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The Validity of the Tourism-induced EKC Hypothesis: The Case of Turkey

Turizm Kaynaklı EKC Hipotezinin Geçerliliği: Türkiye Örneği

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ABSTRACT

This paper examines the existence of relationship between international tourist arrivals (TA), and Carbon dioxide emissions per capita (CO2) in Turkey over the period 1960-2015. We also use energy use per capita (EU) and GDP per capita (GDP) as a control variables. The autoregressive distributed lag (ARDL) bounds test approach was applied to analyze the long-run relationship among the variables. The results confirmed the validity of the tourism-induced Environmental Kuznets Curve (EKC) hypothesis. An increased tourism demand increases environmental pollution up to a point where the sector attains a certain development level, after which emissions begin to fall. On the other hand, the results indicate that the EKC hypothesis between income and CO2 emissions has not been confirmed. Energy usage has positive and significant effects on carbon dioxide emissions as expected. For sustainable tourism and to the reduction of emissions in Turkey, environmental protection and the use of renewable energy should be supported by policy makers.

Anahtar Kelimeler:

Turizm

ÇKE Hipotezi,

ARDL Sınır Testi,

Türkiye

ÖZET

Bu makale, 1960-2015 döneminde Türkiye'de uluslararası turist varışları (TA) ile kişi başına düşen Karbondioksit emisyonları (CO2) arasındaki ilişkinin varlığını incelemektedir. Ayrıca, kontrol değişkenleri olarak kişi başına düşen enerji kullanımını (AB) ve kişi başına düşen GSYİH'yı (GSYİH) kullanıyoruz. Değişkenler arasındaki uzun dönemli ilişkiyi analiz etmek için otoregresif dağıtılmış gecikme (ARDL) sınırları testi yaklaşımı uygulandı. Sonuçlar, turizm kaynaklı Çevresel Kuznets Eğrisi (EKC) hipotezinin geçerliliğini doğruladı. Artan turizm talebi, çevre kirliliğini sektörün belirli bir gelişme düzeyine ulaştığı noktaya kadar artırmakta ve ardından emisyonlar düşmeye başlamaktadır. Öte yandan, sonuçlar, gelir ve CO2 emisyonları arasındaki EKC hipotezinin doğrulanmadığını göstermektedir. Enerji kullanımının karbondioksit emisyonları üzerinde beklendiği gibi olumlu ve önemli etkileri bulunmaktadır. Türkiye'de sürdürülebilir turizm ve emisyonların azaltılması için çevrenin korunması ve yenilenebilir enerji kullanımı politika yapıcılar tarafından desteklenmelidir.

1. INTRODUCTION

In recent years, we have started to hear more and more about the terms "climate change" and "global warming" which refers to the rise in the average global temperatures by increased concentrations of greenhouse gases (GHG) in the atmosphere. They are among the most important problems because of the increase in the concentration of GHG, which has significant negative effects on humans and the environment worldwide. There are a lot of factors such as economic growth, gross capital formation, trade openness, urbanization, agriculture, energy use, tourism, etc. which lead to an increase in GHG emissions. The countries that heavily dependent on their natural resources and environment are affected much more negatively by global warming. It is necessary to take quick measures in all areas which include agriculture, forestry, energy, infrastructure, tourism, energy-intensive manufacturing industries, etc. Otherwise, global warming will increase hunger and water crises, health problems, low employment and growth, loss of biodiversity, spreads of pests and pathogens, etc. Tourism is a sector that provides significant income, employment, and foreign exchange for many countries. But on the other hand, it also causes pollution because of waste, energy use, and transportation. As the tourism industry is a rapidly growing industry and has a high level of relationship with other industries, it causes large amounts of carbon dioxide (CO2) emissions and negative influence on climate change and the ecological environment.

The relationship between the international tourism sector, energy consumption and, greenhouse gases attracts the attention of many researchers in recent years (Chishti et al., 2020; Koçak et al., 2020; Balsalobre-Lorente et al., 2020; Ben Jebli, et al., 2019; Tang et al., 2018; Azam et al., 2018; Doğan and Aslan, 2017; Shakouri et al., 2017; Ben Jebli et al., 2015; Katircioğlu, 2014a; Katircioğlu, 2014b; Lee and Brahmasrene, 2013; Tiwari et al., 2013). Depending on the purpose, energy usage in the tourism sector can be divided into two groups as transportation and destination (accommodation, food, and beverage, touristic activities, etc.). For this reason, the relationship and estimates of energy consumption and GHG emissions in the tourism sector are very important in terms of policy recommendations (Wu and Shi, 2011). Becken and Simmons (2002) report that tourist attractions and activities increase energy demand which causes environmental pollutions.

There has been an increasing trend in global GHG emissions since the beginning of the 21st century. CO2 emissions are is the most important greenhouse gases generated from human activities and the main responsible for global warming (EPA, 2019). One of the GHG is CO2 which is the largest contributor to climate change and comes heavily from the combustion of fossil fuels. GHG emissions have been increasing since the first industrial revolution which led to significant increases in energy use and output. A serious decline in carbon emissions is required to keep the world at a livable temperature. In 2019, China (30.34%), the United States (13.43%), India (6.83%), the EU27+UK (8.69%), Russia (4.71%), and Japan (3.03%)- the world's largest CO2 emitters- together accounted for 67% of total global fossil CO2. China and the US, are responsible for more than 40% of the global emissions. Turkey is responsible for 1.09% of the global emissions in 2019 (Crippa et al., 2020; WEFORUM, 2019). The statistics show that the level of carbon dioxide emissions increased during the last years in Turkey and rose from 205.7 million metric tons in 2000 to 383.3 million metric tons in 2019 (Statista, 2020). Turkey's high economic and population growth strongly increases the energy demand. In 2018, Turkey's primary energy supply consists of petroleum 29.2%, natural gas 28.6%, hard coal 17.4% lignite 10.5% and geothermal 5.8% which the share of fossil resources is 86.3%. They have negative effects on air and environmental pollution (MMO, 2020).

The energy sources for doing work are called nonrenewable and renewable. In many countries, most energy sources are nonrenewable such as fossil fuels (coal, natural gas and petroleum), hydrocarbon gas liquids and nuclear energy. Increasing consumption of fossil fuels in the world depending on industrialization, increase of the world population and the quality of life cause environmental pollution, which causes an increase in health risks and global climate change problem (Panwar et al., 2011). Energy requirements are largely met by transforming fossil fuels into various forms of energy but different GHG emissions are released into the atmosphere during this transformation process (Kelly & Williams, 2007).

International tourism is one of the largest and fastest-growing sectors in the world and now represents 10% of global employment and 10% of global GDP (World Tourism Organization (UNWTO) and International Transport Forum (ITF), 2019). The technical report in 2008, prepared by an expert team of the United Nations, is the first detailed initiative to determine the global share of tourism-induced CO2 emissions (UNWTO et al., 2008). According to the report, tourism makes a significant contribution to climate change and emissions are expected to increase significantly in the future. It was estimated that between 3.7% and 5.4% of global CO2 emissions in 2005 originated from the tourism-related sectors (transport, accommodations and activities) and the transportation sector causes around 75% of the CO2 emissions generated by tourism (UNWTO et al., 2008). Transport-related

CO_2 Emissions of the Tourism Sector Report has been prepared to update the estimate of the largest component of tourism GHG emissions which are transport-related emissions by UNWTO and the International Transport Forum (ITF) in 2019. The estimation results for 2030 show that the total expected transport-related tourism emissions (excluding cruise) is 1.998 million tonnes of CO_2 which would represent 23% of the total expected transport emissions (UNWTO and ITF, December 2019). Gössling (2013) analyzed national emissions from tourism and indicate that emissions from tourism are equivalent to 5-15% of official national emissions and growing rapidly.

The COVID-19 pandemic shows that the world tourism industry is experiencing a negative trend due to the decline in tourism demand. For this reason, countries that are dependent on tourism in terms of foreign exchange earnings and employment have been adversely affected by the COVID-19 pandemic period. Under the international tourism 2020 scenarios (UNWTO, 7 May 2020), international tourism is expected to decrease by 60-80%. This means 850 million to 1.2 billion international tourists and 100 to 120 million tourism jobs lost. Therefore, it is estimated that tourism revenues will decrease by US$910 billion to US$1.2 trillion in 2020. Therefore, COVID-19 is not only causing a health-related crisis, but also an economic crisis. However, the decreasing demand in the tourism sector causes a decrease in CO_2 emissions in the world. Global greenhouse gas emissions fell suddenly roughly 10 to 30 per cent on average during April 2020 because of COVID-19-related restrictions (Forster et al., 2020). Liu et al. (2020) stated that in the first half of 2020, there was a sudden drop in global CO_2 emissions of 8.8% compared to the same period of 2019. According to Gössling et al. (2020), the main causes of increased CO_2 emissions and pandemic threats in the 21st century are similar. Factors such as increasing population, urbanization, industrialization, increase in production, transportation and increased mobility in the world are effective in the spread of pathogens.

Especially after the industrial revolutions, the dependence of production on energy and the predominance of fossil fuels in energy production cause environmental pollution. For this reason, there are studies and models investigating the relationship between production and environmental pollution. The environmental Kuznets curve (EKC) hypothesis (Grossman and Krueger, 1991; Grossman and Krueger, 1995) claims that while an increase in income at low-income levels has harmful effects on the environment after the income level reaches a certain level, the negative effect of the increase in income on the environment begins to decrease. This is because as the country develops and new technologies are found, environmentally friendly production begins. The hypothesis is called the inverted U-shaped hypothesis. Similar to the EKC hypothesis, it is expected an inverted U-shaped type relationship between tourism arrival and environmental degradation is called the tourism-induced EKC hypothesis. Because tourism demand is highly sensitive to environmental quality. An increased tourism demand increases environmental pollution up to a point where the sector attains a certain development level, after which emissions begin to fall.

Within the framework of the variables mentioned above, we analyze the long-term relationship among CO_2 emissions, the number of tourists' arrivals, economic growth, and energy usage for Turkey. We also investigate the question which whether or not does the tourism sector increase environmental pollution? The rest of the paper is organized as follows. The second section is a literature review explaining the relationship between tourism and environmental pollution with other explanatory variables. The third section reports the empirical results and their discussions. A summary of the analysis results and some suggestions for further research are presented in section four.

2. LITERATUR REVIEW

Academic studies on global warming and environmental pollution have been increasing in recent years. The impact of the tourism sector on global warming is one of the research topics (Chishti et al., 2020; Koçak et al., 202; Balsalobre-Lorente et al., 2020; Ben Jebli, et al., 2019; Tang et al., 2018; Azam et al., 2018; Fang et al. 2018; Doğan and Aslan, 2017; Shakouri et al., 2017; Pandy, 2017; Hoogendoorn and Fitchett, 2016; Ben Jebli et al., 2015; Katircioğlu, 2014a and 2014b; Lee and Brahmasrene, 2013; Tiwari et al 2013; Scott and Lemieux, 2010; Dwyer et al., 2009). Using different methods, they analyzed whether the tourism sector has an impact on GHG emissions. Lenzen et al. (2018) find that tourism's global carbon footprint has increased from 3.9 to 4.5 $GtCO_2e$ between 2009 and 2013 using 160 countries data. They also state that the rapidly growing tourism sector will constitute an increasing part of the world GHG emissions due to its high carbon intensity in the future. Since the tourism industry is the most diverse business sector, It is not easy to determine tourism-related energy consumption. The results of the research on tourism and CO_2 emissions are inconclusive. Some studies have concluded that transport is the main driver of GHG emissions (Unger et al., 2016; Nepal, 2008; UNWTO, UNEP, WMO, 2008; Sarrano-Bernardo et al., 2012). Liu et al. (2011) suggest that the input-output analysis could be used in computing CO2 emission from energy consumption for different sectors related to the tourism industry. They also emphasize the important contribution of the transportation sector to carbon emissions. Solarin (2013), Katircioğlu et al. (2014), Hoyer (2000) and Saenz-de-Miera & Rossello (2014) found a positive relationship between tourist arrivals and emissions. On the other hand, some studies (Scott 2011; Weaver 2011; Lee and Brahmasrene 2013) indicate that sustainable tourism could cause a decrease in CO2 emissions. That is why the relationship between tourism development and CO2 emissions is not always positive. Balsalobre-Lorente et al. (2020), Shakouri et al. (2017), Sherafatian-Jahromi et al. (2017) and Paramati et al. (2016) found the tourism-induces EKC hypothesis between tourism and environmental pollutions. The tourism sector is a highly climate-sensitive economical sector and has affected by weather and climate variations. Thus, there may be a bilateral relationship between the tourism sector and climate changes. This result is very important and will cause problems like unemployment, inequality, poverty and migration in the future for the global economy. Some studies analyzing the relationship between CO2 emissions and tourism are briefly summarized in Table 1 below.

Table 1. Summary of the Studies that Examined the Tourism-CO2 Relationship

Author	Time period	Country	Methodology	Results
Chishti et al. (2020)	1980-2018	5 South Asian countries	Non-linear autoregressive distributed lag (NARDL) technique	Increased tourism demand has negative signs on pollution in Bangladesh, India and Pakistan, while adverse results are found in Nepal and Sri Lanka.
Khan et al. (2020)	1975-2017	Developing economies and Pakistan	ARDL and Granger causality tests	It is found a positive relationship between tourism and CO_2 emissions both in the long- and short run.
Balsalobre-Lorente et al. (2020)	1994-2014	OECD countries	Fully modified ordinary least squares (FMOLS) model	An inverted U-shaped relationship exists between tourism and CO_2 emissions.
Koçak et al. (2020)	1995-2014	Top 10 visited economies	Fully modified (CUP-FM) and the continuously updated bias-corrected (CUP-BC) estimators	Tourism arrivals contribute to carbon increase, while tourism receipts contribute to carbon reduction in the long-run.
Ben Jebli, et al. (2019)	1995-2010	22 Central and South American countries	FMOLS and dynamic ordinary least squares (DOLS) panel estimate methods	The number of tourist arrivals has a negative influence on emissions, while trade and economic growth have a positive effect on CO_2 emissions.
Nepal et al. (2019)	1975-2014	Nepal	ARDL and Granger causality tests	Tourism has been found to have a positive relationship with carbon emissions.

Azam et al. (2018)	1990-2014	Malaysia, Thailand and Singapore	The fully modified ordinary least squared regression (FMOLS)	It is found a positive relationship between tourism and environmental pollution in Malaysia but there is an inverse relationship between the variables in Thailand and Singapore.
Shakouri et al. (2017)	1995-2013	12 selected Asia-Pasific countries	Panel vector autoregression, panel Granger causality test, Panel GMM-model	The tourism-induced EKC hypothesis is valid in Asia-Pacific countries.
Işik et al. (2017)	1970-2014	Greece	ARDL	Tourism expenditure has positive effects on Greece's CO_2 emissions.
Doğan and Aslan (2017)	1995-2011	The European Union and candidate countries	Heterogenous panel estimation techniques	Energy consumption increases emission level, while real income and tourism developments decrease CO_2 emissions.
Sherafatian-Jahromi et al. (2017)	1970-2010	Five Southeast Asian countries	Panel econometric methods	A nonlinear relationship exists between tourism and environmental pollutions confirming the tourism-induced EKC hypothesis.
Paramati et al. (2016)	1995-2012	26 developed and 18 developing economies.	Robust panel econometric techniques	An inverted U relationship exists between CO_2 emissions and tourism growth.
Ben Jebli et al. (2015)	1990-2010	Tunisia	ARDL and Granger causality test	International tourism affects positively CO_2 emissions and also CO2 emissions decrease international tourism.
Sajjad et al. (2014)	1975-2012	South Asia, Middle East and North Africa (MENA), sub-Saharan Arica, and East Asia and Pacific regions	ARDL, Granger causality tests	There is a negative relationship between CO_2 emissions and international tourism expenditures in South Asia, the MENA region, and East Asia and Pasific but a positive relationship with sub-Saharan Africa.
Solarin (2014)	1972-2010	Malaysia	ARDL, Granger causality analysis and DOLS model	There is a positive correlation between carbon dioxide emissions and tourism arrivals.
Katircioğlu (2014)	1960-2010	Turkey	ARDL	Tourist arrivals increase CO_2 emissions, but the coefficient of tourist arrival is positively inelastic.
Durbarry and	1978-2011	Mauritius	ARDL	Although the increase in tourist demand has a positive effect on CO2 emissions, the contribution of tourism to emissions is

Seetanah (2015)				relatively small compared to other explanatory variables.
Katircioğlu et al. (2014)	1970-2009	Cyprus	ARDL, Granger causality tests.	Increased tourism demand leads to CO_2 emissions.
Katircioğlu (2014b)	1971-2010	Singapore	DOLS model	It is found a U-shaped relationship between tourism and pollution confirming the tourism-induced EKC hypothesis.
Lee and Brahmasrene (2013)	1988-2009	European Union countries	Panel cointegration and fixed effects models	Economic growth has a positive effect while tourism and FDI have a negative influence on CO_2 emissions.
Tiwari et al. (2013)	1995-2005	25 OECD countries	Panel-data Vector Autoregression (PVAR)	Tourism has insignificant impact on CO_2.

3. GENERATION OF THE DATA

3.1. Theoretical Model

As we mentioned above, there are different determinants of environmental pollution such as GDP, energy and electricity consumptions, tourism, trade openness, urbanization, financial development, agriculture. This study mainly examines the possible influence of tourism arrival (TA) on air pollution in Turkey which is the main tourism destination of the world. The dependent variable is CO2 emission which accounts for over 50% of green gas emissions and is an indicator of air pollution. We used GDP and square of GDP as an independent variable to test the existence of the Environmental Kuznets Curve (EKC) hypothesis, which investigates the relationship between real income growth and environmental pollution. WE used also TA and square of TA to test tourism induced EKC hypothesis, which determines the relationship between tourist arrivals and environmental pollution. The other independent variable is energy consumption (EU). Tourism is an energy-dependent sector and is an important determinant of income in Turkey. Therefore, we included GDP, tourism arrivals and energy use as independent variables in the model to determine the effects of these variables on CO2 emissions. The model is specified as follows:

$$CO2_t = f(\,GDP_t, GDP_t^2\; TA_t, TA_t^2, EU_t)$$

We used the model which is the log-linear form and written as follows:

$$lnCO2_t = \beta_0 + \beta_1\, lnGDP_t + \beta_2\, lnGDP_t^2 + \beta_3 lnTA_t, +\beta_4\, lnTA_t^2 + B_5 lnEU_t\, + \mu_t$$

All data used in this study are annual and collected from the World Bank's (WB) World Development Indicators (WDI) database between 1960 and 2015, according to data availability. Table 2 indicates the variables as well as their definitions and sources of data. All variables are in natural logarithmic forms.

Table 2. Variables and definitions (1960-2015)

Symbol	Definition and units of measurement
CO_2	Carbon dioxide emissions measured as metric tons per capita
GDP	GDP per capita (constant 2010 US$)
GDP^2	The squared term of GDP
TA	International tourism, number of arrivals

TA^2	The squared term of TA
EU	Energy use (kg of oil equivalent per capita)

The hypotheses of this paper are as follows.
Hypothesis 1: According to the Environmental Kuznets Curve (EKC) approach, it is expected that the β1 parameter will be positive and the β2 parameter will be negative (β1> 0, β2< 0).
Hypothesis 2: According to an inverted U-shaped relationship between TA and CO2, the β3 parameter is expected to be positive and the β4 parameter to be negative (β3> 0, β4< 0).
Hypothesis 3: Increasing energy usage increases CO2 emissions (β5> 0).

4. RESULTS

4.1. Unit Root Test

In the first stage of the analysis, Phillips-Perron (PP) and DF-GLS unit root tests were applied to investigate the stationarity level of the variables. The DF-GLS test stands out due to its strong performance in small samples (Elliot et al., 1996). The results of the unit root test which are applied intercept and intercept and trend form of PP are presented in Table 3. GDP, GDP2, TA and TA2 variables have unit roots in their level forms at a 5 per cent significance level and they are integrated after the first differences. On the other hand, we can reject the null of unit root for CO2 variable which is found to be stationary in level.

Table 3. Phillips-Perron unit root analysis

	Level		1st Difference	
Variable	Constant	Constant&Linear Trend	Constant	Constant&Linear Trend
lnCO2	-3.6605* (0.0075)	-3.0081 (0.1394)	-	-
lnEU	-1.1352 (0.6956)	-2.5675 (0.2962)	-7.2167* (0.0000)	-7.2961* (0.0000)
lnGDP	0.3067 (0.9766)	-2.3060 (0.4236)	-7.2704* (0.0000)	-7.2178* (0.0000)
$LnGDP^2$	0.5898 (0.9882)	-1.9903 (0.5935)	-7.2003* (0.0000)	-7.1862* (0.0000)
lnTA	-1.6231 (0.4642)	-2.5727 (0.2939)	-7.8343* (0.0000)	-7.9982* (0.0000)
$lnTA^2$	-0.9539 (0.7633)	-2.5185 (0.3184)	-8.1397* (0.0000)	-8.1342 (0.0000)
*Significant at 5% level of significance. Null hypothesis: the series has a unit root				

DF-GLS unit root test results are given in Table 4. GDP, GDP2 and TA2 variables are significant at the levels. Thus, the null hypothesis which variables contain a unit root are rejected. CO2, TA, and EU variables are stationary at the first difference.

Table 4. DF-GLS Unit Root Test

	Level		1st Difference	
Variable	Constant[a]	Constant&Linear Trend[b]	Constant[a]	Constant&Linear Trend[b]
lnCO2	1.5204	-1.4276	-7.9811*	-7.1508*
lnEU	1.8655	-2.5671	-6.2942*	-6.7649*
lnGDP	2.7460*	-2.3278	-	-
$LnGDP^2$	2.8847*	-2.0867	-	-

lnTA	1.7933	-1.9571	-7.7341*	-8.0457*
$lnTA^2$	2.0625*	-2.2465	-	-
*Significant at 5% level of significance. Null hypothesis: the series has a unit root a-Test critical value: 5% level -1.9468 b- Test critical value: 5% level: -3.1740				

4.2. ARDL Bound Test

Because we have a group of time-series, some I(0), others I(1), we employed the ARDL bound test to ensure the validity of long-run relationships among variables (Pesaran and Shin, 1998; Pesaran et al., 2001). In a classical cointegration test (Engle and Granger (1987), Phillips and Hansed (1990) and Johansen (1988)) all variables must be equally stationary. However, the ARDL model can be used if the variables are stationary to different degrees (except I (2)). ARDL model contains the lagged value(s) of the dependent variable, current and lagged values of regressors as explanatory variables. ARDL limit test developed by Pesaran et al. (2001) reveals long-term relationships between variables regardless of whether the series is I (0) or I (1). If variables are cointegrated after the boundary test, both short-run (ARDL) and long-run (VECM) models are used. The basic ARDL (p, q1, q2, q3, q4, q5) model used in the study around this advantage provided by the method can be expressed as follows:

$$lnCO2_t = \alpha + \sum_{i=1}^{p} \beta_{1i}(\ln CO2)_{t-i} + \sum_{i=0}^{q1} \beta_{2i}(lnGDP_{t-i}) + \sum_{i=0}^{q2} \beta_{3i}(lnGDP^2_{t-i}) + \sum_{i=0}^{q3} \beta_{4i}(lnTA_{t-i}) + \sum_{i=0}^{q4} \beta_{5i}(lnTA^2_{t-i}) + \sum_{i=0}^{q5} \beta_{6i}(lnEU)_{t-i} + \varepsilon_t$$

ARDL boundary test model adapted to work for cointegration;

$$\Delta lnCO2_t = \alpha + \delta_1 lnCO2_{t-1} + \delta_2 lnGDP_{t-1} + \delta_3 lnGDP^2_{t-1} + \delta_4 lnTA_{t-1} + \delta_5 lnTA^2_{t-1} + +\delta_6 lnEU_{t-1} + \sum_{i=1}^{p} \beta_{1i}\Delta(lnCO2)_{t-i} + \sum_{i=0}^{q1} \beta_{2i}\Delta(lnGDP)_{t-i} + \sum_{i=0}^{q2} \beta_{3i}\Delta(lnGDP^2)_{t-i} + \sum_{i=0}^{q3} \beta_{4i}\Delta(lnTA)_{t-i} + \sum_{i=0}^{q4} \beta_{5i}\Delta(lnTA^2)_{t-i} + \sum_{i=0}^{q5} \beta_{6i}\Delta(lnEU)_{t-i} + \varepsilon_t$$

ARDL bound test hypotheses are established as follows:

H0: $\delta_1 = \delta_2 = \delta_3 = \delta_4 = \delta_5 = \delta_6 = 0$ (no cointegration)

H1: $\delta_1 \neq \delta_2 \neq \delta_3 \neq \delta_4 \neq \delta_5 \neq \delta_6 \neq 0$ (cointegration)

Where Δ represents the first difference operatör; α is the constant term; and δ_1,.. δ_6 are the long-run coefficients; $\beta_1, \dots \beta_6$, represent the short-run coefficients; $p, q_1, .. q_5$ are optimal lag orders; ε_t represents the white noise error term.

The null hypothesis indicating that there is no cointegration among the variables is rejected when the calculated F statistic value is higher than the upper critical limit value (Pesaran et al. 2001. This result shows that there is a long-run relationship between variables. In case H0 is rejected, the next step is to estimate the Error Correction Model (ECM). At this stage, error testing is defined as follows to obtain short and long term dynamics:

$$\Delta lnCO2_t = \alpha + \sum_{i=1}^{p} \beta_{1i}\Delta(lnCO2)_{t-i} \sum_{i=1}^{q1} \beta_{2i}\Delta(lnGDP)_{t-i} + \sum_{i=1}^{q2} \beta_{3i}\Delta lnGP_{t-i}^{2} + \sum_{i=1}^{q3} \beta_{4i}\Delta(lnTA)_{t-i} + \sum_{i=1}^{q4} \beta_{5i}\Delta lnTA_{t-i}^{2} + \sum_{i=1}^{q5} \beta_{6i}\Delta(lnEU)_{t-i} + \lambda ECT_{t-1} + \varepsilon_t$$

The coefficient (λ) of the Error Correction Term ($ECT_{t-1)}$ is expected to be negative and statistically significant. It shows how long it will take for short-term shocks caused by independent variables to disappear and approach the long-term equilibrium value. $\beta_1, \ldots, \beta_6$ are the short-run dynamic coefficients of the model.

The long-run, as well as short-run results of income, income squared, tourist arrival, energy consumption on CO2, are reported in Table 5. Calculated F statistics (4.90608) is greater than the upper critical value (3.79) at a 5% level of significance. That is why the null hypothesis of no cointegration among variables are rejected. This confirms the presence of a long-run relationship among the variables.

Table 5. Estimated Coefficients from ARDL Model

Panel A: F Bound Test				
Model: ARDL(4, 1, 0, 0,0, 0) Case 3: Unrestricted Constant and No Trend	**F-Bounds Test Statistics**	**Significance**	**I(0)**	**I(1)**
	4.90608	%10 %5 %1	2.26 2.62 3.41	3.35 3.79 4.68
Panel B: Long-run elasticities Dependent Variable: $lnCO_2$				
Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
LNGDP	-0.011859	3.182400	-0.003726	0.9970
LNGDP2	0.014814	0.170866	0.086697	0.9313
LNTA	0.708563	0.279976	2.530798	0.0153
LNTA2	-0.023050	0.009038	-2.550330	0.0146
LNEU	0.935011	0.224230	4.169877	0.0002
EC = LNCO2 - (-0.0119*LNGDP + 0.0148*LNGDP2 + 0.7086*LNTA -0.0231*LNTA2 + 0.9350*LNEU)				
Panel C: Short-run elasticities and Error Correction Term				
Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
C	-6.249239	1.088574	-5.740758	0.0000
D(LNCO2(-1))	-0.097670	0.056718	-1.722035	0.0926
D(LNCO2(-2))	0.034747	0.053888	0.644807	0.5226
D(LNCO2(-3))	-0.111973	0.052741	-2.123051	0.0398
D(LNEU)	1.037990	0.072903	14.23805	0.0000
CointEq(-1)*	-0.523960	0.091173	-5.746856	0.0000
Panel D: Diagnostic Test Statistics				
Adjusted R-squared: 0.8463 Durbin-Watson stat: 1.9332				
			Test istatistiği	**Prob.**
Heteroskedasticity Test: Breusch-Pagan-Godfrey			7.9096	0.6377

Breusch-Godfrey Serial Correlation LM Test	0.2901	0.8649
Jarque-Bera Normality Test	0.8774	0.6448
Ramsey RESET Test	0.2879	0.5945

Table 5 reports the results for short and long-run estimates for the model with CO2 emissions as the dependent variable and economic growth, international tourist arrival and energy usage as independent variables. The coefficients $\beta1 < 0$ and $\beta2 > 0$ are not statistically significant and do not confirm the existence of the EKC hypothesis between economic growth and environmental degradation. This finding is not similar to the majority of studies, such as in Zaman et al. (2016), Solarin (2014), Al-Mulali et al. (2015), Shahbaz et al. (2015), Lee and Brahmasrene (2013), Katircioğlu (2014) and Ben Jebli et al. (2019) and consistent with Tiwari et al. (2013). Some studies find an N-shape relationship between the variables (Destek et al. 2020).

On the other hand, the results ($\beta3>0$ and $\beta4<0$) support the hypothesis that increasing tourism demand increases environmental pollution up to a point where the sector attains a certain development level, after which emissions begin to fall. These results confirm an inverted U-shaped relationship between international tourist arrival and CO2 emissions. The result is consistent with Katircioğlu (2014b), Sherafatian-Jahromi et al. (2017), Balsalobre-Lorente et al. (2002), Shakouri et al. (2017) and Paramati et al. (2016).

The analysis results also show that energy usage (EU) has a positive and significant impact on CO2 in the long run. A 1% increase in EU increases CO2 emissions by 0.935%. An increase in income, tourism, transportation and communication increases the demand for energy sources which production depends on mainly fossil fuels such as gas, oil and coal which produce CO2 and other GHG emissions. The result consistents with Khan et al. (2020), Say&Yücel (2006), Katırcıogle et al. (2014) and Doğan&Aslan (2017), Al-Mulali&Sheau-Ting (2014).

The analysis results also show that there is a short-run relationship between CO2 and energy usage as shown in Panel C of Table 5. This result confirms that the most important source of CO2 emissions is energy usage in the long run and short run. As can be seen in Table 5, the coefficient of the error correction term ECT_{t-1} (- 0.523) is negative and statistically significant confirming a long-run relationship between CO2 emissions, tourist arrival, income growth and energy usage. In addition, the error correction term states that 52,3% of an imbalance that occurs in the short run will disappear in the first year. In other words, an imbalance in the short term will come back to long-term equilibrium approximately in 2 years (1/ 0,523).

The results of diagnostic tests for the error-correction model, i.e. serial correlation test, functional form specification, normality test and heteroscedasticity test are reported in Panel D of Table 5. The test results accept null hypotheses stating that there is no econometric problem in the model.The estimated model also passes the diagnostic tests of normality and functional form. The diagnostic test results suggest that the estimated model is stable over the sample period. The high R-squared is indicative of the good explanatory power of the model. To check the stability of the short-and long-run estimates, CUSUM and CUSUM of squares are also employed. Figure 1 and Figure 2 show CUSUM and CUSUM of squares where CO2 is the dependent variable. The plots of both statistics are well within the critical 5% bounds that confirm the stability of coefficients in the error-correction model.

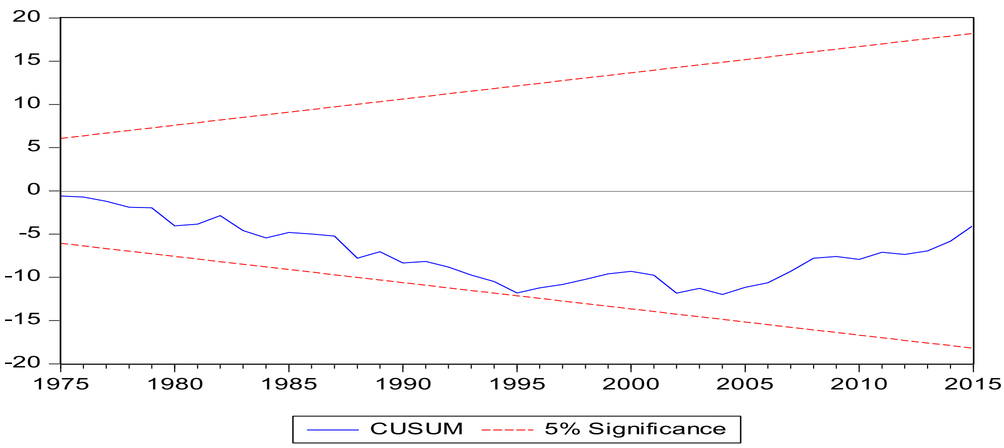

Figure 1. Plot of Cumulative Sum of Recursive Residuals

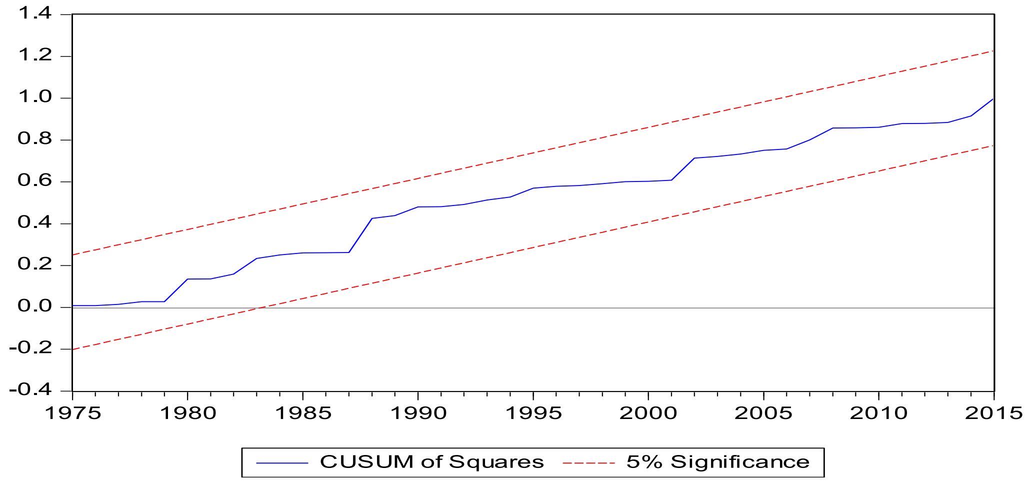

Figure 2. Plot of Cumulative Sum of Squares of Recursive Residuals.

5. DISCUSSION AND CONCLUSION

This paper examined the presence of a long-run relationship among CO2 emissions, tourist arrival, economic growth, and energy consumption in Turkey. ARDL Bound test results show the existence of a long-run relationship among the variables. These results confirm an inverted U-shaped relationship between international tourist arrival and CO2 emissions. The results are in line with Katircioğlu (2014b), Sherafatian-Jahromi et al. (2017), Balsalobre-Lorente et al. (2002), Shakouri et al. (2017) and Paramati et al. (2016). The tourism sector is an energy-intensive sector in many areas such as accommodation, heating/cooling, transportation and more tourist arrivals creates more demand for energy which translates to significant emissions. This finding supports the idea which more tourist arrivals create more demand for energy which translates to significant emissions. Then the analysis results of this paper confirm that energy use leads to increase CO2 emissions. Our analysis results do not provide any evidence for the EKC hypothesis between economic growth and CO2 emissions in Turkey during the period under study. This result is not similar to findings of Zaman et al. (2016), Solarin (2014), Al-Mulali et al. (2015), Shahbaz et al. (2015), Lee and Brahmasrene (2013), Katircioğlu (2014) and Ben Jebli et al. (2019) and consistent with Tiwari et al. (2013).

The tourism sector is an important sector for Turkey in terms of both income and employment. In 2019, the share of the tourism and travel sector in Turkey's GDP is 11.3%. On the other hand, the number of people working in the tourism sector in Turkey is about 2.6438 million people, and this figure is equivalent to 9.4% of total employment (TÜİK, 2020). The sector was following a positive trend before the pandemic and had 51,9 mn visitors and US$34,5 bn total receipts in 2019 (EY Turkey, 2020). Tourism is an energy-dependent sector that causes a significant positive impact on environmental pollution in Turkey. For sustainable development, all sectors including tourism must improve infrastructure construction, enhance environmental awareness, investment in renewable energy services and focus on eco-friendly policies to reduce carbon emissions and environmental pollutions. This is also important to protect the environment and increase Turkey's competitiveness in the world. Energy, which causes industrial revolutions and a more comfortable life, has turned into a problem that threatens human life, such as climate changes and environmental pollution It has vital importance for the whole world to support investments in clean energy and low-carbon technologies for sustainable development and sustainable tourism. These investments could avert the worst warming and reduce the negative effects of climate changes on tourism in the world. The subject of the next study will be to investigate the effects of the decrease in tourism demand due to global climate changes on employment, income and migration in tourism-dependent countries. Especially, international migration which is a big problem for Turkey and unemployment are going to the most important problems in the future in the world. Therefore, to prevent environmental pollution and prevent global warming, increasing international joint efforts, especially in the field of energy, should be considered as an emergency for sustainable development and a peaceful world.

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