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The impact of tourism on CO_2 emission in Turkey

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ABSTRACT

This study analyzes the linkages among CO_2 emissions, tourist arrivals, energy consumption, and economic growth for the period 1960–2014 in Turkey. The study employed three cointegration tests (Bayer & Hanck, Fourier ADL and ARDL) to analyze the long-term nexus among the variables. Results indicate that tourism, growth, and energy consumption effect CO_2 positively both in the long and the short-term. VECM causality results indicate that tourism, economic growth, and energy consumption are the causes of CO_2 emissions. Also, CO_2 emissions, economic growth, and energy consumption are the causes of tourism in the long-term. This finding indicates that the tourists pay attention to the environmental quality of the country that they travel.

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Introduction

Tourism is one of the largest and fastest growing industries in the world. Despite economic crises and social-political instability during the last few decades, tourism mobility has increased rapidly throughout the world (Paramati, Alam, & Chen, 2017). The rapid growth of the tourism industry as well as increasing tourism mobility have contributed significantly to both developed and developing economies.

Furthermore, the rapid growth of the tourism and travel industry has influenced the host countries' economies in various ways. Previous studies have indicated that tourism can be an important catalyst for economic growth (Eyuboglu & Eyuboglu, 2019; Jurdana & Frleta, 2017; Roudi, Arasli, & Akadiri, 2018; Tugcu, 2014). According to Alam and Paramati (2016), tourism supports economic growth through foreign exchange earnings, international investments, increased tax revenues, and new business opportunities. Foreign exchange earnings from tourism activities, especially in developing countries, are an important source of financing for capital goods imports. Furthermore, the high level forward and backward links of the tourism industry can increase employment and production in tourism-related sectors by creating a multiplier effect (Li, Chen, Li, & Goh, 2016). Tourism's capacity to create employment (MacNeill & Wozniak, 2018; Walpole & Goodwin, 2000; Zurub, Ionescu, & Constantin, 2015) is another important economic impact thereof. In particular, the transportation, hospitality, and entertainment sectors are important beneficiaries of tourism's capacity to create employment. Taxis, passenger ships, airlines, hotels, resorts, shopping centres, and entertainment venues offer significant employment opportunities in this regard (Sharif, Afshan, & Nisha, 2017).

Although tourism plays an important role in economic growth and new job creation, in recent years, the tourism industry has caused environmental damage as a result of CO_2 emissions that are related to high energy consumption (Alam, Paramati, & Sudharshan, 2016; Paramati et al.,

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2017; Raza, Sharif, Wong, & Karim, 2017; Shi et al., 2019). According to World Development Indicators in 1968, carbon emissions were 13,017,193.6 kiloton (kt), but had increased by almost 300% in 2014, reaching 36,138,285 kt. The high level of environmental problems, such as climate change and global warming caused by high CO_2 emissions, places considerable pressure on policymakers. Accordingly, reducing global CO_2 emissions and developing sustainable low-carbon emission economies has become an imperative goal throughout the world. Increasingly, researchers have started to explore potential links between tourism and CO_2 emissions as well as tourism's contribution to total CO_2 emissions. Gossling (2002) noted that the use of fossil fuels in the tourism sector and land degradation have intensified environmental problems such as climate change and global warming by increasing CO_2 emissions. Peeters and Dubois (2010) revealed that tourism and travel industry activities, for example, transportation and accommodation, account for 4.4% of the total CO_2 emissions. The high energy consumption of transportation causes a significant amount of CO_2 emissions. Approximately 90% of the energy consumption in the tourism and travel sector is caused by airline (43%), road (42%), sea and railway (15%) transportation (Higham, Cohen, Cavaliere, Reis, & Finkler, 2016; Isik, Dogan, & Ongan, 2017). We can conclude that the high energy consumption and environmental deterioration of the tourism industry has a significant impact on CO_2 emissions. On the contrary, the United Nations Environment Programme (UNEP) (2008) declared that tourism development and environmental quality should not be viewed as opposing forces. Rather, the integration of environment-friendly technologies and clean energy into tourism activities may reduce environmental damage; thus; sustainable tourism may be realized (Roxas, Rivera, & Gutierrez, 2018).

In the tourism economics literature, earlier studies generally focused on the impact of tourism on economic growth (Balaguer & Cantavella-Jorda, 2002; Brida, Cortes-Jimenez, & Pulina, 2016; Durbarry, 2004; Dogru & Bulut, 2018; Eyuboglu & Eyuboglu, 2019), job creation (Andriotis & Vaughan, 2004; Walpole & Goodwin, 2000; Zurub et al., 2015), and poverty (Llorca-Rodríguez, García-Fernández, & Casas-Jurado, 2018; Mahadevan & Suardi, 2019; Scheyvens, 2008). Although these studies contributed significantly to an understanding of the impact of tourism, they did not examine the effect of tourism on CO_2 emissions. Recently, however, researchers have begun to analyse the impact of tourism on CO_2 emissions (Katircioglu, 2014a; Paramati et al., 2017; Sharif et al., 2017). The critical level of environmental problems such as climate change and global warming caused by high CO_2 emissions have made the investigation of the determinants thereof imperative. Although variables such as economic growth, energy consumption, foreign direct investment, financial development and urbanization have been included in studies that have examined the determinants of CO_2 emissions, they have not focused on tourism (Bekhet, Matar, & Yasmin, 2017; Gokmenoglu & Taspinar, 2016; Shahbaz, Tiwari, & Nasir, 2013).

The purpose of this study is to examine the linkages between tourism and CO_2 emissions in Turkey during the period 1960–2014. Economic growth and energy consumption are also included in the model as control variables. It is appropriate that Turkey is chosen to explore the nexus between tourism and CO_2 emissions because it is an important global tourist destination. Unique natural and cultural beauties attract a significant number of tourists to Turkey every year. However, Turkey also has high CO_2 emissions (Ozturk & Acaravcı, 2010). According to the Global Carbon Atlas, in 2016, Turkey had the 15th highest CO_2 emissions the world. In essence, Turkey is not only a major tourist destination, but also a country with high CO_2 emissions. Therefore, determination of the interaction between tourism and CO_2 emissions is imperative for the design of tourism and environmental policies. Accordingly, it is hoped that the results of the study will constitute an important guide for policymakers.

This study aimed to contribute to the literature in several ways. First, the study aimed to present new empirical evidence to the tourism-environment literature. Second, as noted previously, Turkey is both a major tourist destination, and a country with high CO_2 emissions. Consequently, an examination of interaction between tourism and CO_2 emissions is imperative. Although Katircioglu (2014a), Yorucu (2016), and Gokmenoglu and Taspinar (2016) examined the determinants of CO_2 emissions in Turkey, only Katircioglu (2014a) and Yorucu (2016) included tourism in their models. Third, in this

study the relationship between tourism and CO_2 emissions was examined by means of various new econometric techniques. The unit root properties of the variables were investigated by using Christopoulos and León-Ledesma's (2010) newly developed Fourier ADF unit root test. Thus, the unit root characteristics of the series were more clearly demonstrated. Cointegration relationships among variables were examined by employing the newly developed Fourier ADL, Bayer and Hanck (2013) and Autoregressive Distributed Lag (ARDL) cointegration tests. Cointegration was introduced by Engle and Granger's (1987) test. Subsequently, cointegration tests, which take into account structural breaks, were introduced (e.g. Gregory & Hansen, 1996; Hatemi-j, 2008). However, the primary problem in these tests is that the number and form of the structural breaks are determined as a priori. In this respect, Fourier cointegration tests give robust results despite the number and form of the structural changes. Finally, the long-term coefficients were estimated by the ARDL estimator as well as by employing Phillips and Hansen's (1990) fully-modified OLS (FMOLS), Stock and Watson's (1993) dynamic OLS (DOLS) and Park's (1992) canonical cointegration regression (CCR) estimators. In this regard, our study is may be distinguished from Yorucu (2016) and Katircioglu (2014a). Our study aimed to present more robust results.

The rest of the study is organized as follows. Section 2 gives information about the trends and potential causes of tourism and CO_2 emissions in Turkey. Section 3 explains the literature review. Section 4 describes the data and methodology applied in the study. The findings are presented in Section 5. In Section 6, the study is concluded and policy implications are outlined.

Tourism and CO_2 emissions in Turkey

In 1980, the import substitution industrialization strategy was abandoned in Turkey. The economic decisions adopted on 24 January 1980, ensured that the liberalization of markets was realized, the restrictions on exports/imports were eliminated and the export-based industrialization strategy was adopted. Following the implementation of the export-oriented industrialization strategy, the tourism sector was viewed as an effective and efficient tool in the realization of the development process. Therefore, the tourism-led growth model was implemented as an extension of the export-based growth strategy. In addition, by providing political and economic stability to the country, significant incentives were afforded to the tourism sector by the government and incentives accelerated tourism activities after 1980. In particular, the Tourism Incentive Law No. 2634, issued in 1982, provided significant incentives such as tax exemption and credit support for investments in tourism. Subsequently, tourism continued to increase and became an important tourism centre around the world. Table 1 shows tourist arrivals, total CO_2 emissions and GDP (per capita US$) in Turkey cover the period 1960–2014.

In 1970, there were 724,784 tourists. However, the transition to the export-oriented growth regime in 1980 and incentives provided to the tourism sector led to an increase in the number of tourists in the 1990s. This increase was most evident in the 2000s when the number of visitors increased rapidly. In 2011, there were 34,654,000 tourists; this number rose to 39,811,000 in 2014; an increase of

Table 1. The trend in tourism, CO_2 emissions, GDP, and energy consumption in Turkey.

Year	Tourism (number of arrivals)	CO_2 emission (metric tons per capita)	GDP (per capita US$)
1960	124,228	0.612	3,175.0
1970	724,784	1.222	4,221.1
1980	1,057,364	1.722	4,986.6
1990	5,397,748	2.705	6,774.6
2000	9,586,000	3.417	8,237.6
2011	34,654,000	4.370	11,683.6
2012	35,698,000	4.419	12,052.7
2013	37,795,000	4.285	12,866.0
2014	39,811,000	4.491	13,312.4

Source: World Bank, World Development Indicators (2018), the Turkish Statistical Institute.

5,157,000 in a relatively short period. According to the World Trade Organization (WTO) (2017), Turkey ranked in the top 10 of most visited countries in 2015 and 2016. Undoubtedly, one of the most important reasons for this increase in the number of tourists is that Turkey constitutes a bridge between Europe and Asia and thus, has a crucial geographical position. The country's natural beauty, climate, and extensive coastline are the most important reasons for attracting tourists (Sariisik, Turkay, & Akova, 2011). According to The World Travel and Tourism Council (WTTC) (2018), in 2017, the tourism sector of Turkey contributed 32.08 billion US$ directly to the country's economy. The share of the sector to the GDP was 3.8%. Furthermore, the total contribution of the sector was 98.4 billion US$, constituting 11.6% of the GDP. Similarly, the sector also contributed significantly to employment; in 2017, the sector contributed to employment by creating 462,000 jobs directly and 2,093,500 jobs in total.

However, Turkey is also responsible for one of the highest CO_2 emissions in the world (Acaravci & Ozturk, 2010). The trend of total CO_2 emissions in Turkey is presented in Table 1. Similar to global trends, CO_2 emissions have increased significantly over the years in Turkey. In 1960, the CO_2 emission per capita was 0.612 mt. In the 1990s, the rate of CO_2 emissions started to increase. Similar to tourism trends in the 2000s, CO_2 emissions also increased. In the 54 years, after 1960, CO_2 emissions increased significantly, reaching 4.370 and 4.491 mt in 2011 and 2014, respectively. One of the main reasons for the rapid increase in carbon emissions in Turkey is the increase in economic activity. As shown in Table 1, the per capita income increased by 10,137.4 US$ from 1960 to 2014; this is an increase of approximately 419%. In other words, economic growth has resulted in significant energy consumption in Turkey. Thus, a large amount of energy consumption is required to sustain high growth rates in the country.

The tourism and travel industry is crucial for Turkey's macroeconomic performance including economic growth and employment creation. Furthermore, Turkey has had a current account deficit for many years. The foreign exchange obtained from tourism activities is very important to address this deficit. In addition, tourism is an important source of funding for capital accumulation and imports of capital goods. However, the tourism sector has also had an impact on various negative environmental impacts such as CO_2 emissions. Higher carbon emissions in Turkey suggest that in the future, environmental quality may be reduced. Turkey is a part of the Kyoto protocol and thus, is faced with significant carbon emission restrictions (Halicioglu, 2009; Seker, Ertugrul, & Cetin, 2015). The fulfillment of the obligations related to the reduction of carbon emissions will have a profound effect on increasing environmental quality. These restrictions have been a major source of motivation to examine the impact of tourism, which is one of Turkey's largest sectors, on CO_2 emissions.

Literature review

In recent years, potential links between socioeconomic factors such as tourism and the environment have been followed by academics and policymakers. Despite increasing interest, tourism-CO_2 emissions studies still contain some shortcomings. As mentioned, most of the studies in the literature have analyzed the interactions between economic growth and CO_2 emissions but tourism effect is often neglected. Focusing on the positive effects of tourism such as income, employment, and foreign exchange inflow has caused neglect of the interaction of the sector with CO_2 (Solarin, 2014). In a few studies taking into account tourism, variables such as energy consumption, income, FDI and financial development have been included in the model as a control variable (Azam, Alam, & Hafeez, 2018; Chen, Thapa, & Yan, 2018; He, Zha, & Loo, 2019; Katircioglu, 2014a, 2014b; Paramati et al., 2017; Shakouri, Yazdi, & Ghorchebigi, 2017; Sharif et al., 2017; Shi et al., 2019; Solarin, 2014). Some of the studies focused on a single country and investigated the interaction between tourism and CO_2 emissions. Some studies tested the nexus for country groups with applying panel data. In the literature, most of the studies conclude that tourism effects CO_2 emissions positively, but some studies found opposite results. In this context, it can be concluded that the linkages between tourism and environmental quality are complicated and that there is no consensus on

this issue. There is also no consensus about the direction of causality between tourism and CO_2 emissions.

In the literature, some studies examined the relationship between tourism and the environment, focusing on a single country. For example, Solarin (2014) examined the impact of real GDP, energy consumption, financial development, urbanization and tourism arrivals on CO_2 emissions in Malaysia for the period 1972–2010. The cointegration analysis showed that the series are cointegrated. ARDL results indicated that tourist arrivals increased pollution, and a one-way causality is determined from tourist arrivals to pollution. Durbarry and Seetanah (2015) analyzed the impact of tourist arrivals on CO_2 emissions in Mauritius. In the study, using the ARDL method, it is concluded that tourist arrivals have a positive effect on CO_2 emissions for the period 1978–2011. Sharif et al. (2017) tested the nexus among CO_2 emissions, tourist arrivals, and economic growth in Pakistan. The results showed that CO_2 emissions and tourist arrivals are cointegrated. In addition, the results of the variance decomposition denoted that there is a one-way causality running from tourist arrivals to CO_2 emissions. Chen et al. (2018) tested the linkages among tourism, CO_2 emissions and economic growth in China during the period 2001–2015. They emphasized that the developments in tourism have a positive effect on CO_2 emissions and especially the transportation sector is the basic factor of CO_2 emission. Raza et al. (2017) tested the linkages between tourism and CO_2 emissions in the US cover the period 1996–2015. The results showed that tourism is a determinant of CO_2 emissions. It is also found that there is one-way causality from tourism to CO_2 emissions. He et al. (2019) examined the energy efficiency of the tourism industry in the 30 regions of China cover the period 2005–2013. They found that tourism's energy efficiency is lower than the industry as a whole.

The nexus between tourism and CO_2 emissions have been investigated in some studies by focusing on country groups with panel data. Dogan, Seker, and Bulbul (2015) tested the long-term dynamic linkages among real GDP, GDP, energy consumption, trade openness and tourism in OECD countries for the period 1995–2010. Findings showed that tourism reduces environmental quality by increasing CO_2 emissions. The results of the causality test denoted the existence of a one-way causality relationship from tourism to CO_2. Shakouri et al. (2017) tested the linkages among economic growth, tourism, and CO_2 emissions cover the period 1995–2013 in selected Asia-Pacific countries. They indicated that tourist arrivals affect CO_2 emissions positively in the long-term. Azam et al. (2018) analyzed the nexus between tourism and CO_2 emission in Malaysia, Thailand, and Singapore. They indicated that tourism has a positive impact on CO_2 emission in Malaysia, but tourism has a negative impact on CO_2 emission in Thailand and Singapore. Akadiri, Lasisi, Uzuner, and Akadiri (2018) analyzed the interaction among tourism, economic growth and CO_2 emissions in 16 small island countries cover the period 1995–2014. Findings showed that tourism is one of the main determinants of CO_2 emissions. Shi et al. (2019) analyzed the nexus between tourist inflows, tourism expenditures and CO_2 emissions in 147 countries during the period 1995–2015. The findings indicated that tourism expenditures increase CO_2 emissions in low-income countries, while tourism inflows have a positive effect on CO_2 emissions both in low and high-income countries.

Although most studies in the literature concluded that developments in the tourism sector had a positive effect on CO_2 emissions, Lee and Brahmasrene (2013) found a negative nexus. In the study, the linkages among tourism, economic growth, and CO_2 emissions are analyzed in the European Union countries cover the period 1988–2009. The results showed that the series are moving together and tourism negatively affects CO_2 emissions. Katircioglu (2014b), who analyzed Singapore for the period 1971–2010, reached a similar result. He found that the variables are cointegrated and tourism reduces CO_2 emissions. In addition, Granger causality showed a one-way causality from tourism to CO_2 emissions. Al-Mulali, Fereidouni, and Mohammed (2015) tested the nexus between CO_2 emissions and tourism-transport sector for 48 tourism regions. Although they found a long-term nexus in Asia, Africa, the Americas, and the Middle East, the same relationship could not be found for the European region. They emphasized that the strict environmental policies of Europe have a significant effect on this result. Akadiri, Akadiri, and Alola (2017) tested the linkages in selected small island states. They found that tourist arrivals negatively effects CO_2 emissions in the long-term.

Some studies tried to predict the trend of tourism and CO_2 emissions. These studies have tried to analyze the contribution of tourism sub-sectors to CO_2 emissions, such as transportation. For example, Gossling (2002) emphasized that the most important reason for the tourism sector to cause environmental degradation is the transportation sector and that the sector has a 94% share of tourism. Peeters, Szimba, and Duijnisveld (2007) provided information on the environmental impacts of tourism in European Union citizens and tourism destinations. Results showed that aviation and international tourism increases air pollution. Peeters and Dubois (2010) stated that tourism activities cause CO_2 emissions. According to the projections and simulations, CO_2 emissions are predicted to rise by an average of 3.2% per year by 2035. They pointed out that a significant portion of this increase was due to transportation. It is stated that current tourism policies do not overlap the target of reducing CO_2 emissions. They suggested the reconsideration of tourism policies.

In Turkey, a few studies examined the nexus among tourism and CO_2 emissions. Katircioglu (2014a) concluded that tourism and energy consumption and CO_2 emission acted together in the long-term and tourism effects CO_2 emission positively for the period 1960–2010. Yorucu (2016) analyzed the determinants of CO_2 emissions cover the period 1960–2010. Results indicated that international tourist arrivals and electricity consumption are the determinants of CO_2 emissions. A one-way causality relationship is also determined by international tourist arrivals and electricity consumption to CO_2 emissions. Tugcu and Topcu (2018) examined the effect of CO_2 emissions on tourism revenues. In the study, it is concluded that CO_2 emission had a negative effect on tourism revenues. It is explained by the environmental quality importance given by tourists'. In general, studies found that there is a positive impact of tourism activities on CO_2 in Turkey.

Data and methodology

The linkages among CO_2 emission, tourist arrivals, economic growth, and energy consumption in Turkey are tested cover the period 1960–2014. The variables are selected by following Katircioglu (2014a) and Azam et al. (2018). Data is dictated by data availability because CO_2 emission data is available only until 2014. Therefore, the sample period is restricted, based on data unavailability for CO_2 emission. The dependent variable CO_2 emissions per capita in metric tons (CO_2) is a proxy for CO_2 emission and an independent variable tourist arrivals (TOU) and control variables economic growth (GDP) and energy consumption (ENE) are the proxies for GDP per capita (constant 2010 US$) and energy consumption (kg of oil equivalent per capita) respectively. In order to reduce or remove the problem of heteroscedasticity, we used natural logarithm forms of the variables. Thus, our model can be written as follows:

$$\ln CO_{2t} = f(\ln TOU_t, \ln GDP_t, \ln ENE_t) \quad (1)$$

All the data sets (except tourism) are taken from the World Bank Development database. Tourist arrivals are taken from the Turkish Statistical Institute. The stationary levels of the variables are determined by employing the ADF (1981) unit root test. But ADF results can be spurious due to the existence of structural breaks in the data set. Thus, we also applied Fourier-ADF unit root test. In the Fourier unit root tests which take into account the structural breaks, you do not need to stipulate number of breaks. They provide more reliable results than others (Yilanci, Saridogan, & Artar, 2014).

The long-term linkages between CO_2, TOU, GDP, and ENE are analyzed by applying three cointegration methods (Bayer & Hanck, Fourier ADL, and ARDL).

In practice, different cointegration tests can give different results. Bayer & Hanck test gives uniform and robust cointegration results by integrating the findings of Engle and Granger (1987) (EG), Johansen and Juselius (1990) (JOH), Boswijk (1994) (BO) and Banerjee, Dolado, and Mestre (1998) (BDM) cointegration tests. In the Bayer and Hanck (2013) cointegration tests, which combine the probability values of the tests, individual probability values are combined with the following formula of Fisher

(1932).

$$EG - JOH - BO - BDM = -2[\ln(PEG) + \ln(PJOH) + \ln(PBO) + \ln(PBDM)] \quad (2)$$

In the case of the estimated test statistic is higher than the critical values obtained by Bayer and Hanck (2013), the null hypothesis that indicates no long-term relationship will be rejected.

Fourier ADL is developed by Banerjee, Arčabić, and Lee (2017). In the Fourier ADL test, you do not have to specify the duration of breaks. The test prevents potential power loss from using too many dummy variables in the equation. The test extends Enders and Lee (2012) Fourier cointegration and takes into account multiple breaks in a single equation. The Fourier ADL test formula can be written as follows: (Banerjee et al., 2017).

$$\Delta y_{1t} = \mathrm{d}(t) + \delta_1 y_{1,t-1} + \gamma' y_{2,t-1} + \varphi' \Delta y_{2t} + \varepsilon_t \tag{3}$$

where γ, φ and y_{2t} are n x 1 vectors of parameters and explanatory variables. d(t) is the deterministic term. d(t) can be estimated as follows:

$$\mathrm{d}(t) = \gamma_0 + \sum_{k=1}^{q} \gamma_{1,k} \sin\left(\frac{2\pi kt}{T}\right) + \sum_{k=1}^{q} \gamma_{2,k}\left(\frac{2\pi kt}{T}\right), q \leq T/2 \tag{4}$$

where γ_0 is the usual deterministic term, k is frequency, q indicates the number of frequencies contained in the estimation, and T is the number of observations. The null hypothesis denotes there is no cointegration relationship will be rejected if the critical value of Banerjee et al. (2017) is under the estimated test statistic.

The Bayer and Hanck (2013) and Fourier ADL results are also confirmed by using the ARDL model is developed by Pesaran, Shin, and Smith (2001). The main advantage of the model is it can be applied without having variables integrated of the same order, but integrated of order one I(1), and order zero I(0) mutually co-integrated. The ARDL model can be estimated as follows.

$$\begin{aligned}\Delta \ln CO2_t = &\alpha_0 + \sum_{i=1}^{m} b_i \Delta \ln CO2_{t-i} + \sum_{i=0}^{n} c_i \Delta \ln TOU_{t-i} + \sum_{i=0}^{o} d_i \Delta \ln GDP_{t-i} \\ &+ \sum_{i=0}^{p} e_i \Delta \ln ENE_{t-i} + \lambda_1 \ln CO2_{t-1} + \lambda_2 \ln TOU_{t-1} + \lambda_3 \ln GDP_{t-1} + \lambda_4 \ln ENE_{t-1} + \varepsilon_t\end{aligned} \tag{5}$$

where ln, Δ, α_0, t and ε_t denotes the natural logarithm, variable in the first difference, the constant, the time period in years from 1960 to 2014, and white-noise error term respectively. b_i,c_i,d_i,$e_i$are short-term and λ_1, λ_2, λ_3,λ_4 are long-term coefficients.

In the Bound test, the cointegration linkages between variables are investigated by the null hypothesis (H_0: $\lambda_1 = \lambda_2 = \lambda_3 = \lambda_4 = 0$) where the alternative hypothesis is (H_0: $\lambda_1 \neq \lambda_2 \neq \lambda_3 \neq \lambda_4 \neq 0$). If the computed F statistic is lower than the critical value, we can conclude that there is no cointegration. If the computed F statistic falls into the critical values then the test becomes inconclusive. If the computed F statistic is higher than critical values, we can conclude that the variables are cointegrated.

After displaying the long-term nexus among variables, ECM is applied in order to estimate short-run coefficients and error correction term. Thus, the short-term relationship can be tested as follows:

$$\begin{aligned}\Delta \ln CO2_t = &\gamma_0 + \sum_{i=1}^{a} \eta_i \Delta \ln CO2_{t-i} + \sum_{i=0}^{b} \vartheta_i \Delta \ln TOU_{t-i} + \sum_{i=0}^{c} \varphi_i \Delta \ln GDP_{t-i} \\ &+ \sum_{i=0}^{d} \chi_i \Delta \ln ENE_{t-i} + \gamma ECT_{t-i} + \mu_t\end{aligned} \tag{6}$$

where ECT indicates error correction term, γ denotes is the speed of adjustment parameter to long-term equilibrium.

In order to explore the direction of causality between among the CO_2, TOU, GDP, and ENE Vector Error Correction Model (VECM) is employed. VECM can separate long and short-term causality nexus among the variables and also it also reports causality sources that cannot be determined by the Granger causality (Oh & Lee, 2004). Corresponding to the model, VECM for CO_2, TOU, GDP, and ENE are given in Equations 7–10 respectively.

$$\begin{aligned}\Delta \ln CO2_t = &\alpha_1 + \sum_{i=1}^{n} \omega_1(i) \Delta \ln CO2_{t-i} + \sum_{i=1}^{n} \xi_1(i) \Delta \ln TOU_{t-i} \\ &+ \sum_{i=1}^{n} \sigma_1(i) \Delta \ln GDP_{t-i} + \sum_{i=1}^{n} \mu_1(i) \Delta \ln ENE_{t-i} + \psi_1 z_{t-1} + \varepsilon_{1t}\end{aligned} \tag{7}$$

$$\begin{aligned}\Delta \ln TOU_t = &\alpha_2 + \sum_{i=1}^{n} \omega_2(i) \Delta \ln CO2_{t-i} + \sum_{i=1}^{n} \xi_2(i) \Delta \ln TOU_{t-i} \\ &+ \sum_{i=1}^{n} \sigma_2(i) \Delta \ln GDP_{t-i} + \sum_{i=1}^{n} \mu_2(i) \Delta \ln ENE_{t-i} + \psi_2 z_{t-1} + \varepsilon_{2t}\end{aligned} \tag{8}$$

$$\begin{aligned}\Delta \ln GDP_t = &\alpha_3 + \sum_{i=1}^{n} \omega_3(i) \Delta \ln CO2_{t-i} + \sum_{i=1}^{n} \xi_3(i) \Delta \ln TOU_{t-i} \\ &+ \sum_{i=1}^{n} \sigma_3(i) \Delta \ln GDP_{t-i} + \sum_{i=1}^{n} \mu_3(i) \Delta \ln ENE_{t-i} + \psi_3 z_{t-1} + \varepsilon_{3t}\end{aligned} \tag{9}$$

$$\begin{aligned}\Delta \ln ENE_t = &\alpha_4 + \sum_{i=1}^{n} \omega_4(i) \Delta \ln CO2_{t-i} + \sum_{i=1}^{n} \xi_4(i) \Delta \ln TOU_{t-i} \\ &+ \sum_{i=1}^{n} \sigma_4(i) \Delta \ln GDP_{t-i} + \sum_{i=1}^{n} \mu_4(i) \Delta \ln ENE_{t-i} + \psi_4 z_{t-1} + \varepsilon_{4t}\end{aligned} \tag{10}$$

where z_{t-1} is the ECT, ω,ξ,σ,μ are the parameters, n is the lag length and ε_t is random processes. The long-term causality is proposed by the significance of the t-test(s) of the lagged ECT that includes long-term information. Wald test is employed on the joint significance of the lagged terms of the independent variables to explore short-term causality.

Empirical results

The descriptive statistics of the CO_2, TOU, GDP, and ENE are reported in Table 2. The means of CO_2, TOU, GDP, and ENE are 0.75, 14.94, 8.74 and 6.73 respectively. Results also show that variables are normally distributed and they are mostly negatively skewed (lnCO2, lnTOU, lnENE).

The ADF and FADF unit root test results are presented in Table 3. ADF unit root test results indicate that all variables have unit roots at level form, which means they are not stationary at their levels. They become stationary at their first differences. The results of FADF structural break unit root test are also reported in Table 3. Results verify findings of ADF that in spite of the presence of structural breaks, CO_2, TOU, GDP, and ENE are integrated of order one.

As a result of we discover that variables are integrated of order one, we applied Bayer and Hanck (2013) and Fourier ADL cointegration tests. Based on the Bayer and Hanck (2013) and Fourier ADL cointegration tests, we can reject the null hypothesis and conclude that CO_2, TOU, GDP, and ENE are cointegrated. The results are presented in Tables 4 and 5 respectively.

Table 2. The descriptive statistics.

	$\ln CO_2$	lnTOU	lnGDP	lnENE
Mean	0.75	14.94	8.74	6.73
Median	0.89	14.88	8.75	6.81
Maximum	1.50	17.50	9.50	7.37
Minimum	−0.49	11.73	8.05	5.95
Std. Deviation	0.55	1.62	0.39	0.41
Skewness	−0.62	−0.11	0.09	−0.28
Kurtosis	2.43	2.00	2.12	2.02
Jarque-Bera	4.27	2.41	1.87	2.90
Probability	0.12	0.30	0.39	0.23
Observations	55	55	55	55

Table 3. FADF and ADF unit root tests.

Variables	minSSR	$\hat{k}$	FADF	F(k)	ADF	Result
$\ln CO_2$	7.63	1	−1.51(1)		−2.59(0)	nonstationary
lnTOU	62.34	1	−1.50(4)		−1.48(0)	nonstationary
lnGDP	3.90	1	−0.93(1)		0.21(0)	nonstationary
lnENE	4.11	1	−1.16(1)		−1.20(0)	nonstationary
$\Delta \ln CO_2$	0.13	5	−8.35(0)***	3.79*	−8.11(0)***	stationary
ΔlnTOU	0.91	3	−9.93(0)***	4.93***	−7.89***	stationary
ΔlnGDP	0.07	5	−7.51(0)***	0.85	−7.20***	stationary
ΔlnENE	0.07	5	−8.30(0)***	3.99**	−7.15***	stationary

Notes: Significant at *** 0.01 and ** 0.05. FADF test critical values (k = 1) are −3.52, −3.85, −4.43 at 0.10, 0.05 and 0.01 level respectively.

Table 4. Bayer and Hanck (2013) cointegration test.

Model	EG-JOH-BO-BDM	Critical value (%5)	Result
$\ln CO_{2t} = f(\ln TOU_t, \ln GDP_t, \ln ENE_t)$	86.76	20.486	cointegrated

Table 5. Fourier ADL cointegration test.

			Lags				
F_{ADL} ($\hat{k}$)	$\hat{k}$	AIC	$\Delta \ln CO_{2t}$	$\Delta \ln TOU_t$	$\Delta \ln GDP_t$	$\Delta \ln ENE_t$	Result
−3.87**	5	−1.327	3	1	1	1	cointegrated

Notes: ** shows the significance at the 0.05 level. Critical values for Fourier ADL (2017) cointegration test (k = 5) are −3.57, −3.94, −4.66, at 0.10, 0.05 and 0.01 level. The frequency is selected based on AIC criteria.

The results of Bayer and Hanck (2013) and Fourier ADL tests are also verified by employing the ARDL model. Table 6 denotes that the estimated F-statistic is greater than the critical value. Thus, we can reject H_0 hypothesis. In other words, there is a long-term nexus among CO_2, TOU, GDP, and ENE in Turkey.

Since the existence of a cointegration nexus among CO_2, TOU, GDP, and ENE is determined, we can analyze the long-term and short-term effects of TOU, GDP, and ENE on CO_2 in Turkey.

Table 6. Bound test.

Model	Optimal lag	F-statistic	Result
$\ln CO_{2t} = f(\ln TOU_t, \ln GDP_t, \ln ENE_t)$	(4,0,4,1)	4.752***	cointegrated
critical values (%1) = lower 3.65–4.66 upper Lower 3.65–4.66 Upper			
LM(1) = 0.950		ARCH (1) = 0.798	
Normality = 0.294		RESET = 0.935	

Notes:*** denotes significance at the 0.01 level.

Table 7. ARDL (4,0,4,1) model coefficients.

Variables	Coefficient	Std. error	T-statistic	P-value
lnTOU	0.099	0.056	1.764	0.085
lnGDP	0.766	0.339	2.255	0.030
lnENE	1.411	0.300	4.702	0.000
c	−3.500	1.482	−2.361	0.023

The estimated long-term coefficients of TOU, GDP, and ENE are presented in Table 7. Results showed that TOU, GDP, and ENE affect positively CO_2 both in the long and the short-term. A 1% rise in TOU, GDP, and ENE increase CO_2 by 0.099%, 0.766%, and 1.411% respectively.

According to the results, ENE is the most important determinant of CO_2. These results indicate that fossil fuel-related energy consumption is high and there is no energy efficiency in Turkey. In other words, results indicate that the usage of renewable energy sources is not sufficient in Turkey. GDP also increases CO_2. Since the increase in economic activities requires a significant amount of energy, GDP positively affects CO_2. The results show that increased TOU raises CO_2. Increasing tourist arrivals increases the activities of the tourism sector. This situation indicates that the raise in tourism activities increases the ENE and it causes land degradation.

The stability of the ARDL model is tested by using CUSUM and the CUSUMSQ tests. The results of the tests are denoted in Figures 1 and 2 respectively.

We also investigated the sensitivity of our results in Equation 4, by employing FMOLS, DOLS and CCR estimators. Table 8 presents the long-term results of the estimators.

As shown in Table 8, the positive effects of TOU, GDP, and ENE on CO_2 are confirmed by these estimators. 1% increase in TOU increases CO2 by 0.099–0.112%. On the other hand, 1% rises in GDP increases CO2 by 0.766–1.126%. Finally, 1% increase in ENE raises CO2 by 1.411% to 1.912%.

Whether there is a short-term nexus among CO_2, TOU, GDP, and ENE, the ARDL error correction model is estimated and results are indicated in Table 9.

ECT coefficient is -0.245 and significant. In other words, there is a short-term nexus among CO_2, TOU, GDP, and ENE. It also indicates that short-term deviations in the CO_2 take approximately 4.16 years in converging to the long-term equilibrium.

ECM results show that TOU and ENE have a significant and positive effect on GINI in the short-run. We also applied a Wald test for all GDP coefficients separately. Wald test confirmed the results that all coefficients are not equal to zero and conclude that GDP has a positive effect on CO_2.

The causality linkages among CO_2, TOU, GDP, and ENE are analyzed by using the VECM causality. Table 10 indicates VECM results.

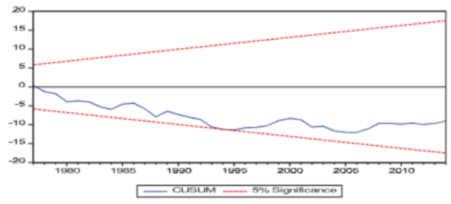

Figure 1. CUSUM test results.

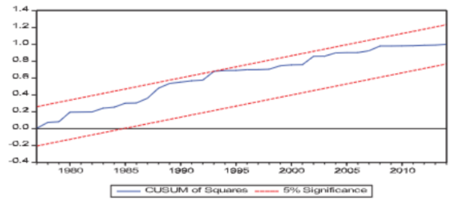

Figure 2. CUSUMSQ test results.

Table 8. Long-term estimates by estimators.

	ARDL (1,0,0,0)	FMOLS	DOLS	CCR
lnTOU	0.099*	0.101**	0.112**	0.104**
lnGDP	0.766**	1.038***	1.126***	1.080***
lnENE	1.411***	1.890***	1.894***	1.912***
c	−3.500**	−4.409***	−3.822***	−4.251***

Notes: *,** and *** shows the significance at the 0.10, 0.05 and 0.01 levels respectively.

Table 9. The ARDL error correction model.

Variables	Coefficient	Standard error	T-statistic	*P*-value
ΔlnCO2(−1)	−0.297	0.075	−3.921	0.000
ΔlnCO2(−2)	−0.009	0.081	−0.111	0.912
ΔlnCO2(−3)	−0.219	0.076	−2.848	0.007
ΔlnTOU	0.036	0.020	1.805	0.082
ΔlnGDP	0.080	0.100	0.798	0.429
ΔlnGDP(−1)	0.319	0.092	3.461	0.001
ΔlnGDP(−2)	0.031	0.103	0.303	0.763
ΔlnGDP(−3)	0.239	0.093	2.552	0.014
ΔlnENE	1.126	0.097	11.527	0.000
ECT(−1)	−0.245	0.047	−5.154	0.000

Considering equations all ECTs are found statistically significant and negative. It implies that TOU, GDP, and ENE are Granger-causes of CO_2 in the long-term. In addition, it is found causal relationship from CO_2, GDP, and ENE to TOU in the long-term.

We also found that causality is running from CO_2, TOU, and ENE to GDP and from CO_2, TOU, and GDP to ENE. The results show that there are significant bidirectional causalities between the

Table 10. VECM results.

	Direction of causality				
	Short-term (Wald Test χ2 statistic)				Long-term
Dependent variable	$\Delta lnCO_2$	ΔlnTOU	ΔlnGDP	ΔlnENE	ECT_{t-1}
$\Delta lnCO_2$	–	−0.034	0.357	0.062	−0.240***
ΔlnTOU	0.584	–	0.544	0.109	−0.336**
ΔlnGDP	−0.009	0.017	–	0.188	−0.080**
ΔlnENE	0.170	−0.016	0.099	–	−0.101**

Note: *** and ** indicate the significance at the 0.01 and 0.05 levels respectively.

variables in the long-term. Thus, a change in any variable will have a significant impact on other variables.

Conclusion and policy implications

Turkey, as one of the world's most important tourism destinations, also has high amounts of carbon emissions; thus, the nexus between tourism and the environment has become important. In this study, the linkages between TOU and CO_2 in Turkey were examined by controlling GDP and ENE for the 1960–2014 period. Cointegration among CO_2, TOU, GDP, and ENE was analyzed by applying Bayer and Hanck, Fourier ADL, and ARDL cointegration tests. All three tests indicated a long-term nexus among the variables. The long and short-term impacts of TOU, GDP, and ENE on CO_2 emissions were examined by employing the ARDL test. The findings revealed that TOU, GDP, and ENE have a positive effect on CO_2 emissions. The results are similar to those of Katircioglu (2014a), Yorucu (2016), Sharif et al. (2017) and Chen et al. (2018). In this context, an increase in TOU increases CO_2 and causes environmental degradation. This could be explained by all the tourism sectors' higher energy use; in particular, the transportation sector. The deterioration of the soil structure and pollution caused by tourism mobility during the establishment of new tourism facilities may also explain CO_2 emissions. The positive nexus between GDP and CO_2 emissions can be interpreted as raising income by increasing production, consumption, and energy usage. In this context, the results are consistent with Halicioglu (2009). The results revealed that CO_2 emissions are best explained by energy consumption. This concurs with Azam et al. (2018). These results imply that fossil fuel-related energy consumption is high and there is no energy efficiency. In other words, renewable energy is not utilized sufficiently in Turkey. The causality among CO_2, TOU, GDP, and ENE was analyzed by applying the VECM causality. While the VECM results did not indicate a short-term causal relationship, CO_2, TOU, GDP, and ENE have a long-term effect on one another. The causality results revealed that both TOU and CO_2 affect one another; this was noted by Tugcu and Topcu (2018). This finding suggests that tourists pay attention to the environmental quality of the country in which they travel.

It is not possible to reduce Turkey's CO_2 emissions with its current tourism policies. Despite the necessity of limiting the environmental impact of tourism, the precautions that will not affect tourism activities and the number of tourists should be considered. The results revealed that energy consumption is the main source of CO_2 emissions in Turkey. Consequently, the government should reduce fossil fuel consumption and ensure energy efficiency in the economy and tourism sector. The government should implement tax, incentives and advisory policies to increase the use of low-carbon green technology in tourism activities such as transportation and accommodation as well as to prevent excessive consumption of natural resources. Therefore, it is of the utmost importance to plan tourism facilities and service buildings in such a way so as to increase energy savings. The determination of planning as a criterion for a tourism services license may be an easy and effective solution. Because tourism facilities are graded with stars, including green criteria in the stars criteria may force enterprises to use environment-friendly technologies. Furthermore, the integration of renewable energy sources such as solar, wind, and hydroelectricity in tourism and other sectors will reduce CO_2 emissions. The incentives per amount of renewable energy may increase the use thereof.

The energy consumption of the transportation sector, a sub-sector of tourism, is an important environmental deterioration factor. Although it is difficult to prevent greenhouse gas emissions from fossil fuel consumption in the transportation sector, it is possible to control them. Supporting R&D activities in the field of information technologies may facilitate the solution. For example, in Istanbul, which has hosted more than 10 million tourists every year since 2013, the use of environment-friendly fuel, for example, an electric car, should be provided in taxi-type vehicles, which are used extensively by tourists. In addition, the promotion of hybrid motor and carbon-neutral technologies in the transportation sector will reduce CO_2 emissions in the medium and long-term.

In addition, the development of existing technology and the transport infrastructure, and establishing public transport systems and light rail systems that use environment-friendly energy in tourist destinations may be very beneficial and reduce fossil fuel consumption. Furthermore, not allowing tourism investments without the necessary technical and transport infrastructures will lead to a reduction in CO_2 emissions.

The fact that the composition of the incentives involves enterprises that employ renewable energy and implement green tourism activities may channel tourism initiatives into these areas. Incentives can include credit facilities and tax reductions. In addition to the incentives, the Ministry of Tourism and Culture should introduce strict control and regulation mechanisms. Within this framework, the penalization of enterprises that do not comply with environment-friendly activities or the cancellation of enterprises' operational licenses may be a deterrent. Finally, as noted by Shi et al. (2019), the prevention of deforestation and realization of sustainable tourism have importance in reducing CO_2 emissions. Therefore, the unconscious and disproportionate expansion of tourism investments should be prevented. Consequently, within the framework of transparent and governance principles, the government should not grant licenses for activities that will disrupt forestation and land structure. The disproportionate expansion and non-inspection of tourism facilities may cause the destruction of forest areas, which serve as important CO_2 storage.

It should be kept in noted that the socio-cultural structure should be carefully protected in order to create a sustainable tourism structure, plan tourism activities by determining the capacity of the destinations, and develop infrastructure. Furthermore, the collection of a portion of the sub-sector revenues of tourism under environmental protection funds will help to increase the quality of the environment without disrupting tourism.

Disclosure Statement

No potential conflict of interest was reported by the authors.

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