. Numerous studies have indicated an attempt to establish the traditional EKC hypothesis by increasing various policy variables such as energy (Ozturk and Acaravci 2010), population (Akbostanci et al. 2009), trade (Halicioglu 2009; Ang 2008), research and development (R&D) (Aggeri 1999; Churchill et al. 2019; and Lee and Min 2015), Nosheen et al. (2019) and financial development and urbanization (Dogan and Turkekul 2016).

To explore the role of tourism on ecological quality, as a research model, the theoretical framework of "environmental Kuznets's curve (EKC) has been" considered. Moreover, latest studies have incorporated tourism growth into the conventional "EKC model" to explore the impacts of tourism on environment change. Hence, in the current research, the tourism-linked EKC growth model can be proposed as follows:

$$CO_{2it} = \beta_0 + \beta_{1t}GDP_{it} + \beta_{2t}GDP2_{it} + \beta_{3t}EC_{it}$$
$$+ \beta_{4t}TO_{it} + \beta_{5t}FD_{it} + \beta_{6t}UR_{it} + \beta_{7t}TR_{it}$$
$$+ \varepsilon_{it}\ldots\ldots \quad (1)$$

where βs are the coefficients. CO_2 is a proxy for carbon release and measured as CO_2 releases in metric tons; GDP is the value of real GDP in constant 2010 US\$; EC is energy use and measured as in kilogram of oil equivalent; TR is the sum of global tourists arriving in Asian economies. TO is trade openness/liberalization measured as the ratio of import and export over GDP. UR is the urbanization measured as fraction of total people living in the country. FD is measured as domestic credit to private sector. The yearly panel data from 1995 to 2017 are taken from the World Development Indicators (WDI). The data are used in logarithmic form. The study used the highest available frequency data of tourism from 1995. The study has highlighted the significance of tourism in addition to other relevant variables in the CO_2 GDP model. The Asian countries used in this study are Pakistan, China, India, Indonesia, Bangladesh, Singapore, Nepal, Philippine, Sri Lanka, and Thailand.[2]

Methodology

The study applies Pesaran's CD test to analyze the possibility of cross-sectional dependence within panel framework. In this situation, conventional unit root tests seem to give invalid results; hence the CADF and the CIPS proposed by Pesaran et al. (2004) are used. We can write the test statistics as:

$$CD = \sqrt{\frac{2T}{N(N-1)}}\left(\sum_{i=1}^{N-1}\sum_{j=i+1}^{N}\widehat{p}_{ij}\right) \Rightarrow N(0,1) \quad (2)$$

The tests are based on the ADF method and take form

$$\Delta y_{it} = a_i + b_i y_{it-1} + \delta_i T + \sum_{j=1}^{n}\varnothing_{ij\Delta y_{it-j}+\epsilon_{it}} \quad (3)$$

where y_{it} show variables to be analyzed and ϵ_{it} is the error term. Null hypothesis implies data is not stationary.

Results in Table 1 show that we are unable to accept null hypothesis of cross-sectional dependence. Results show that CO_2, GDP, GDP2, EC, TR, TO, FD, and UR have cross-sectional dependence. Hence, the study employs CIPS and CADF tests to check the order of integration of all panel series.

---

[1] This will bring the win-win situation for businesses to create services, transport, etc. which in turn is supposed to give benefit to all inhabitants and the companies as well

[2] Selection of the countries is based on the notion that the selected countries are more representative in the sense that the selected countries are emerging economies; all have large populations and have significant share in tourism both in the form of local and international tourists. Furthermore, the selected economies are those which have significant share in CO2 emission.

The results of CADF and CIPS tests are given in Table 2. Outcomes show that environmental

Data analysis and results

degradation, GDP, GDP square, EN, tourism, FD, trade liberalization, and urbanization have unit root at their levels. So, we can use co-integration.

We employ "LM bootstrap test developed by Westerlund and Edgerton" (2007) which addresses the issue of cross-sectional dependence. This test has many characteristics; first it applies in the presence of cross-sectional dependence. Second, it also works in small sample; third, using bootstrap method, it decreases asymptotic test distorting. Fourth, null hypothesis of co-integration is assumed. The test is used by different studies, for example, Erdem et al. (2010), Afonso and Rault (2015), and Dogan and Aslan (2017). Table 3

The results of LM bootstrap panel indicate that probability values are greater than the given levels of significance. We conclude co-integration between dependent and independent variables.

After identifying long-run association between the analyzed variables, we use the fully modified OLS (FMOLS) and the dynamic OLS (DOLS) panel estimate methods, which are more efficient than the OLS method. The FMOLS method employs a non-parametric approach to correct the problems of serial correlation and endogeneity. Kao and Chiang (2001) and by Mark and Sul (1999) recommend the DOLS method which is a parametric approach of panel estimate. The results are given in Table 4 where the estimates include both an intercept and a trend factor. The results show that all estimated coefficients are statistically significant except financial development. The value, sign, and statistical significance of the variables are the same in FMOLS and DOLS. Generally, for the analyzed countries panel, long-run results indicate that GDP growth, energy consumption, the tourist arrivals (numbers), urbanization, and trade are the main factors for increasing CO_2 emissions. In case of FMOLS estimates, rising GDP

Table 1 Pesaran CD test

Variables	Pesaran CD test	Prob-value
CO_2	19.217*	0.0000
GDP	34.406*	0.0000
EC	14.932*	0.0000
TR	7.654*	0.0000
FD	5.098*	0.0000
TO	2.764*	0.0057
UR	12.852*	0.0000

*shows 1% level of significance

Table 2 CADF and CIPS tests

Variables	CADF		CIPS	
	Level	1st difference	Level	1st difference
CO_2	− 1.98	− 2.90***	− 1.91	− 3.98***
GDP GDP2	− 1.62	− 2.34***	− 2.13	− 4.65***
ENC	− 1.58	− 2.63***	− 1.42	− 2.45***
TOUR	− 1.16	− 2.33***	− 1.30	− 2.82***
TR	− 1.68	− 2.08***	− 1.40	− 2.87***
FD	− 1.41	− 2.69***	− 1.45	− 3.92***
UR	− 1.17	− 2.92***	− 1.73	− 3.65***

***1% significance level

by 1% rises releases by 3.845%. The results imply that more GDP growth requires more fossil energy to produce goods, which results in more carbon releases. The same results can be found in most of the studies, for example, Lee and Brahmasrene (2013), Katircioğlu (2014), and De Vita et al. (2015). However, this result is different to that of Ben Jebli and Ben Youssef (2015) who indicated that growing GDP lowers carbon releases. The results point to the role of abatement technologies, use of renewable energy, and energy efficiency. Moreover, a rise of 1% in the trade openness increases carbon releases by 0.358 %. This implies that increasing trade openness may step up more merchandises (imports and exports), demanding more fossil energy to produce, consume, and transport, recommending raises in carbon releases. The outcome is different to those observed by Jayantha kumaran et al. (2012) for China and Dogan and Aslan (2017) for OECD countries. Moreover, a 1% rise in energy use increases carbon releases by 0.645%. This result is different from export model of Ben Jebli and Ben Youssef (2015), and Ben Jebli et al. (2016). However, it is like the outcomes of Apergis et al. (2010) for sample of countries (developed and developing) and to Ben Jebli and Ben Youssef (2015) for study on Tunisia. Moreover, increasing the number of tourist arrivals by 1% increases carbon releases by 0.139% in the case of the FMOLS method.

This result is opposite to the findings by Lee and Brahmasrene (2013) and Katircioğlu (2014). However, it is in accordance with the results of Katircioğlu (2014) and De Vita et al. (2015) for Turkey, Dogan and Aslan (2017) on OECD countries, and Ben Jebli and Ben Youssef (2015) on Tunisia.

Table 3 LM bootstrap test

C		C and T	
Test stats	*p* value	Test stats	*p* value
74.546	0.425	115.677	0.325

Table 4 FMOLS and DOLS results

Independent variables	Dependent variable: environmental degradation			
	FMOLS		DOLS	
	Coefficient	Prob-value	Coefficient	Prob-value
GDP	3.845	0.000	3.656	0.000
GDP2	− 0.28	0.000	− 0.24	0.000
ENC	0.645	0.000	0.623	0.000
TOUR	0.139	0.000	0.132	0.000
TR	0.358	0.000	0.345	0.000
FD	0.357	0.265	0.352	0.314
UR	0.543	0.000	0.536	0.000

Leads and lags were set to 1 and 2 for dynamic least square estimators

Findings of DOLS method show that GDP and GDP square have opposite signs, showing a relationship between GDP and environmental degradation. So, we find an indication of EKC theory in case of economies of Asian region. Same findings can be found by Chen et al. (2016), Nasreen et al. (2017), and Destek et al. (2018).

Tourism and environmental degradation have positive association as shown by positive coefficient and significance. It means tourism performs a dynamic role in the environment degradation of countries of the Asian region. Hence, these countries need sustainability-based inclusive tourism monitoring system. These results are similar with Solarin (2013), Katircioğlu (2014), Yorucu (2016), Sharif et al. (2017), Dogan and Aslan (2017), Chen et al. (2018), and Eyuboglu and Uzar 2020

Tourism sector in the Asian countries boosts the level of carbon emissions through several links, for example, launch of tourism-related services, transportation regional, and management services. Some policies for the sake of low releases may be active in sample countries but clearly not sufficient to

fight for the environment. One obvious solution to control for the level of carbon emissions is the adoption of the use of more renewable energy and cleaner technologies not only in overall production process but also in the tourism sector. In this regard, touristic facilities (e.g., hotels) may build their solar panel system for producing energy to meet their needs accompanying the information that solar is a clean energy and a type of renewable energy. In addition, a bicycle-adapted tourism should be encouraged and adopted in alternate of motorized and environmentally unfavorable transport. Furthermore, Asian countries should aim to increase the share of renewable sources in energy mix and financially support institutions, universities, and researchers to work for the invention of cleaner technologies, particularly, those directly related to tourism sector. Last, policymakers should impose strategies regarding environmental protection renewable energy awareness and green tourism.

Urbanization is significant and has a positive sign. The findings are in line with the theory and as per expectations.

Fig. 4 Granger causality test
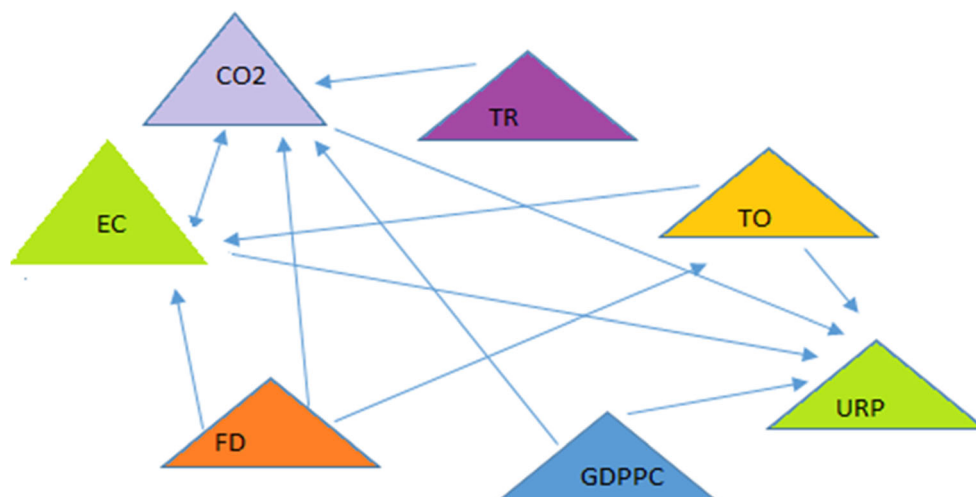
Increasing urbanization is supposed to affect the environment in many ways. First,

increasing urbanization puts pressure on environment by increasing transportation services. Increasing transportation means more CO_2 emission which causes an increase in environmental degradation. Furthermore, urbanization enhances consumption and production activities which in turn tend to increase the volume of pollutants in the forms of wastes both in the water and in the air in the form of carbon emission and other gases. All these activities are supposed to increase environmental degradation. We find the same results from Shahbaz et al. (2016), Zou et al. (2014), and Sasana and Putri (2018).

The effect of trade liberalization on CO_2 emissions is direct and substantial. Trade liberalization (TR) tends to affect the environment in different ways. It can have both the pollution increasing and decreasing effects. As a direct effect, trade tends to affect the environment via scale effect. TR is supposed to increase the scale of production thanks to Adam's invisible hand and increasing specialization. Thus, in the case of free trade, increasing integration causes the production activities to surge at a larger scale which causes the quality of the environment to deteriorate. On the other hand, free trade is supposed to increase the inflow of efficient and clean technologies. The improved and efficient technologies are supposed to be efficient in terms of resources use and tend to have less pollution effect. In this case, TR is likely to reduce the pollution level. On the other hand, if the comparative advantage of a country is based on resource base, then, the production process which makes use of more natural resources is supposed to have pollution increasing effect. In case of our study, the result indicates that the quality of environment tends to exacerbate in response to increasing integration which indicate that the scale effect is most likely dominated in the Asian region. Our results support the findings of Mahmud and Jalil (2009) and Shahbaz et al. (2013).

FD has statistically substantial and direct impact on ecological degradation, as indicated by the value of coefficient which is 0.352. FD is one of the important variables which has been used by many studies while examining its impact on the quality of the environment. FD is supposed to affect the environment both in positive and in a negative way. In case of its detrimental effect, FD is supposed to increase the availability of more credit to banks and other financial institutions. Availability of more capital is supposed to increase the investment and other economic activities. While increasing investment and other economic opportunities are supposed to increase the pollution and carbon emission as well. On the other hand, availability of capital is also supposed to increase the investment in cleaner and environment-friendly technologies that may enhance the quality of the environment. However, in the case of the Asian region, FD has caused the pollution level to increase which calls for the necessary steps by the government to channelize the investment in clean industries. These results are in line with the finding of Pan et al. (2019) and Shahbaz et al. (2020) who have come with the same results.

Table 5 Pairwise Granger causality tests

Null hypothesis	Obs	F-Statistic	Prob.
EC does not Granger cause CO_2	242	2.94364	0.0875
CO_2 does not Granger cause EC		7.54109	0.0065
FD does not Granger cause CO_2	241	7.16664	0.0079
CO_2 does not Granger cause FD		0.74526	0.3888
GDPPC does not Granger cause CO_2	242	3.49535	0.0628
CO_2 does not Granger cause GDPPC		0.07119	0.7898
TO does not Granger cause CO_2	242	0.30803	0.5794
CO_2 does not Granger cause TO		0.47594	0.4909
TR does not Granger cause CO_2	242	10.2350	0.0016
CO_2 does not Granger cause TR		1.68228	0.1959
URP does not Granger cause CO_2	242	2.60123	0.1081
CO_2 does not Granger cause URP		5.67023	0.0180
FD does not Granger cause EC	241	12.0921	0.0006
EC does not Granger cause FD		0.26587	0.6066
GDPPC does not Granger cause EC	242	1.19417	0.2756
EC does not Granger cause GDPPC		1.11198	0.2927
TO does not Granger cause EC	242	0.49069	0.4843
EC does not Granger cause TO		1.20293	0.2738
TR does not Granger cause EC	242	9.41345	0.0024
EC does not Granger cause TR		1.33745	0.2486
URP does not Granger cause EC	242	1.99846	0.1588
EC does not Granger cause URP		4.81789	0.0291
GDPPC does not Granger cause FD	241	1.70029	0.1935
FD does not Granger cause GDPPC		0.19897	0.6560
TO does not Granger cause FD	241	2.10455	0.1482
FD does not Granger cause TO		5.15980	0.0240
TR does not Granger cause FD	241	0.67509	0.4121
FD does not Granger cause TR		0.09796	0.7546
URP does not Granger cause FD	241	0.71699	0.3980
FD does not Granger cause URP		50.2271	2.E-11
TO does not Granger cause GDPPC	242	0.51287	0.4746
GDPPC does not Granger cause TO		0.00453	0.9464
TR does not Granger cause GDPPC	242	2.38750	0.1236
GDPPC does not Granger cause TR		0.12746	0.7214
URP does not Granger cause GDPPC	242	0.02527	0.8738
GDPPC does not Granger cause URP		11.5859	0.0008
TR does not Granger cause TO	242	0.59894	0.4397
TO does not Granger cause TR		0.10944	0.7411
URP does not Granger cause TO	242	0.30725	0.5799
TO does not Granger cause URP		4.20685	0.0414
URP does not Granger cause TR	242	0.06050	0.8059
TR does not Granger cause URP		38.7195	2.E-09

EN has direct and profound impact on environmental degradation. EN indicates the energy use which is supposed to have a direct pollution increasing effect, on carbon emission. EN affects the environment both through an increase in economic activities being the major primary production input and through an increase in the waste as per the principles of law of thermodynamics. Thus, the more the economic activities, the more energy is assumed to be used which is supposed to affect the environment by depleting the nonrenewable resources and via its emission effects on the environment. In case of our result, a one-unit increase in EN increases CO_2 emission by 0.623%. We can find similar results from Jamel and Derbali (2016), Sasana and Putri (2018), Ozcan et al. (2020), and Munir and Riaz (2020). Moreover, findings of causality test are reported in Fig. 4 below: Fig. 4 indicates the bidirectional association between EN and environmental degradation. Outcomes also show a one-way causal association between trade tourism to environmental degradation, GDP growth to environmental degradation, FD to CO_2 emissions, FD to EN, trade Table 5

liberalization to EN, environmental degradation to urbanization, GDP to urbanization, and EN to urbanization.

The figure indicates that tourism is responsible for environmental degradation; however, the direction is found to be a one-way connection running from tourism towards CO_2, while CO_2 emission is not supposed to have any impact on tourism. The findings indicate that tourism is a key predictor affecting the quality of the environment. This supports the tourism-led preposition. On the other hand, energy consumption is a key determinant which tends to have a profound impact on quality of environment. Thus, a reduction in energy consumption is a contributing factor in the improvement of environmental quality. However, the association between energy use and tourism is found to be a two-way relationship. Hence, though energy consumption may affect CO_2 emission, CO_2 emission is also supposed to result in more energy use and consumption as well. The findings point to the fact that the countries concerned need to focus on a more sustainable and renewable energy sources. Finally, the increase in per capita income is also responsible for carbon emissions; however, the relation is found to be a one-way causation from GDP per capita towards CO_2 only.

Conclusion

The present study examined the impact of tourism and energy consumption on carbon emission in the selected Asian economies. The study aimed at investigating the question whether tourism is responsible for environmental degradation in the Asian region or not. For this purpose, the study has utilized the data over the period 1995–2017 by applying the LM bootstrap approach to address the issue of cross-sectional dependence. Furthermore, to address the issue of endogeneity, the study has used both fully modified OLS (FMOLS) and the dynamic OLS (DOLS) techniques to get empirical estimates. The study is important in the sense that the Asian region is characterized as the one which is considered the second most visited tourist destination, as well as the region is outward-looking region with increasing urbanization and increasing financial development. Empirical results indicate a long-run LR dynamic association among GDP, tourism, EC, financial development, trade and urbanization, and environmental degradation. Empirical results indicate that tourism is responsible for increasing environmental degradation in the form of carbon emissions in the Asian region. These results are similar with Solarin (2013), Katircioğlu (2014), Yorucu (2016), Sharif et al. (2017), Dogan and Aslan (2017), Chen et al. (2018), and Eyuboglu and Uzar (2020).

The magnitude of coefficient is 0.132. It means tourism plays a vital role in increasing environment degradation of economies of the Asian region. However, an interesting finding that this study has come up with is the evidence of environmental Kuznets curve hypothesis. Furthermore, the study indicates that trade openness and urbanization are also significant variables that tend to have a significant effect on environmental degradation in the Asian region.

The study has important policy underpinnings for the Asian region. First, though tourism has turned out to be a key industry that contributes to economic opportunities in the Asian region in the form of increasing employment, income, and economic growth, it tends to contribute towards environmental degradation as hoteling industry is developed and more roads are paved and tourism-related infrastructure is built to help facilitate the arrival of both domestic and international tourists. Likewise, the Asian region being an outward-looking region with increasing urbanization is supposed to experience more carbon emission thanks to the increasing scale of production and increasing economic activities. However, the study indicates the evidence of EKC hypothesis which indicates that after a threshold level, there is a likelihood that environmental degradation will improve, because of more environment-friendly techniques and technology. In other words, pro-environment technology is supposed to outweigh the negative consequences of tourism and urbanization.

Thus, the study points to the fact that the Asian region should rely on the use of environment-friendly and modern techniques that will not only result inefficiency in inputs and energy use but it will help in eco-friendly tourism and economic growth as well. Furthermore, to counter the negative effects of environmental degradation, the economies of the region should rely more and more on renewable energy resources, in order to counter the CO_2 emission effect of increasing urbanization and trade openness as well as to help establish the tourism industry on sustainable basis.

Keeping in view the contributions of tourism industry in the local employment, economic activities, and regional growth, drastic reforms in the tourism industry are imperative to curtail carbon emissions in the region. However, this is an uphill task keeping in view its political implications and inertia among the various stakeholders. Firstly, the tourism industry is controlled by the elites, and political dynasties of the region; therefore, it is not that easy to go for sweeping reforms and substantially cutting the carbon emissions in the region through total overhaul of the industry, as switching over from the existing to the environment-friendly technologies in the tourism industry is a great political challenge in terms of its effects on the current level of employment and rate of returns for the investors and local elites. Moreover, green technologies require huge upfront investments with considerably long payback periods. Therefore, the investors both local and foreign always hesitate to go for such investments, particularly in the post COVID-19 scenarios. To avoid possible political back clash from the local elite and other stakeholders, and restore the investors' confidence, the local and national governments of the region countries have to encourage the use of environment-friendly technologies through incentivizing the technological reform process in the tourism industry via provision of subsidies, tax rebates, and zero import duties for those investors and stakeholders who will opt for environment-friendly technologies and practices. This will also create a competition within the industry for clean energy use. Moreover, the civil society organizations (CSOs), which are also quite strong and influential in the region, can also play their role towards awareness rising of the general public and tourists regarding green tourism and lobbying for stronger legislations ensuring the use of clean and green energy as well as practices in the tourism industry.

The ongoing corona pandemic has severely hit the tourism industries in the world and in the Asian region. Hence, these economies need to open up the tourism sector under WHO directions, as well as future policies need be to be designed in a way that tourism activities can be continued in uninterrupted way, in the face of ongoing and upcoming uncertainties such as pandemics. In particular, the countries of the region can ensure the safety of tourists by following the SOPs such as compulsory vaccinations and necessary tests facilities at the entry of the countries concerned. Tourism departments of the member countries need to focus more and more on eco-friendly tourism and should rely more and more on renewable energy sources.

The main limitation of the study is that in a panel study, in general, the results are masked by the aggregation bias, while different countries have different economic structures; thus if a more disaggregated level studies are conducted for the Asia region, it may provide more insights, in terms of policy implications. One of the future research directions of this study is to employ disaggregated data in future studies to overcome this issue.

Compliance with ethical standards

References

Aggeri F (1999) Environmental policies and innovation: A knowledge-based perspective on cooperative approaches. Res Policy 28(7): 699–717

Akbostanci E, Türüt-Asik S, Tunç GI (2009) The relationship between income and environmental in Turkey: is there an environmental Kuznets curve? Energy Policy 37(3):861–867

Ang JB (2007) CO_2 emissions, energy consumption, and output in France. Energy Policy 35(10):4772–4778. https://doi.org/10.1016/j.enpol.2007.03.032

Ang JB (2008) Economic development, pollutant emissions and energy consumption in Malaysia. J Policy Model 30(2):271–278

Anser MK, Alharthi M, Aziz B, Wasim S (2020) Impact of urbanization, economic growth, and population size on residential carbon emissions in the SAARC countries. Clean Techn Environ Policy 22(4): 923–936. https://doi.org/10.1007/s10098-020-01833-Y

Aslan A (2016) Does tourism cause growth? Evidence from Turkey. Curr Issue Tour 19(12):1176–1184. https://doi.org/10.1080/13683500.2015.1015970

Apergis N, Payne JE (2010) The emissions, energy consumption, and growth nexus: evidence from the commonwealth of independent states. Energy Policy 38(1):650–655

Azam M, Khan AQ, Ozturk I (2019) The effects of energy on investment, human health, environment and economic growth: empirical evidence from China. Environ Sci Pollut Res 26(11):10816–10825. https://doi.org/10.1007/s11356-019-04497-4

Balcilar M, Van Eyden R, Inglesi-lotz R, Gupta R (2014) Time-varying linkages between tourism receipts and economic growth in South Africa Time varying linkages between tourism receipts and

economic growth in South Africa. Appl Econ 46(36):37–41. https://doi.org/10.1080/0003684

Becken S, Frampton C, Simmons D (2001) Energy consumption patterns in the accommodation sector — the New Zealand case. Ecol Econ 39:371–386

Canning PN, Perez AC (2008) Economic geography of the US wine industry. American Association of Wine Economists. https://doi.org/10.22004/ag.econ.43891

Chen P, Chen S, Hsu C, Chen C (2016) Modeling the global relationships among economic growth, energy consumption and CO2 emissions. Renew Sust Energ Rev 65:420–431. https://doi.org/10.1016/j.rser.2016.06.074

Cheng C, Ren X, Wang Z, Shi Y (2018) The impacts of non-fossil energy, economic growth, energy consumption, and oil price on carbon intensity: Evidence from a panel quantile regression analysis of EU 28. Sustainability 10(11):4067

Chikaraishi M, Fujiwara A, Kaneko S, Poumanyvong P, Komatsu S, Kalugin A (2015) The moderating effects of urbanization on carbon dioxide emissions: A latent class modeling approach. Technol Forecast Soc Change 90:302–317

Churchill SA, Inekwe J, Smyth R, Zhang X (2019) R&D intensity and carbon emissions in the G7: 1870–2014. Energy Econ 80:30–37

Destek MA, Ulucak R, Dogan E (2018) Analyzing the environmental Kuznets curve for the EU countries: the role of ecological footprint. Environ Sci Pollut Res 25(29):29387–29396. https://doi.org/10.1007/s11356-018-PP.2911-4

De Vita G, Katircioglu S, Altinay L, Fethi S, Mercan M (2015) Revisiting the environmental Kuznets curve hypothesis in a tourism development context. Environ Sci Pollut Res 22(21):16652–16663

Dinh VT, De Kleine Feige AI, Pham DM, Eckardt S, Vashakmadze ET, Kojucharov ND, Mtonya BG (2019) Taking Stock:recent economic developments of Vietnam–Special Focus: Vietnam's tourism developments-stepping back from the Tipping Point-Vietnam's tourism trends, challenges and policy priorities. The World Bank, Washington, DC, pp 1–62

Dogan E, Turkekul B (2016) CO2 emissions, real output, energy consumption, trade, urbanization and financial development: Testing the EKC hypothesis for the USA. Environ Sci Pollut Res 23(2):1203–1213

Dogan E, Aslan A (2017) Exploring the relationship among CO2 emissions, real GDP, energy consumption and tourism in the EU and candidate countries: evidence from panel models robust to heterogeneity and cross-sectional dependence. Renew Sust Energ Rev 77(March):239–245. https://doi.org/10.1016/j.rser.2017.03.111

Dritsakis N (2004) Tourism as a long-run economic growth factor: an empirical investigation for Greece using causality analysis. Soc Sci 10(3):305–316. https://doi.org/10.1080/13683500.2015.1119103

Durbarry R, Seetanah B (2015) The impact of long haul destinations on carbon emissions: the case of Mauritius. J Hosp Mark Manag 24(4):401–410

Eyuboglu K, Uzar U (2020) The impact of tourism on CO2 emission in Turkey. Curr Issue Tour 23(13):1631–1645. https://doi.org/10.1080/13683500.2019.1636006

Gössling S, Peeters P (2015) Assessing tourism's global environmental impact 1900-2050. J Sustain Tour 35(3):221–257

Halicioglu F (2009) An econometric study of CO2 emissions, energy consumption, income and foreign trade in Turkey. Energy Policy 37(3):1156–1164. https://doi.org/10.1016/j.enpol.2008.11.012

Hamilton JM, Maddison DJ, Tol RSJ (2005) Effects of climate change on international tourism. Clim Res 29(3):245–254

Hammami S, Saidi K (2015) The impact of CO2 emissions and economic growth on energy consumption in 58 countries Kais. Energy Rep 1:62–70. https://doi.org/10.1016/j.egyr.2015.01.003

Hossain S (2012) An econometric analysis for emissions, energy consumption, economic growth, foreign trade and urbanization of Japan. Low Carbon Econ 03(03):92–105. https://doi.org/10.4236/lce.2012.323013

Hussain HI, Salem MA, Rashid AZA, Kamarudin F (2019) Environmental impact of sectoral energy consumption on economic growth in Malaysia: evidence from ARDL bound testing approach. Ekoloji 28(107):199–210

Iwata H, Okada K (2014) Greenhouse gas emissions and the role of the Kyoto Protocol. Environ Econ Policy Stud 16(4):325–342. https://doi.org/10.1007/s10018-012-0047-1

Jamel L, Derbali A (2016) Do energy consumption and economic growth lead to environmental degradation? Evidence from Asian economies. Cogent Econ Financ 4(1):1170653

Jalil A, Mahmud SF (2009) Environment Kuznets curve for CO2 emissions: a cointegration analysis for China. Energy Policy 37(12):5167–5172

Jebli MB, Youssef SB (2015) The environmental Kuznets curve, economic growth, renewable and non-renewable energy, and trade in Tunisia. Renew Sust Energ Rev 47:173–185

Jebli MB, Youssef SB, Ozturk I (2016) Testing environmental Kuznets curve hypothesis: The role of renewable and non-renewable energy consumption and trade in OECD countries. Ecol Indic 60:824–831

Kasman A, Duman YS (2015) CO2 emissions, economic growth, energy consumption, trade and urbanization in new EU member and candidate countries: a panel data analysis. Econ Model 44:97–103. https://doi.org/10.1016/j.econmod.2014.10.022

Katircioğlu ST (2014) Testing the tourism-induced EKC hypothesis: the case of Singapore. Econ Model 41:383–391. https://doi.org/10.1016/j.econmod.2014.05.028

Kao C, Chiang M-H (2001) On the estimation and inference of a cointegrated regression in panel data. Adv Econ 15:179–222

Kuo NW, Chen PH (2009) Quantifying energy use, carbon dioxide emission, and other environmental loads from island tourism based on a life cycle assessment approach. J Clean Prod 17(15):1324–1330

Lee JW, Brahmasrene T (2013) Investigating the influence of tourism on economic growth and carbon emissions: Evidence from panel analysis of the European Union. Tour Manag 38:69–76

Lee K, Min B (2015) Green R&D for eco innovation and its impact on carbon emissions and firm performance. J Clean Prod 108:534–542

Lean HH, Smyth R (2010) CO2 emissions, electricity consumption and output in ASEAN. Appl Energy 87(6):1858–1864

León CJ, Arana JE, Alemán AH, León CJ, Arana JE, Alemán AH (2014) CO2 emissions and tourism in developed and less developed countries. Appl Econ Lett 21(16):1169–1173. https://doi.org/10.1080/13504851.2014.916376

Majeed MT, Siddique HMA, Ahmad HK (2016) The impact of urbanization and EN on CO2 emissions in South Asia. South Asian Studies A 31(7):745–757. https://doi.org/10.1007/s11356-018-3525-6

Mark N, Sul D (1999) A Computationally Simple Cointegration Vector Estimator for Panel Data. Working paper, Department of Economics, Ohio State University, Columbus

Modeste NC (1995) The impact of growth in the tourism sector on economic development: the experience of selected Caribbean countries. Economia Internazionale 46(3):375–385

Munir S, Khan A (2014) Impact of fossil fuel energy consumption on CO2 emissions: evidence from Pakistan (1980-2010). Pak Dev Rev:327–346

Munir K, Riaz N (2020) Asymmetric impact of energy consumption on environmental degradation: evidence from Australia, China, and USA. Environ Sci Poll Res, Dincer 1998. https://doi.org/10.1007/s11356-020-07777-6%0A

Nasreen S, Anwar S, Ozturk I (2017) Financial stability, energy consumption and environmental quality: evidence from South Asian economies. Renew Sust Energ Rev 67:1105–1122. https://doi.org/10.1016/j.rser.2016.09.021

Nosheen M, Iqbal J, Hassan SA (2019) Economic growth, financial development, and trade in nexuses of CO 2 emissions for Southeast Asia. Environ Sci Pollut Res 26(36):36274–36286.7

Omri A, Khuong D, Rault C (2014) Causal interactions between CO2 emissions, FDI, and economic growth: evidence from dynamic simultaneous-equation models. Econ Model 42:382–389. https://doi.org/10.1016/j.econmod.2014.07.026

Ozcan B, Tzeremes PG, Tzeremes NG (2020) Energy consumption, economic growth and environmental degradation in OECD countries. Econ Model 84(2018):203–213. https://doi.org/10.1016/j.econmod.2019.04.010

Ozturk I, Acaravci A (2010) CO2 emissions, energy consumption and economic growth in Turkey. Renew Sust Energ Rev 14(9):3220–3225

Pan Z, Liu Q, Sun Y, Sun X, Lin H (2019) Environmental implications of microplastic pollution in the Northwestern Pacific Ocean. Mar Pollut Bull 146:215–224

Paul VJ (2008) Global warming and cyanobacterial harmful algal blooms. Cyanobacterial Harmful Algal Blooms: State of the Science and Research Needs 619:39–257

Pesaran MH, Schuermann T, Weiner SM (2004) Rejoinder. J Bus Econ Stat 22(2):175–181. https://doi.org/10.1198/073500104000000064

Rafiq S, Nielsen I, Smyth R (2017) Effect of internal migration on the environment in China. Energy Econ 64:31–44

Reiter P (2008) Global warming and malaria: knowing the horse before hitching the cart. Malar J 7(SUPPL. 1):1–9. https://doi.org/10.1186/1475-2875-7-S1-S3

Ridderstaat J, Croes R, Nijkamp P (2014) Tourism and long-run economic growth in Aruba JORGE. Int J Tour Res 16:472–484. https://doi.org/10.1002/jtr.1941

Saidi, K. (2017). The causal relationship among environmental quality, economic growth and energy use: new evidence from five OPEC countries. In 1st International Conference on Energy, Finance and the Macroeconomy Book of Abstracts (ICEFM-2017). Montpellier Business School, pp, 1–25. https://eprints.usq.edu.au/33738/3/Saidi_Rahman_Saadaoui_AV.pdf

Sasana H, Putri AE (2018) The increase of energy consumption and carbon dioxide (CO$_2$) emission in Indonesia. E3S Web Conf 31:1–5 EDP Sciences

Scott D, Peeters P, Gössling S (2010) Can tourism deliver its "aspirational" greenhouse gas emission reduction targets? J Sustain Tour 18(3):393–408. https://doi.org/10.1080/09669581003653

Shahbaz M, Hye QMA, Tiwari AK, Leitão NC (2013) Economic growth, energy consumption, financial development, international trade and CO$_2$ emissions in Indonesia. Renew Sust Energ Rev 25:109–121. https://doi.org/10.1016/j.rser.2013.04.009

Shahbaz M, Loganathan N, Muzaffar AT, Ahmed K, Ali Jabran M (2016) How urbanization affects CO$_2$ emissions in Malaysia? The application of STIRPAT model. Renew Sust Energ Rev 57:83–93. https://doi.org/10.1016/j.rser.2015.12.096

Shahbaz M, Haouas I, Sohag K, Ozturk I (2020) The financial development-environmental degradation nexus in the United Arab Emirates: the importance of growth, globalization and structural breaks. Environ Sci Pollut Res:1–15

Sherafatian-Jahromi R, Othman MS, Law SH, Ismail NW (2017) Tourism and CO$_2$ emissions nexus in Southeast Asia: new evidence from panel estimation. Environ Dev Sustain 19(4):1407–1423. https://doi.org/10.1007/s10668-016-9811-x

Solarin SA (2013) Tourist arrivals and macroeconomic determinants of CO emissions in Malaysia. Anatolia 25(2):228–241

Sharif A, Afshan S, Nisha N (2017) Impact of tourism on CO2 emission: Evidence from Pakistan. Asia Pacifc J Tour Res 22(4):408–421

Tang Q, Li Y, Xu Y (2015) Land suitability assessment for post-earthquake reconstruction: A case study of Lushan in Sichuan, China. J Geogr Sci 25:865–878

Tsai KT, Lin TP, Hwang RL, Huang YJ (2014) Carbon dioxide emissions generated by energy consumption of hotels and homestay facilities in Taiwan. Tour Manag 42:13–21

Tsui WHK, Balli F, Tan DTW, Lau O, Hasan M (2018) New Zealand business tourism: exploring the impact of economic policy uncertainties. Tour Econ 24(4):386–417. https://doi.org/10.1177/1354816617731387

UNWTO (2018) T. H. edition scientific papers Znanstveniprilozi evaluating and selecting. G. Kos, H. Carić, a. PandžaKunčević,UNWTO, pp 298–309

Usman O, Alola AA, Sarkodie SA (2020) Assessment of the role of renewable energy consumption and trade policy on environmental degradation using innovation accounting: evidence from the US. Renew Energy 150:266–277. https://doi.org/10.1016/j.renene.2019.12.151

Wang S, Fang C, Guan X, Pang B, Ma H (2014) Urbanisation, energy consumption, and carbon dioxide emissions in China: a panel data analysis of China's provinces. Appl Energy 136(2014):738–749. https://doi.org/10.1016/j.apenergy.2014.09.059

World, Bank, T. (2018). World Bank open data. World Bank Web site(INTERNET).

World Tourism Organization (2019) 'Davos Declaration "Climate Change and Tourism: Responding to Global Challenges"', Compilation of UNWTO Declarations. UNWTO, Madrid, 1980–2018

Yorucu V (2016) Growth impact of CO emissions caused by tourist arrivals in Turkey. Int J Clim Change Strategies Manage 8(1):19–37

Zaman K, el Moemen MA, Islam T (2017) Dynamic linkages between tourism transportation expenditures, carbon dioxide emission, energy consumption and growth factors: evidence from the transition economies. Curr Issue Tour 20(16):1720–1735. https://doi.org/10.1080/13683500.2015.1135107

Zou Q, Chen X, Lv JN (2014) The environmental Kuznets curve and effect factors of CO$_2$ emissions in China: dynamic econometric test based on ARDL model. Adv Mater Res 962–965:1670–1675. https://doi.org/10.4028/www.scientific.net/AMR.962-965.1670