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ARAŞTIRMA MAKALESİ / RESEARCH ARTICLE

INVESTIGATING THE ASYMMETRIC EFFECTS OF DISAGGREGATED TOURISM TRANSPORTATION ON ECOLOGICAL FOOTPRINT*

AYRIŞTIRILMIŞ TURİZM TAŞIMACILIĞININ EKOLOJİK AYAK İZİ ÜZERİNDEKİ ASİMETRİK ETKİLERİNİN İNCELENMESİ

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ABSTRACT

The principal motivation for the study is to investigate the effect of tourism transportation on environmental pollution for 16 emerging markets. In the study, which analyses the period 1995-2018, the number of international tourists is classified into three categories as airway, waterway, and land way. Also, the ecological footprint represents environmental pollution. The quantile cointegration test is used, which provides a theoretical basis for exploring the asymmetric structure in the data. According to the results, there is a significant increase in the number of cointegration relationships obtained from the quantile approach compared to the conventional approach. Regarding to the long-run coefficient results, the increase in international tourist transportation encourages pollution. Furthermore, the links between the variables behave differently at the quantiles. In this regard, the evidence highlights the existence of an asymmetric adjustment process conditional on the sign and size of the shocks. Finally, the paper observes that the impact of airway, waterway and land way transportation types on pollution differs across countries.

Keywords: Tourism, Environmental Pollution, Transportation, Asymmetric Persistence, Quantile Cointegration.

JEL Classification Codes: C22, F64, R4, Q01, Z3.

ÖZ

Bu çalışmanın temel motivasyonu, turizm taşımacılığının çevre kirliliği üzerindeki etkisini 16 gelişmekte olan ülke için araştırmaktır. 1995-2018 döneminin incelendiği çalışmada uluslararası turist sayısı havayolu, su yolu ve karayolu olmak üzere üç kategoride ele alınmaktadır. Ekolojik ayak izi ise çevre kirliliğini temsil etmektedir. Verilerdeki asimetrik yapıyı keşfetmek için teorik bir temel sağlayan kantil eşbütünleşme testini kullanıyoruz. Sonuçlara göre, kantil yaklaşımından elde edilen eşbütünleşme ilişkilerinin sayısında geleneksel yaklaşıma kıyasla önemli bir artış söz konusudur. Uzun dönem katsayı sonuçlarına göre, uluslararası turist taşımacılığındaki artış kirliliği teşvik etmektedir. Ayrıca, değişkenler arasındaki bağlantılar kantillerde farklı davranmaktadır. Bu bağlamda, kanıtlar şokların işaretine ve boyutuna bağlı olarak asimetrik bir uyum sürecinin varlığını vurgulamaktadır. Son olarak, çalışma havayolu, su yolu ve karayolu taşımacılığı türlerinin kirlilik üzerindeki etkisinin ülkeler arasında farklılık gösterdiğini gözlemlemektedir.

Anahtar Kelimeler: Turizm, Çevre Kirliliği, Taşımacılık, Asimetrik Kalıcılık, Kantil Eşbütünleşme.

JEL Sınıflandırma Kodları: C22, F64, R4, Q01, Z3.

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GENİŞLETİLMİŞ ÖZET

Amaç ve Kapsam:

Çevre kirliliğinin önemli belirleyicilerinden biri, etkisini her geçen gün artıran turizm sektörüdür. Çalışma, 1995-2018 dönemi için 16 gelişmekte olan ülkede (Brezilya, Çin, Şili, Kolombiya, Endonezya, Hindistan, Kore, Malezya, Meksika, Peru, Polonya, G. Afrika, S. Arabistan, Filipinler, Türkiye ve Tayland) havayolu, su yolu ve karayolu turizm taşımacılığının çevre kirliliği üzerindeki etkisini ampirik olarak analiz etmeyi amaçlamaktadır. Çalışma literatüre dört açıdan katkı sunmaktadır: İlk olarak çalışma, turizm taşımacılığını havayolu, su yolu ve karayolu olarak ayrıştırarak çevre kirliliği üzerindeki etkilerini araştırmaktadır. İkinci olarak, çalışmada çevre kirliliğini temsilen yaygın olarak tercih edilen karbon emisyonu yerine daha kapsamlı olan ekolojik ayak izi göstergesi kullanılmaktadır. Üçüncü olarak, çalışma verilerine ulaşılabilen 16 gelişmekte olan ülkeyi analiz ederek, gelişmekte olan piyasalar açısından kapsamlı kanıtlar sunmaktadır. Son olarak çalışma, uygulanan asimetrik yaklaşım ile turizm taşımacılığı ile çevre kirliliği arasındaki bağı, pozitif ve negatif şoklara ayrıştırarak alana yeni bakış açısı kazandırmaktadır.

Yöntem:

Ekonomik değişkenler arasındaki ilişki farklı kantillerde değişkenlik gösterebilmektedir (Syed vd., 2019). Dolayısıyla kantil tabanlı yaklaşımlar bu değişkenliği yakalamak ve doğru bir şekilde açıklamak için kullanışlıdır. Ayrıca ampirik modellerde hata terimi ve açıklayıcı değişkenler arasında içsellik sorunu oluşabilmektedir. Bu sorun, tahmincilerin asimptotik dağılımlarında değişikliklere neden olabilmekte ve sonuçlarda tahminlerin yanıltıcı olmasına yol açmaktadır (Portnoy, 1991). Çalışmada, Xiao (2009) tarafından geliştirilen kantil tabanlı yaklaşım (QCR testi) uygulanmaktadır. Değişkenler arasındaki ilişkiyi pozitif ve negatif şoklara ayrıştırarak incelemesi, içselliği dikkate alması ve ağır kuyruklu dağılımlara karşı dayanıklı olması, QCR yaklaşımının avantajlarıdır. Kullanılan yöntem, modellere ilişkin eşbütünleşme sonuçlarının yanı sıra pozitif ve negatif şokları dikkate alarak etkilere ilişkin katsayılar üretmektedir.

Bulgular:

Analizde ilk olarak, değişkenlerin birim kök seviyeleri Dickey ve Fuller (ADF) (1979) testi ile incelenmektedir. Sonuçlar, az sayıda istisna dışında değişkenlerde düzey seviyede birim kök olduğunu ortaya koymaktadır. Değişkenlerin birinci farkları alındığında ise, durağanlaştıkları tespit edilmektedir. Birim kök testinin ardından havayolu, su yolu ve karayolu turizm taşımacılığı ile ekolojik ayak izi modellerinde eşbütünleşme ilişkisi sınanmaktadır. Çalışma, karşılaştırma yapmak amacıyla Xiao (2009) kantil yaklaşımın yanı sıra geleneksel yaklaşımlardan biri olan Engle-Granger (EG) (1987) testini de uygulamaktadır. EG (1987) sonuçlarına göre, havayolu modelinde yedi ülkede (Şili, Kolombiya, Kore, Malezya, Meksika, Peru ve S. Arabistan), su yolu modelinde bir ülkede (Peru) ve karayolu modelinde üç ülkede (Şili, Meksika ve Türkiye) eşbütünleşme ilişkisi bulunurken, diğer ülkelerde değişkenler uzun vadede birlikte hareket etmemektedir. Kantil eşbütünleşme yaklaşımından elde edilen sonuçlarda ise havayolu modelinde bir ülkede (Polonya), su yolu modelinde üç ülkede (Malezya, Polonya ve S. Arabistan) ve karayolu modelinde bir ülkede (Meksika) eşbütünleşmenin olmadığı gözlenmektedir. Dolayısıyla kantil yaklaşımda daha fazla eşbütünleşme ilişkisi tespit edilmektedir. Eşbütünleşme testlerinin ardından, ilişkinin boyutu ve yönünü belirlemek amacıyla katsayı tahminleri yapılmaktadır. Bu kapsamda, modellerde yer alan değişkenlere dair 0.1'den 0.9'a kadar her kantil için regresyon katsayıları hesaplanmaktadır. Anlamlı katsayı bulgularının pozitif işarete sahip olduğu görülmektedir. Dolayısıyla tüm taşımacılık türleri, ekolojik ayak izini artırarak çevresel bozulmaya neden olmaktadır. Model bazında sonuçlar incelendiğinde Şili, Kolombiya, Kore, Peru ve Filipinler'de havayolu taşımacılığının; Çin, Endonezya, Tayland ve Türkiye'de su yolu taşımacılığının; Brezilya, Hindistan, Malezya, G. Afrika ve S. Arabistan'da karayolu taşımacılığının diğer taşımacılık türlerine kıyasla daha fazla çevresel baskıyı artırdığı gözlenmektedir. Ayrıca tüm modellerde katsayılara ilişkin etkilerin pozitif ve negatif şoklarda değiştiği görülmektedir.

Sonuç ve Tartışma:

Çalışma, 16 gelişmekte olan ülkede havayolu, su yolu ve karayolu turizm taşımacılığının ekolojik ayak izi üzerindeki etkilerini EG (1987) ve QCR yaklaşımları ile analiz etmektedir. Eşbütünleşme testi sonuçları açısından geleneksel yaklaşım ile kantil bazlı yaklaşım arasında dramatik fark gözlenmektedir. Karayolu modelinde EG testi, örneklemin %21'inde eşbütünleşme tespit ederken, QCR testi örneklemin %92'sinde benzer sonuca ulaşmaktadır. Bu oranlar, su yolu modeli için %26'dan %83'e, havayolu modeli için ise %41'den %94'e yükselmektedir. Sonuçlar, kantil yaklaşımların veri yapısını daha iyi açıkladığına işaret etmektedir. Ampirik kanıtlar, gelişmekte olan ülkelerde turizm taşımacılık türlerinin genel olarak ekolojik ayak izini olumlu yönde etkilediğini ortaya koymaktadır. Ancak bu etkilerin boyutu, taşımacılık türleri ile pozitif ve negatif şoklara göre farklılaşmaktadır. Dolayısıyla hükümetler, kısa vadede çevresel zararı en fazla olan taşımacılık türünden diğerlerine geçiş yapmaları gerekmektedir. Uzun vadede ise, taşımacılık türlerinde fosil yakıt kullanımının azaltılması ve yenilebilir enerji kaynaklarının teşvik edilmesi yönünde politikalar uygulanmalıdır. Ayrıca çalışma, turizm taşımacılığı-çevre kirliliği ilişkinde asimetrik yapının etkin olduğuna dair kanıtlar sunmaktadır. Gelecekteki çalışmalar için, benzer modellerin farklı örneklemler için uygulanması önerilebilir. Çalışmada çevre göstergesi olarak ekolojik ayak izi tercih edilmiştir. Yapılacak çalışmalarda çevre kirliliği, çevre arzı veya çevre kalitesine dair diğer çevre göstergeleri kullanılabilir. Son olarak, dinamik bir sürece sahip olan ampirik yaklaşımlar takip edilerek, veri yapısını daha iyi açıklayacak yeni testler uygulanabilir.

1. INTRODUCTION

Climate crisis and environmental degradation are the major future challenges of the world. These two problems directly affect 11 of the 17 goals set by the United Nations (UN) for the global challenges of the century (UN, 2023). To realise the global goals, measures to improve environmental quality are discussed in many areas. One of these main areas is tourism, which plays an important role in terms of both national and world economy.

The tourism, which is an important component of the service sector, increased by 5.6% on average for 1995-2019, representing 1.8% and 6.8% of world GDP and exports, respectively (WB, 2023). In the second decade of the 21st century, the total number of tourist arrivals reached 1.466 billion, an increase of nearly 50% (UNWTO, 2023a). Meanwhile, the sector supported one of the 11 business lines in the world economy, employing 289.5 million jobs in 2021 (WTTC, 2022). Unsurprisingly, the environmental costs of the tourism sector, which has a large economic volume and impact area, are also increasing. For example, according to the Climate Change and Tourism-Responding to Global Challenges report, carbon emissions (CO_2) from the global tourism sector is projected to rise by 161% by 2035 (UNWTO, UNEP & WMO, 2008).

The sum of CO_2 emitted from the products purchased by tourists and directly in the realisation of activities reflects the tourism carbon footprint (Lenzen et al., 2018). Besides, energy consumption required for tourism activities and zoning works required by the sector are other factors that stimulate pollution (Becken et al., 2003; Gössling, 2013; Cadarso Gómez et al., 2015; Gao & Zhang, 2021; Li et al., 2022). However, pollution caused by tourism transportation is prominent among these factors. Because tourism transportation causes approximately 75% of tourism-related pollution. Therefore, various measures such as technological improvements and market-based regulations are needed for the transportation sector (UNWTO, UNEP & WMO, 2008). With this motivation, the paper focuses on tourism transportation pollution and provides empirical evidence for mitigation policies for emerging markets (EMs) .

EMs have a vital role in terms of environmental pollution on a global scale. The EMs examined in the analysis represented about one-third of the global ecological footprint (EF) in 1995, which jumped to 46.5% in 2018 (GFN, 2023). Favouring aggressive growth and development policies in EMs leads to high pollution. Meanwhile, EMs, with nearly six billion tourist arrivals, host about one-fifth of the global tourist arrivals (UNWTO, 2023b). ICAO (2017) also emphasises the increasing attractiveness of international tourism in EMs.

In light of these statistics, the paper analyses the relationship between transport activities and environmental degradation in international tourism for EMs. We categorise the types of tourism transport in EMs into air tourism arrivals (AIR), water tourism arrivals (WATER) and land tourism arrivals (LAND). In this way, we can see the impact of sub-categories of tourism transport on EF separately. The relationship between tourism transportation and environmental pollution is analysed with the quantile cointegration (Quantile Cointegrating Regression (QCR)) approach proposed by Xiao (2009). Quantile cointegration method has many advantages over conventional cointegration methods. It can take into account the possible endogeneity problem that may arise in analyses with market data, and the tail distributions that may arise due to reasons such as economic shocks, political moves and domestic market conditions etc. It allows the relationship between variables to be analysed on a quantile basis. Especially in samples such as EMs where the volatility in the economy is high, it allows asymmetric analysis of economic relations by separating positive and negative shocks to the series[4]. Accordingly, when tourism transportation increases and/or decreases, its effect on environmental pollution can be decomposed and analysed.

Empirical evidence reveals the existence of a long-run relationship between tourism transportation types and EF in EMs. Moreover, the findings prove the existence of an asymmetric effect and report that this effect varies depending on the size and sign of the shock. These findings point out that the sign and size of the shock should be taken into account in the policies to be produced regarding the relationship between tourism transportation and environmental pollution.

[4] Asymmetric structure in economic series refers to a situation where the data or results are not symmetric. This can manifest itself in a variety of economic contexts. Asymmetry can be caused by natural distributional features (such as skewness and kurtosis), exogenous economic shocks, policy responses, heteroskedasticity in time series, behavioural biases and non-linear relationships. The recognition and modelling of this asymmetry is important for the understanding of economic phenomena because it explains why some events have larger effects than others, why economic data are not symmetric, and avoids possible biases by taking into account the distributional properties of the data.

The paper contributes to the gap in the literature in four ways: Firstly, the paper is the first attempt to analyse the environmental impact of tourism transportation by decomposing it as airway, waterway and land way sub-types. Secondly, the research uses the more comprehensive EF instead of the widely preferred CO_2 as an environmental indicator. Hunter and Shaw (2007) argued that EF is a more appropriate indicator for existing and potential tourism activities from a broader ecological demand perspective. Thirdly, the empirical model brings more holistic evidence by analyzing 16 EMs for which data are available. Finally, the empirical method gains an asymmetric perspective by disaggregating the nexus between tourism transportation and EF into positive and negative shocks.

2. LITERATURE REVIEW

Researchers have been questioning the environmental impact of tourism, a driving force for sustainable development, especially since the early 2000s. While most of these papers reflect environmental degradation through CO_2 (Solarin, 2014; Paramati et al., 2017), more recent researchers analyze the EF (Peeters & Schouten, 2006; Martín-Cejas & Sánchez, 2010; Yavuz et al., 2023; 2024). EF calculates the ecological assets needed to produce the natural resources consumed by any population or product and to absorb its wastes. EF is more inclusive than other environmental indicators as it consists of six components namely carbon demand, built-up land, forest area, cropland, fishing grounds, and grazing land (GFN, 2024). On the other side of the equation, the tourism indicator is represented by two main variables as tourism revenues (Paramati et al., 2017; Gao & Zhang, 2021) and tourism transportation. This paper focuses on the tourism transportation-environmental pollution literature.

In the literature on the environmental impacts of tourism transportation, one group of researchers investigate the holistic impacts of tourism transportation. Peeters and Schouten (2006) note that transportation causes about two-thirds of the tourism-related EF in Amsterdam. Dubois and Ceron (2006) project that the amount of GHG emissions from tourism transportation will nearly double in 2050 for France. Liu et al. (2011) find that transportation is the largest contributor to the energy consumption and carbon emissions of the tourism industry in Chengdu.

The other group of researchers try to answer the question of how the types of tourism transportation affect environmental pollution. Dubois and Ceron (2006) research the tourism transportation-environmental pollution nexus by airplane, train, bus and car. The findings underline that airplane pollution is higher than the others. Lin (2010) analyzes the effects of four components of land way tourism transportation on CO_2 and offers evidence that the use of private cars causes significantly higher emissions compared to others. Martín-Cejas and Sánchez (2010) point out that land way transportation is an important component of tourist EF for Lanzorate. Sanyé-Mengual et al. (2014) examines the effects of tourism transportation on CO_2 by dividing it into airway, land way and waterway. The results highlights the dominant share of airway transportation in total CO_2. Tang et al. (2015) survey the impact of 10 different types of vehicles on CO_2 and reported that the automobile causes the highest emissions, while the yacht causes the lowest emissions. Rico et al. (2019) finds that carbon footprint from tourism transportation is nearly doubled due to airway transportation for Barcelona. Gurcam (2023) produces evidence that the number of flights promotes personal carbon footprint for Cappadocia.

The prominent points in the summarised literature are (i) although CO_2, which is an older indicator of pollution, is used extensively in the literature examining the impact of tourism on the environment, the number of studies that take into account the more comprehensive EF is relatively limited, (ii) there is a puzzle due to the fact that the rate of affecting environmental pollution differs according to the type of transportation and there is no unity, (iii) in regard to the sample group, there are papers that deal with one or more EMs, but there is no study that focuses entirely on EMs, and finally (iv) tourism transportation is not analysed from an asymmetric perspective. This paper differs from the literature in that it focuses on EMs as a sample, considers tourism transportation in three subcategories (airway, waterway and land way) and uses an asymmetric perspective as a methodology.

3. DATA

We selected 16 EM countries (Brazil, China, Chile, Colombia, Indonesia, India, Korea, Malaysia, Mexico, Peru, Poland, S. Africa, S. Arabia, Philippines, Türkiye, and Thailand) as a research sample. Data covers the time period of 1995-2018. The analysis period is determined according to data availability. We follow MSCI for emerging market classification (MSCI, 2024). There are some restrictions in our data set. We could not access data for four countries in waterway transportation (Chile, Mexico, Colombia and S. Africa) and for two countries in land way transportation (Poland and Korea). Due to data availability, we also examine the period 2004-2018 for S. Arabia. Data is transformed into logarithmic form to eliminate scale differences in the analysis. EF and international inbound tourism arrivals in the model are obtained from Global Footprint Network (GFN, 2023) and World Tourism Organization (UNWTO, 2023a), respectively. Unit root and cointegration tests were carried out using the tspdlib library developed by Nazlioglu (2021) with the help of GAUSS-24.

Table 1 depicts the descriptive statistics. According to the average of the analysis period, China, which has a very large population, has the highest EF, while Korea contributes the lowest EF. Similarly, China also stands out in tourism transportation. In the analysis period, while China ranks first in the sample in terms of the number of tourist arrivals by waterway and land way, the highest number of tourist arrivals by the airway belongs to Türkiye. Colombia, Peru and Chile are the countries with the lowest average number of tourist arrivals by transportation types.

A pre-test results for the series are also reported in Table 1. According to the results of Jarque and Bera (1987), one country (Philippines) in the EF series, five countries (Indonesia, India, Colombia, Mexico, and Chile) in the land way series, three countries (Korea, S. Arabia, and Philippines) in the waterway series and one country (Chile) in the airway series have non-normal (non-Gaussian) distributions. Four countries (Malaysia, Mexico, S. Arabia, and Thailand) in EF, two countries (China and Malaysia) in land way, four countries (Brazil, S. Africa, S. Arabia, and China) in airway and two countries (Brazil and Türkiye) in waterway have negative skewness values, thus the series show left-tailed distribution. The others have a right-tailed distribution with positive skewness values. Finally, since the kurtosis value is greater than 3 for two countries (Mexico and Philippines) in EF, five countries (Colombia, Indonesia, India, Chile, and Mexico) in land way, three countries (Korea, S. Arabia, and Philippines) in waterway and two countries (Chile and Mexico) in airway, leptokurtic distribution (extreme negative kurtosis) is observed in the series. As the kurtosis value is less than 3 in other series, platykurtic distribution (extreme positive kurtosis) is detected.

Table 1. Descriptive Statistics

Countries	Ecological Footprint (Million gha)				Tourist Arrivals-Airway (Thousand Person)			
	M	**S**	**K**	**JB (p-val)**	**M**	**S**	**K**	**JB (p-val)**
Brazil	529.1	0.56	1.85	2.580(0.280)	3375.0	-0.70	2.57	2.170(0.340)
Chile	62.5	0.44	1.84	2.140(0.340)	1117.7	1.16	3.42	5.520[c](0.060)
China	3698.2	0.08	1.42	2.520(0.280)	14755.4	-0.20	1.48	2.450(0.290)
Colombia	85.0	0.31	1.95	1.480(0.480)	1084.0	0.89	2.86	3.160(0.210)
India	1135.2	0.34	1.69	2.160(0.340)	4310.2	0.37	1.76	2.100(0.350)
Indonesia	338.3	0.43	1.80	2.180(0.340)	4576.5	1.01	2.79	4.130(0.130)
Korea	6.0	0.35	2.69	0.580(0.750)	6685.2	0.70	2.13	2.680(0.260)
Malaysia	101.1	-0.03	1.76	1.540(0.460)	4016.7	0.78	2.42	2.750(0.250)
Mexico	309.9	-0.05	3.10	0.020(0.990)	10490.9	0.98	3.06	3.830(0.150)
Peru	57.8	0.21	1.55	2.280(0.320)	1203.4	0.49	1.94	2.080(0.350)
Philippines	107.8	1.43	4.92	11.840[a](0.000)	3335.1	0.93	2.67	3.560(0.170)
Poland	172.4	0.17	1.80	1.550(0.460)	2614.9	0.30	1.58	2.370(0.310)
S. Africa	175.3	0.68	2.44	2.140(0.340)	2205.7	-0.14	1.81	1.500(0.470)
S. Arabia	149.7	-0.51	2.01	1.260(0530)	9002.6	-0.23	1.58	1.380(0.500)
Thailand	141.0	-0.21	1.98	1.230(0.540)	13997.1	0.98	2.61	4.010(0.130)
Türkiye	209.9	0.16	1.80	1.530(0.460)	17813.9	0.14	1.57	2.110(0.350)

Countries	Tourist Arrivals-Waterway (Thousand Person)				Tourist Arrivals-Land Way (Thousand Person)			
	M	S	K	JB (p-val)	M	S	K	JB (p-val)
Brazil	120.8	-0.22	2.57	0.380(0.830)	1506.7	0.21	2.02	1.130(0.570)
Chile	-	-	-	-	1676.4	1.19	3.31	5.720[c](0.060)
China	4609.8	0.34	2.63	0.590(0.750)	90746.2	-0.69	2.36	2.300(0.320)
Colombia	-	-	-	-	128.2	4.37	20.77	391.940[a](0.000)
India	32.8	0.41	2.47	0.950(0.620)	660.1	1.89	5.42	20.090[a](0.000)
Indonesia	2240.0	0.09	2.75	0.090(0.950)	248.7	3.41	13.65	159.820[a](0.000)
Korea	1059.9	1.10	3.48	5.100[c](0.080)	-	-	-	-
Malaysia	620.8	0.54	2.41	1.510(0.470)	11333.0	-0.04	1.92	1.170(0.560)
Mexico	-	-	-	-	13648.3	1.58	4.45	12.100[a](0.000)
Peru	18.0	0.07	1.42	2.530(0.280)	758.5	0.47	2.09	1.690(0.430)
Philippines	53.6	3.13	13.23	143.920[a](0.000)	-	-	-	-
Poland	745.0	0.89	1.98	4.180(0.120)	-	-	-	-
S. Africa	-	-	-	-	68145.6	0.08	1.66	1.810(0.400)
S. Arabia	255.4	1.31	3.94	4.870[c](0.090)	5498.4	0.08	1.62	1.940(0.380)
Thailand	325.3	0.84	2.52	3.020(0.220)	2362.4	0.80	2.55	2.740(0.250)
Türkiye	82.8	-0.25	2.14	1.000(0.610)	5051.1	0.11	1.52	2.240(0.330)

Notes: JB is refers to Jarque and Bera (1987), the test of normality. Values in parentheses represent probability values for the JB test. M: Mean, S: Skewness, K:Kurtosis. The statistics in the table are calculated with raw data. [a], [b], [c] denote the significance level at 1%, 5%, and 10%, respectively.

For a visual inspection we plotted the long-term link between EF and tourist arrivals by mode of transportation in Appendix 1. According to Figure 1, the tendency of the variables to converge in equilibrium points to the co-movement of the variables in almost all countries. However, the observation of periodic breaks in the variables leads to the need for quantile-based analysis. A time-varying cointegration link can emerge as periodic shocks can differentiate the relationship between the parameters.

4. METHOD

The relationship between economic variables may vary in different quantiles (Syed et al., 2019). Quantile-based approaches are useful for capturing and accurately explaining this variability.

In econometric analyses using market data, there may be a relationship problem between the error term and the explanatory variable(s) (endogeneity). This possible endogeneity problem causes changes in the asymptotic distributions of the estimators and eventually leads to biases estimates (Portnoy, 1991). To overcome this problem, Saikkonen (1991) develops a parametric augmented QCR approach (with added leads and lags). Therefore, Xiao (2009) makes this approach suitable for quantile-base analysis.

This approach is a renewal of the conventional approach in terms of being able to decompose positive and negative shocks in the relationship between variables, taking endogeneity into account and being robust to the heavy-tailed distributions.

We start the modelling with Equation 1:

$$y_t = d_t + \beta_t X_t + e_t \tag{1}$$

where d_t is the deterministic components (constant/trend) matrix. β is the time-varying regression coefficient. X_t is the independent variable(s) matrix. $e_{i,t}$ is the error term.

Xiao (2009) calculates the conditional quantile τ of y_t as follows:

$$Q_{i_t}(\tau|X_t) = \alpha(\tau) + \beta(\tau)X_t + \sum_{j=-K}^{K} \gamma_j(\tau) \cdot X_{t-j} + F_\varepsilon^{-1}(\tau) \quad (2)$$

where $F_\varepsilon(\tau)$ is the error term for each quantile. K and $-K$ are the leads and lags of ΔX_t, respectively, and are added to the model to correct for endogeneity. $\beta(\tau)$ is the time-varying cointegration coefficient for each quantile.

The $\gamma_n$statistic is used to test for the existence of a cointegration relationship and is formulated as follows:

$$\gamma_n = \frac{1}{\omega_\psi^* \sqrt{n}} \sum_{j=1}^{K} \psi_\tau(\varepsilon_{j\tau}) \quad (3)$$

where ω_ψ^* is the long-run variance of $\psi_\tau(\varepsilon_{j\tau})$. $\varepsilon_{j\tau}$ are the errors from the QCR. The γ_n statistic tests "H_0: cointegration" against "H_A: no cointegration".

5. EMPIRICAL RESULTS

We start the empirical analysis by examining the unit root levels of the variables. At this point, we use the Dickey and Fuller (ADF) (1979) unit root test. The results are given in Table 2. With very few exceptions, the null hypothesis of unit root cannot be rejected at the level, i.e. the variables have a unit root process. When first differences are taken, all variables come stationary. Accordingly, our variables have I(1) process.

Table 2. Unit Root Test (Dickey & Fuller, 1979)

Countries	Level							
	$lnEF_t$		$lnAIR_t$		$lnWATER_t$		$lnLAND_t$	
	statistic	p-val.	statistic	p-val.	statistic	p-val.	statistic	p-val.
Brazil	-1.371(0)	0.579	-4.754(0) [a]	0.001	-2.820(1)[c]	0.072	-4.534(2)[a]	0.002
Chile	-0.356(0)	0.901	0.609(0)	0.987	-	-	0.290(0)	0.972
China	-0.554(1)	-0.554	-1.497(0)	0.517	-2.022(0)	0.276	-4.291(0)[a]	0.003
Colombia	-1.035(0)	0.723	-0.997(0)	0.737	-	-	-6.765(0)[a]	0.000
India	0.256(0)	0.970	-0.018(0)	0.948	-2.250(0)	0.195	0.825(0)	0.992
Indonesia	0.997(2)	0.995	0.659(0)	0.988	-2.251(0)	0.195	3.432(1)	0.999
Korea	-2.007(0)	0.282	-0.099(1)	0.938	-1.248(0)	0.635	-	-
Malaysia	-0.751(1)	0.813	-0.580(0)	0.857	-1.646(0)	0.444	-1.191(0)	0.660
Mexico	-4.125(0)[a]	0.004	-0.097(0)	0.939	-	-	0.380(0)	0.977
Peru	0.127(1)	0.961	-0.820(0)	0.794	-1.158(1)	0.673	-1.548(2)	0.491
Philippines	0.692(0)	0.989	0.925(0)	0.994	-0.096(1)	0.938	-	-
Poland	-2.192(0)	0.214	-0.708(2)	0.824	-1.552(1)	0.490	-	-
S. Africa	-1.017(0)	0.729	-1.770(1)	0.384	-	-	-1.543(0)	0.495
S. Arabia	-4.425(1)[a]	0.005	-1.615(0)	0.450	-1.667(0)	0.425	-1.740(0)	0.392
Thailand	-1.117(0)	0.691	0.657(0)	0.988	-1.266(0)	0.627	-1.112(2)	0.691
Türkiye	-0.127(1)	0.935	-1.017(0)	0.729	-2.192(0)	0.214	-0.615(0)	0.849

Countries	First Difference							
	$lnEF_t$		$lnAIR_t$		$lnWATER_t$		$lnLAND_t$	
	statistic	p-val.	statistic	p-val.	statistic	p-val.	statistic	p-val.
Brazil	-4.490(0)[a]	0.002	-5.675(0)[a]	0.000	-4.257(2)[a]	0.004	-6.104(2)[a]	0.000
Chile	-5.971(0)[a]	0.000	-4.088(0)[a]	0.005	-	-	-3.868(0)[a]	0.008
China	-2.643(2)[c]	0.099	-5.985(0)[a]	0.000	-5.245(0)[a]	0.000	-2.679(0)[c]	0.094
Colombia	-5.880(0)[a]	0.000	-3.499(0)[b]	0.019	-	-	-2.065(2)[b]	0.040
India	-5.007(0)[a]	0.001	-3.237(0)[b]	0.031	-4.815(0)[a]	0.001	-4.505(0)[a]	0.002
Indonesia	-4.830(0)[a]	0.001	-4.529(0)[a]	0.002	-4.559(0)[a]	0.002	-12.691(0)[a]	0.000
Korea	-5.343(0)[a]	0.000	-8.351(0)[a]	0.000	-5.217(0)[a]	0.000	-	-
Malaysia	-7.746(0)[a]	0.000	-4.084(0)[a]	0.005	-4.929(0)[a]	0.001	-4.227(0)[a]	0.004
Mexico	-7.677(0)[a]	0.000	-5.242(0)[a]	0.000	-	-	-4.145(0)[a]	0.004
Peru	-7.733(0)[a]	0.000	-5.102(0)[a]	0.001	-7.149(0)[a]	0.000	-4.738(1)[a]	0.001
Philippines	-3.511(0)[b]	0.018	-3.476(0)[b]	0.019	-2.322(0)[b]	0.023	-	-
Poland	-2.371(2)[b]	0.021	-3.614(0)[b]	0.015	-2.931(0)[c]	0.058	-	-
S. Africa	-4.454(0)[a]	0.002	-6.487(0)[a]	0.000	-	-	-5.541(0)[a]	0.000
S. Arabia	-6.776(0)[a]	0.001	-3.980(0)[b]	0.011	-2.852(0)[c]	0.078	-4.138(0)[a]	0.009
Thailand	-4.626(0)[a]	0.002	-4.554(0)[a]	0.002	-4.592(0)[a]	0.002	-6.895(1)[a]	0.000
Türkiye	-8.432(0)[a]	0.000	-5.261(0)[a]	0.000	-6.191(0)[a]	0.000	-4.938(0)[a]	0.001

Notes: We determined p with t-statistic by setting maximum lags to 2 for all tests. Values in parentheses indicate the appropriate lag length. The "-" sign indicates the countries whose estimation results could not be obtained due to the availability of data in the relevant variable. p-val<0.01([a]), 0.05([b]), and 0.1([c]) indicate significance at 1%, 5%, and 10%.

In order to present comparative findings, the cointegration relationship is analysed using the conventional and quantile approaches. Table 3 lists the results obtained from cointegration analysis. According to EG (1987), the null hypothesis of no cointegration is rejected for the relationship between EF and AIR in 7 EMs (Chile, Colombia, Korea, Malaysia, Mexico, Peru, and S. Arabia), for the relationship between EF and WATER in 1 EM (Peru) and finally for the relationship between EF and LAND in 3 EMs (Chile, Mexico, and Türkiye).

Conventional methods such as EG (1987) have strict assumptions that the data are Gaussian distributed and that there is no relationship between the error term and the explanatory variables (endogeneity problem). Deviations from these assumptions can lead to biased results. Additionally, conventional methods do not allow β to change over time and can only analyse the linear relationship between variables. At this point, in this study, the relationship between environmental pollution and tourism transportation is analysed with the quantile approach, which can take into account the tailed distributions, is resistant to the possible endogeneity problem and allows for asymmetric (separate effects of positive and negative shocks) analysis.

According to the results of the quantile cointegration approach (see Table 3), the null hypothesis of cointegration is rejected for the relationship between EF and AIR in 1 EM (Poland), for the relationship between EF and WATER in 3 EMs (Malaysia, Poland, and S. Arabia) and lastly for the relationship between EF and LAND in 1 EM (Mexico). Thus, in contrast to conventional method, the quantile approach finds that pollution and tourism transportation are cointegrated in all countries, with a few exceptions.

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Table 3. Cointegration Tests Results

Dependent Variable: EF	**Conventional Method (Engle & Granger, 1987)**					
Countries	***AIR***		***WATER***		***LAND***	
	statistic	**prob.**	**statistic**	**prob.**	**statistic**	**prob.**
Brazil	-1.830(0)	0.621	-1.927(0)	0.574	-1.569(0)	0.737
Chile	-4.219(0)[b]	0.015	-	-	-3.488(0)[c]	0.063
China	-2.341(0)	0.377	-0.988(0)	0.905	-1.811(1)	0.630
Colombia	-3.909(0)[b]	0.028	-	-	-1.358(0)	0.814
India	-2.046(0)	0.516	-1.480(0)	0.772	-1.409(0)	0.797
Indonesia	-2.297(0)	0.396	-0.838(0)	0.929	-2.886(0)	0.379
Korea	-3.367(0)[c]	0.079	-2.725(0)	0.226	-	-
Malaysia	-3.850(0)[b]	0.032	-3.346(0)	0.082	-2.870(0)	0.182
Mexico	-3.922(0)[b]	0.028	-	-	-4.177(0)[b]	0.016
Peru	-4.191(0)[b]	0.016	-3.697(0)[b]	0.043	-2.342(0)	0.376
Philippines	-2.512(2)	0.307	-2.347(0)	0.374	-	-
Poland	-2.283(0)	0.403	-2.472(0)	0.320	-	-
S. Africa	-2.455(0)	0.327	-	-	-3.018(0)	0.144
S. Arabia	-3.410(0)[c]	0.093	-2.079(0)	0.508	-1.910(0)	0.587
Thailand	-2.102(0)	0.489	-2.470(0)	0.321	-3.078(0)	0.130
Türkiye	-3.108(0)	0.124	0.001(1)	0.989	-3.630(0)[b]	0.049
Dependent Variable: EF	**Quantile Method (Xiao, 2009)**					
Countries	***AIR***		***WATER***		***LAND***	
	statistic	**prob.**	**statistic**	**prob.**	**statistic**	**prob.**
Brazil	1.410	0.360	1.224	0.849	1.404	0.424
Chile	1.419	0.353	-	-	1.559	0.130
China	1.391	0.534	1.467	0.196	1.393	0.572
Colombia	1.043	0.958	-	-	1.495	0.106
India	1.512	0.157	1.186	0.916	1.568	0.134
Indonesia	1.403	0.365	1.483	0.290	1.328	0.640
Korea	1.454	0.388	1.043	0.975	-	-
Malaysia	1.431	0.360	1.653[c]	0.065	1.217	0.876
Mexico	1.197	0.582	-	-	1.622[c]	0.099
Peru	1.266	0.676	1.418	0.354	1.162	0.865
Philippines	1.305	0.617	1.546	0.146	-	-
Poland	1.569[c]	0.093	1.732[b]	0.039	-	-
S. Africa	1.289	0.654	-	-	1.523	0.196
S. Arabia	1.265	0.688	1.423[a]	0.000	1.388	0.410
Thailand	1.093	0.940	1.063	0.978	1.311	0.554
Türkiye	1.232	0.771	1.496	0.239	1.445	0.317

Notes: We determined p with t-statistic by setting maximum lags to 2 for both tests. Values in parentheses indicate the appropriate lag length. The “-” sign indicates the countries whose estimation results could not be obtained due to the availability of data in the relevant variable. γ_n statistic tests the null hypothesis of cointegration. p-values were based on resampling procedure with 1,000 replications. p-val<0.01([a]), 0.05([b]), and 0.1([c]) indicate significance at 1%, 5%, and 10%.

After determining the cointegration between the variables, long-term coefficient estimates are made to determine the size and sign of the relationship. Table 4 lists the regression coefficients for the relationship between AIR, WATER, and LAND and EF for each quantile from 0.1 to 0.9 for the variables with cointegration relationship. When the coefficient estimates are analysed in general, all statistically significant coefficients have a positive sign. Therefore, we can conclude that tourism arrivals in all modes of transportation increase environmental pollution. In order to see whether this effect varies according to the type of transportation, the coefficients obtained are compared according to the type of tourism transportation. Accordingly, in Chile, Colombia, Korea, Peru, and the Philippines, AIR has a relatively greater impact on EF than other modes of tourism transportation. In China, Indonesia, Thailand, and Türkiye, WATER causes comparatively more environmental damage than other modes of tourism transportation. In Brazil, India, Malaysia, S. Africa, and S. Arabia, LAND is found to increase environmental pressure compared to other modes of tourism transportation.

But is there any effect of sign and size of shocks in the relationship between tourism transportation and environmental pollution? To answer this question, we analyse the impact of positive and negative shocks to airway, waterway and land way tourism arrivals for each country on a quantile basis (see Table 4).

- The Relation between Environmental Pollution and the Airway Tourist Arrivals

The impact of AIR on EF is statistically significant for all quantiles for a group of countries (China, Indonesia, India, Colombia, Chile, Malaysia, Peru, S. Arabia, and Türkiye). There is strong evidence of a relationship between the two variables in these countries. When the coefficients are analysed on a quantile basis, Colombia, India, Indonesia, Peru, and Türkiye have very close magnitudes in each quantile, but in Chile, China, Malaysia, and S. Arabia, the size of the coefficients varies over quantiles. This result suggests that the size and sign of the shock have a significant effect on the impact of AIR on EF in these 4 countries. In Brazil and the Philippines, the effect of AIR on EF is statistically significant for positive shocks. In other words, in these countries, AIR has a statistically significant effect on the EF only when it increases. Otherwise, there is no significant effect of AIR on EF for Brazil and the Philippines. In Korea, Mexico, and S. Africa, on the contrary, the effect of AIR on EF is statistically significant in negative shocks. Finally, in Thailand, the relationship becomes statistically insignificant only for extremely positive shocks. In other quantiles, there is a statistically significant relationship, though of different sizes.

- The Relation between Environmental Pollution and the Waterway Tourist Arrivals

In India, Malaysia, Peru, and Thailand, the impact of WATER on EF is statistically significant for all quantiles. The coefficients vary in magnitude across quantiles. In Brazil and the Philippines, the effect of WATER on EF is significant in the presence of positive shocks. In other words, in these countries, WATER has a negative impact on the EF when it is on the rise. This effect becomes insignificant when it is at its average or when it decreases. In Indonesia, there is a significant relationship in the middle quantiles. The effect becomes insignificant in large positive and large negative shocks. In Türkiye, the relationship becomes significant for negative shocks and extreme positive shocks and there is a significant difference in the coefficient size according to the sign of the shock. An interesting result is that in China and Korea, the effect of WATER on EF is significant for negative shocks and becomes insignificant in other cases.

- The Relation between Environmental Pollution and the Land Way Tourist Arrivals

The coefficients are statistically significant in all cantiles in Chile, India, Malaysia, Peru, S. Africa, Thailand, and Türkiye for relationship between LAND and EF. In Chile, India, S. Africa, and Türkiye, coefficient varies in magnitude across quantiles. There are no significant differences in size of coefficients in Malaysia, Peru, and Thailand. In Brazil, China, and Indonesia, the effect of LAND on EF is significant in the presence of positive shocks. For negative shocks, this effect becomes insignificant. In S. Arabia, only in the middle quantile is the relationship significant, positive, and negative shocks render it insignificant. In Colombia, the relationship becomes significant for negative shocks and for extremely positive shocks and there is a significant difference in the coefficient size according to the sign of the shock.

As a summary inference, Table 4 shows that effect of positive and negative shocks differ in the relationship between environmental pollution and tourism transportation. The size and sign of the shock are effective on the magnitude and significance of the coefficient. In this context, the size of the cointegration relationship in the between AIR, WATER, and LAND and EF behaves differently in different quantiles and has an asymmetric adjustment depending on the sign and size of the shocks.

Table 4. Results of Quantile Cointegration Coefficient for Each Quantile

Countries	$\widehat{\beta}(\tau)$	Negative Shocks			Middle Quantiles			Positive Shocks		
		0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
Brazil	Airway	0.021	0.038	0.308	0.321	0.386[c]	0.374[c]	0.401[b]	0.402[b]	0.338[c]
		(0.060)	(0.117)	(1.042)	(1.165)	(1.654)	(1.744)	(2.212)	(2.193)	(1.846)
	Waterway	0.052	0.100	0.121	0.227	0.303[b]	0.202	0.236[c]	0.233	0.230
		(0.280)	(0.545)	(0.706)	(1.457)	(2.025)	(1.494)	(1.664)	(1.567)	(1.515)
	Land Way	0.021	0.203	0.227	0.275	0.276	0.451[b]	0.367[c]	0.367	0.367
		(0.116)	(1.082)	(1.228)	(1.242)	(1.339)	(2.230)	(1.696)	(1.607)	(1.414)
Chile	Airway	0.223[b]	0.252[a]	0.324[a]	0.336[a]	0.364[a]	0.366[a]	0.358[a]	0.357[a]	0.358[a]
		(2.303)	(3.033)	(4.887)	(5.178)	(5.928)	(6.349)	(6.478)	(6.006)	(6.023)
	Land Way	0.196[c]	0.264[a]	0.241[a]	0.247[a]	0.248[a]	0.292[a]	0.362[a]	0.343[a]	0.340[a]
		(1.691)	(2.962)	(2.887)	(3.359)	(3.311)	(4.095)	(5.135)	(5.240)	(5.194)
China	Airway	0.580[a]	0.635[a]	0.642[a]	0.635[a]	0.666[a]	0.694[a]	0.719[a]	0.513[a]	0.516[a]
		(3.567)	(4.507)	(5.068)	(5.594)	(5.655)	(5.936)	(5.724)	(3.633)	(3.533)
	Waterway	1.275[a]	1.201[b]	1.189[c]	1.473[c]	1.629	1.562	2.355	2.316	-0.229
		(2.731)	(2.413)	(1.818)	(1.659)	(1.548)	(1.142)	(1.449)	(1.302)	(-0.110)
	Land Way	0.303	0.557	0.615	0.720	0.599	0.607	0.687	0.851[b]	0.404
		(0.341)	(0.766)	(0.958)	(1.303)	(1.160)	(1.262)	(1.612)	(2.185)	(1.029)
Colombia	Airway	0.146[a]	0.176[a]	0.176[a]	0.172[a]	0.161[a]	0.143[a]	0.143[a]	0.143[a]	0.124[a]
		(6.553)	(7.893)	(8.148)	(7.696)	(7.609)	(7.047)	(6.826)	(6.347)	(5.267)
	Land Way	0.077[a]	0.079[a]	0.085[b]	0.081	0.074	0.127	0.157	0.168[c]	0.103
		(2.683)	(2.795)	(2.288)	(1.530)	(0.941)	(1.364)	(1.523)	(1.655)	(1.152)
India	Airway	0.430[a]	0.430[a]	0.447[a]	0.450[a]	0.447[a]	0.440[a]	0.449[a]	0.449[a]	0.442[a]
		(19.311)	(21.642)	(23.477)	(23.889)	(22.576)	(24.586)	(23.743)	(25.168)	(24.268)
	Waterway	0.449[a]	0.390[a]	0.305[a]	0.353[a]	0.349[a]	0.344[a]	0.357[a]	0.379[a]	0.236[a]
		(4.261)	(4.004)	(3.879)	(4.598)	(4.674)	(4.351)	(4.483)	(3.998)	(2.096)
	Land Way	0.365[b]	0.391[a]	0.528[a]	0.479[a]	0.479[a]	0.504[a]	0.462[a]	0.470[a]	0.517[a]
		(2.105)	(2.631)	(3.239)	(3.898)	(4.095)	(4.299)	(3.163)	(3.393)	(2.379)
Indonesia	Airway	0.318[a]	0.322[a]	0.307[a]	0.307[a]	0.317[a]	0.347[a]	0.319[a]	0.323[a]	0.336[a]
		(8.833)	(8.313)	(7.066)	(6.395)	(5.795)	(6.074)	(5.335)	(4.620)	(4.446)
	Waterway	-0.245	0.777	1.454	1.454[c]	1.165[c]	1.027[c]	0.733	0.594	0.582
		(-0.215)	(0.792)	(1.613)	(1.957)	(1.782)	(1.720)	(1.379)	(1.1139	(0.993)
	Land Way	0.120	0.119	0.107	0.083	0.073	0.234	0.240[b]	0.312[b]	0.349[b]
		(0.760)	(0.799)	(0.743)	(0.558)	(0.523)	(1.610)	(1.711)	(2.248)	(2.482)
Korea	Airway	0.444	0.392	0.412[c]	0.395	0.163	0.327	0.130	0.058	0.155
		(1.622)	(1.572)	(1.678)	(1.544)	(0.614)	(1.361)	(0.506)	(0.202)	(0.521)
	Waterway	0.328[c]	0.276[c]	0.082	0.066	0.071	0.105	0.076	0.051	-0.046
		(1.867)	(1.674)	(0.543)	(0.467)	(0.574)	(0.887)	(0.617)	(0.400)	(-0.367)
Malaysia	Airway	0.380[a]	0.380[a]	0.317[a]	0.315[a]	0.356[a]	0.315[a]	0.313[a]	0.299[a]	0.242[a]
		(5.836)	(6.002)	(5.334)	(5.327)	(5.549)	(4.819)	(4.234)	(3.534)	(2.664)
	Waterway	0.360[a]	0.345[a]	0.286[a]	0.286[a]	0.268[a]	0.269[a]	0.289[a]	0.293[a]	0.293[a]
		(3.066)	(3.025)	(2.742)	(2.970)	(3.375)	(3.253)	(3.978)	(3.749)	(3.939)
	Land Way	0.218	0.382[a]	0.398[a]	0.414[a]	0.410[a]	0.419[a]	0.424[a]	0.424[a]	0.382[a]
		(1.532)	(3.158)	(4.461)	(4.863)	(5.006)	(5.515)	(4.961)	(4.421)	(3.937)

Countries	$\hat{\beta}(\tau)$	Negative Shocks			Middle Quantiles			Positive Shocks		
		0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
Mexico	Airway	0.218[b]	0.144	0.099	0.110	0.009	-0.061	-0.081	-0.130	-0.195
		(2.026)	(1.542)	(1.034)	(0.975)	(0.070)	(-0.420)	(-0.523)	(-0.782)	(-1.142)
Peru	Airway	0.308[a]	0.308[a]	0.308[a]	0.306[a]	0.308[a]	0.292[a]	0.304[a]	0.316[a]	0.320[a]
		(14.076)	(14.649)	(12.974)	(13.688)	(13.990)	(13.453)	(14.621)	(14.459)	(13.498)
	Waterway	0.227[a]	0.257[a]	0.249[a]	0.305[a]	0.301[a]	0.303[a]	0.242[a]	0.263[a]	0.263[a]
		(4.176)	(4.450)	(4.560)	(5.621)	(5.330)	(5.203)	(3.889)	(4.618)	(4.530)
	Land Way	0.228[a]	0.228[a]	0.266[a]	0.270[a]	0.270[a]	0.236[a]	0.236[a]	0.221[a]	0.237[a]
		(3.658)	(3.958)	(4.738)	(5.326)	(5.614)	(5.027)	(5.085)	(4.242)	(4.645)
Philippines	Airway	0.131	0.141	0.138	0.105	0.106	0.113	0.113	0.279[a]	0.276[a]
		(0.939)	(1.206)	(1.274)	(0.975)	(1.025)	(1.130)	(1.059)	(2.648)	(2.615)
	Waterway	0.050	0.059	0.107	0.106	0.165[b]	0.161[b]	0.214[b]	0.202[b]	0.175[b]
		(0.567)	(0.729)	(1.325)	(1.399)	(2.146)	(2.107)	(2.515)	(2.542)	(2.106)
S. Africa	Airway	0.316[c]	0.264	0.277[c]	0.292[c]	0.171	0.171	0.174	0.181	0.205
		(1.722)	(0.950)	(1.681)	(1.945)	(1.393)	(1.419)	(1.498)	(1.581)	(1.708)
	Land Way	0.725[a]	0.736[a]	0.727[a]	0.767[a]	0.895[a]	0.987[a]	0.993[a]	0.998[a]	1.251[a]
		(4.525)	(4.635)	(3.980)	(4.159)	(4.304)	(4.610)	(4.465)	(4.432)	(4.464)
S. Arabia	Airway	0.794[c]	0.582[c]	0.602[c]	0.602[b]	0.484[c]	0.513[b]	0.440[b]	0.441[b]	0.524[b]
		(1.794)	(1.716)	(1.670)	(2.186)	(1.935)	(2.186)	(2.035)	(2.266)	(2.259)
	Land Way	0.742	0.829	0.855	0.855	0.942[c]	0.101	0.038	0.126	0.126
		(1.432)	(1.378)	(1.409)	(1.427)	(1.696)	(0.158)	(0.075)	(0.220)	(0.256)
Thailand	Airway	0.352[a]	0.332[a]	0.380[a]	0.400[a]	0.223	0.308[c]	0.294[c]	0.127	0.146
		(2.707)	(2.591)	(2.636)	(2.845)	(1.392)	(1.793)	(1.715)	(0.697)	(0.762)
	Waterway	0.440[a]	0.412[a]	0.333[a]	0.342[b]	0.270[b]	0.243[c]	0.227	0.224	0.265[c]
		(3.865)	(3.776)	(3.061)	(2.564)	(2.012)	(1.701)	(1.638)	(1.596)	(1.945)
	Land Way	0.308[a]	0.315[a]	0.290[a]	0.278[a]	0.325[a]	0.351[a]	0.338[a]	0.301[a]	0.300[a]
		(5.698)	(5.890)	(4.758)	(4.027)	(4.338)	(3.979)	(3.547)	(2.660)	(2.241)
Türkiye	Airway	0.364[a]	0.323[a]	0.331[a]	0.355[a]	0.355[a]	0.339[a]	0.314[a]	0.288[a]	0.316[a]
		(7.248)	(6.747)	(6.783)	(7.065)	(7.133)	(6.842)	(6.487)	(5.923)	(6.764)
	Waterway	0.777[c]	0.758[c]	0.679[c]	0.543	0.355	0.355	0.328	1.041[c]	0.800
		(1.937)	(1.878)	(1.785)	(1.370)	(0.843)	(0.802)	(0.652)	(1.724)	(1.232)
	Land Way	0.378[a]	0.282[a]	0.285[a]	0.294[a]	0.293[a]	0.246[a]	0.266[a]	0.264[a]	0.270[a]
		(5.498)	(4.169)	(4.093)	(4.661)	(5.159)	(4.896)	(5.327)	(5.791)	(5.639)

Notes: *0.1, ..., 0.9* represent specific quantiles. $\beta(\tau)$ is the quantile cointegration estimates with 2 lead and lag. Values in parentheses give t-statistics for $\beta(\tau)$. t-table values are 1.645 (10%), 1.960 (5%) and 2.578 (1%). The "-" sign indicates the countries whose estimation results could not be obtained due to the availability of data in the relevant variable. We use resampling procedure with 1,000 replications. a, b, and c indicate significance at 1%, 5%, and 10% respectively.

6. CONCLUSION AND DISCUSSION

The paper explores the effect of tourism transportation disaggregated into airway, waterway and land way on EF in 16 EMs for the period 1995-2018 using conventional (EG, 1987) and quantile (Xiao, 2009) approaches. The cointegration findings reveal a dramatic difference between conventional and quantile methods. While the EG test detects cointegration in 21% of the sample for the land way model, this rate jumps to 92% in the QCR test. Similarly, these rates increase from 26% to 83% for the waterway model and from 41% to 94% for the airway model. The significant differences between the findings of the tests imply that the quantile approach better captures the dynamics in the data structure.

In the QCR test, quantile-based coefficients offer information about the size and direction of the link between variables. In accordance with the results, land way transportation for S. Arabia, S. Africa, Malaysia, India, Brazil waterway transportation for China, Indonesia, Thailand, and Türkiye and airway transportation for Philippines, Colombia, Korea, Mexico, Peru, and Chile increase EF more than other types. In the short run, governments can improve environmental quality by transitioning gradually to transportation types that produce the least EF. In the long run, governments should minimise fossil fuel consumption in transportation types and promote renewable energy. In addition, countries suffering from ecological deficit should attempt to enrich their biocapacity, which is considered as an antidote to EF. For this goal, protecting and increasing the amount of biocapacity components consisting of forest, grazing land, fishing ground, cropland, etc. is of vital importance for sustainable environment. Thus, a part of the EF stimulated by tourism transportation will be absorbed by biocapacity.

The quantile-based results also reveal that countries need to consider the asymmetric structure in their tourism transportation-environment policies. In the land way model, positive shocks in Indonesia, Brazil, and China, negative shocks in Colombia and moderate shocks in S. Arabia increase environmental stress. In the airway model, positive shocks for the Philippines and Brazil and negative shocks for Thailand, Korea, Mexico, and S. Africa trigger EF stress. Finally, in the waterway model, moderate shocks for Indonesia, both negative and positive shocks for Türkiye, positive shocks for the Philippines and Brazil, and negative shocks for Korea, Thailand, and China lead to greater environmental degradation. In other countries, shocks have no effect on the tourism transportation-EF nexus. In general, positive shocks to fossil fuel-intensive tourism transportation types reduce environmental quality, which is in accordance with expectations. On the other hand, it is surprising that environmental stress increases with negative shocks. This can be explained by negative shocks occurring in less polluting transportation types. In sum, the paper highlights the need for EMs governments to consider asymmetric evidence and the impact of shocks in designing policies for sustainable tourism transportation.

Transportation services have a negative impact on the EF in both the short and long term, with different modes of transportation in different countries. Governments should start by identifying the modes of transportation that increase the EF the most and make decisions to gradually move to more ecological practices. For example, tourists should be motivated to walk in places that are within walking distance of their destination. Governments should market (advertise) and inform tourists about the positive effects of walking on personal health and the environment. Tourists should also be encouraged to choose eco-friendly transportation such as bicycles, public transportation, shuttle transportation and hybrid vehicles. Tourism businesses should be oriented towards eco-tourism, alternative tourism and sustainable tourism practices with the support of sector stakeholders and policy makers. For example, these businesses can be encouraged to obtain sustainable tourism certificates such as Green Star and Blue Flag. Sustainable tourism and travel are now known, considered and preferred by tourists.

For future papers, researchers can contribute to the tourism transportation-environment literature with different environmental indicators, different sample groups or new generation empirical approaches that are more suitable for the data structure.

DECLARATION OF THE AUTHORS

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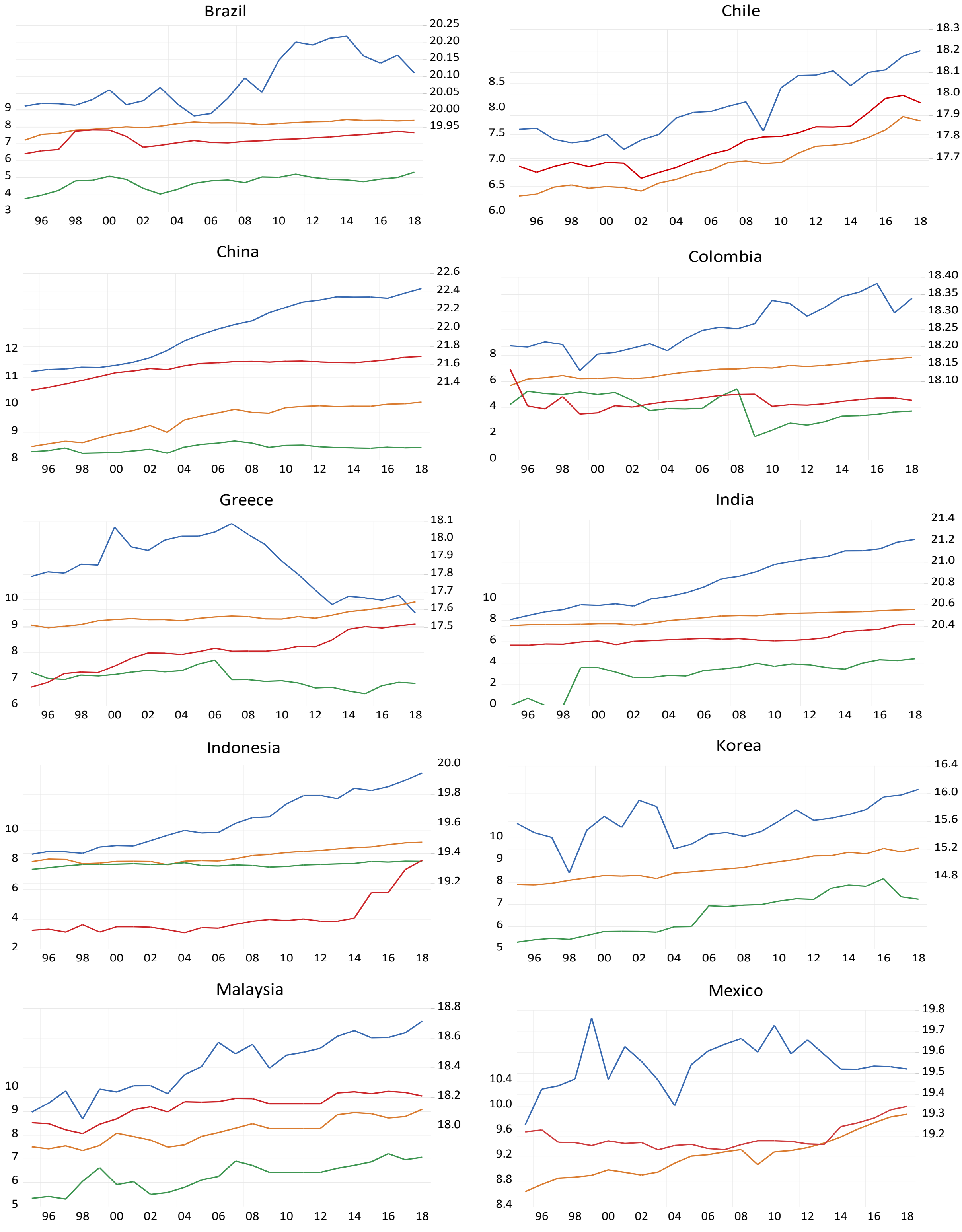
Appendix 1. Time Varying-Dependent Compatibility of Environmental Pollution and Tourist Way Arrivals (Drawn by the Authors)



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