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DETERMINANTS OF TOURISM DEMAND IN CONTEXT OF ENVIRONMENTAL QUALITY

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ABSTRACT

Tourism is a sector that contributes to the economic development of both developed and developing countries, and with this structure, it contains the environmental, social, and economic dimensions of sustainable development. This study aims to estimate the effects of environmental quality and other determinants on international tourism demand. Within the scope of the 2008–2017 period, the tourism demand from 27 different countries to the top 10 countries that attract the most tourists worldwide was examined using the multidimensional panel gravity model. The effects of environmental, economic, and non-economic indicators on tourism demand were investigated using Poisson pseudo-maximum likelihood (PPML) estimation methods. The findings showed that the low environmental quality significantly reduces tourism demand. In addition, tourist income, common language, and common border had positive effects on tourism demand, while distance, relative price, and visa restrictions had negative effects. This study offers recommendations for policymakers and other stakeholders and contributes to the literature on tourism economics and the environment.

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INTRODUCTION

Tourism and travel, which are part of the service sector, are growing industries worldwide and in many countries recognized as *"a potential driver for development"* (Chaisumpunsakul & Pholphirul, 2018). Tourism

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generates trade, employment, investments, infrastructure development, and a source of tax revenue and plays an important role in a country's growth (Isik et al., 2018). In the context of international tourism, destinations and domestic tourism and hospitality businesses compete to attract more tourists, generate more tax revenue, and increase both tourism revenue and export numbers (Dogru et al., 2017; Dogru et al., 2019). Between 2010 and 2019, the travel and tourism sector grew faster than the global economy every year, enriching local communities and destinations faster than many other sectors. As one of the largest economic sectors worldwide, it accounts for 10.3% of global GDP (Manzo & Smith, 2019). Although the countries examined within the period covered in the present study received ~56% of the world tourism income by 2010, this number increased to 68% in 2019. Also, although the countries examined in the present study accounted for ~72% of the total world CO_2 emissions by 2010, they represented ~69% in 2019 (Global Carbon Atlas, 2021; UNTWO, 2021). It has been understood that the countries examined in the present study account for more than one-half of the world's CO_2 emissions, which shows that they are among the countries that contribute the most to environmental pollution.

For sustainable tourism, it is important to understand the factors that influence tourism and serve as catalysts for a country's development and economic growth (Angelkova et al., 2012). There are many factors such as economics (gross domestic product (GDP), relative prices, real exchange rates) and non-economics (common borders, common language, visa restrictions, distance) that influence the tourism sector. One of the key factors affecting the tourism industry is the environment. Although many previous studies have investigated the impact of tourism on environmental pollution (Katircioglu, 2014; Ahmad et al., 2018), this study focuses on the impact of environmental pollution on tourism. The basis of tourism demand research is factors such as the reasons why tourists travel and their motivation to choose their destination country. These factors can generally be addressed within the framework of the Push-Pull theory. Push factors can be defined as socio-psychological motivation factors that cause tourists to travel. On the other hand, pull factors can be referred to as the factors that attract tourists who decide to travel to a particular destination country.

Environmental factors are one of the factors that influence tourists' destination choices (Klenosky, 2002; Lise & Tol, 2002). Environmental factors influence tourism in different ways. First, since environmental pollution or air pollution has a negative impact on tourists' satisfaction, it can negatively affect tourism demand for destinations with high

environmental pollution. In addition, since pollution is believed to cause health problems, tourists are expected to avoid destinations with high pollution (Kim et al., 2017; Zhang et al., 2020). On the other hand, it is believed that there is a significant relationship between environmental and climate change-related factors such as drought, higher or lower air temperatures, sea level changes and tourism demand (Sajjad et al., 2014; Zaman et al., 2016). It is also noted that environmental quality is important in attracting tourists and that tourists prefer places with high environmental quality (Brau & Cao, 2006; Davies & Cahill, 2000). Countries have tried to reach a common agreement to prevent environmental degradation. In this regard, 177 countries signed the Paris Agreement in 2015. The Paris Agreement is about providing adequate funding to reduce greenhouse gas emissions, adapt to climate change, and develop alternative energy sources (Isik et al., 2018). The implementation of the Paris Agreement will contribute to the sustainability of the tourism sector by promoting environmentally friendly practices, especially in the destinations that attract the most tourists.

Studies that examine the impact of the environment on tourism tend to focus on climate change. In addition, most previous studies have used pollutants, such as greenhouse gases (GHGs), carbon dioxide (CO_2), nitrogen oxides (NO_X), nitrous oxide (N_2O), and sulphur dioxide (SO_2) as indicators of environmental quality (Lee & Brahmasrene, 2013; Sajjad et al., 2014; Usman et al., 2020). One of the main disadvantages of pollutant emissions is that it does not take into account environmental sustainability, thus ignoring human and industrial activities that (directly or indirectly) affect environmental quality and ecosystem sustainability (Ali et al., 2020, 2021). The ecological footprint is another indicator that is widely known as a new measure of sustainable environmental system. It is more suitable as a measurement tool for ecosystem sustainability than pollutant emissions. It provides a synchronous analysis of soil, water, and air pollution. The ecological footprint is composed of six elements; cultivation, forest grazing, settled land, carbon footprint, and fishing grounds (Global Footprint Network, 2021). An increase in the ecological footprint indicates a lower level of environmental quality, while a decrease in the value indicates a higher level of environmental quality. To understand the presence of conditions that ensure sustainability in a geographic area, ecological footprint and biological capacity can be compared (Lin et al., 2018; Pata, 2021). Therefore, ecological footprint was used as an indicator of environmental quality in this study.

Gravity models have been widely used to estimate tourism demand in numerous studies. Gravity models are based on Newton's theory of gravity, which states that the gravitational force between two objects increases as the mass of the two objects increases and decreases as the physical distance between them increases. This theory was applied to economics by Tinbergen (1962) to explain foreign trade between countries. Based on Newton's theory of gravity, the standard gravity model developed to explain foreign trade between countries is expressed as follows:

$$T_{ij} = \beta_0 \frac{(Y_i)^{\beta_1}(Y_j)^{\beta_2}}{(D_{ij})^{\beta_3}} \quad \textbf{(1)}$$

In the equation, i represents the exporting country and j the importing country. T_{ij} represents the volume of foreign trade and D_{ij} represents the distance between i and j. Y_i and Y_j represent the economic size of i and j. Finally, β_0 is the proportionality constant. So, the gravity model fitted to foreign trade shows that the volume of trade is directly proportional to the size of the countries and inversely proportional to the distance between the countries. Empirical analyzes in studies are conducted by adding additional variables to those used in classical gravity models, and results vary by country, time period, selected variables, and estimation methods.

During the 2008–2017 study period, we used a multidimensional approach within the gravity model to discuss the factors that influence tourism demand from the twenty-seven countries that send the most tourists to the top ten countries that attract the most tourists worldwide. The effects of environmental quality, income, relative price, distance, common language, common border, and visa restrictions on tourism demand were examined using the Poisson pseudo maximum likelihood estimator (PPML) within the gravity model. From this perspective, this study makes the following contributions to the tourism-environment literature:

- There are some gaps in the existing literature examining the relationship between the environment and tourism. Studies investigating the relationship between tourism and environment have generally focused on the impact of tourism activities on the environment (Isik et al., 2017a; Isik et al., 2020, Dogru et al., 2020). In addition, studies that examined tourism demand were generally conducted for a single destination country. Unlike previous studies, this study examined the effects of

environmental quality on tourism demand using multidimensional models for more than one destination country.

- Gravity models were not used in the limited literature that examined the relationship between environmental quality and tourism demand with multidimensional models. More comprehensive and extensive results were obtained with the applied methodology.
- Overall, the results are intended to highlight the factors that influence tourism demand, provide recommendations for policymakers and other stakeholders, and contribute to the tourism economics literature.

The second part of this paper contains a literature review. The third part explains the data set, the method, and the results of the empirical model. The last part contains a discussion, conclusion, and suggestions for the tourism sector.

LITERATURE REVIEW

Many factors influence the tourism sector. Most studies on the determinants of tourism demand focus primarily on economic factors. Tourist income and price variables are the most used variables to explain tourism demand in specific countries (Algieri, 2006; Garín-Muñoz & Montero-Martín, 2006; Ibrahim, 2013). Previous studies generally used gross domestic product (GDP) per capita to represent income (Lorde et al., 2016; Adeola & Evans, 2020; Khalid et al., 2020), real exchange rate to represent prices (Maloney & Montes Rojas, 2005; Cheng et al., 2013; Ongan et al., 2017), and relative price variables (Divisekera, 2010; Santos & Cincera, 2018). Divisekera (2010) found that relative prices and real income are the most important determinants of tourism spending. They found that tourists' consumption is very sensitive to income, while price levels are less sensitive. When prices rise, tourists reduce much of their spending on tourism. Moreover, the relationship between growth and tourism is generally studied (Isik et al., 2017b; Isik & Radulescu, 2017).

The exchange rate is also an important indicator of international tourism demand (Dogru et al., 2017; Isik et al., 2019). The depreciation of a country's national currency against the currencies of other countries leads to an increase in inbound tourism because international tourism becomes cheaper, and tourism becomes more expensive for those leaving a country where the national currency depreciates (Chi, 2015; Dogru et al., 2017). As a result, although tourism demand from a country where the local currency

depreciates decreases, tourism demand to that country increases, which improves the trade balance (Dogru et al., 2019).

Gravity models have been widely used in various studies, and the distance variable has been used within gravity models in estimating tourism demand to represent transportation costs. Tourism demand is expected to decrease as the distance between countries increases. Garín-Muñoz and Montero-Martín (2007) showed that after the terrorist attacks of September 11, 2001, long-distance travel turned into short-distance travel and that travel by car was preferred over travel by air. In this respect, the distance between countries had a positive effect on tourism demand for short-distance destinations; however, the importance of adopting policies to reduce the distance disadvantage for long-distance destinations is evident here.

Considering the importance of the tourism industry to the economic activity of countries and the importance of the environment as a resource for the tourism industry and people's enjoyment, the number of empirical studies examining the relationship between tourism development and environmental degradation has increased in recent years (Dogru et al., 2019).

In the literature, the number of tourists coming to countries has been mainly used to represent the tourism demand (Chasapopoulos et al., 2014; Akter et al., 2017; Yerdelen Tatoglu & Gul, 2019). Other studies have used tourism revenue in addition to the number of tourists to represent tourism demand (Zhang et al., 2020; Chaudhry et al., 2021). In addition, the variables of per capita income of countries sending and receiving tourists (Khadaroo & Seetanah, 2008; Chasapopoulos et al., 2014; Ghosh, 2020), distance between countries (Ulucak et al., 2020; Altaf, 2021; Malaj, 2020), relative price (Eryiğit et al., 2010; Seetanah et al., 2010; Ghosh, 2020) were used. On the other hand, dummy variables such as common language (Okafor et al., 2018; Ghosh, 2020), common border (Kaplan & Aktas, 2016; Malaj, 2020), and visa restrictions (Balli et al., 2013; Velasquez & Oh, 2013) were often included in the models. Review of studies on the relationship between environmental quality and tourism activities revealed that air pollution indicators (Zhou et al., 2019; Tang et al., 2019; Zhang et al., 2020) were mainly used to represent environmental quality; some studies (Chaudhry et al., 2021) also used ecological footprint as a variable.

Regarding the methods used, it is noticeable that two-dimensional models were used mainly for a single destination. In these studies, estimators such as Generalized Methods of Moment (GMM) (Khadaroo &

Seetanah, 2008; Chasapopoulos et al., 2014; Zhang et al., 2020), fixed-random effects (Eryiğit et al., 2010; Malaj, 2020), PPML (Kaplan and Aktas, 2016; Zhou et al., 2019), Quantile panel (Santeramo & Morelli, 2016), Common Correlated Effects (CCE) (Ghosh, 2020; Chaudhry et al., 2021) were used. Appendix A shows a literature review of some previous studies that used gravity models to examine the variables that determine tourism demand.

There are some gaps in the existing literature dealing with this topic. Unlike previous studies, the present study used a multidimensional gravity model that includes more than one tourist-receiving country. The number of studies using the multidimensional model is few (Okafor et al., 2018; Yerdelen Tatoglu & Gul, 2019). On the other hand, in multidimensional studies (Chaudhry et al., 2021) investigating the relationship between ecological footprints and tourism, did not evaluate the relationship between variables within the gravity model. As far as we know, this is the first study in which the ecological footprint and the countries that attract the most tourists, as well as the countries that send the most tourists to these countries, are included simultaneously in a multidimensional model. This study aimed to contribute to the studies that use the multidimensional model and address the relationship between environmental quality and tourism. We thought that the study will develop a different perspective within the framework of the methods and variables used.

EMPIRICAL ANALYSIS

Data set and Model

The empirical model used in this study estimates the impact of environmental quality and other variables on tourism under the multidimensional panel gravity model. Ecological footprint was used as an indicator of environmental quality. In addition to the economic size of destination and origin countries and distance, which are the main variables of the gravity model, the variables of relative price, common language, common border, and visa restrictions, which are commonly used in these models, were included. The model created by adding independent variables to the basic gravity model is as follows:

$$lnTA_{ijt} = \beta_0 + \beta_1 lnGDP_{it} + \beta_2 lnGDP_{jt} + \beta_3 lnDIST_{ij} + \beta_4 lnRP_{ijt} + \beta_5 BOR_{ij} + \beta_6 VISA_{ij} + \beta_7 LANG_{ij} + \beta_8 lnEFP_{it} + \mu_i + \gamma_j + \lambda_t + e_{ijt} \quad \textbf{(2)}$$

The explanations of the variables[2] are as follows: $lnTA_{ijt}$ shows the number of tourists from the country of origin to the destination countries. $lnGDP_{it}$ and $lnGDP_{jt}$: express the GDP per capita of the destination and origin countries, respectively. One of the measures of economic size of destination and origin countries is GDP per capita. This indicator expresses the potential of countries to realize tourism flows. Therefore, GDPit and GDPjt variables are expected to have a positive impact on the number of tourists (Chasapopoulos et al., 2014; Ghosh, 2020; Ulucak et al., 2020).

$lnDIST_{ij}$ is the distance between the capitals of the destination and origin countries and is expressed in km. The distance represents the transportation cost; therefore, the variable $lnDIST_{ij}$ is expected to negatively affect tourism flows (Akter et al., 2017; Yerdelen Tatoglu & Gul, 2019; Malaj, 2020).

$lnRP_{ijt}$ expresses the relative price level between country of destination and country of origin calculated using the following formula:

$$RP_{ijt} = \frac{CPI_{it}}{CPI_{jt} * ER_{jt}} \quad \textbf{(3)}$$

CPI_{it} and CPI_{jt} are the consumer price indices of the country of destination and the country of origin, respectively. ER_{jt} is the value of the currencies of the countries of origin against one unit of dollars. Relative price is the price difference between the destination country and the origin country. A price that is higher in destination countries than in origin countries is likely to have a negative impact on tourism demand in those countries (Khadaroo & Seetanah, 2008; Ulucak et al., 2020; Altaf, 2021).

BOR_{ij} is a dummy variable indicating whether countries have common borders. It takes the value of "1" if the two countries have common borders, and "0" otherwise. Transportation costs are low if the countries have common borders, and it also indicates that the countries may have similar geographic and cultural characteristics; therefore, the BOR_{ij} variable is expected to positively affect tourism flows (Seetanah et al., 2010; Kaplan & Aktas, 2016; Malaj, 2020).

$VISA_{ij}$ is a dummy variable indicating whether there are visa restrictions between countries. If country i requires citizens of country j to obtain a visa, it has a value of "1" and "0" otherwise. Visa restrictions

[2] Variable explanations and their sources are included in Appendix B.

between countries are expected to negatively affect tourism demand (Balli et al., 2013; Velasquez & Oh, 2013; Deichmann & Liu, 2017).

$LANG_{ij}$ is a dummy variable indicating whether countries use a common language. If the countries have a common official or primary language, it has a value of "1" and "0" otherwise. In terms of cultural similarity and ease of communication, this variable is expected to positively influence tourism demand (Khadaroo & Seetanah, 2008; Seetanah et al., 2010; Okafor et al., 2018).

$lnEFP_{it}$ expresses the ecological footprint variable used to represent environmental quality. Environmental quality is important for destination selection. It is considered that high environmental quality in countries hosting tourists contributes to the understanding of sustainable tourism; otherwise, tourism demand will be adversely affected. Therefore, the parameter for the EFP_{it} variable is expected to be negative (Chaudhry et al., 2021).

The study created a balanced panel data set and examined the twenty-seven countries that sent the most tourists to the 10 countries that attracted the most tourists during 2008-2017. The countries are listed in Table 1.

Table 1. *Destination and Origin Countries*

Destination	**Origin**
Canada	Germany, Australia, China, United Kingdom, Japan, United States, France
Czech Republic	Slovak Republic, China, Germany, Italy, United Kingdom, Poland, Russian Federation, United States
France	Belgium, Spain, United Kingdom, Germany, Netherlands, United States, Switzerland, Italy
Italy	Austria, United Kingdom, Switzerland, France, United States, Germany
Mexico	Canada, Spain, United States, France, United Kingdom
Poland	Belarus, Germany, United Kingdom, Lithuania, Russian Federation, Ukraine
Spain	Germany, France, Italy, United Kingdom
Turkey	Bulgaria, United Kingdom, Germany, Russian Federation, Georgia, Iran
United Kingdom	Germany, Spain, Netherlands, United States, France, Ireland,
United States	Brazil, Canada, China, United Kingdom, Japan, Korea, Mexico, Germany

Methodology

The standard gravity model was fitted to tourism flows by adding independent variables, and the equation was estimated by logarithmic transformation in linear form. We found that models focusing on a single

unit and a single time dimension are generally used in panel data analyses; however, the above dimensions are not sufficient, and models using more than one dimension can be estimated. These multidimensional models allow for estimates considering the circumstances of more than one unit or time, or both, nested or not nested within each other. In estimating the models, the presence of effects is first tested, and based on these results, the model estimates are calculated using appropriate estimators. The present study is based on a multidimensional panel data model with two non-nested units and one-time dimension (Silva & Tenreyro, 2006; Westerlund & Wilhelmsson, 2011). The multidimensional panel gravity model for tourism demand created from the basic gravity model was as follows:

$$lnTA_{ijt} = \beta_0 + \beta_1 lnGDP_{it} + \beta_2 lnGDP_{jt} + \beta_3 lnDIST_{ij} + \beta_4 X_{ijt} + \mu_i + \gamma_j + \lambda_t + e_{ijt} \quad \textbf{(4)}$$

In Eq. 4, i and j represent the destination and origin countries, respectively. $lnTA_{ijt}$ is the number of tourists coming from the origin country j to the destination country i; $lnGDP_{it}$ and $lnGDP_{jt}$ are the GDP per capita of the destination and origin countries, respectively; $lnDIST_{ij}$ is the distance between the countries; and X_{ijt} is the vector of control variables. In addition, μ_i and γ_j are the unit effects for countries i and j, respectively, and λ_t represents the time effect.

The multidimensional model for determinants of tourism demand was estimated using the PPML estimator. Previous studies using the gravity model mainly used ordinary least squares (OLS)–based estimators, and the gravity model was estimated using a log-linear transformation; however, the dependent variable can take a value of "0" in gravity models that can be applied to trade, migration, and tourism flows. OLS-based estimators do not consider values that pass as "0", and since the logarithm cannot be taken, observations with "0" values are excluded from the model. The exclusion of observations with "0" values can cause deviations in the gravity model estimate. Furthermore, since OLS-based estimators work under the assumption that the variance of error term is constant, estimating the gravity model with these methods by log-linear transformation leads to a violation of this assumption. To solve this problem, it is proposed to estimate the model in exponential form using the PPML estimator, which gives effective results, even in the presence of "0" observations and varying variance. The exponential representation of the multidimensional gravity model estimated using the PPML estimator is as follows:

$$TA_{ijt} = \exp(\beta_0 + \beta_1 LNGDP_{it} + \beta_2 LNGDP_{jt} + \beta_3 LNDIST_{ij} + \beta_4 X_{ijt}) + \mu_i + \gamma_j + \lambda_t + e_{ijt} \quad \textbf{(5)}$$

The presence of unit effects was examined with the likelihood ratio (LR) test. The constrained model with no effect and unconstrained model with effects in the LR test were estimated using the maximum likelihood method, and LR test statistics were generated. In the LR test, the main hypothesis was made assuming that the restricted model was valid. Rejection of the main hypothesis meant that valid effects should be included in the model (Yerdelen Tatoglu & Gul, 2019).

EMPIRICAL RESULTS

The presence of unit and time effects was tested with the LR test in triple, double and single combinations. The test results are shown in Table 2. The first line in the table refers to the LR test with two units and a time effect. The tests in the second, third and, fourth lines give the results of the LR test which was performed to test the significance of the effects in pairwise combinations. The last three lines are the results of the LR test, which was performed to test the significance of the effects individually. Examination of all the results showed that the main hypothesis could not be rejected with the LR test for the presence of the time effect and that there was no time effect. We then decided to estimate the multidimensional panel gravity model with two-unit effects.

Table 2. *LR test results*

Test	Basic Hypothesis	LR Statistic	Probability
1	$H_0: \sigma_\mu = \sigma_\gamma = \sigma_\lambda = 0$	168.61***	0.000
2	$H_0: \sigma_\mu = \sigma_\gamma = 0$	166.67***	0.000
3	$H_0: \sigma_\mu = \sigma_\lambda = 0$	109.79***	0.000
4	$H_0: \sigma_\gamma = \sigma_\lambda = 0$	18.59***	0.000
5	$H_0: \sigma_\mu = 0$	108.99***	0.000
6	$H_0: \sigma_\gamma = 0$	18.47***	0.000
7	$H_0: \sigma_\lambda = 0$	0.0003	0.497

Note: *** represents 1% significance level.

After the LR tests, the model was estimated using the PPML estimator. The results of the estimation are shown in Table 3. According to the estimation results in Table 3, the effect of the variable $\ln GDP_{jt}$ on the number of tourist arrivals is positive and statistically significant. Accordingly, a 1% increase in GDP per capita in the countries of origin increases the number of tourists by 0.369%; however, it was found that the parameter for the variable $\ln GDP_{it}$ was not statistically significant. Thus, it was assumed that the changes in income in the country of origin are more

important for tourism demand, while the change in income in the destination country does not affect that demand. The $lnDIST_{ij}$, $lnEFP_{it}$, and $lnRP_{ijt}$ variables have a negative and statistically significant impact on tourism demand. It was found that a 1% increase in the distance between countries, ecological footprint and relative prices reduces the number of tourists by ~0.877%, 0.382% and 0.161%, respectively. We found that the tourism demand was negatively affected by the $VISA_{ij}$ variable, and positively and statistically significantly affected by the BOR_{ij} and $LANG_{ij}$ variables. However, the "common language", "common border" and "visa restrictions" variables were included in the models without using their natural logarithms. Since the PPML is estimated in exponential form, the inverse logarithm should be applied while evaluating the parameters associated with the variables in question[3]. The results obtained after the conversion show that the tourism demand in the countries with visa restrictions is 28.78% lower than in the countries without visa restrictions. It was found that the tourism flow between the countries that share a common language was about 51% higher than the countries that do not. In addition, it was determined that the tourism flow between the neighboring countries was about 83% higher than the countries that do not.

Table 3. *PPML estimation results*

Variable	Coefficient	Robust Standard Error	Probability
$lnGDP_{jt}$	0.369***	0.115	0.001
$lnGDP_{it}$	-0.007	0.020	0.720
$lnDIST_{ij}$	-0.877***	0.030	0.000
$lnRP_{ijt}$	-0.161***	0.057	0.005
BOR_{ij}	0.605***	0.059	0.000
$VISA_{ij}$	-0.253***	0.087	0.004
$LANG_{ij}$	0.410***	0.077	0.000
$lnEFP_{it}$	-0.382**	0.201	0.058
Constant	25.336***	4.324	0.000

Note: *** and **, express 1%, and 5% significance level, respectively.

DISCUSSION AND CONCLUSION

The tourism sector has a multiplier effect on the economy. Tourism plays an important role in national economies, in terms of GDP, the share of tourism revenues in export earnings, value-added and employment. Some studies claim that environmental factors affect tourism demand, but few studies examine the impact of the ecological footprint on tourism demand. In this study, tourism demand was examined in the context of

[3] The $(e^{\beta_n} - 1) * 100$ formula was used for transformation, and number e was taken as 2.718. β_n represents the coefficient for the variable to be calculated.

environmental quality using the ecological footprint for the top ten countries that attracted the most tourists worldwide from 2008 to 2017. To this end, a multidimensional panel gravity model was used to analyze tourism demand for the top ten countries from twenty-seven origin countries that send the most tourists. The countries included in the analysis played a significant role in both environmental quality degradation and attracting international tourists. In addition to environmental quality, the effects of per capita income, distance, relative price, common language, common border, and visa restrictions on tourism were determined.

As a result of the study, it was found that the increase in the ecological footprint has a negative impact on tourism demand. One of the other results of the study was that non-economic factors are more important than the economic factors of income and price; however, we found that per capita income (0.338), which is an economic factor, is more important than relative price (-0.150) in terms of coefficients. It was found that visa restrictions, common language, and common border variables are factors that significantly affected tourism demand. It was also found that the tourism demand was lower in countries that applied visa restrictions than in countries that did not. Therefore, policymakers and governments can negotiate visa agreements for tourists visiting their countries. Speaking a common language strengthened the cultural ties and facilitated communication. A common border was an advantage because it both reduced transportation costs and had similar geographical and cultural characteristics; therefore, destination countries that want to increase their tourism demand should be able to use some active elements, such as advertising and promotion, which turn the cultural link into an advantage. Distance factor had a negative impact on tourism demand, as it reflected both higher transportation costs and greater inconvenience due to long journeys. To eliminate this disadvantage, measures should be taken to reduce transportation costs, with public support if necessary. Findings are consistent with below studies: in terms of environmental degradation, Chaudhry et al. (2021); in terms of economic size, Chasapopoulos et al. (2014) and Ghosh (2020); in terms of distance, Akter et al. (2017) and Malaj (2020); in terms of relative price, Khadaroo and Seetanah (2008) and Ulucak et al. (2020); in terms of common border, common language and visa restrictions, Kaplan and Aktas (2016), Balli et al. (2013) and Okafor et al. (2018).

This study contains valuable information for tourism stakeholders and policymakers. First, we have confirmed that environmental degradation can have a negative impact on tourism. This situation shows

that a country should pay attention to the quality of its environment to ensure the sustainability of tourism demand. In light of these findings, we recommend appropriate measures to reduce the ecological footprint. In this context, environment-related taxes can be used as an important policy tool. In addition to environment-related taxes, tax policy measures such as real estate and vehicle taxes that may have an impact on the environment can also be considered. These environmental taxes can be used to fund environmentally friendly technologies. Given the growing awareness that tourism is inextricably linked to the environment, countries must prioritize environmental quality to ensure sustainable tourist flows.

The use of renewable energy sources by countries that strive for sustainable environmental quality is also an important attraction for tourism. Increasing the use of renewable energy is important for reducing greenhouse gas emissions. It also promotes tourism development and economic growth. The growth of a country can increase depending on the development of tourism and the efficiency of renewable energy sectors. For this reason, it is considered that countries should increase their investments in the renewable energy sector based on the relationship between tourism development and ecological footprint. As suggested by Isik et al. (2018), countries can designate primary industrial zones for renewable energy and subsidize their traditional energy sectors. In this way, growth in tourism and renewable energy industries can be achieved, and countries can produce renewable energy. In addition, tax incentives for investment in the renewable energy sector and the removal of barriers to investment contribute to the development of the sector. By using renewable energy, these countries can give themselves an environmentally friendly image. In this way, both the negative effects of tourism on the environment can be eliminated and the positive effects of environmental quality on tourism can be increased. On the other hand, the widespread use of renewable energy is a costly process that can be fraught with difficulties, especially for less developed countries. To this end, countries and organizations such as the United Nations and the World Bank may develop a comprehensive agreement within the framework of sustainable tourism development and renewable energy production and provide financial assistance to less developed countries to ensure that they comply with the agreement. It is believed that greenhouse gas emissions and climate change impacts can be reduced in the future through the above measures.

Policymakers should consider all other variables that have been shown to be effective in the model when determining actions. Tourism stakeholders should take a proactive approach to create sustainable forms

of tourism. Tourism businesses should recognize the impact of production processes resulting from tourism movements and adjust their activities to take these impacts into account. In addition to tourism businesses, regulators should also monitor the impact of tourism policies on tourism demand in countries and revise these policies as necessary. Sustainable tourism requires the participation and consensus of the political authorities as well as tourism sector stakeholders. A wide range of economic benefits from the tourism industry, such as job creation and increased tax revenues, could be diminished if appropriate measures are not taken. Due to environmental degradation, they may not be able to sustain their tourism development. Therefore, policymakers should focus their agendas on environmentally sustainable tourism practices to promote tourism development. The inclusion of economic and sociocultural factors would expand the existing literature and provide a more comprehensive framework for studying sustainable tourism development.

While the damage we cause to the environment in the development process is destroying the environment, on the other hand, development is moving away from sustainability due to the worsening. This situation deprives future generations of the possibility to live in an environment with good conditions. For this reason, it is necessary to establish common and mutually supportive goals that consider the interactions between people, resources, environment, and development in global cooperation.

The 2019 Coronavirus (COVID -19) pandemic led to unprecedented global health, social, and economic crises. The travel and tourism sectors were one of the hardest-hit industries (UNTWO, 2020). Many countries have imposed travel restrictions on tourists by closing all or part of their borders and sometimes suspending international flights; therefore, international tourism is expected to increase in the coming years as the tourism sector begins to return to pre-pandemic activities. The pandemic has reminded us of the importance of involving all relevant stakeholders, including the travel and tourism industry, in decision-making and planning for the future. Although COVID -19 has had a devastating impact on the travel and tourism industry, people's desire to travel and explore the world has not diminished. By 2020, approximately $4.9 trillion in GDP will be lost and 62 million jobs will be lost. With climate change worsening at an alarming rate and a looming biodiversity crisis, countries have an important role to play in proactively incorporating environmental sustainability into their visions and strategies for the travel and tourism sector, as well as their country planning in general. Looking at the global economic and social recovery of COVID -19, it is clear that no single group can meet the

challenges ahead alone. It will take the commitment and partnerships of multiple stakeholders if we are to pave the way to a better future together. As commitment to sustainability increases because of COVID -19, governments and destinations alike should capitalise on this renewed interest and build on the Paris Agreement to further improve wildlife and environmental conservation in collaboration with the private sector and local communities.

This study contributes to the current literature by using a multidimensional panel gravity model and examining environmental effects in addition to the variables used. Furthermore, the model is estimated using the PPML estimator, which performs well even with "0" observations and variance changes that may occur in the dependent variable. However, the study also had some limitations. The inability to include sociocultural factors that cannot be converted into a quantitative variable to the model is a limitation. The findings obtained with a larger sample can be confirmed by increasing the number of countries. The data used for the study are from 2008–2017 and the study does not consider the effects of seasonality because the variables used were not daily or monthly published data. Since the time dimension was limited, the relationship between the variables could not be examined by including the effects of different periods. Future studies on tourism demand could be developed within the announced limitations. In addition, they could be expanded to include other key factors, such as destination accessibility, country risk, institutional factors, cultural distance, tourism promotion, and public spending on tourism. On the other hand, several types of tourism demand could be analyzed by adding age variables representing specific age groups within a country or variables representing regional differences.

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APPENDICES

Appendix A. *Literature review*

Author (Year)	Countries/Regions/ Organization, Period	Indicators	Method	Results
Khadaroo and Seetanah (2008)	28 countries, 1990–2000	Tourist arrivals, relative prices, distance, GDP of origin countries, population, common border, common language, tourism infrastructure, proximity	GMM	Tourism infrastructure has a significant impact on tourism demand in countries. GDP has a positive and distance has a negative impact on tourist arrivals.
Seetanah et al. (2010)	South Africa, 1985–2000	Tourist arrivals, relative prices, real GDP per capita of South Africa and origin countries, distance, number of rooms, common border, common language, politic instability	Panel FMOLS	Tourism demand is susceptible to tourism price changes in both South Africa and competing destinations. The variables of development, common border, distance, tourism infrastructure, and common language affect tourism demand.
Eryiğit et al. (2010)	Turkey, 1995–2005	Tourist arrivals, tourism climate index, bilateral trade, population, distance, relative prices, GDP per capita of Turkey and origin countries, dummy variables for 1999 earthquake, Iraq War, neighbor effect, September 11 attacks	GLS	Distance and climate negatively affect tourism demand in Turkey. The effect of the relative price variable is statistically insignificant.
Balli et al. (2013)	Turkey, 1995–2010	Tourist inflows, GDP per capita of origin countries, population, trade, visa-free, CPI, number of the rooms in hotels, Turkish soap operas	GMM	The absence of visa requirements and GDP have a positive impact on tourism demand.
Velasquez and Oh (2013)	Peru, 1990–2011	Tourist arrivals, GDP, and GDP per capita of Peru and origin countries, common border, common language, visa requirements, relative prices	RE	While relative prices and visa requirements have a negative effect on tourist arrivals, common border and language have positive effect on tourist demand.
Chasapoulos et al. (2014)	Greece, 2001–2010	Tourist arrivals, GDP per capita of origin countries, relative price, competitive prices, comparative prices, ratio of bilateral trade to GDP of Greece and origin countries, distance, political	System GMM	Distance and trade are the main indicators affecting the tourism demand for Greece. Political stability and GDP variables also

		stability, gross investment spending in transport infrastructure, a dummy variable for 2004		contribute significantly to tourism demand.
Kaplan and Aktas (2016)	Turkey, 1996–2014	Tourist arrivals, distance, border, a part of OECD country in EU, a non-part of OECD country in EU, an eastern bloc country, another part of OECD country, an African country, a west Asia country. a west America country, a country in Asia, GDP per capita of Turkey and origin countries, dummy variables for 2008 crisis and 2010 Arab spring crisis	PPML	GDP per capita has a positive and distance is negative on tourism demand.
Santeramo and Morelli (2016)	Italy, 1998–2010	Tourist arrivals for structures and agricultural, GDP per capita of origin countries, population, number of touristic and agritouristic structures, distance, common currency, Schengen agreement, agricultural population	Quantile PPML estimator	Distance, GDP, urbanization rate and agreements are the main determinants demand of agritourism in Italy.
Akter et al. (2017)	Bangladesh, 2009–2012	Tourist arrivals, GDP of origin countries, distance, population, exchange rate ($), CPI	Panels corrected standard errors estimator	There is a positive relationship between tourism demand and GDP and population. The effects of distance, exchange rate and CPI are negative.
Khoshnevis Yazdi and Khanalizadeh (2017)	United States, 1995–2014	Tourist arrivals, GDP of USA and origin countries, distance, CPI, exchange rate, total number of flights in international airports, dummy variable for September 11 attacks	Panel ARDL	GDP, CPI, exchange rate and certain events in the country significantly affect tourism demand.
Deichmann and Liu (2017)	Croatia, 1993–2015	Tourist arrivals, GDP per capita of origin countries, exchange rate, distance, population, visa-free	SUR	The absence of visa requirements has a positive effect on tourism demand.
Okafor et al. (2018)	222 countries, 1995–2015	Tourist arrivals, GDP per capita of destination and origin countries, population, distance, common official language, and unofficial language	FE, RE, PPML	Language variables havea positive effect on tourist arrivals.
Yerdelen Tatoglu and Gul (2019)	14 countries, 2008–2016	Tourist arrivals, GDP per capita of destination and origin countries, exports, imports, distance, PPP, dummy for Mediterranean Coast	ML	Distance and economic factors have a significant impact on tourism demand.
Tang et al. (2019)	China, 2004:01–2015:12	Tourist arrivals, GDP per capita of origin countries, relative prices, air quality	Johansen cointegration, VECM	Air pollution has negative impact on tourist arrivals in long the term. However, in the short term, there is no statistically significant relationship between air pollution and tourist arrivals

Zhou et al. (2019)	China (Beijing), 2005–2016	Tourist arrivals, distance, population, exchange rate, GDP per capita of Beijing and origin countries, air pollution variables (Air quality, PM_{10}, $PM_{2.5}$, SO_2,NO_2)	PPML	Air pollution has a negative impact tourist flows in Beijing.
Ghosh (2020)	Australia, 1991–2018	Tourist arrivals, distance, population, GDP per capita of Australia and origins, money supply, KOF globalization index, relative consumer price index, relative exchange rate, uncertainty index, common language, membership to the commonwealth set of nations	CCE	While GDP and globalization have a positive impact on tourism demand, prices and distance have a negative impact.
Malaj (2020)	Albania, 2001–2018	Tourist arrivals, GDP per capita of Albania and origin countries, political stability, distance, similar climate, border, total infrastructure investments, absence of violence and terrorism	Pooled OLS, FE, and RE	There is a positive relationship between tourism demand for Albania and the variables of per capita GDP of Albania and the countries of origin, the existence of common borders, political stability, total infrastructure investments, absence of violence and terrorism.
Ulucak et al. (2020)	Turkey, 1998–2017	Tourist arrivals, distance, relative exchange rate, GDP per capita of Turkey and origin countries, relative CPI, terror incidents, KOF globalization Index, Money supply, household debt level	CUP-FM, CUP-BC	GDP per capita, relative exchange rate and globalization have a positive impact on tourism demand. The effects of CPI, terrorism, debt level and distance on tourism demand are negative.
Zhang et al. (2020)	58 major cities in China, 2013:10–2017:12	Tourist arrivals, air quality index, $PM_{2.5}$, tourism income	GMM	$PM_{2.5}$ and air quality index have a negative impact on both tourist arrivals and tourism income.
Altaf (2021)	India, 2000–2018	Tourist arrivals, distance, population, relative price, CPI, GDP per capita of India and origin countries, exchange rate ($), bilateral exports and imports, Political risk.	2SLS	The variables GDP, political stability, population and import rate have cvdf tourism demand positively to India, while distance, export and relative price variables affect negatively.
Chaudhry et al. (2021)	20 countries, 1991–2018	Tourism receipts, institutional performance, trade openness, real exchange rate, ecological footprint	DCCE	The relationship between tourism receipts and ecological footprint is negative and statistically significant.

Note: *DCCE: Dynamic common correlated effects; OLS: Ordinary Least Squares, 2SLS: Two-stage least squares; CUP-BC: Continuously updated bias-corrected estimator; RE: Random effects model; CCE: Common correlated effects; PPML: Poisson pseudo-maximum likelihood estimator; VECM: Vector error correction model; ML: Maximum likelihood; SUR: Panel seemingly unrelated regression; CUP-FM: Continuously updated fully modified estimator; ARDL: Autoregressive distributed lag; GLS: Generalized least squares; GMM: Generalized method of moments; FMOLS: Panel full modified OLS; FE: Fixed effects model.*

Appendix B. *The sources of the variables*

TA_{ijt}	The number of tourists from country of origin to the countries of destination	OECD Database
GDP_{it}	GDP per capita of the countries that accept tourists	World Bank Database
GDP_{jt}	GDP per capita of the countries that send tourists	World Bank Database
$DIST_{ij}$	Distance between the capitals of the countries that accept and send tourists and is expressed in km	CEPII Database
RP_{ijt}	The relative price level between the tourist receiving and tourist sending countries	The calculation was made with data obtained from the World Bank database.
BOR_{ij}	Common borders (It takes the value 1 if the two countries have common borders, if not, it is 0.)	CEPII Database
$VISA_{ij}$	Visa restrictions (If country i requests a visa from the citizens of country j, it takes the value 1, if not, it is 0.)	DEMIG visa database
$LANG_{ij}$	Common language (If countries share a common official or primary language, it takes the value 1, if not, it is 0.)	CEPII Database
EFP_{it}	Ecological Footprint (gha)	Global Footprint Network database