



Assessing the linkage between energy consumption, financial development, tourism and environment: evidence from method of moments quantile regression

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Abstract

According to the United Nations World Tourism Organization (UNWTO), tourism sector ranks high in terms of her contribution to economic growth and employment opportunity generation in most economies. Several studies have been documented in the extant literature on the nexus between emission, tourism, and economic growth. However, the role of foreign direct investment that highlights either pollution haven or halo hypothesis and pivotal role of domestic credit to private sector in an environmental Kuznets curve (EKC) environment is lacking in the extant literature. To this end, this study used augmented mean group (AMG) and method of moment quantile regression (MM-QR) approaches to explore the nexus between per capital income and its square, tourism, foreign direct investment, domestic credit to private sector and CO₂ emission. Empirical results show that tourism had a negative significant relationship with CO₂ emission. Furthermore, income on the other hand had positive relationship with emissions while its square had negative relationship with emissions. This result also shows the presence of EKC indicating the inverted U-shaped curve. FDI has shown a positive significant relationship with pollution which indicates the pollutant haven hypothesis (PHH), and credit to private sector shows a positive relationship with CO₂ emission. On the causality analysis from Dumitrescu and Hurlin panel causality test, there was a bi-directional causality between: tourism and CO₂ emission, per capital income and CO₂ emission as well as domestic credit and CO₂ emission. From these outcomes, it shows that tourism development is not detrimental to environmental quality in the Mediterranean region investigated. However, there is need for caution on FDI influx and dirty economic activities that might compromise environmental quality in the study bloc.

Keywords Green tourism · Sustainable development · Sustainability · Carbon reduction · Panel econometrics · Mediterranean countries

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Introduction

The COVID-19 pandemic continues to have a destructive effect on global tourism, with new figures indicating an 87% drop in global tourist arrivals in 2021 compared to 2020 (UNWTO 2021). Following a difficult end to 2020, countries increased travel restrictions as a result of new virus upsurge in early 2021, causing more setbacks in global tourism. All world regions saw substantial declines in tourist arrivals in January 2021, according to the current version of the World Tourism Barometer. Commencement of global travel has been hampered by mandatory testing, quarantines, and, in some cases, complete border closures. Moreover, the pace and dispersion of vaccinations has been slower than anticipated, thereby delaying the resumption of tourism (UNWTO 2021). In order to guarantee a safe resumption of tourism and avert one more year of monumental financial loss for the industry, the World Tourism Organization continues to advocate for increased international cooperation on travel protocols. Global tourism arrivals increased from 25 million in 1950 to more than 825 million in 2007, and then to 1.035 billion in 2012 (Akadiri et al. 2017). In 2019, approximately 1.5 billion international tourism travels were recorded, showing a 4% increase over the previous year (Xian-Liang et al. 2020). However, current trends predict that global tourist arrivals

will decrease by about 85% in early 2021 compared to the same time frame in 2019 (UNWTO 2021). When compared to pre-pandemic levels, this would imply a reduction of approximately 260 million international arrivals. The UNWTO foretasted two scenarios for 2021, both of which anticipate an increase in global travel latter half of the year. These are supported on a variety of elements, including a significant reduction in travel restrictions, the effectiveness of vaccination campaigns, or the implementation of protocols that have been harmonized, for instance the European Commission's Digital Green Certificate. The first scenario predicts a July comeback, resulting in a 66% increase in international arrivals in 2021 over 2020 historic lows. Here, arrivals would still be 55% lower than in 2019. The second scenario assumes a September comeback, resulting in a 22% increase in arrivals over the previous year (UNWTO 2021). Figure 1 gives insights into the tourism mix in the presence of COVID-19.

Although global tourism contributes to economies' income, studies show that additionally, it leads to increases in energy consumption (Liu et al. 2011). A rise in tourism activities raises energy demand in a variety of areas, including transportation, catering, lodging, and tourist attraction management (Gössling 2002; Becken et al. 2001, 2003; Liu et al. 2011), which will almost certainly result in pollution and deterioration of the environment. Nepal (2008) recognized global tourism as one of the most energy-intensive

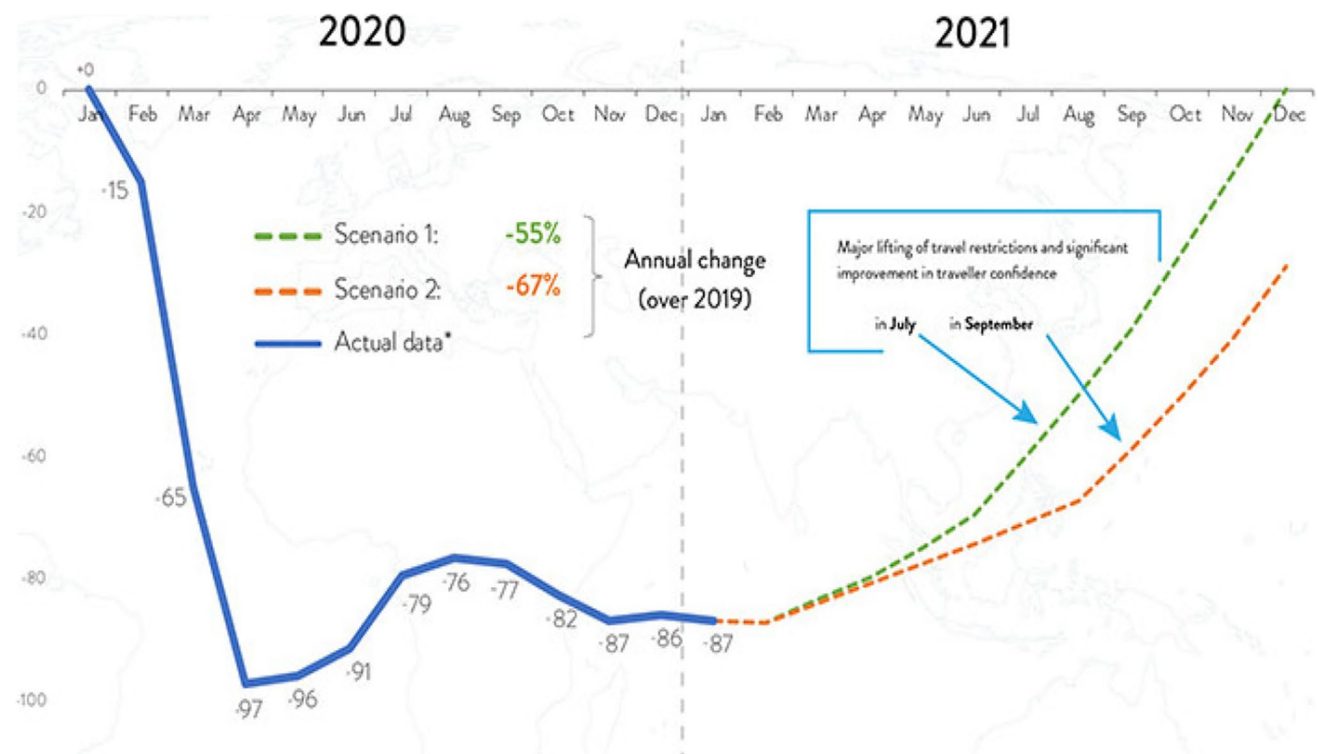


Fig. 1 International tourist arrivals in 2020 and scenarios for 2021 (Y-O-Y monthly change, %). Source: UNWTO (2021)

industries. Travelers from countries with a higher level of environmental consciousness are more open to hotels with energy-saving features and renewable energy sources (Tsarakakis et al. 2011). They argue that tourists from countries that effectively adapt energy-saving policies (e.g., Canada, Japan, Sweden, and Finland) favor hotels in destination countries with energy-saving installations. The capability of financing, raising capital, and creating jobs around the globe are some significant contributors of tourism to economic growth (Dwyer and Forsyth 2008; Choi and Sirakaya 2006). As such, tourism has emerged as a critical goal for the country's development.

Although foreign direct investment (FDI) has been identified as essential variable influencing emissions, research on the nexus between CO₂ emissions and FDI is limited for the bloc understudy. Financial development, according to researchers, is the catalyst for the advancement of energy-saving or environmentally friendly technologies. As a result, environmental pollutants, such as CO₂ emissions will be reduced (Pata 2018). This stems primarily from the belief that increased financial intermediation and financial openness would attract more foreign direct investment (FDI), which would in turn boost research and development and result in environmental improvement (Baum 2004). Tamazian et al. (2009) observed that a higher level of financial development enhances environmental conditions. On the contrary, Jalil and Feridun (2011) found financial development in China has a negative impact on CO₂ emissions. Zhang (2011) determined that one of the variables contributing to the rise in CO₂ emissions is financial development. According to Al-Mulali et al. (2013), in Sub-Saharan African countries, financial development also increases energy consumption and CO₂ emissions. The literature on the relationship between financial development and CO₂ emissions yields different results; thus, further research into this nexus appears needed.

Tourism is expected to become more energy-dependent as it grows. As a result, energy consumption may rise (Katiccioglu et al. 2013). In view of the fact that a growth in tourism activities result in a surge in energy consumption, the significance of energy in the tourism sector cannot be overstated. Consequently, policymakers and practitioners alike are interested in investigating the link between tourism management, energy consumption, and environmental pollution. Additionally, a growth in international tourist arrivals, and an increase in energy usage, may have an effect on the environment. Initiatives aimed at reducing the energy intensity of tourism, on the other hand, may help to prevent climate change by reducing energy consumption. Nonetheless, research into the relationship between tourism management, energy consumption, financial development, and environmental pollution have been limited. In light of this, this research looks into the relationships between tourist arrivals,

energy use, and pollution in Mediterranean countries. These countries provide related, if not identical, tourist products (sandy beaches, sun, sea, archeological sites, etc.) (Patsouratis et al. 2005). Italy, France, Turkey, Portugal, Spain, and Greece are popular tourist destinations. Tourists visit Italy for its culture and historical heritage, in addition to the sea and sun. Spain pursued market-attraction schemes focused on the sun and sandy beaches. Meanwhile, it attempted to enhance the service quality provided. In comparison to Spain, Portugal is further away from tourist attractions. To distinguish itself from Spain, Portugal focuses on family-oriented vacations, while the Spanish product is geared toward the younger generation. On the other hand, Turkey provides low-cost package vacations. This is because of the low living cost in comparison to other nations, as well as its currency policy. To counteract high inflation rates, Turkey implemented an exchange rate depreciation. Greece is chosen only as a recreational destination; its cultural component is not the primary motivator for tourist appeal (Patsouratis et al. 2005). Because Mediterranean countries attract a large number of international tourists, it is critical to investigate the role of environmental pollution in these countries.

Importance of Tourism and linkage with Mediterranean countries

Tourism is widely regarded as a source of economic growth around the world. The Mediterranean region, which includes both the northern and southern coasts, is the world's most popular tourist destination (Aslan et al. 2020). However, the Mediterranean region as a whole (European Union countries included) is the global leading tourist destination, with the highest growth rates in inbound world tourism over the last two decades (EU 2012). The UNWTO (2019) report listed the top ten tourist destination in the world. France is the top-ranked country, followed by Spain, Italy, and Turkey. Worth mentioning is that four Mediterranean countries are found among the top ten. The region's most popular tourist attractions, on the contrary, are Egypt, Lebanon, Tunisia, Morocco, and Cyprus. This demonstrates that interest in tourism is concentrated primarily in the Mediterranean nations. The Mediterranean countries' growth rates differ from one another. In the Mediterranean region, between 1999 and 2017, Lebanon increased by 2.10% on average, Italy by 2.47%, Greece by 2.38%, Spain by 3.76%, Albania by 8.02%, Turkey by 5.95%, and Montenegro by 6.59% (Aslan et al. 2020). This demonstrates that interest in tourism is primarily concentrated in these countries. According to UNWTO (2019) data, tourism-related economic activity is worth 1.7 trillion US dollars. Countries would naturally try to get a piece of this action within the context of the current economic cycle and the ever-expanding tourism industry.

Tourism is primarily clustered along the coast, which roughly receive 30% of global tourist arrivals (EU 2012). By attracting foreigners, tourism provides a significant source of income and job opportunities for the economies (Xian-Liang et al. 2020). Hence, tourism plays an important role in the region's economies, serving as an important source of economic development and job creation while also contributing positively to a nation's external balance of payments (EU 2012). According to Vicky Karantzavelou (2019) cited in Xian-Liang et al. (2020), one out of five jobs belong to the tourism sector. Increased job opportunities can be directly linked to tourism, such as tour guides or hotel management roles, or indirectly, such as food processing or retail suppliers (EU 2012). Tourism promotes employment, which is especially important in countries with acutely higher levels of unemployment and underemployment (particularly among the youth). In many countries' balance of payments, inbound tourism spending plays a major and positive role due to the significance of tourism in total exports of goods and services. Simply put, devoid of tourism receipts, most Mediterranean countries would be forced to drastically cut down on the importation of goods and services in order to maintain a sustainable external balance (EU 2012). Moreover, one of the most effective means of wealth redistribution is tourism because it brings income from abroad and other regions of the nation into local economies. It brings money into a community that would not have otherwise been earned (EU 2012). Tourism not only generates revenue, but it also provides opportunities for economic growth and development. It modernizes remote areas while also accelerating economic and cultural development (Yang and Wall 2009; Yan and Santos 2009; Candice 2015). Global tourism has grown steadily over the last few decades, in tandem with robust economic growth, particularly in countries with high tourist outflows (Dritsakis 2012). Tourist spending has acted as an alternative form of export, helping many countries improve their balance of payments through foreign exchange earnings (Balaguer and Cantavella-Jorda 2002). Consequently, tourism development has been widely regarded as a significant contributor to economic growth. Other benefits of tourism in the Mediterranean include increased spending in local and regional communities, better amenities such as good road networks, parks, and other public spaces that are frequently developed for both tourists and locals as a result of increased tourist activity in a region (EU 2012). Furthermore, economic diversification provides an insurance policy against downturns in other sectors of the economy for many local and regional communities. Tourism, by providing an extra source of income, can help a district when a traditional industry is struggling, especially if the community is heavily reliant on a singular industry. This is especially important in few Mediterranean nations that rely on energy exports or the manufacture of a narrow range of goods (EU 2012). Several

studies have been documented in the extant literature on the nexus between emission, tourism, and economic growth. However, the role of foreign direct investment that highlights either pollution haven or halo hypothesis and pivotal role of domestic credit to private sector in an environmental Kuznets curve (EKC) environment is lacking in the extant literature which the current study seek to fill for the case of Mediterranean countries which is a high tourism destination.

The remainder of this study is structured as the “Literature review” section provides a brief review of the related literature. The “Data and methodology” section renders the data and econometrics procedures while the “Empirical results and discussions” section presents the empirical results. Finally concluding remarks with policy prescriptions is documented in the “Conclusion and policy implications” section.

Literature review

Tourism and energy consumption

Tourism has contributed significantly to the development of any tourist nation's carbon dioxide emissions. Several authors have debated the consequences of tourism development on climate change and CO₂ emissions (Akadiri et al. 2017; Becken 2013; Gössling 2013; Katircioglu 2014a, b; De Vita et al. 2015; Katircioglu et al. 2014). In Cyprus, Katircioglu et al. (2014) investigated the long-term equilibrium relationship between energy consumption, CO₂ emissions, and global tourist arrivals. The researchers found a positive link between global tourist arrivals, CO₂ emissions, and energy usage. According to the results, global tourism raises energy consumption and CO₂ emissions. In their study of Turkey, De Vita et al. (2015) found that tourist arrivals, energy consumption, and economic development all have a significant long-term effect on CO₂ emissions. The development of Turkey's tourism activities has contributed to increased energy consumption and global warming (Katircioglu 2014b). The influx of many tourists into destinations will spur economic development, which will lead to increased energy consumption, as a result, carbon emissions will increase (Nie et al. 2019; Zhang and Zhang 2018; Dogru and Bulut 2018; Akalpler and Hove 2019). Consequently, it has been determined that tourism-related energy consumption produces high emissions, which negatively impacts the environmental quality in tourism-dependent nations (Adedoyin and Bekun 2020). Zhang and Zhang (2020) examined the link between tourism, energy consumption, economic development, and CO₂ emissions in thirty Chinese provinces. According to the findings, a 1% increase in tourism raises CO₂ emissions by 0.51 percent, whereas a 1% increase in energy consumption raises CO₂

emissions by 0.12 percent in China. A 1% increase in real GDP causes a 0.55% increase in CO₂ emissions. Overtime, tourism, economic development, and energy consumption all contributed to CO₂ emissions.

Studies into the nexus between emissions and the tourism sector has greatly increased, with particular emphasis on the industry's top earners. Hence, it is anticipated that increased consumption of energy will have a favorable effect on tourism demand, implying a direct relationship between tourism and economic development. This argument raises additional concerns about the possible outcome of tourism on economic development and energy demand, which has environmental implications, resulting in new insights into the significance of the relationship between these variables (Katircioglu 2014a, b). This claim is supported by Roudi et al. (2019) study, which found that tourism increases pollutant emissions in small island states. In rural Nepal, tourism enhanced the consumption of essential energy sources such as wood and kerosene (Nepal 2008). In Malaysia, Solarin (2014) observed a long-run unidirectional relationship between tourist arrivals and energy consumption. Tang et al. (2016) demonstrated that tourism had a positive long-run effect on energy consumption in the Indian context using a trivariate model that included tourism, economic growth, and energy consumption. Many countries have significant tourism-induced energy-related vulnerabilities (Gössling 2013). Over the last 150 years, there has been evidence that the worldwide earth's temperature is ever-changing and has a significant influence on people's lives (Brooke 2014). CO₂ emissions have increased by 80% since 1980, from 19 to 36 million kilotons (WDI 2017). The International Energy Agency (IEA) anticipates that international energy consumption will rise by up to 28% by 2060 (International Energy Agency 2014); this increase in energy consumption may have a negative impact on the environment. All economic sectors must collaborate to reduce emissions, with tourism being one of many that can have a positive effect on CO₂ emissions.

Tourism, financial development, and foreign direct investment

Le and Ozturk (2020a, b) found one of the most important factors of environmental degradation is financial development. Financial development attracts FDI and facilitates gross domestic product (GDP) growth, which necessitates increased energy consumption (Mahalik et al. 2017). Sadorsky (2011) found that effective financial intermediary process created by the growth of the financial sector leads to a rise in credit for the purchase of goods and services, which absorbs energy and harms the environment. Moreover, a highly developed financial system boosts capital, which enhances manufacturing capacity, increases energy

demand, and negatively affects the environment (Charfedine and Khediri 2016). According to Frankel and Romer (1999), developing nations are impelled to use more innovative and cleaner technology during the financial development process, thereby reducing environmental impacts. Furthermore, they assert that financial development supports organizations to acquire capital while lowering expenses through the use of environmentally friendly technology. Yuxiang and Chen (2011) supported this argument by stating that stimulating financial development policies is a critical concern for promoting technological spillovers, thereby reducing CO₂ emissions and increasing local production. Recent literature has investigated the nexus between financial development and CO₂ emissions. However, the effects of relevant factors on CO₂ emissions are unclear within the EKC hypothesis framework. Between 1960 and 2007, Ozturk and Acaravci (2013) discovered the EKC sign in Turkey and observed no relationship between financial development and CO₂ emissions. Boutabba (2014) examined the long-term equilibrium of CO₂ emissions, economic growth, financial development, trade openness, and energy consumption in India, providing support for the bulk of the aforesaid variables' long-run and causal relationships, and demonstrating that financial development and energy consumption increased CO₂ emissions. Between 1971 and 2012, Farhani and Ozturk (2015) found no evidence of EKC in Tunisia and recorded the negative environmental impacts of urbanization, trade openness, real GDP, financial development, and energy usage. From 1972 to 2013, Javid and Sharif (2016) used the ARDL model to assess the contribution of economic growth, financial development, and energy use to CO₂ emissions in Pakistan. They discovered the presence of EKC and revealed that all explanatory variables contributed to increased pollution.

Tourism and environment

Tourism demand has recently been identified as a source of pollutant emissions, as measured by global tourist/tourist receipt. This proposition is based on the EKC phenomenon, which states that increased international tourism demand increases energy demand, which leads to a rise in environmental quality (Katircioglu 2014a, b; Stern 2004). Zhang and Liu (2019), cited in Bano et al. (2021), showed that enhancing tourist growth in the long run can aid in the regeneration of environmental infrastructure in ten nations in Northeast and South-East Asia. Tourism is, nevertheless, regarded as a critical part of the environment in this region. According to the authors (Zhang and Liu 2019), there has been an improvement in the environment in some nations as a result of increased tourism. The study by Lei and Jing (2016) found a link between tourism-related CO₂ emissions and environmental degradation in eastern China, and the findings confirmed the existence of both short- and

long-term causality. While tourism has a long-term positive and stable relationship with CO₂, it has been determined to be a degrading element for the environment in Cyprus (Katircioglu et al. 2014). Using panel data from 1995 to 2010, Ben et al. (2015) cited in Khan et al. (2020), found that tourist arrivals and energy use have a negative impact on Tunisia’s ecology. They demonstrate that in the long run, the entrance of tourists reduces CO₂ emissions. It has been established through a review of the literature that previous investigations of the relationships between the variables under consideration have yielded inconsistent results. Consequently, more research is needed to verify the link in order to recommend sustainable development approaches.

where TR, RGDP, FDI, and DC denote tourist arrival, income, foreign direct investment, and domestic credit to private sector. *I*, on the other hand, represents the environmental indicator used in this analysis, thus, CO₂ emission. Next, Eq. (3) is augmented with the square of per capita income (RGDP²) to account for the assumptions of environmental Kuznets curve (EKC) hypothesis. The EKC framework predicts an inverted U-shaped relationship between CO₂ emissions and per capita income, suggesting that economic activities are more carbon intensive at the early stage of growth but reverses after certain level of income is achieved (Gupta and Dalei 2020). The following augmented EKC model specifications are therefore derived for additional empirical investigation:

$$\ln CO_{2it} = a_0 + \alpha_1 \ln TR_{it} + \alpha_2 \ln RGDP_{it} + \alpha_3 \ln RGDP^2_{it} + \alpha_4 FDI_{it} + \alpha_5 \ln DC_{it} + \epsilon_{it} \tag{3}$$

Data and methodology

Data

This study utilized a panel data of countries from the Mediterranean area (list of countries in appendix section) starting from 1995 to 2016 with data from the World Bank development indicator (WDI 2020) database. The choice of the period for the investigation was guided by and limited to the accessibility of data on the countries as we provide a summary of the description of the variables in Table 1. More information on data variables are presented in appendix section.

Given the highlighted study motivation, i.e., based on previous empirical studies (see Sarpong et al. 2020; Gyamfi et al. 2021b, c, d; Bamidele et al. 2021), the following functional form is fitted with backing from economic intuition and on the EKC ideology.

$$\ln I_{it} = a_0 + \alpha_1 \ln TR_{it} + \alpha_2 \ln RGDP_{it} + \alpha_3 FDI_{it} + \alpha_4 \ln DC + \epsilon_{it} \tag{1}$$

$$\ln CO_{2it} = a_0 + \alpha_1 \ln TR_{it} + \alpha_2 \ln RGDP_{it} + \alpha_3 \ln FDI_{it} + \alpha_4 \ln DC_{it} + \epsilon_{it} \tag{2}$$

where *RGDP*² is for the square of per capital income. Depending on the value of α_2 , the coefficient of PCI and the value of α_3 , the coefficient of square (*RGDP*²). The EKC is only one of these possible functional outcomes, which exists when the value of α_2 is positive ($\alpha_2 > 0$) and the value of α_3 is negative ($\alpha_3 < 0$). Further empirical steps are considered in order to determine whether tourism arrival helps in decreasing the environmental degradation for the understudy countries.

Estimation techniques

Preliminary tests

The required preliminary tests include (i) cross-section dependence (CD) test and (ii) unit root tests. We perform Pesaran (2007), Pesaran (2015), and LM and Breusch and Pagan (1980) LM techniques for cross-section dependence. For panel unit root analysis, we use cross-sectionally augmented IPS test of Pesaran (2007) and cross-sectionally augmented Dickey-Fuller (CADF) test developed by Im et al. (2003).

Table 1 Description of variables

Name of indicator	Abbreviation	Proxy/scale of measurement	Source
Carbon dioxide emissions per capita	CO ₂	Measured in metric tons	WDI
Tourist arrivals	TR	Number of arrivals	WDI
Per capital income	RGDP	It is proxied by the gross domestic product per capita (2010 Constant USD)	WDI
Square of per capital income	RGDP ²	It measures the square of GDP per capita	WDI
Foreign direct investment	FDI	% of real GDP	WDI
Domestic credit to private sector by banks	DC	% of GDP	WDI

All variables except FDI are transformed to their natural logarithm form to ensure homoscedasticity of the coefficients

Source: authors’ compilation

Cointegration test

Having established the order of integration, we applied Westerlund’s (2007) cointegration technique that is founded on error correction mechanism (ECM) with the assumption that variables exist in their first order of integration to establish a cointegration relationship for the panel study. The error rectification method (ECM) of the estimation follows the expression in Eq. (2):

$$\Delta Y_{it} = \pi_i d_i + \theta_i (Y_{it-1} + \gamma_i^* X_{it-1}) + \sum_{j=1}^m \theta_{ij} \Delta Y_{it-j} + \sum_{j=0}^m \delta_{ij} \Delta X_{it-j} + \varepsilon_{it} \tag{4}$$

From Eq. (2), $\pi_i^* = (\pi_{1i}, \pi_{2i})^*$ represents the vector of parameters, while $d_i = (1 - t)^*$, and θ_i are deterministic mechanisms, as well as error correction parameter correspondingly. To identify cointegration existence, Westerlund’s (2007) approach produces four major statistics based on the least square estimation and corresponding significance of the adjustment term θ_i of ECM model in Eq. (4), and these statistics can be categorized under two major subdivisions namely the group statistics and the panel statistics. The group mean statistics $G\tau$ and $G\alpha$ follows the derivations from the expressions in Eqs. 3 and 4:

$$G\tau = \frac{1}{N} \sum_{i=1}^N \frac{\hat{\alpha} i}{SE(\hat{\alpha} i)} \tag{5}$$

$$G\alpha = \frac{1}{N} \sum_{i=1}^N \frac{T \hat{\alpha} i}{\hat{\alpha} i(1)} \tag{6}$$

where, $\hat{\alpha} i$ is denoted by $SE(\hat{\alpha} i)$ as standard error. The semiparametric kernel technique of $\hat{\alpha} i(1)$ is $\hat{\alpha} i(1)$.

$$P\tau = \frac{\hat{\alpha} i}{SE(\hat{\alpha} i)} \tag{7}$$

$$P\alpha = T \hat{\alpha} \tag{8}$$

The two remaining panel mean estimations proof that the entire panel is cointegrated as shown in Eq. 3, where variables remained as earlier defined. The application of this test has been substantially reported in existing literature as they are designed to accommodate cross-sectional dependency in a panel study (Shahbaz et al. 2018; Le and Ozturk 2020a, b).

Parameter estimation using augmented mean group estimator

Hence, we applied three robust techniques that are designed to accommodate the latter concern for the study. The augmented mean group (AMG) heterogenous panel estimator of

Eberhardt and Bond (2009) and Eberhardt and Teal (2010) was utilized in the study following the expression in Eq. (9):

$$\Delta Y_{it} = \alpha_i + \beta_i \Delta X_{it} + \sum_{t=1}^T \pi_t D_t + \varphi_i UCF_t + \mu_{it} \tag{9}$$

The OLS estimation of the differenced Eq. (9) is utilized to generate AMG estimator as given in Eq. (10) where φ_i denotes the estimated slope parameters of X_{it} variable in Eq. (9).

$$AMG = \frac{1}{N} \sum_{i=1}^N \varphi_i \tag{10}$$

Distributional heterogeneity analysis using method of moment quantile regression approach

The panel quantile regression approach was implemented to investigate the sectoral and heterogeneous influence throughout quantiles (Sarkodie and Strezov 2019). The panel regression analysis was conducted by Koenker and Bassett (1978). It is usually used to calculate the median in terms of attitude measurement of the quantile regressions in order to determine the attitude of the respondents. The quantile regressions are more reliable for prediction than simple regressions. This is the most significant consideration because the connection among two parameters is fragile or non-existent (Binder and Coad 2011). Nevertheless, we engaged method of moment quantile regression (MMQR) with static impact by Machado and Silva (2019). A quantile regression is not sensitive to potential unseen heterogeneity (Koenker 2004; Canay 2011). The MM-QR approach permits detection of partial heterogeneous covariance effects in a parsimonious fashion. This approach is effective in conditions that have several consequences of human actions and endogenous response variable MM-QR method is also simple to use because it provides non-crossing predictions of the regression quantiles. For estimating the contingent quantiles $Q_\gamma(\tau/X)$, the estimate is given by:

$$Y_{it} = \alpha_i + X'_{it} \beta + (\delta_i + Z'_{it} \gamma) U_{it} \tag{11}$$

where the probability, $P \{ \delta_i + Z'_{it} \gamma > 0 \} = 1$. $(\alpha, \beta', \delta, \gamma)'$ are factors for the analysis. (α_i, δ_i) , $i = 1, \dots, n$, shows the individuals I fixed impact and Z is the k -vector of recognized factor of X which are differentiable alterations with component l given by:

$$Z_l = Z_l(X), l = 1 \dots k \tag{12}$$

where, X_{it} is the proxy of any fixed i and is independent across time (t). U_{it} is a proxy of distributed across individuals (i) and across time (t) which are normalized to satisfy the

moment situation in Machado and Silva (2019) which does not imply limit as show in Eq. (15) show as:

$$Q_Y(\tau/X_{it}) = (\alpha_i + \delta_i q(\tau)) + X'_{it}\beta + Z'_{it}\gamma q(\tau) \tag{13}$$

From Eq. (13), X_{it} represents vector of explanatory factors which are tourism arrival (TR), income (RGDP) and its square (RGDP²), foreign direct investment (FDI) as well as domestic credit to private sector (DC). $Q_Y(\tau/X_{it})$ represents the dependent variable in this analysis which is, CO₂ emissions (CO₂).

Panel causality test

To determine the direction of causal relationship among the variables, we perform Dumitrescu and Hurlin (2012) modified Ganger (1969) non-causality test which accommodates heterogeneity and CD in panel data. We report the Dumitrescu and Hurlin (2012) Granger causality test for empirical analysis as follows:

$$Y_{it} = \delta_i + \sum_{k=1}^p \beta_{1ik} Y_{i,t-k} + \sum_{k=1}^p \beta_{2ik} X_{i,t-k} + \epsilon_{it} \tag{14}$$

From Eq. 14, β_{2ik} and β_{1ik} denote the regression coefficients and autoregressive parameters for individual panel variable i at time t respectively. Following the assumption of a balance panel of observation for the variable Y_{it} and X_{it} , the null hypothesis of absence of causality among variables was tested against the alternative hypothesis of heterogenous causality in the panel observation.

Empirical results and discussions

The cross-sectional dependence (CD) techniques proposed by Pesaran (2007, 2015) as well as Breusch and Pagan (1980) LM technique are used to check for possible dependence among the variables under study. The empirical results in Table 2 reject the null hypothesis of no cross-sectional dependence for all the techniques at 1% significance level.

Table 2 Cross-sectional dependency (CD) estimation outcome

Model	Pesaran (2007) CD test	Pesaran (2015) LM test	Breusch and Pagan (1980) LM test
LnCO ₂ =f(LnTR, LnRGDP, FDI, LnDC)	5.564*	-1.673*	1174.35*
p-value	(0.000)	(0.004)	(0.000)

* < 0.01

Prior preliminary analysis (summary statistics and correlation analysis are reported in appendix section in Tables 7 and 8 of appendix section). Therefore, the variables contain cross-sectional dependence, indicating that shocks in one country spread to other countries in panel. Next, we examine the stationarity properties of the variables using two second-generation panel unit root tests that are cross-sectionally augmented; CIPS and CADF. The empirical results in Table 3 show the presence of unit root in the variables at level form but reject the null hypothesis of unit root at first difference for all the variables.

Determining that the second-generation co-integration model is more suitable for this analysis, it became necessitated the use the proposed approach by Westerlund (2007). The second-generation time series model is sensitive enough to detect co-integration even with cross-dependence estimation problems and finds that there is no involvement of association as stated by the null assumption. The numerically represented findings from Table 4 show that the null statement must be dismissed. The results seen are long run in nature in that they can affect the dependent factor in the long run. It says that the factors are strongly correlated with portfolio output at the 1% and 5% significant stages, and there is a long-run impact on portfolio creativity.

We use the augmented mean group (AMG) estimator, which accounts for the presence of cross-sectional dependence and country-specific heterogeneity in panel data to estimate the parameters of the model specifications. The derived estimates are therefore highly robust, unbiased, and

Table 3 Panel CIPS and CADF unit root test

Variables	CIPS		CADF		Decision
	I(1)		I(1)		
	C	C&T	C	C&T	
LnCO ₂	-5.185*	-5.264*	-5.868*	-3.544*	I(1)
LnTR	-4.742*	-4.859*	-3.250*	-3.274*	I(1)
LnRGDP	-3.713*	-3.930*	-4.416*	-4.331*	I(1)
LnRGDP ²	-3.296*	-3.618*	-2.484*	-2.954*	I(1)
FDI	-4.925*	-4.957*	-3.413*	-3.435*	I(1)
LnDC	-3.626*	-3.815*	-3.550*	-3.803*	I(1)

* < 0.01, ** < 0.05, *** < 0.10

Table 4 Westerlund’s (2007) cointegration test

Statistics	Value	p-value
$G\tau$	-1.099**	(0.012)
$G\alpha$	-1.522*	(0.000)
$P\tau$	-2.083*	(0.008)
$P\alpha$	-1.209*	(0.000)

* < 0.01, ** < 0.05, *** < 0.10

efficient for various combinations of cross-section and time dimensions even when considered with non-stationary data and in the absence of cointegration (Eberhardt and Teal 2010). To account for distributional heterogeneity in the panel, we use MM-qreg, defining three sections of quantiles: the lower quantile (qtile_25th), the median quantile (qtile_50th), and the upper quantile (qtile_75th). From the outcome from Table 5, the adopted estimators produced relatively close results on the average, with little difference that are only observed in terms of the magnitudes of estimated coefficients and their corresponding level of statistical significance.

The coefficient of tourism arrival (LnTR) is negatively and statistically significant at both 1% and 5% across all specification. The AMG estimates in model specification 1.1a show that a 1% increase in the number of tourist arrival in to the under-study countries decrease pollution by 0.024% while MM-qreg estimates highlight stronger mitigation effect in countries at the lower quantiles of LnCO₂ distribution. This outcome implies that environmental quality is not threatened with an increase in tourist arrivals in the Mediterranean nations; hence, tourism does not degrade the environment but is sustainable to the environment. This observation makes important revelations referring from previous studies, Bamidele et al. (2021), Sarpong et al. (2020), and Katircioglu (2014a, b), which advocate that proper tourism management reduces carbon dioxide emission.

Moreover, the coefficient of per capita income (LnRGDP) in extended model is positive and statistically significant at 1% level and indicates a 0.122% increase in and CO₂ emissions in response to a 1% increase in per capita income (LnRGDP). In specification 1.1a, the model is augmented with the square of per capita income (LnRGDP²) to accommodate the EKC hypothesis. The results show valid an inverted U-shaped curve in the relationship between income per capita and CO₂ emissions in the under study countries. This indicates that pollution rises during the early stages of economic growth, but declines during the later stages of economic growth. An economic expansion that translates to higher income levels among these nations is expected to assist in pushing these economies toward environmental sustainability. Moreover, the MM-qreg estimates also show that an inverted U-shaped curve in the relationship between income per capita and CO₂ emissions is valid irrespective of the quantile location of the countries and affirms the findings of Gyamfi et al. (2021e), Onifade et al. (2021), Bekun et al. (2021a), Saint Akadiri et al. (2019), and Gokmenoglu and Taspinar (2018). However, this result reinforces the environmental Kuznets curve hypothesis which suggests that there is a direct connection between an increasing standard of living and environmental degradation (Shahbaz and Sinha 2019 and Bekun et al. 2021b).

However, the coefficient of foreign direct investment (FDI) shows a positive significant relationship with CO₂

Table 5 AMG and MM-QR

Variables	1.1a	1.2b	1.2c		1.2d
	AMG	MM-qtile_25	MM-qtile_50	MM-qtile_75	
LnTR	−0.024** (0.018) [−0.060]	−0.093* (0.013) [−0.120]	−0.073* (0.009) [−0.091]	−0.090* (0.011) [−0.113]	
LnRGDP	0.021* (0.240) [0.468]	0.457* (0.030) [0.517]	0.443* (0.021) [0.485]	0.527* (0.027) [0.580]	
LnRGDP ²	−0.734* (0.284) [−2.582]	−0.135* (0.014) [−9.692]	−0.1473*** (0.0123) [−11.932]	−0.1595*** (0.0137) [−11.633]	
FDI	0.039*** (0.088) [0.021]	0.019** (0.088) [0.036]	0.010** (0.006) [0.002]	0.009** (0.007) [0.002]	
LnDC	0.032** (0.043) [−0.052]	0.332* (0.051) [0.230]	0.173* (0.035) [0.103]	0.149* (0.045) [0.060]	
Constant	−0.252*** (1.717) [−3.619]	3.686* (0.256) [3.181]	3.978* (0.176) [3.631]	5.357* (0.225) [4.913]	
Observations	308	308	308	308	
Number of ID	14	14	14	14	

Standard errors in (); t-statistics in []; * < 0.01, ** < 0.05, *** < 0.10

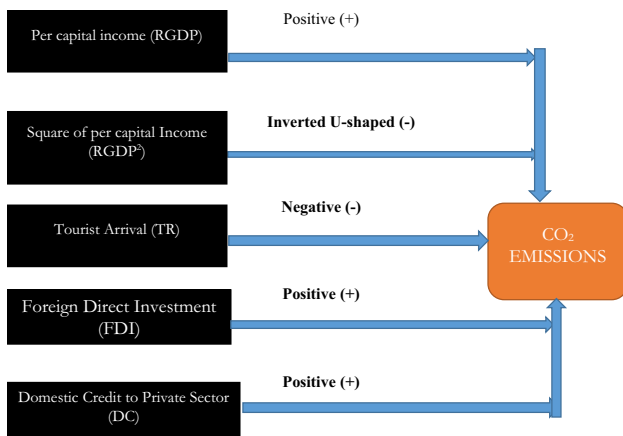


Fig. 2 Empirical scheme

emission across all estimations. From the AMG, a percent change in FDI will increase CO₂ emission by 0.039%. The MM-qreg estimates also show that, FDI has a negative impact on the environments of the under-review countries. This mitigates the possibility that oil wealth may be a determining factor in the flow of foreign direct investment. Most likely, there are additional factors at play, such as access to cheap labor, proximity to the market, and less restrictive policies aimed at reining in foreign investors’ deprecations. This demonstrates that Mediterranean countries continue to advance economically and develop at the expense of environmental quality. This substantiated some advocates’ opposition to the beneficial effects of FDI, particularly on the stabilization of developing nations. This result lends support to the theory of a pollution haven (PHH). This confirms the results of Solarin et al. (2017), Salahuddin et al. (2018), Gorus and Aslan (2019), Sarkodie and Strezov (2019), Gyamfi (2021), and Steve et al. (2021).

Nevertheless, domestic credit to private sector (DC) also has a positively significant relationship with CO₂ emission across all the estimations. The AMG estimates in model specification show that a 1% increase in the providing of domestic credit positively increase CO₂ emissions by 0.032% while from the MM-qreg estimates, it affirms the positively significant relation with CO₂ emissions which affirms the finding of Ali et al (2021), Zhao and Yang (2020), and Gök (2020).

Figure 2 present the empirical output scheme.

Dumitrescu and Hurlin causality test

The Dumitrescu and Hurlin panel causality test is reported in Table 6. The panel causality technique is required by the requirement to evaluate the Granger non-causality moving from the dependent variables to the independent variable as hypothesized in the examination of Dumitrescu and

Hurlin (2012) in a heterogeneous panel dataset. Following the importance of testing for causality in empirical studies (Gyamfi et al 2021a, Adedoyin et al 2021 and Onifade et al. 2021), from the table, it can be observed that, there is a bi-directional causality between: tourism and CO₂, per capital income and CO₂ as well as domestic credit and CO₂. Nevertheless, the remaining variables, thus, FDI and CO₂ as well as square of per capital income have a uni-directional relationship.

Conclusion and policy implications

At the COP 21 in Paris, the Parties to the United Nations Framework Convention on Climate Change (UNFCCC) reached a historic resolution on environmental issues addressing, and accelerating and improving efforts and initiatives to guarantee a secure and carbon-free future. The Paris Agreement draws on it and gathers all states united for the first moment, by means of increased finance for underdeveloped nations, to excellent collaborative efforts to address and adjust to environmental shift. It also sets a fresh direction for the sustainable environment strategy. The Mediterranean nations acknowledge the responsibility of enhancing the ecological consequences of carbon emission and are therefore increasingly devoted to a sustainable development-environment. However, this analysis exploited the connection regarding carbon pollution, tourism arrival, per capital income, square of per capital income, foreign direct investment, and credit to private sector for Mediterranean countries from the period of 1995–2016. We utilized cross-sectional dependence techniques, thus, Westerlund’s (2007) co-integration technique, method of moment quantile regression (MM-QR), approach and augmented mean group (AMG), while the Dumitrescu and Hurlin panel causality test was used for causality purposes. The co-integration

Table 6 Dumitrescu and Hurlin (2012) analysis

Null hypothesis	W-bar	Z-bar stat	P-value
	Statistic	Statistic	
LnTR → LnCO ₂	3.863	2.160**	0.030
LnCO ₂ → LnTR	4.236	2.677*	0.007
LnRGDP → LnCO ₂	3.566	1.747***	0.080
LnCO ₂ → LnRGDP	3.842	2.130**	0.033
LnRGDP ² → LnCO ₂	8.183	19.553*	0.000
LnCO ₂ → LnRGDP ²	9.010	8.021	0.440
FDI → LnCO ₂	2.383	0.105	0.915
LnCO ₂ → FDI	4.741	3.379*	0.000
LnDC → LnCO ₂	6.296	5.538*	3.E-0
LnCO ₂ → LnDC	4.021	2.379**	0.017

* < 0.01, ** < 0.05, *** < 0.10; → “does not Granger-cause”

outcome from Westerlund (2007) shows a statistically significant cointegration connection among the variables.

However, the two techniques being the MM-QR and the AMG gave almost similar result revealing tourism had a negative significant relationship with CO₂ emission. Moreover, income on the other hand had positive relationship with emissions, while its square had negative relationship with emissions. This result also shows the presence of EKC indicating the inverted U-shaped curve. FDI shows a positive significant relationship with pollution which indicated a pollutant haven hypothesis (PHH), and credit to private sector shows a positive relationship with CO₂ emission.

From the Dumitrescu and Hurlin panel causality test, it was observed that there was a bi-directional causality between: tourism and CO₂, per capital income and CO₂ as well as domestic credit and CO₂. Nevertheless, the remaining variables, thus, FDI and CO₂ as well as square of per capital income, had a uni-directional relationship. Based on the outcomes from this analysis, the following recommendation are suggested for policy makers.

- Pertaining policy implications, regulatory initiatives to increase energy efficiency and the share of renewable energy in the energy mix should be implemented. Decision makers in Mediterranean countries should support investigators and academic institutions that concentrate on incremental energy efficiency. Given the negligible effect on tourism, additional measures should be taken to mitigate the industry's ecological consequences. Funding and adoption of bicycle-oriented tourism as a viable alternative to motorized and environmentally destructive modes of transport should be promoted. This can be accomplished by using more environmentally friendly modes of transport, such as electrical rail, rather than air travel, which would limit mobility within a particular tourist attraction. If done properly, these steps would significantly enhance the natural environment.
- Moreover, our findings on the breakdown of foreign production do not have significant impacts on the Mediterranean countries. In order to prevent being pollution havens, Mediterranean states should meet the requirements of the global market, for example, raising the entrance barrier of dirty industry, controlling exports of pollution-producing products, and encouraging new export comparative edge. In addition, the Mediterranean states must progressively and effectively adapt the economic growth trend to accomplish balanced and stable progress through the supply-side change.
- Next, one of several program's "project-based" frameworks is the clear development mechanism (CDM), aiming to facilitate cleaner assistance to emerging nations. This framework must be used entirely by Mediterranean countries to drive the adoption of technological advance-

ments for energy conservation and environmental regulation.

- Moreover, decision makers in the Mediterranean countries should encourage sustainable and healthier forms of energy for the economies to minimize reliance on fossil fuel emission in the region. This can be done by the efficient utilization of renewable energy's environmental assets (such as solar, wind power, and hydraulic energy).

Notwithstanding these results, this analysis has some drawbacks naturally: cultures have varying preferences, for instance, political pressures and structural factors may have an effect on the tourism-led growth hypothesis and its relationship to ecological sustainability. These variables must be included in subsequent studies because they have the potential to dramatically reduce emission levels. Additionally, this analysis uses data from 1995 to 2016 considering the lack of information on tourism prior to 1995. Moreover, this study utilized data from the Mediterranean blocs which is also a limitation to the studies, further can look at the other blocks such as the E7, G7, and Sub-Sahara Africa countries.

Appendix

Tables 7, 8, 9

Details on selected variables under review

Carbon dioxide emissions per capita (CO₂) This variable is used as the dependent variable in the model as the proxy for the environment. The unit for measuring carbon pollutions is metric tons per capita. The apriority expectation of this variable can either be positive or negative. A positive change in carbon dioxide emissions would suggest environmental degradation whereas the negative change indicates environmental sustainability.

Tourist arrivals (TA) This is the independent variable that is proxied for tourism. This tourism variable measures the number of international tourists who visit and stay within the confines of tourist establishments. A positive change in tourist arrivals signifies gains from tourism while a negative change indicates that tourism has no significant benefit.

Per capital income (RGDP) This variable is utilized as the explanatory to proxy for economic advancement across the countries under consideration. The income values are transformed from the local currencies to the United States by applying the current exchange rate. A positive change in the income values of the panel countries would indicate economic growth and vice versa.

Table 7 Descriptive statistics

Variable	Obs	Mean	Std. Dev	Min	Max	Skewness	Kurtosis	Jarque–Bera
LnCO ₂	308	−0.896	0.591	−2.240	0.320	5.05	34.95	43,036.28
LnTR	308	19.569	2.701	8.083	23.119	4.98	33.94	40,492.08
LnRGDP	308	9.193	1.100	6.768	10.648	5.47	33.65	40,610.75
FDI	308	8.480	31.776	0.396	280.131	2.28	9.44	2390.38
LnDC	308	3.893	0.8238	1.180	5.542	3.03	16.98	8898.94

Source: Calculations by authors

Table 8 Correlation matrix

Variable	LnCO ₂	LnTR	LnRGDP	FDI	LnDC
LnCO ₂	1				
LnTR	−0.5419	1			
LnRGDP	−0.8459	0.4623	1		
FDI	−0.0210	−0.0302	0.0538	1	
LnDC	−0.4651	0.6572	0.6263	0.2585	1

Source: Calculations by authors

Table 9 List of countries

Albania	Greece
Algeria	Israel
Bosnia	Morocco
Croatia	Turkey
Cyprus	Tunisia
Arab republic of Egypt	Spain
France	Italy

Source: Authors' computation

Foreign direct investment (FDI) This variable is used as the independent variable to proxy for overseas investment across the countries under consideration. Foreign direct investment is the net injection of investment opportunity running in an economy apart from the investor to gain permanent management interest (10% or more vote equity). It is the amount of equity capital, earnings reinvestment, long-term capital and short-term capital as indicated in the balance of trade. This sequence presents net inflows of foreign investors into the accounting economies (new investment inflows less disinvestment), and it is separated by GDP. A positive change in the FDI value with regards to a priori expectation would imply pollutant haven hypothesis whiles negative change will be pollutant halo hypothesis or the panel countries.

Domestic credit to private sector by banks (DC) This variable is used as the independent variable to proxy for credit provided by banks to local enterprises. Domestic credit to the private sector offered by banks corresponds to monetary services offered to the private market by other deposit

companies (fund taking organizations apart from federal reserve), such as loans, acquisitions of non-equity assets, credit sales, and other receivables that supply a request for recovery. Loan to public companies is included in several nations' statements.

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Availability of data and materials The data for this present study are sourced from WDI as outlined in the data section.

Declarations

Ethical approval Authors mentioned in the manuscript have agreed for authorship read and approved the manuscript, and given consent for submission and subsequent publication of the manuscript.

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Consent for publication Applicable.

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