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The Tourism-Based Environmental Kuznets Curve Hypothesis: Evidence From the Turkish Economy

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Abstract

This study aimed to determine the impact of tourism on environmental pollution and test the validity of the Environmental Kuznets Curve (EKC) hypothesis for the Turkish economy based on data from 1975–2018 in cubic form by observing the impacts of tourism indicators on the environment. We analyzed the correlations among per-capita ecological footprint, international tourist arrivals, per capita GDP, the social globalization index, and urbanization rate using the ARDL limit test. Based on our research, we have found evidence that during the study period, there is an N-shaped correlation between tourist arrivals and ecological footprint in the Turkish economy. This contradicts the idea of an inverted U-shaped Kuznets curve for both the short- and long-term. Our findings reveal that domestic and national policies to fight against pollution need to be developed rather than wasting time by waiting for the end of the relationship between tourist arrivals and environmental pollution after a certain milestone.

Keywords: Environmental Kuznet's Curve, ecological footprint, international tourist arrivals, per capita real GDP, Türkiye.

JEL Codes: O13, Q01, Q56

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1. Introduction

In the globalizing world, tourism is an industry that grows every day. As the demand for tourism has been drastically increasing, millions of individuals are participating in tourism activities worldwide. According to data issued by the World Tourism Organization (UNWTO) in 2022, international tourist arrivals are 962.8 million (UNWTO, 2023). The total number of tourists arriving in Türkiye was 44.6 million in 2022 (KTB, 2023).

Tourism displays a complicated relationship with the environment because it includes a number of activities that might have adverse environmental impacts. The majority of these impacts are related to the construction of general infrastructure such as roads and airports and tourism facilities such as holiday resorts, hotels, restaurants, shopping malls, golf fields, and marinas (GhulamRabbany et al., 2013, p. 117). This study aims to investigate the validity of the Environmental Kuznets Curve (EKC) hypothesis for the period 1975–2018 by taking the ecological footprint of tourist arrivals to Türkiye, one of the global significant global tourism destinations, into account.

Regarding the potential contribution of our study into the current literature, i) The majority of studies testing the EKC hypothesis concentrated on carbon dioxide emissions are taken into consideration as the benchmark for environmental pollution (Katircioglu, 2014a, 2014b; Shakouri et al., 2017; Kumail et al., 2020) whereas our study includes the ecological footprint variable (EF) developed by Wackernagel and Reels into the model in the form of per capita for better represent of environmental pollution in the analysis because the EF is obtained using more comprehensive measurements such as carbon footprint, agricultural area, pasture area, forests, etc., respectively (Destek, 2018, p. 273), which seems to be an appropriate variable for better represent of environmental degradation; ii) Across the majority of studies testing the EKC hypothesis in terms of the globalization variable, the KOF general globalization index has been employed (Çoban & Özkan, 2022; Pata & Yurtkuran, 2022). However, our study utilized from the social globalization index, one of the sub-indexes of the general globalization index on the base that it includes international tourist movements more specifically; iii) Since two-variable models are widely criticized because they cause the skipped variable bias (Alam & Paramati, 2016), our study model was included in several variables such as social globalization, economic growth, and urbanization rate to eliminate the neglected variable deviation problem; iv) As far as is known by the authors, the present study is one of the limited studies investigating the impact of tourism on the environment within the scope of the EKC hypothesis by having a square and cube of the number of international tourist arrivals to employ the Kuznets curve in cubic format for the Turkish economy. Accordingly, novel empirical evidence is expected to be added to the relevant literature.

2. Literature Review

2.1 Tourism and Ecological Footprint

Tourism induces consumption and spending because it requires investments in energy, natural resources, human-made resources, and respective facilities (Kongbuamai et al., 2020 p. 19254). Tourism is considered one of the largest global industries and significantly motivates consumption behaviors (Hunter, 2002, p. 7). The impacts of tourism on the ecological footprint may arise through various possible activities across accommodation, lodging facilities, transportation, purchasing, tourism services, entertainment, and the exiting of the tourist population (Nathaniel et al., 2021, p. 38324). Tourism development coefficients (e.g., tourist arrivals, receipts, and spending) have an adverse impact on the ecological footprint (Liu et al., 2022, p. 2).

The ecological footprint provides a measure of biological productivity imposed by human lifestyles and demands on the respective processing capacity of nature (Hunter, 2002, p. 7). The utility of environmental indicators such as ecological footprints could be helpful to confirm or reject our assumptions about environmental impacts, yield common ground to make comparisons between populations and help create scales for enhancements (Patterson et al., 2007, p. 754).

According to Peng and Guihua (2007), it is the most recent and efficient method employed to analyze the ecological footprint and environmental impacts of tourism because ecological footprint methodology combines a great deal of different environmental impacts in a single parameter and allows a measure of impacts caused by the main factors of tourism, transportation, accommodation, and other activities in a single indicator (Peeters & Schouten, 2006). Ecological footprint provides a framework to measure tourism growth and civil and industry capacity and determine targets regarding the future impacts of tourism for host countries (Patterson et al., 2007, p. 754). In this line, information on ecological footprints could be beneficial in focusing on enhancing the sustainability of tourism policies for a certain destination and prioritizing the elimination of not only domestic impacts but also global ones (Peeters & Schouten, 2006, p. 169).

As a result of the study conducted by Nathaniel et al. (2021) in an attempt to determine the factors that affect ecological footprint across the first most popular tourist destination by using data obtained through advanced panel methods, they report a negative correlation between ecological footprint, urbanization, and natural resources. According to Ansari & Villanthenkodath (2022), even though tourism income has a negative correlation with environmental degradation, this confirms the significant and long-term positive effect of tourism arrivals on ecological footprints. These results also indicate that economic growth, energy intensity, and urbanization decrease environmental quality in the long run. According to the results of a study conducted by Guan et al. (2022) for the period 1995–2019, in which the impacts of international tourism, globalization, and technological innovation on the ecological footprints of G-10 countries were examined, it was reported that tourism, globalization, and economic growth have a significant effect on ecological footprints, whereas technological innovation decreases the burden of environmental impact, thus decreasing example countries' ecological footprints. In İlban & Liceli's (2022) study investigating the causal relationship between the ecological footprint, one of the environmental degradation indicators, and tourism growth, the authors employ data from the 10 most tourist-attractive countries from 1995–2018. As a result of their causality analysis, a dual-causality correlation is reported between the ecological footprint and the number of tourists.

In the study conducted by Godil et al. (2020), which investigates the asymmetric impacts of tourism, financial development, and globalization on the ecological footprint in Türkiye for the period from 1986 to 2018, the researchers conclude that tourism, globalization, and financial development are significantly positively correlated with the ecological footprint. Şahin Kutlu and Kutlu (2022) investigated the effect of tourism activities on the ecological footprint in Türkiye for the period between 1970 and 2017 by means of the ARDL limit test approach, and according to their results, energy consumption and tourism spending had a positive effect on the ecological footprint in the long term. Additionally, they report that per capita income and tourism incomes have a negative effect on the ecological footprint in the long term.

2.2 The KOF Globalization Index, Urbanization, Economic Growth, and Ecological Footprint

The KOF Globalization Index distinguishes economic, social, and political aspects of globalization from each other. Economic globalization includes commercial and financial globalization, whereas social globalization includes inter-personal, knowledge-based, and cultural globalization (Gygli et al., 2019, pp. 549–550). In the study conducted by Kirikkaleli et al. (2021), which investigates the role of globalization in the ecological footprint in Türkiye, their findings reveal that globalization has a positive effect on the ecological footprint over the long term. Apaydın (2020) concludes in his study investigating the effect of globalization on the ecological footprint for Türkiye in the period 1980–2014 that globalization has had a significantly negative effect on Türkiye's ecological system.

An increase in manufacturing and consumption required for economic growth decreases the resources the environment supplies. Still, in the meantime, waste caused by manufacturing and consumption would yield harmful environmental effects, which suggests that manufacturing and consumption activities are the most important reasons for environmental destruction (Ulucak & Erdem, 2017, p. 117). Wang et al. (2022) indicate that human beings obtain economic welfare in exchange for significant environmental costs, but that if the ecological footprint is not kept under control, economic growth would be obtained. Ahmad et al. (2021) employed an annual frequency from 1980 until 2016 to investigate the effect of financial globalization, urbanization, eco-innovation, and economic growth variables on ecological footprints in G7 countries. The authors report that financial globalization and eco-innovation have a decreasing effect on ecological footprints, whereas urbanization has an increasing effect on ecological footprints and, thus, environmental degradation. Moreover, it is reported that a reverse U-shape correlation is found between economic growth and ecological footprint. Accordingly, the authors conclude that the environmental Kuznets curve hypothesis is valid for the G7 countries.

2.3 The Literature on Tourism and the EKC

The tourism industry, seen as one of the essential income resources for developing countries, is considered a fundamental ingredient of economic growth through developing infrastructure, employment, nourishing businesses, and a positive contribution to the current account equilibrium of countries (Mikayilov et al., 2019, p. 19389). Accordingly, pollution is expected to increase as a result of an increase in energy consumption and real income among tourism-destination countries (Katircioglu, 2014b, p. 384). Therefore, a tourism-based EKC model was employed in our study.

In their study's conclusion section, Katircioglu (2014b) confirmed the tourism-based EKC hypothesis for the Singapore case, which tests the EKC hypothesis to determine the relationship between Singapore's tourism development and its carbon emissions. In the study by Arbulú et al. (2015), they used the EKC framework to look at tourism and solid waste production in 32 European countries from 1997 to 2010. Their empirical results support the EKC hypothesis for solid municipal wastes and show that the number of tourists, the amount of money each tourist spends, and the type of tourism have a significant and non-linear effect on solid municipal waste production. Similarly, Ozturk et al. (2016) tested the EKC hypothesis in their study by constructing an environmental degradation model using ecological footprint as an environmental indicator and tourism-based GDP as an economic indicator for 144 countries from 1988–2008. Their results reveal that the number of countries displaying a negative correlation between ecological footprint and its determinants (tourism-based GDP growth, energy consumption, commercial openness, and urbanization) is higher among the upper-medium and high-income countries.

Katircioglu et al. (2018), in their study investigating the role of tourism development on environmental quality for primary tourism destinations, preferred ecological footprint as an indicator of environment quality for the 10 most tourist-attracting countries. According to panel data analysis in their study, tourism based EKC has the reverse U shape, and the hypothesis is confirmed for the tourism countries. Tourism development in the selected countries has a significant negative effect on their ecological footprint levels. Therefore, they conclude that tourism development in the countries attracting the most tourists has a remedial effect on environmental quality levels. According to the results reported by Kongbuamai et al. (2020) from their study on ASEAN countries, in which they investigated the effect of economic growth, energy consumption, tourism, and natural resources on the ecological footprint for the period from 1995 to 2016, there is reverse U-shape EKC behavior, and thus there is a negative correlation between tourism, natural resources, and ecological footprint. Bandyopadhyay et al. (2023) include tourism polynomials and energy intensity in the EKC specification so as to investigate the correlation between economic growth, hydroelectric consumption, and CO2 emissions in India. The researchers conclude that there is a "reverse N-figure" correlation between tourism and CO2 emissions. Liu et al. (2022) report a reverse U-shape correlation between tourism-based growth hypothesis, travel and tourism, and ecological footprint in their study conducted for Pakistan for the period 1980–2017, in which they used EKC analysis.

In the current literature, there are various studies investigating the EKC hypothesis by using tourism-related variables for Türkiye as well (Katircioglu, 2014a; de Vita et al., 2015; Bozkurt et al., 2016; Arı, 2021; Fethi & Senyucel, 2021; Kılavuz et al., 2021; Boluk & Guven, 2022; Canpolat Gökçe & Kızılkaya, 2022; Han et al., 2022).

Katircioglu (2014a) analyzes the long-term equilibrium relationship between tourism, energy consumption, and environmental degradation represented by carbon dioxide (CO_2) emissions in Türkiye for the period 1960–2010. Their results reveal that tourism and energy consumption have a long-term equilibrium correlation with CO_2 emissions. De Vita et al. (2015) employ data from 1960 to 2009 to investigate tourism development through an expanded version of the EKC model. They report that income, income-square, energy consumption, and the number of international tourists arriving from Türkiye are co-integrative with CO_2 emissions; tourist arrivals, growth, and energy consumption have a positive and significant effect on CO_2 emissions in the long term. Bozkurt et al. (2016) investigate the correlation between tourism and carbon emissions for the period from 1995 to 2011 as per capita CO_2 emission, per capita real GDP, per capita energy consumption, commercial openness rate, and number of international tourists visiting the BRICTS countries by employing the EKC framework. Their results indicate a co-integration correlation between CO_2 emissions and independent variables. The researchers suggest that tourist arrivals and economic growth have an adverse effect on CO_2 emissions, but commercial openness decreases emissions in BRICTS countries.

Arı (2021) investigates the correlation between tourism, renewable energy, GDP, and CO_2 for the Turkish economy, covering the 1990–2015 period. As a result of the analysis, renewable energy is reported to decrease CO_2 emissions, whereas tourism development is not statistically significant and effective on CO_2. Additionally, GDP has a positive effect on CO_2 emissions and the tourism industry. On the other hand, CO_2 has no significant effect on tourism. Fethi & Senyucel (2021), in an extended version of the EKC study for 50 most touristic countries, including Türkiye, for the period of 1996–2016, use empirical study to investigate the role of tourism development by using panel data. Their results indicate that tourism development displays a long-term effect in the extended version of the EKC, but carbon emission levels have varied significantly throughout the years through tourism development. Kılavuz et al. (2021) investigate the correlation between international tourist arrivals and per capita carbon dioxide emissions in Türkiye for the period 1960–2015. Their results confirm the validity of the tourism-based EKC hypothesis.

Boluk & Guven (2022), in their study investigating the effect of tourism, energy consumption, urbanization, and economic growth on environment quality in Türkiye for the period 1963–2015, report that both tourism-based EKC and tourism-based growth are not confirmed. Canpolat Gökçe & Kızılkaya (2022) tested the validity of the tourism-based EKC hypothesis in terms of the relationship of tourism with variables of carbon dioxide emissions, energy consumption, economic growth, and tourism income for Türkiye for the period 1965–2019. As a result of their analysis, a long-term equilibrium correlation is reported among variables, and the tourism based EKC hypothesis is found to be valid. The empirical findings of the study by Han et al. (2022), which investigated the impact of tourism development on the ecological footprint, carbon dioxide emissions, and, consequently, environmental degradation for Türkiye for the period 1995–2017, show a long-term correlation between tourism and environmental degradation in Türkiye.

2.4 Theoretical Framework of the Environmental Kuznets Curve

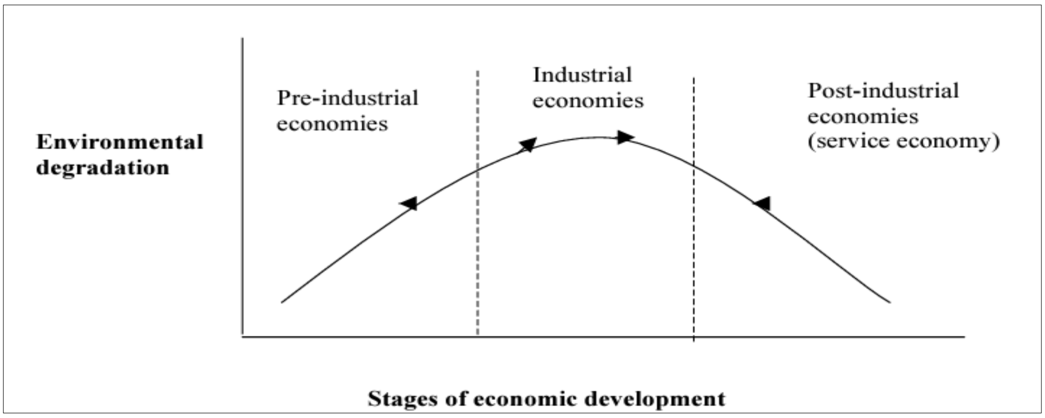
The combinational effect of various factors such as increasing industrialization, globalization, and climate change and their consequent result of environmental degradation have brought economic and environmental science together, and they concentrated on the impacts of social activities on the environment, which made the relationship between environmental pollution and economic growth one of the most attractive subjects for many economists. The impacts of economic activities on the environment have further intensified along the post-World War II era. As developmental economics has come to the agenda, the race among countries regarding economic growth and development has intensified, especially worries about environmental deterioration resulting from heavy consumption of natural resources such as oil, energy, and coal, and sustainable development has emerged.

In 1955, Simon Kuznets made a groundbreaking claim about the relationship between income distribution and economic growth. He argued that as per capita income increases, it initially leads to a decline in fair income distribution. However, as income continues to grow, it eventually helps to reduce inequality in income distribution. Simon suggests that income inequality tends to increase during the initial stages of economic growth but decreases as the economy progresses. He also highlights the presence of a reverse U-shaped bell curve relationship between income and expenditure.

As environmental damage has become evident due to increasing global warming, air pollution, and carbon dioxide release in the 1990s, the Kuznets Curve was adapted to the environment by Grossman and Krueger (1991, 1995), and the relationships between per capita income and environmental pollution were reconsidered. This curve, referred to as the Environmental Kuznets Curve (EKC) in the literature, indicates that the increase in per capita income triggers environmental pollution at the beginning, but after a certain point, this impact starts to reverse. In sum, there is a tradeoff between environmental pollution levels and economic growth, which prescribes that environmental pollution is elevated at the very beginning of economic development but then decreases beyond a certain threshold level. Figure 1 illustrates this relationship:

Figure 1

Environmental Kuznets Curve (EKC Diagram)



Note. Resource: Panayotou, 2003, p. 3.

Among the studies explaining how the EKC Hypothesis works, Grossman and Krueger (1991), Carson (2010), and Panayotou (2003) come to the forefront. Grossman and Krueger (1991) and Carson (2010) claim that the correlation between economic growth and the environment works in three different impact channels: scale, structural (composition-combination), and technological impact. Scale impacts emerge during the initial phase of economic growth. Due to the greater consumption of energy and resources to elevate manufacturing, the amount of waste would increase, and structural impacts would emerge at the next stage. Structural impact refers to the fact that the effect of economic growth on the environment would turn in a positive direction through structural transformation in an economy. Structural transformations include agriculture, industry, service, and information technology transitions. The first phase of the structural transformation is the change from agriculture to industry, which leads to more pollution because more natural resources and inputs are used. The second phase is the change from an energy-intensive industry to a technology-intensive service and information economy. This leads to less pollution because fewer natural resources and inputs are used. The essential reason for this impact is that technology-intensive industries consume fewer natural resources, which reduces their contribution to environmental pollution (Tsurumi & Managi, 2010, p. 20). Another impact channel in the growth process is technological impact, which emerges from replacing old pollutive technologies with novel, productive, and clean technologies obtained with higher economic welfare (Ang, 2007, p. 4773). Panayotou (2003) mentions the income flexibility impact of environmental quality demand in addition to these impacts. Increasing income motivates individuals to "green" products, and they become more sensitive toward the environment and place more emphasis on environmental quality, resulting in decreased environmental pollution. In light of these explanations, the EKC Hypothesis states that the negative impact of scale impacts on growth at the initial phase would be in equilibrium with structural and technological impacts, and the positive effects of these factors would be more dominant in the posterior stages (Dinda, 2004, pp. 435–436). The decreasing part of the curve in the diagram in Figure 1 represents the structural and technological impacts, while the increasing part represents the scale impacts.

3. Data and Econometric Methodology

3.1 Data

As a starting point for our study, we hypothesized that international tourism movements could be a determinant factor for environmental pollution. In this context, annual Turkish economy data from 1975 to 2018 was analyzed using the ARDL limit test for the EKC hypothesis for tourism's environmental impact. Based on the literature, our research model and variables included in the analysis were preferred.

In the literature, several different variables are employed to represent environmental degradation and its impact. In our study, per capita ecological footprint (EF) is preferred to represent environmental degradation, whereas number of tourists (TA)—representing tourism-based economic growth—per capita real GDP (Y), (KOFsos) social globalization index—one of the KOF general globalization sub-indexes—and urbanization (URB) rate were employed as the variables that have an impact on environmental degradation. Table 1 exhibits the description, annotation, and resources of the variables below.

Table 1

Data Table

Description of Variable	Annotation	Resource
Per capita ecological footprint	EF	Global Footprint Network database
Per capita real GDP / 2015 fixed prices	Y	The World Bank
Number of international tourists visiting Türkiye	TA	R.T. Ministry of Culture and Tourism
KOF social globalization index	KOF_{SOS}	Swiss Economic Institute
Urbanization rate	URB	The World Bank

3.2 Model Constructions

In the analysis of the correlation between environmental pollution and income, basically three different models have been utilized so far: linear, quadratic, and cubic forms, as they are given below (Shafik & Bandyopadhyay, 1992, p. 5).

$$E_{i,t} = a_1 + a_2 \log Y + a_3 \, time + \varepsilon_{i,t} \quad (1)$$

$$E_{i,t} = a_1 + a_2 \log Y + a_3 \log Y^2 + a_4 \, time + \varepsilon_{i,t} \quad (2)$$

$$E_{i,t} = a_1 + a_2 \log Y + a_3 \log Y^2 + a_4 \log Y^3 + a_5 time + \varepsilon_{i,t} \quad (3)$$

where, E denotes environmental pollution, Y denotes per capita income, and t denotes the time parameter. In assessing the validity of the EKC, it is necessary to look up a_1 and a_2 coefficients for the quadratic form and a_1, a_2, a_3 coefficients for the cubic form.

Conditions for the parameters of the model could be given as below (Dinda, 2004, pp. 440–441):

- $\beta_1 = \beta_2 = \beta_3 = 0$. There is no correlation between income and environmental pollution.
- $\beta_1 > 0$, $\beta_2 = \beta_3 = 0$. The correlation between income and environmental pollution is linear.
- $\beta_1 < 0$, $\beta_2 = \beta_3 = 0$. The correlation between income and environmental pollution is negative.
- $\beta_1 > 0$, $\beta_2 < 0$, $\beta_3 = 0$. The correlation between income and environmental pollution is in a quadratic reverse U-shape, and the EKC is valid.
- $\beta_1 < 0$, $\beta_2 > 0$, $\beta_3 = 0$. The correlation between income and environmental pollution is in quadratic U shape.
- $\beta_1 > 0$, $\beta_2 < 0$, $\beta_3 > 0$. The correlation between income and environmental pollution is in a cubic polynomic N-shape.
- $\beta_1 < 0$, $\beta_2 > 0$, $\beta_3 < 0$. The correlation between income and environmental pollution is in cubic polynomic reverse N-shape.

If the β_3 parameter is not statistically significant, in this case the correlation between environmental pollution and income is only second degree and the model is in quadratic form. If the coefficient of the β_1 parameter is positive, this supports the view that the coefficient of the β_2 parameter is negative, and the correlation in the EKC hypothesis is reverse U-shape or in bell-curve form.

3.3 Methodology

In the analysis of time series, at first, the stationarity of the series is probed. In our study, Augmented Dickey-Fuller (ADF) developed by Dickey and Fuller (1979) and Phillips-Perron (PP) conventional unit root tests developed by Phillips and Perron (1988) were employed for the stationarity test. In addition to conventional unit root tests, the Lee and Strazicich (2003, 2004) structural-break unit root test was applied to avoid the false-stationarity problem. After stationarity tests, the ARDL co-integration test suggested by Pesaran et al. (2001) was conducted in order to check whether there is co-integration between variables.

The equation structured for the tourism-based EKC model for our study is given in Equation 4 below:

$$EF = f\,(TA, Y, KOFsos, URB) \tag{4}$$

The formulation given in Equation 4 was transformed into logarithmic form and given in Equation 5 below.

$$LnEF_t = \beta_0 + \beta_1 LnTA_t + \beta_2 LnTA_t^2 + \beta_3 LnTA_t^3 + \beta_4 LnY + \beta_5 LnKOF_{sos} + \beta_6 LnURB + \varepsilon_{i,t} \tag{5}$$

Where EF denotes per capita ecological footprint, Y denotes per capita real GDP, TA, TA^2, and TA^3 denote the number of tourists, squares, and cubes of the number of tourists, respectively; KOFsos denotes the social globalization index; and URB denotes the urbanization rate. β_1, β_2,… β_6 are regression coefficients, whereas ε_{it} denotes the error term.

In the ARDL model, the first step is to estimate the unrestricted error correction model. Equations 6 and 7 exhibit the long- and short-term equation forms. Equation 4 is adapted to the ARDL model with the variables employed in our study, respectively:

$$\Delta \ln EF = \beta_0 + \sum_{i=1}^{n}\beta_{1i}\,\Delta \ln EF_{t-i} + \sum_{i=1}^{n}\beta_{2i}\,\Delta \ln TA_{t-i} + \sum_{i=1}^{n}\beta_{3i}\,\ln TA^2_{t-i} + \sum_{i=1}^{n}\beta_{4i}\ln TA^3_{t-1} + \sum_{i=1}^{n}\beta_{5i}\ln Y_{t-1} + \sum_{i=1}^{n}\beta_{6i}\ln KOF_{SOS\ t-1} + \sum_{i=1}^{n}\beta_{7i}\ln URB_{t-1} + \varepsilon_t + \beta_8 \ln EF + \beta_9 \ln TA + \beta_{10}\ln TA^2 + \beta_{11}\ln TA^3 + \beta_{12}\ln Y + \beta_{13}KOF_{SOS} + \beta_{14}\ln URB + \mathcal{E}_t \quad (6)$$

$$\Delta \ln EF = \beta_0 + \sum_{i=1}^{n}\beta_{1i}\,\Delta \ln EF_{t-i} + \sum_{i=1}^{n}\beta_{2i}\,\Delta \ln TA_{t-i} + \sum_{i=1}^{n}\beta_{3i}\,\ln TA^2_{t-i} + \sum_{i=1}^{n}\beta_{4i}\ln TA^3_{t-1} + \sum_{i=1}^{n}\beta_{5i}\ln Y_{t-1} + \sum_{i=1}^{n}\beta_{6i}\ln KOF_{SOSt-1} + \sum_{i=1}^{n}\beta_{7i}\ln URB_{t-1} + \alpha_8 ECT_{t-1} + \varepsilon_t \quad (7)$$

In Equation 7, ECT denotes the error correction term, and its value is expected to be between 0 and –1. This shows the direct convergence to the long-term equilibrium value.

4. Results

In the stationarity analysis, the first step of the time series analyses, ADF (1979) and PP (1988) tests, conventional unit root tests, were conducted, and their results are exhibited in Table 2. According to these results, all of the variables were found to be co-integrative at the first degree in both methods.

Table 2

ADF-PP Unit Root Test Results

	ADF Test				PP Test			
	Level		First Degree Difference		Level		First Degree Difference	
Variables	Fixed	Fixed-trend	Fixed	Fixed-trend	Fixed	Fixed-trend	Fixed	Fixed-trend
LnY	0.882	–2.694	–7.551***	–7.911***	1.192	–2.631	–7.551***	–7.987***
LnURB	–1.035	–2.697	–4.294***	–4.362***	–0.692	–2.137	–4.320***	–4.356***
LnKOF $_{SOS}$	0.092	–1.509	–5.277***	–5.208***	–0.127	–1.509	–5.208***	–5.133***
LnEF	–0.769	–3.182	–6.311***	–6.190***	–0.699	–3.180	–6.273***	–6.136***
LnTA	–0.399	–2.287	–6.590***	–4.756***	–0.371	–2.362	–6.591***	–6.503***

Note: Critical values were –4.192, –3.520, and –3.191 at 1%, 5%, and 10% significance levels, respectively; *,**,and *** denote 10%, 5%, and 1% significance levels, respectively.

Timely, it is possible that series include unit roots because of conditions that may arise with the current economy, such as crises and political shifts. Such structural variations are described as breaks that could hardly be detected by conventional unit root tests (Sevüktekin & Çınar, 2014, p. 413). In analyses in which structural breaks are taken into consideration, many non-stationary series might display stationary characteristics. In order to overcome this false stationarity issue, the Lee and Strazicich (2003, 2004) structural-break unit root test was preferred in our study.

Lee and Strazicich (2003) suggests that if there are multiple breaks within the time series analyzed, the estimation accuracy of a unit root test considering a single break could be questionable. Therefore, we preferred the LM unit root test, which allowed at least two breaks for series in both level and slope, and Table 3 exhibits the obtained results.

Table 3

Results of LM Unit Root Test with Two Breaks: Model A

Variables	$S_{(t-1)}$	T_B		k
LnY	–3,115	1999;	2009	2
LnURB	–3,385*	1987;	1997	8
LnKOF $_{SOS}$	–3,217	1988;	1994	7
LnEF	–2,547	1987;	2005	7
LnTA	–3,665**	1999;	2004	7

Note. k denotes appropriate lag lengths. T_B denotes the estimated break time; S_{t-1} denotes the test–statistics of LM unit root test with two breaks. Critical values at 1%, 5%, and 10% significance levels were –4.073, –3.563, –3.296, respectively; ***, **, and * denote 1%, 5%, and 10% significance levels.

According to the results of Model A, a two-break LM test with constant structural break dates for Ln Y, Ln URB, Ln KOFsos, Ln EF, and Ln TA variables were determined as 1999–2009, 1987–1997, 1988–1994, 1987–2005, and 1999–2004, respectively. Whereas the Ln URB and Ln TA variables remained stationary at the level with the structural break, other variables contained unit roots with the structural break.

In this case, it was required to decide which test to prefer in order to investigate whether there is long-term co-integration between variables or not. For conventional co-integration tests, it is important for variables to be co-integrative to the same degree, and this situation is a restriction for conventional co-integrative tests. Furthermore, having differences might cause data loss in time series. However, the ARDL co-integration test suggested by Pesaran et al. (2001) allows us to test co-integration among co-integrative series with different degrees. The ARDL model depends on the least-squares method; and its essential advantage is that it allows co-integration tests even though variables are I(0) or I(1) and yield meaningful results (Paudel & Jayanthakumaran, 2009, p. 137). Accordingly, the ARDL model was preferred for our study as a co-integrative method.

In order to determine whether there is a long-term co-integration correlation among variables, the estimated *F* test statistic value is required to be greater than the one exhibited in the table published in the study of Pesaran et al. (2001). If the *F* test statistic is greater than the upper critical value, this could be interpreted as the correlation having a co-integration characteristic, which requires structuring long- and short-term equations.[1] The model estimations were assessed, and lag lengths in the model were determined as (1,1,1,4,0,4,4) with respect to the Akaike information criterion. Alternative models for lag length are exhibited in Figure 2.

[1] If all of the variables are stationary at the level, the lower critical value is taken into consideration; if it is different or if it is stationary when its difference is taken, the upper critical value is taken into consideration.

Figure 2

Lag-Length Alternative Models

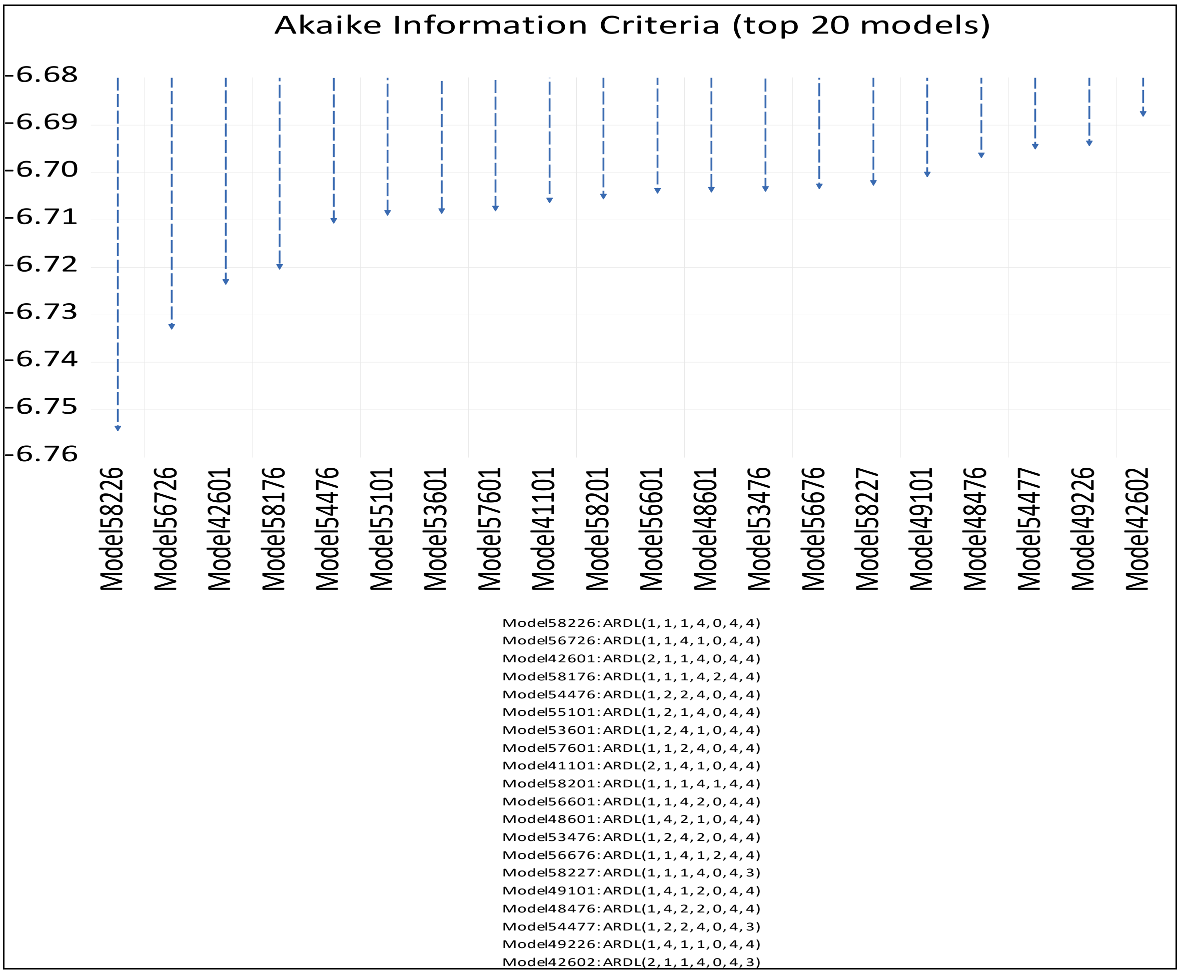


Table 4 exhibits *F* test results; the obtained *F* test value was 9.59; a co-integrative relationship was determined among relevant variables at the 1% significance level. This result suggested we move on to the next level of the analysis.

Table 4

F-test Results

Test statistics	Value	Kk
F-test	9.599	5
	Critical values	
Significance Levels	Lower Limit	Upper Limit
10%	2.12	3.23
5%	2.45	3.61
2.5%	2.75	3.99
1%	3.15	4.43

Note. Where, k denotes the number of independent variables in the model. The number of lags was taken as 4 according to the Akaike criterion of the Eviews 12.0 software.

After finding a co-integrative correlation among variables, it was time to test the validity of the EKC hypothesis in cubic form. To that end, coefficient results were exhibited in Table 5 together with the diagnostic tests below:

Table 5

Estimation Coefficients of the ARDL Model (1, 1, 1, 4, 0, 4, 4)

Panel A: Long-Term Flexibilities			
Variables	Coefficient	t-Statistics	Probability
LnTA	42.02651	4.535642	0.0003
$LnTA^2$	–6.098795	4.489955	0.0003
$LnTA^3$	0.294625	–4.209512	0.0003
LnY	–0.276105	–1.973629	0.0640
LnURB	–0.109215	–3.173148	0.0053
$LnKOF_{sos}$	1.058668	3.125546	0.0058
EC = LnEKO – (42.0265*LnTA – 6.0988*$LnTA^2$ + 0.2946*$LnTA^3$ – 0.2761*LnY –0.1092*LnURB + 1.0587*$LnKOF_{SOS}$)			
Panel B: Short-Term Flexibilities			
C	–89.09107	–9.465856	0.0000
D(LnTA)	23.29730	4.481428	0.0003
D($LnTA^2$)	–3.403516	–4.499648	0.0003
D($LnTA^3$)	0.164281	4.497110	0.0003
D($LnKOF_{SOS}$)	0.673148	2.465368	0.0240
D($LnKOF_{SOS}$(–1))	1.069149	3.985913	0.0009
D(LnY)	0.374699	6.383661	0.0000
D(LnY(–1))	0.785066	9.273824	0.0000
CointEq(–1)*	**–0.921474**	**–9.465469**	**0.0000**
Panel C: Diagnostic Tests			
R-squared: 0.724941; Adjusted R-square: 0.877703; Durbin Watson Stat: 2.580356			
		Test STATISTICS	Prob.
Heteroscedasticity Test ARCH:		0.125211	0.7255
Breusch-Godfrey Serial Correlation LM Test:		2.230725	0.1398
Ramsey-Reset Test:		0.215427	0.8320
Jarque-Bera Normality Test:		2.461915	0.2920

Table 6 shows that the long-term correlation between environmental pollution and the number of tourists was statistically significant, and the LnTA, $LnTA^2$, and $LnTA^3$ variables had positive, negative, and positive effects on environmental pollution, respectively. As generally accepted by the literature, the form of the EKC hypothesis is reverse U; thus, it is required that the coefficients of LnTA and $LnTA^2$ be positive and negative, respectively, and statistically significant, whereas the coefficient of $LnTA^3$ is not statistically significant. The obtained analysis results suggested an N-shape correlation between environmental pollution and international tourist arrivals. In consideration of other variables, the following results were determined: a negative and statistically significant correlation between growth (LnY) and environmental pollution; a positive correlation between globalization index ($LnKOF_{sos}$) and environmental pollution; and a negative and statistically significant correlation between urbanization rate (LnURB) and environmental pollution.

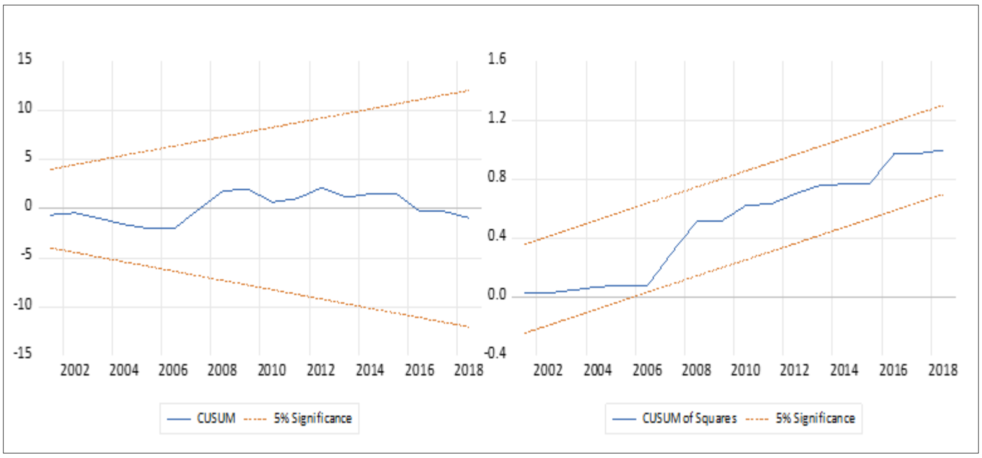
Various diagnostic tests were necessary to measure the reliability of these results. To that end, the Breusch Godfrey LM test was conducted to check auto-correlation with the structured model; the ARCH test was conducted to check heteroscedasticity; the Jarque-Bera Normality test was conducted to determine the distribution of time series; and finally, the Ramsey-Reset test was conducted to check the accuracy of the specification. Our results are summarized in Table 6. According to our test results, series were found to have a normal distribution; there were neither autocorrelation nor heteroscedasticity issues with the model; and the structured model contained no specification error.

The EKC is a long-term hypothesis. However, it is crucial to determine whether the error correction model is functional to ensure the consistency of the structured model. Therefore, it is beneficial to look up short-term data for the reliability of our results. Table 6 also exhibits short-term results for our estimation model. According to Table 6, the error correction term was negative (–0.92) and statistically significant, suggesting that the structured model had stable equilibrium, and the long-term convergence of short-term deviations in the ecological footprint takes about 1.7 years. In consideration of short-term correlations between the number of tourists and environmental pollution, parallel results were seen with long-term coefficients. Correlations between LnTA, $LnTA^2$, and $LnTA^3$ variables and environmental pollution were found to be positive, negative, positive, and statistically significant, respectively. This result suggested that an N-shape Kuznets Curve is valid, which supported our long-term findings.

To test the consistency of the analysis results, the CUSUM test and the CUSUM of Squares test were estimated by taking the cumulative sum of consecutive errors exhibited in Figure 3. Our results suggested no structural break in the model; the structured model was consistent.

Figure 3

CUSUM and CUSUM of Squares Test



5. Conclusion

The tourism industry not only makes a significant contribution to the economy but also affects other industries. Tourism development leads to increased energy demand and urbanization, which in turn result in environmental pollution (Bozkurt et al., 2016, p. 59). Considering that tourism is closely interconnected with the natural environment, research, studies, and policies related to tourism and the environment are of paramount importance.

In the present study, the impact of tourism on environmental pollution was investigated for the Turkish economy on the basis of annual data from the period 1975–2018 within the EKC hypothesis framework by means of the ARDL limit test. Our findings indicated an N-shaped correlation between per capita ecological footprint and the number of international tourist arrivals in both the short and long term. Additionally, long-term negative, positive, and negative correlations were determined between the ecological footprint and per capita real GDP, KOF social globalization index, and urbanization rate, respectively.

We looked at the data and found an N-shape EKC function between pollution and tourist arrivals. This suggests that the EKC hypothesis was not supported by this set of data; even at high levels of tourism development, it could make the damage to the environment worse. In this case, environmental pollution increases during the initial period of experiencing tourism-based development. Even though pollution decreases after reaching a certain level of welfare, it tends to increase again in the subsequent period.

Regarding the validity of the EKC hypothesis, economic policies put nearly unlimited pressure on the environment to gain higher growth because the fundamental argument upon which the hypothesis is erected is that pollution would decrease on its own after a certain threshold, along with increasing income. The policy suggested at this point is to do nothing about environmental destruction. However, following such policies introduces a series of risks and hazards. Suppose developing countries like Türkiye overlook preserving the environment by relying on increasing income levels to remediate the environmental costs of such high growth. In that case, they will reach a point of no return. Another risk is the possibility that the hypothesis is wrong. Relying on estimations of the hypothesis would continuously result in poor environmental preservation, as well as this could mean that developing countries ignoring environmental preservation would never reach an income level that would guarantee their economic growth (de Vita et al., 2015, pp. 7–8).

From this point, it is possible to state that tourism-based economic growth would not be enough to overcome environmental issues on its own. Our findings revealed that domestic and national policies to fight against pollution are required to be developed instead of waiting for tourist arrivals, and environmental pollution decreases after a threshold. Especially for developing countries like Türkiye, it would be more appropriate to design and implement active policies, including incentives and regulations aimed at environmental preservation, rather than relying solely on income growth to mitigate environmental destruction. In this case, it is important to consider environmental policies together with economy policies that are practiced or that would be practiced in Türkiye, the utility of renewable energy resources, the development of environment-sensitive technologies, sustainable development policies, and rising environmental awareness in society in attempts to ensure economic development and growth targets. Furthermore, increasing the share of renewable energy resources would decrease the need for further conventional energy, which could decrease the current account balance deficit.

Tourism is not an industry that can only be assessed by the number of arriving tourists. Different parameters, such as tourism incomes and receipts, could be included in the model to better represent the tourism industry. However, the limitation of this study was the lack of possibility of reaching these data for the concerned study period. It is suggested for future studies that tourism-environment relationships could be investigated with these parameters in more detail.

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ETHICS

The authors declare that this article complies with ethical standards and rules.

AUTHOR CONTRIBUTION

Hilal Şeker | Concept/idea; Literature review; Design; Drafting; Data collection/analysis; Interpretation of data/findings; Supervising; Critical review; Final approval and accountability. Contribution rate: 50%

Melahat Avşar | Concept/idea; Literature review; Design; Drafting; Data collection/analysis; Interpretation of data/findings; Supervising; Critical review; Final approval and accountability. Contribution rate: 50%

CONFLICT OF INTEREST

The authors declare no conflict of interest.

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