If tourism induces the EKC hypothesis, how does governance moderate its impact in the EU without the UK

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Abstract

What happens to the impact of tourism on environmental degradation as the income level of the nations or regions increases? The Environmental Kuznets Curve (EKC) hypothesis asserts that the influence of tourism on CO_2 emissions decreases with a rise in income levels. This study captures the role of governance in the tourism-induced EKC hypothesis in the European Union (EU), after Brexit. Given that the United Kingdom (UK) is the most visited country in the region, and tourism is a very vital instrument to economic stability and growth, it would be interesting to inspect the relationship among these variables without the UK. Auto-Regressive Distributed Lags (ARDL) estimates show that tourist arrivals decrease the carbon emissions in the long-run, while per capita growth fosters carbon emissions in the long-run. In addition, Quantile Regressions (QR) reveal that all the governance indicators considered have positive effects on the emissions. Finally, regarding the causality relationship, a unidirectional relationship from per capita growth to carbon emission, and from carbon emission to tourism arrivals emerge, while no causal link exists between energy consumption and carbon emissions. Moreover, a feedback (bidirectional causality) is discovered between per capita growth and tourism arrivals, and energy consumption as per capita growth. Policy directions based on the results were also highlighted.

Keywords: Energy consumption; Environmental Degradation; European Union; Quantile Regressions; Tourism; Governance

1. Introduction

As the world evolves, most economic activities also do. To meet the needs of the rapidly growing population, these activities have witnessed noticeable expansions. This paramount growth is essential and must be maintained for sustainability, and their positive impacts on the economy. However, examining their effect on the environment is also crucial. The tourism industry as a case study has a significant influence on economic growth in developed and developing economies (Chou, 2013). World Tourism Organization (WTO) reported that the industry account for a 9 percent growth in the global Gross Domestic Product (GDP) in 2011. It has grown to be intertwined with other sectors of the economy, such as the transport, and the hospitality industry (Zaei and Zaei, 2013). The direct, indirect, and impelled effects of these intertwists also abound. This somehow makes the measurement of the overall growth emissions difficult. Tourism is ranked the third biggest socio-economic activity in the European Union (EU), and Europe is the most visited tourist destination across the globe (Hashemi and Ghaffary, 2017). This represents about 51 percent of the global international tourist arrivals (European Parliamentary Research Service, 2017). Largely, this implies that the possibility that Europe will be most affected by any effect of tourism on the environment is considerably high.

Furthermore, 54 percent of the international tourist arrivals in the EU in 2015 were by air transport (European Parliamentary Research Service, 2017). As stated earlier, 75 percent of tourism-induced emission was from transportation. This signifies that transport produces a considerable proportion of tourism emissions.

In 2010, tourism accounted for about 5.3 percent of the global greenhouse gas (GHG) emissions while tourism-induced transportation contributes for 75 percent, accommodation has 21 percent, and other exercises account for 4 percent of this share (Organisation for Economic Cooperation and Development, 2010). In 2013, tourism contribution to global GHG emissions has rapidly increased to 8 percent (Lenzen et al., 2018). 1,600 million tonnes of carbon dioxide (CO_2) were emitted by tourism transportation in 2016. Although tourism-induced energy efficiency per head has been improved over time, it has not canceled out the effect of the growing tourist population. Yet, domestic and international tourist arrivals are predicted to be 15.6 billion and 1.8 billion respectively in 2030 (World Tourism Organization, 2019).

The Environmental Kuznets Curve (EKC) was eventually made popular by the World Bank Development Report in 1992 to measure the interaction between income and environmental deterioration. The EKC model assumes that a country witnesses environmental deterioration in the early stages of economic growth, caused by emissions, pollutions, etc. (Mikayilov et al., 2019). Whether growth in the tourism sector influences GHG emissions or not has been a highly debated question in the literature. Several studies have been carried out for different countries and regions (Ahmad et al., 2019). Testing the EKC hypothesis on developed and relatively less developed economies, León et al. (2014) stated that although tourism notably influences CO_2 emissions, it has a greater effect in less developed than in developed countries. Paramati et al. (2017) based on the idea that Western EU countries are largely noted to be developed relative to the Eastern EU economies further confirmed León et al. (2014) claim.

The culture and systems for which authority is administered in a country are reflected in how the government is chosen, observed, and substituted; the capability of the government to efficiently map out and execute good policies; and the honor nationals and states exercise towards institutions that manage socio-economic relationships (Kaufmann et al., 2010). Good culture and systems of governance have a critical role to play to keep the profits and minimize the losses of economic development. Kaufmann et al. (2010) hinged governance on six dimensions.

Generally, there has been difficulty in generalizing a pattern for the EKC hypothesis as literature describes contrasting results from EKC hypothesis tests on different economies. Mikayilov et al. (2019) mentioned that the outcomes from the literature are debatable. This may be due to a series of factors that might have not been captured in the studies. Thus, in this research, we aim to capture the role of governance in the tourism-induced EKC in the EU, after Brexit. Given that the United Kingdom (UK) is the most visited country in the region, and tourism is a very vital instrument to economic stability and growth, it would be informative to examine the position of governance in the EU without the UK.

Besides the introduction, the remainder of this paper follows with Section 2 that shows the relevant literature on the topic. Section 3 illustrates the dataset together with the empirical strategy. Section 4 gives the results and their discussion. Finally, Section 5 concludes, providing some policy implications.

2. Literature Review

2.1 The Nexus between Quality of Governance and Environment

Governance, as described and analyzed in Kaufmann et al. (2010) and adopted by the World Bank (WB) as measures of the quality of governance, is represented by seven indicators (Rule of Law, Government Effectiveness, Control of Corruption, Regulatory Quality, Voice and Accountability, Political Stability, and Absence of Violence/Terrorism). Halkos and Tzeremes (2013) employed these indicators for a non-parametric study of the relationship between CO_2 emissions and the quality of governance in the G-20 countries. The study covers data from the year 1996 to 2010. This relationship was discovered to be highly non-linear, and the amount of governance indicators varies notably across the considered countries. Thus, the relationship was not linear, and not the same across the countries, through the period examined. Government Effectiveness (GE), Control of Corruption (CC), and Regulatory Quality (RQ) were discovered to be the only stimulus to CO_2 emissions in Germany, Italy, France, and the UK. CO_2 levels in Russia, India, South Africa, and Turkey are influenced by political stability alone, while the emissions level in Australia, Canada, Saudi Arabia, and the US are not affected by the Rule of Law and Voice and Accountability. The study also proposed that though the revealed variation is subject to the peculiarity of each country's regional and growth differences, improving the quality of governance across the board may not necessarily cause the reduction of emissions.

Milhorance and Bursztyn (2018) considered the effectiveness of the government's structural policies to mitigate carbon emissions in Brazil's largest emitting state (Mato Grosso), following the Governor's commitment in December 2015. The Produce, Conserve, and Include (PCI) strategy, which was initiated to i) integrate and organize ideas in vital sector players; ii) produce knowledge and administration; iii) provide aid in raising funds and administering assets; iv) aid projects and agendas; v) encourage communication, transparency, and the involvement of vital sector players. This details the involvement of citizens, private sector players, as well as government institutions that align with the Voice and Accountability, institutional governance, and corruption indicators of the World Bank Governance indicator were used in the PCI strategy for reducing emission in the state. The strategy was concluded to have a huge capacity to integrate innovative governance because of sustainable and stabilized plans for lesser emissions.

To measure governance, Khan et al. (2018) used the corruption and democracy index, studying the impact of governance on environmental degradation for a set of countries. The countries were classified into low-income class, lower-middle-income class, upper-middle-income class, and a high-income class of countries, utilizing disjointed and combined panel data between the years 1995 and 2015. The Fully Modified Ordinary Least Squares (FMOLS) estimates revealed that corruption, as well as tourism, contributes massively to CO_2 emissions collectively and separately, but this effect is more pronounced in low-income countries. Instead, democracy has an inverse interaction with CO_2: indeed, democracy reduces emissions. Since corruption is a symbol of poor governance, emissions will increase in a country, irrespective of the class of income the country belongs to, if the corruption level is high. A two-way directional causality exists between democracy and tourism, while a one-way directional flow running from tourism to corruption and CO_2 emissions emerges.

Employing the EKC, Danish et al. (2019) explored the influence of governance on CO_2 emissions in Brazil, Russia, India, China, and South Africa (BRICS) in the 1996-2017 period. Westerlund panel cointegration and several other panel data estimation techniques were used to discover that governance poses a notably negative impact on CO_2 emissions. The effect is statistically significant. Thus, good governance reduces emissions in the BRICS. Omri and Ben Mabrouk (2020) also considered the effect of efficient and good governance in readjusting the social, economic, and environmental components of sustainable growth. Tourism is a socio-economic activity having an environmental impact. A panel of twenty Middle East and North African (MENA) countries were studied for the years between 1996 and 2014. Using the simultaneous-equation model methods, the study revealed that: sustainable growth is positively influenced by political and institutional governance; economic development increases emissions, whereas, increased emissions eventually reduce economic growth; improving the quality of political and institutional governance helps MENA countries to regulate the impact of CO_2 emissions on the economy and environment and the effect of economic development on raising emission levels.

Similarly, political and institutional governance was chosen as governance indices by Omri and Bel Hadj (2020) to test whether good governance and technological innovation are able to significantly affect air pollution and Foreign Direct Investments in twenty-three developing countries. CO_2 emissions per capita, CO_2 intensity, CO_2 emissions from electricity and heat production, and CO_2 emissions from liquid fuel consumption were considered as indicators for CO_2 emissions. The Generalized Method of Moments (GMM) approach and interactive regression technique results show that improving governance and increasing technological innovation reduces emissions. Good political and institutional governance interacts with FDI to reduce emissions.

Since good governance is a critical factor in developing countries, and various economic activities are being intensified to enhance growth, Ali and Pour (2012) made a comparative study of how good governance affects the quality of the environment in 30 emerging countries and 30 Organization of Economic Cooperation and Development (OECD) countries. The study engaged good governance, economic development, technological growth, educational improvement, and inflation rate, while CO_2 was used as a proxy for environmental quality. A higher level of political stability produced a cleaner environment in the OECD countries than in the emerging countries, which are more politically unstable. Government effectiveness on the environment was found to be significant in the OECD, but not significant in the emerging countries. Regulation quality proves to be very efficient in achieving a cleaner environment.

The World Bank governance index described in Kaufmann et al. (2010) has been a widely adopted measure for good governance. However, quite a large number of them are without thorough examination. Some studies selected a few of the indicators, while some grouped the six indicators as political and institutional governance. Although the outcomes of the studies generally reveal that good governance helps environmental quality, different governance indicator explains this relationship at different levels across the countries. In addition, several conditions must be considered while studying this relationship, as some countries display illogical outcomes as stated by Khan et al. (2018). This is why there have been studies that revisited the EKC tests in some countries (Bilgili et al., 2016; de Vita et al., 2015), and others discovered a different scenario as shown in Ozturk et al. (2016) and Mikayilov et al. (2019).

2.2 Other factors that matter in the TEKC hypothesis

Since the EKC hypothesis was introduced by Grossman and Krueger (1991), several studies have been performed to determine the Tourism-induced Environmental Kuznets Curve (TEKC). Arbulú et al. (2015) explored the relationship between tourism development and solid waste generation in 32 European countries for the 1997-2010 years. Tourism development was characterized by tourism volume, tourism quality, and tourism specialization, while Municipal Solid Waste (MSW) proxied solid waste generation. Included in the study were variables such as the unemployment rate, education, rural population, merchandized trade, real GDP, and government effectiveness. The results highlighted that the exclusion of tourism features may affect some important qualities of the EKC, and thus might have been the cause of overestimation of the effect of economic development on MSW in the literature. A non-linear and statistically significant interaction between tourist expenditure, tourist arrivals, tourism specialization on MSW production was detected. This is similar to the previously discussed findings in Halkos and Tzeremes (2013). The rural population has an insignificant interaction with MSW. Less developed countries have higher income elasticity than richer countries. Government effectiveness, good education, and high unemployment rate all improve environmental quality. The study suggests that a high unemployment rate improves environmental quality. In a trivariate panel analysis of emerged and emerging economies, Zaman et al. (2016) also characterized tourism development by tourist arrivals, international tourism expenses, and tourist receipts. The study tested the existence of the tourism-led EKC, using variables such as economic development, energy demand, tourism growth, domestic investment, and health expenses, while CO_2 emissions were a proxy for environmental quality. East Asia and Pacific, EU, and high-income OECD countries as three differentiated global regions were studied for the period 2005-2013. A tourism growth index was developed using the Principal Component Analysis (PCA) technique on the number of tourist arrivals, international tourism expenses, and tourist receipts. An inverted U-shaped interaction between CO_2 emissions and per capita income exists in the regions, thereby validating the EKC hypothesis. Furthermore, the study reveals that tourism, energy, and investment causes carbon emissions; while economic development, investment, and health lead to tourism growth. Wakimin et al. (2019) combined tourism demand, government expense on education, and income in the TEKC hypothesis in 5 ASEAN countries for 1970-2014 years, using the Non-Linear Auto-

Regressive Distributed Lags (NARDL) approach. The results show that a negative interaction exists between income and CO_2 emissions in 4 out of 5 countries. All variables are significant to the environment, and there exists a long-run effect of tourism demand, government expenses on education, and income on the environment. The EKC hypothesis was not found to be true in all cases. However, government expenses on education decrease emission in almost all the ASEAN-5.

Quite a large volume of literature proxied environmental degradation by CO_2 emissions. However, using ecological footprint as a measure of environmental quality, and tourism induced GDP as an indicator for economic development, Ozturk et al. (2016) tested the existence of the TEKC in 144 countries, for the period between 1988 and 2008. The study also considered variables such as trade openness, energy consumption, and urbanization. GMM estimates show that: energy consumption has an insignificant and negative interaction with an ecological footprint in low and lower-middle-income countries due to low energy consumption, while a bulk of the high-income countries also showed a significant negative relationship. This is attributed to high energy-efficient technology and integration of renewables; countries with a negative interaction between trade openness and ecological footprint increases as the level of income also rises; urbanization and ecological footprint also showed the same pattern. Tourism-induced EKC was found to exist only in upper-middle and upper-income economies. High-income countries have fewer environmental problems. While examining the existence of the tourism-induced EKC in Azerbaijan between 1996 and 2014, Mikayilov et al. (2019) also considered ecological footprint as an environmental indicator, combined with total trade, urbanization, energy consumption, and international tourism receipts, but included the institutional qualities of governance, which are government effectiveness and regulatory quality. Results showed that trade and energy consumption positively and significantly affect ecological footprint, while other factors (urbanization and institutional qualities of governance) are not significant. The time-variant cointegration coefficient techniques revealed the absence of the tourism-led EKC in Azerbaijan, casting doubts on the results by Ozturk et al. (2016). Mikayilov et al. (2019) suggested that the disparities may be because Ozturk et al. (2016) did not capture Azerbaijan's growth process.

Being the region with the most rapid CO_2 emissions growth, Zhang and Liu (2019) tested the TEKC hypothesis in ten North and Southeast Asian (NSEA-10) countries for the period 1995-2014. They studied the effect of the real GDP, renewable and non-renewable energy consumption, and tourism on CO_2 emissions. Using FMOLS and Augmented Mean Group (AMG) estimators, the outcomes indicate the absence of the TEKC in the NSEA-10. Moreover, renewable energy was discovered to significantly reduce emissions, while non-renewable proves to be a major cause of environmental deterioration. Furthermore, it is found that the rate at which non-renewables destroy the environment is stronger than the rate at which renewables improve it. Also, tourism development has propensities to degenerate the environment. Kongbuamai et al. (2020) introduced natural resources as a variable in the test for the TEKC hypothesis in the Association of Southeast Asian Nations (ASEAN) countries. The study combined natural resources, primary energy consumption, international tourist arrivals, and GDP, while ecological footprint was also used as a proxy for environmental quality. Several techniques were applied, such as the cross-sectional dependence tests, the cross-sectional IPS unit root test, panel cointegration (Westerlund test), causality test (Dumitrescu-Hurlin), and regression (Kraay) techniques. The outcomes display the presence of an inverted U-shape EKC hypothesis. Natural resources, as well as tourism, hurt the ecological footprint, while primary energy consumption has a positive effect. GDP, energy consumption, and ecological footprint exhibit a bi-directional causal link (with a feedback effect).

Some other variables that matter to environmental quality are included in de Vita et al. (2015) examination of the tourism EKC hypothesis in Turkey using income, squared income, and energy consumption. The EKC hypothesis was present for the period studied. Also, tourist arrivals, growth, and energy consumption positively influence CO_2 emissions. An increase in income also raises the CO_2 emission level at an exponential increase in the short-run, but the relationship turns inverse in a very short while.

Lee and Chen (2021) examined the tourism-induced, economic-induced, and country risk-induced EKC hypothesis using ecological footprint as a measure for international environmental deterioration. The test was done on 123 countries across the globe for the period 1992-2016. The outcome implied that tourism, country risk, and economic development no longer supports policies that improve the environment but ecological footprint consuming culture. The EKC hypotheses vary across the countries.

Several variables have been engaged in the TEKC hypothesis. Energy consumption (renewable and non-renewable), real GDP, trade, income, urbanization, health expense, government expenses, natural resources, to name a few. The impact of these factors also varies across countries. Some confirm the presence of the TEKC, while others reject it.

2.3 Research Gap

Mikayilov et al. (2019) criticized the findings in Ozturk et al. (2016), who highlighted the presence of TEKC in Azerbaijan. This reveals that following the growth process of the subject country or region is vital for appropriate inference. The growth process of a country is significantly dependent on policies and government activities. Although the TEKC hypothesis has been tested in several countries including Europe, as in Paramati et al. (2017), the UK has been one of the major members of the EU, and Brexit may have a significant effect on the EU. This study aims at studying the role of governance in the TEKC hypothesis in the EU, without considering the UK.

3. Data and Methods

3.1 Data

Following the research gaps, this study uses variables that are capable to model the mitigation of environmental change in the European countries. A dataset of yearly observations over the 1998-2019 period has been constructed. The variables employed in the empirical analyses are *CO2E* (in metric tons per capita), which proxies environmental degradation; per capita GDP (*PCGDP*), tourist arrivals (*TA*), energy consumption (*EC*) measured in million tonnes oil equivalent, and government indicators as control variables. All the variables were derived from the World Development Indicators by World Bank (WB). The exploratory data analyses on the dataset are given in the Appendix (see Table 1). For a preliminary visual inspection of the series, check Figures 1 and 2. To eliminate the large disparities among these countries, the variables were transformed using natural logarithms.

3.2 The Model and the Empirical Strategy

The estimated empirical model is the following:

$$CO_2 = f(PCGDP, EC, TA, GOV) \quad [1]$$

$$lnCO_{2it} = a_0 + a_1\, lnPCGDP_{it} + a_2\, lnEC_{it} + a_3\, lnTA_{it} + a_4\, GOV_{it} + \varepsilon_{it} \quad [2]$$

where t = 1998,…, 2019 is the time identifier and i = 1,…, 27 represent the individual (EU country) identifier. $lnCO_2$ represents the natural log of CO_2 emissions, $lnPCGDP$ the natural log of per capita GDP, $lnEC$ the natural log of energy consumption, $lnTA_{it}$ the natural log of tourist arrivals, and GOV the set of governance indicators, which are index variables – regulatory quality index, government efficiency index, control of corruption index, political stability index. Finally, a_0 denotes the constant term, while a_1,…, a_4 denotes the coefficients of all the predictors. ε_{it} represents the disturbance term.

Because the data have been collected across different countries that have common relationships with each other, then the shocks or problems experienced in one country might also be experienced in other countries. As a result, it is essential to carry out cross-sectional dependence tests on the data series in order to eliminate possible bias (Pesaran et al., 2008), and reduce unobserved common factors. To this extent, different cross-sectional dependency tests are performed: Pesaran (2004) cross-sectional dependence in panel data models test; Friedman (1937) test for cross-sectional dependence (with Friedman's χ^2 distributed statistic); Frees (1995) test for cross-sectional dependence (with Frees' Q distribution, T-asymptotically distributed); Breusch-Pagan (1980) Lagrange Multiplier (LM) test of cross-sectional dependence; Pesaran (2004) scaled or adjusted LM test; Chudik and Pesaran (2015) test for weak cross-sectional dependence; and Baltagi et al. (2012) bias-corrected scaled LM test. Regardless of the test statistic used, the null hypothesis (H_0) is that there is no cross-sectional dependence among the series. If the null hypothesis is not rejected, then one can examine the stationarity of the series using the first-generation unit root tests; otherwise, the second-generation unit root tests which take into account the cross-sectional dependence of the panel data series must be employed.

If the hypothesis of unit root is rejected at a 5% level of significance, we proceed to firmly establish the long-run relationship using cointegration techniques. Subsequently, we can estimate the model using long-run estimators, such as the ARDL approach. However, an in-depth analysis is required; thus, Quantile Regressions (QR) provide the relationships between the dependent and independent variables at different quantiles.

Moreover, causality tests are needed, to establish the direction of the causal flow. Therefore, we also perform a Dumitrescu-Hurlin (2012) causality test, and then make a proper recommendation from the results.

4. Results and Discussions

As we clarified earlier, it is of utmost importance to inspect whether or not the cross-sections are interrelated. By doing so, appropriate unit root tests and cointegration tests would be selected to assess the stationarity of the series and long-run relationship, respectively. Cross-section dependence is one of the main diagnostics to be performedbeforeo conducting panel data econometric procedures.

In Table 1, we show the results of panel cross-section dependence tests for the selected sample. The null hypothesis (H_0) of no cross-sectional dependence is rejected, for all variables, at any level of significance; thus, we can derive that cross-section dependence ought to be considered in the ongoing analysis. This means that influential shock occurs from one country to another, and thus units in the same cross-section are correlated. Minimizing or removing the unobserved factors, we can proceed with testing the stationarity properties of the selected variables using second-generation unit root tests.

Table 1. Panel cross-section dependence tests.

Test	CO2E	PCGDP	TA	EC
1. Pesaran (2004)	27.168*** (0.0000)	52.079*** (0.0000)	23.660*** (0.0000)	24.974*** (0.0000)
2. Friedman (1937)	171.102*** (0.0000)	261.542*** (0.0000)	109.661*** (0.0000)	146.510*** (0.0000)
3. Frees (1995)	2.752*** (0.1782)	6.273*** (0.1695)	2.626*** (0.2838)	2.330*** (0.1888)
4. Chudik and Pesaran (2015)	22.190*** (0.0000)	23.382*** (0.0000)	23.550*** (0.0000)	-0.381 (0.7035)
5. Pesaran (2004) CD	42.600*** (0.0000)	67.330*** (0.0000)	68.806*** (0.0000)	28.304*** (0.0000)
6. Breusch-Pagan (1980)	3538.016*** (0.0000)	5428.641*** (0.0000)	5010.059*** (0.0000)	1760.749*** (0.0000)
7. Pesaran (2004) LM	120.286*** (0.0000)	191.643*** (0.0000)	175.845*** (0.0000)	56.315*** (0.0000)
8. Baltagi *et al.* (2012)	119.611*** (0.0000)	191.000*** (0.0000)	175.170*** (0.0000)	55.630*** (0.0000)

Notes: 1: Pesaran (2004) cross-sectional dependence in panel data models test;

2: Friedman (1937) test for cross-sectional dependence by using Friedman's χ^2 distributed statistic;

3: Frees (1995) for cross-sectional dependence by using Frees' Q distribution (*T*-asymptotically distributed);

4: Chudik and Pesaran (2015) test for weak cross-sectional dependence;

5: Pesaran (2004) CD test for cross-section dependence in panel time-series data;

6: Breusch-Pagan (1980) LM test of independence;

7: Pesaran (2004) scaled LM test;

8. Baltagi *et al.* (2012) bias-corrected scaled LM test.

*** $p<0.01$, ** $p<0.05$, * $p<0.10$.

In what follows, results for the Pesaran Cross-sectional Augmented Dickey-Fuller (Pesaran CADF) test and Pesaran (2007) test are shown, with their outcomes in Table 2. Generally speaking, the results in Table 2 evidence that the conclusions on the stationarity of the tested series are strictly related to the deterministic specification assumption (constant or constant and trend). Combining and summarizing the two tests together, we reject the null hypothesis that the series has unit roots, at 1% and 10% significance levels. Hence, we can conclude that the series are stationary.

Table 2. Panel unit root tests in presence of cross-section dependence.

Variable	Specification	
	Constant	**Constant and trend**
Pesaran CADF test		
CO2E	2.670 (0.996)	-3.860*** (0.000)
PCGDP	-1.042 (0.149)	-0.229 (0.409)
TA	-1.302* (0.096)	-2.521*** (0.006)
EC	0.980 (0.837)	-4.872*** (0.000)
Pesaran (2007) test		
CO2E	-1.835	-3.051***
PCGDP	-2.413***	-2.561
TA	-2.172**	-2.450
EC	-2.417***	-3.506***

Notes: for Pesaran (2003) test, *Z-t*-bar statistics are reported; P-Values in parentheses. Deterministic chosen: constant: Critical Values: -2.07 (10%), -2.15 (5%), -2.30 (1%); deterministic chosen: constant and trend: Critical Values: -2.58 (10%), -2.66 (5%), -2.81 (1%).

*** p<0.01, ** p<0.05, * p<0.10.

From both Kao and Westerlund cointegration tests results reported in Table 3, we fail to reject the null hypothesis of no cointegration at a 10% level of significance. However, as shown by Pedroni's cointegration tests results, again it emerges as the choice of the deterministic component is crucial. Since two approaches are confirming the rejection of the null hypothesis, then we can conclude that there are long-term relationships between the variables. Hence, we can estimate the effects of long-run relationships between the variables.

Table 3. Panel cointegration tests.

Pedroni's residual cointegration test			
	Relation	**Individual intercept**	**Individual intercept and trend**
Within-dimension	Panel *v*	-1.1724 (0.8795)	1.3833* (0.0833)
	Panel *ϱ*	1.0894 (0.8620)	1.5123 (0.9348)
	Panel PP	-1.2829* (0.0998)	-5.4859*** (0.0000)
	Panel ADF	1.0626 (0.8560)	-4.3119*** (0.0000)
Between-dimension	Group *ϱ*	2.9580 (0.9985)	3.3286 (0.9996)
	Group PP	-1.3483* (0.0888)	-8.2113*** (0.0000)
	Group ADF	1.9296 (0.9732)	-3.3345** (0.0004)
Pedroni test for cointegration			
Statistic	**Constant**		**Constant and trend**
Modified Phillips-Perron *t*	1.3455* (0.0892)		2.5831*** (0.0049)
Phillips-Perron *t*	-4.9011*** (0.0000)		-4.4983*** (0.0000)
Augmented Dickey-Fuller *t*	-4.7549** (0.0000)		-5.0195*** (0.0000)
Kao's residual cointegration test			
ADF	0.0145 (0.4942)		
Kao test for cointegration			
Statistic	**Constant**		
Modified Dickey-Fuller *t*	-0.3107 (0.3780)		
Dickey-Fuller t	-0.5643 (0.2863)		
Augmented Dickey-Fuller *t*	1.0593 (0.1447)		
Unadjusted modified Dickey-Fuller *t*	-2.6480*** (0.0040)		
Unadjusted Dickey-Fuller *t*	-2.0280** (0.0213)		
Westerlund cointegration test			
Variance Ratio	-0.8936 (0.1858)		-0.4668 (0.3203)

Notes: P-Values in parentheses. *** p<0.01, ** p<0.05, * p<0.10.

Regression results are shown in Table 4. For the selection of the model, we followed the Hannan-Quinn Information Criterion (HQIC), which suggested an ARDL(1,1,1) model; while the Newey-West Heteroskedasticity and Autocorrelation Consistent (HAC) procedure has been used to calculate the coefficient covariance matrix (with a Bartlett kernel).

Based on this result, energy consumption and per capita growth do not affect carbon emissions. On the contrary, tourist arrivals have a negative and long-run significant impact on the CO_2 at 1% level. As more tourists are coming into the UK, carbon emissions would be reduced by 0.17%. This result supports the findings in Chou (2013) using the EU as a case study but contradicts the works of Zaman et al. (2016) employing 34 developed and developing countries and Nguyen and Su (2021) following 134 developed and developing countries. On the other hand, Balsalobre-Lorente et al. (2021) reach the evidence that international tourism has an inverted U shape relationship with CO_2 emissions in the EU. International tourism first increases the emissions and later diminishes the emissions. However, on assessing the shot-run estimator, tourist arrivals are not a significant predictor of carbon emissions. In addition, energy consumption and per capita growth have a short-run impact on CO_2. Indeed, a 1% increase in energy consumption increases carbon emissions by 0.78% (at a 1% significance level), and a 1% increase in per capita growth raises the emissions by 0.31% (at a 1% level). The results also show a negative and statistically significant error correction of -0.11, which means an 11% speed of correction of the previous disequilibrium over time. Thus, we found a positive short-run effect of both energy consumption and real per capita GDP on CO_2 emissions.

Table 4. Results of ARDL model.

Variable	Coefficient (Std. Error)		
Long-Run Equation			
EC	0.0589 (0.1014)		
PCGDP	-0.0820 (0.0756)		
TA	-0.1668*** (0.0333)		
Short-Run Equation			
Cointegrating Eq.	-0.1143*** (0.0349)		
ΔEC	0.7778*** (0.1012)		
ΔPCGDP	0.3117*** (0.1113)		
ΔTA	0.0067 (0.0285)		
Constant	0.4633*** (0.1526)		
AIC	-3.870467	RMSE	0.029024
SBIC	-2.771136	S.E. of Regression	0.033723
HQIC	-3.439565	Log Likelihood	1125.775

Notes: Heteroskedasticity and Autocorrelation-Consistent (HAC) Newey-West Standard Errors in parentheses (Bartlett kernel). Deterministic component: unrestricted constant and no trend. ***p<0.01, **p<0.05, *p<0.10.

Regarding the model validation, we run several diagnostic tests. In order to get robust Standard Errors, we run 5,000 dynamic simulations. Diagnostic tests include: Jarque-Bera (JB) residuals normality test; Breusch-Godfrey (BG) serial correlation Lagrange Multiplier (LM) test; and Glejser heteroskedasticity test. Results evidenced that the estimated model is appropriate. The BG serial correlation test highlights the absence of autocorrelation. In addition, no heteroskedasticity arises after the results of the Glejser test. The JB normality test confirms that the model's residuals are normally distributed. While the Ramsey Regression Equation Specification Error Test (RESET) results indicate that the model is correctly specified. Therefore, the results show that the estimated model is appropriate.

Furthermore, Table 5 presents the results of the Quantile Regressions for different quantiles. QR estimates with 100 bootstraps show that real per capita GDP is statistically significant in each quantile (at 1 percent significance level), with a positive sign. However, it is worth noting that its estimated coefficient decreases from the lower to the upper quantile (from 0.49 to 0.20, respectively). Tourist arrivals are also a clear determinant of the responding variable, since the estimated beta is again statistically significant in each quantile (at 1 percent), but assuming a negative sign. However, in this case, moving across the three selected quantiles, the coefficient increases (from -0.11 to -0.20). Also for the energy consumption variable, we found a high statistical significance (1 percent), with a slightly decreasing effect across the different quantiles (from 0.11 to 0.08). Regarding the quality of government indicators, generally speaking, it emerges a significance in the two extreme quantiles. The Control of the corruption index and the Regulatory quality index are both significant in the first and the third quartile, with a higher coefficient in the latter (0.27 against 0.24 for *CC*; 0.48 against 0.24 for *RQ*). While the Rule of law index is only significant in Q1; on the opposite, the Government effectiveness index and the Voice and accountability index only in Q3.

As a diagnostic check, an *F* test on the joint significance of this set of quality of government measures strongly rejected the null hypothesis that all these regressors' coefficients are simultaneously equal to 0.

Table 5. Results of Quantile Regressions (with 100 bootstraps).

Variable	**Quantile Regressions**		
	0.25	*0.50*	*0.75*
PCGDP	0.4892*** (0.0881)	0.3764*** (0.1102)	0.1961*** (0.0629)
TA	-0.1137*** (0.0354)	-0.1653*** (0.0343)	-0.2042*** (0.0337)
EC	0.1080*** (0.0347)	0.1020*** (0.0257)	0.0812*** (0.0233)
RL	0.5657*** (0.1167)	-0.1689 (0.1110)	0.0716 (0.1080)
GE	0.0183 (0.0688)	-0.0931 (0.0832)	0.1711* (0.0952)
CC	0.2376*** (0.0845)	0.0371 (0.1187)	0.2735*** (0.0649)
RQ	0.2400* (0.1246)	0.1636 (0.1194)	0.4823*** (0.0946)
VA	-0.1154 (0.1264)	0.1686 (0.1653)	0.4242*** (0.1169)
PS	0.1862*** (0.0720)	0.0910** (0.0459)	-0.0134 (0.0504)
Constant	-2.4776*** (0.7263)	-0.9140 (0.8573)	1.1207* (0.5852)
Pseudo R^2	0.7824	0.7805	0.8211
$F_{RL,GE,CC,RQ,VA,PS}$	8.23*** (0.0000)	1.27 (0.2701)	17.74*** (0.0000)

Notes: *** p<0.01, ** p<0.05, * p<0.10.

Lastly, the causality analysis through the Dumitrescu-Hurlin panel pairwise causality test reveals that CO_2 does not cause *PCGDP*, while per capita GDP causes CO_2 emissions; hence, a unit directional flow exists only from per capita growth to carbon emissions. Furthermore, we found a unidirectional causal flow running from economic growth to energy consumption, in line with the conservation hypothesis. A unidirectional flow also emerges from CO_2 emissions to tourist arrivals, while any statistically significant causal relationship is detected between CO_2 emissions and energy consumption as well as between energy consumption and tourist arrivals (neutrality hypothesis). Finally, a bidirectional causal link between economic growth and energy consumption emerges (feedback hypothesis). For a graphical summary of the causality results, see Figure 3 in the Appendix.

Nguyen and Su (2021), analyzing a global sample of 134 countries using GMM estimations, revealed that environmental sustainability can be supported by improvements in institutional quality, government effectiveness, control of corruption, rule of law, and regulatory quality. Omri and Ben Mabrouk (2020) confirmed Nguyen and Su (2021) empirical findings by yielding that political and institutional governance have positive influences on sustainable development for 20 MENA countries through GMM estimations. Hussain and Dogan (2021) reached as well the conclusion that institutional quality improves the environmental quality by degrading the level of ecological footprint (by lowering environmental degradation) in BRICS countries through the ARDL model, and Augmented Mean Group (AMG) estimations.

Nguyen and Su (2021) reached also evidence that tourism at the international and domestic levels negatively impacts environmental sustainability. Mao et al. (2014), employing data for China and conducting spatial analyses, concluded that development in tourism leads to an increase in demand for construction land, and brings about the loss of eco-land. They eventually suggest that authorities consider some spatial regulations to achieve eco-land conservation.

Zhan et al. (2021), using data for Pakistan and running a quantile ARDL regression model estimations, found evidence that the EKC holds for this country (as GDP has a positive impact on ecological footprint, and the squared GDP has a negative impact on it) and that tourism in Pakistan mitigates the ecological footprint at all quantiles. They also underlined that ecological footprint is positively affected by income and institutional quality in Pakistan (at all quantiles). Their results support the outcomes provided in Table 5, indicating that (a) as the number of tourism arrivals increases, the environmental quality will be improved at all quantiles, and (b) instştutional quality positively affects ecological footprint at all quantiles. Balsalobre-Lorente et al. (2021) suggested that authorities reshape regulatory frameworks with a clearer focus on promoting international tourism and more efficient energy use to improve sustainable economic growth in developed countries.

The differences between the results in the literature might stem from different data or data structures, different econometrical methodologies, income and technology levels, the source of CO_2 emissions, etc. For instance, Lee and Chen (2021) revealed that the revenues from international tourism reduce ecological footprints in countries with higher fishing footprint quintiles, as they increase ecological footprints in countries with lower fishing footprint quintiles. They also reach the evidence that political risk contributes more to the ecological footprint than economic and financial risks in the sample data. Le and Nguyen (2021), observing a panel dataset on 95 countries and employing an extended version of the Stochastic Impacts by Regression on Population, Affluence and Technology (STIRPAT) model combined with the EKC, reached different statistical evidence regarding the influence of tourism on CO_2 emissions. They obtain the outcomes that: (a) tourism receipts and the number of tourist arrivals mitigate CO_2 emissions (total CO_2 emissions and CO_2 emissions from electricity and heat production); (b) CO_2 emissions from transport tend to increase by an increase in tourism.

Liu et al. (2021), considering data for 70 countries through the spatial econometric method, explored the tourism-induced EKC, showing that tourism activities mitigate CO_2 emissions in the long-run.

Table 6. Dumitrescu-Hurlin panel pairwise causality tests.

$CO2E_{it} \nRightarrow PCGDP_{it}$	**$CO2E_{it} \nRightarrow TA_{it}$**	**$CO2E_{it} \nRightarrow EC_{it}$**	**$PCGDP_{it} \nRightarrow TA_{it}$**	**$PCGDP_{it} \nRightarrow EC_{it}$**	**$EC_{it} \nRightarrow TA_{it}$**
0.8877 (0.4473)	5.3232*** (0.0013)	1.06222 (0.2472)	8.9119*** (0.0000)	4.4389*** (0.0044)	0.1694 (0.9170)
$PCGDP_{it} \nRightarrow CO2E_{it}$	**$TA_{it} \nRightarrow CO2E_{it}$**	**$EC_{it} \nRightarrow CO2E_{it}$**	**$TA_{it} \nRightarrow PCGDP_{it}$**	**$EC_{it} \nRightarrow PCGDP_{it}$**	**$TA_{it} \nRightarrow EC_{it}$**
6.3276*** (0.0003)	1.4593 (0.2249)	1.3834 (0.2472)	3.5574** (0.0143)	0.9079 (0.4371)	0.2266 (0.8779)

Notes: *F* statistics are reported. ***p<0.01, **p<0.05, *p<0.10.

5. Conclusions and policy recommendations

This study captures the role of governance in the TEKC in the EU, excluding the UK. We use CO_2 emissions as the dependent variable and employed per capita economic growth, tourism arrivals, energy consumption, and governance indicator index as the independent variables. Before parameter estimation, the analysis of the cross-sectional dependence of the series allows us to use the second-generation panel technique as a basis for our empirical pursuit. The series is stationary at constant and trend, and Pedroni and Kao cointegration analyses affirmed the long-run relationship among the series. Thereafter, the ARDL methods showed that tourist arrivals and energy consumption diminish the carbon emission in the long-run and short-run respectively, while per capita growth foster the divulge positive and long-run impact on the carbon emission.

In addition to revealing the role of the governance indicator, quantile regression revealed that all the governance indicators considered in this study have positive and significant effects on carbon emission. This outcome is in tandem with the study of (Halkos and Tzeremes, 2013) which revealed that Government Effectiveness (GE), Control of Corruption (CC), and Regulatory Quality (RQ) were discovered to stimulate carbon emission in some G-20 countries. The study also proposed that though the revealed variation is subject to the peculiarity of each country's regional and growth differences, improving the quality of governance across the board may not necessarily cause the reduction of CO_2 emissions.

Finally, we examine the pairwise causality of the variables, and as revealed in the study of (Khan et al., 2018), there appears to be a unidirectional relationship from per capita growth to carbon emission, and from carbon emission to tourism arrivals, while no directional link exists between the energy consumption and carbon emission. Also, a bidirectional form of link exists between per capita growth and tourism arrivals, and energy consumption as per capita growth. Direction for policy – the outstanding findings from this study are governance indicators that increase the environmental degradation, as a result, the policymakers are advised to enforce rule of law that enhance the regulatory and monitoring actions which aimed at exposing the citizens and industries to environmental taxes, right of public property so as to those undesirable environmental externalities instigated by activities of human on earth would be internalized. Another policy direction is based on a bidirectional relationship between per capita growth, energy consumption, and tourism arrivals. It is obvious that the key to the sustainable economic growth of the EU without the UK is energy consumption, which of course, resulted from international tourism, however, that no causal relationship run from energy consumption to economic growth needs a considerable amount of study from the policy or government.

Appendix

Table A. Correlation matrix.

Variable	CO2E	PCGDP	TA	EC
CO2E	1.0000			
PCGDP	0.5276*** (0.0000)	1.0000		
TA	-0.2032*** (0.0000)	0.2062*** (0.0000)	1.0000	
EC	-0.0900 (0.2187)	0.2242*** (0.0000)	0.8158*** (0.0000)	1.0000

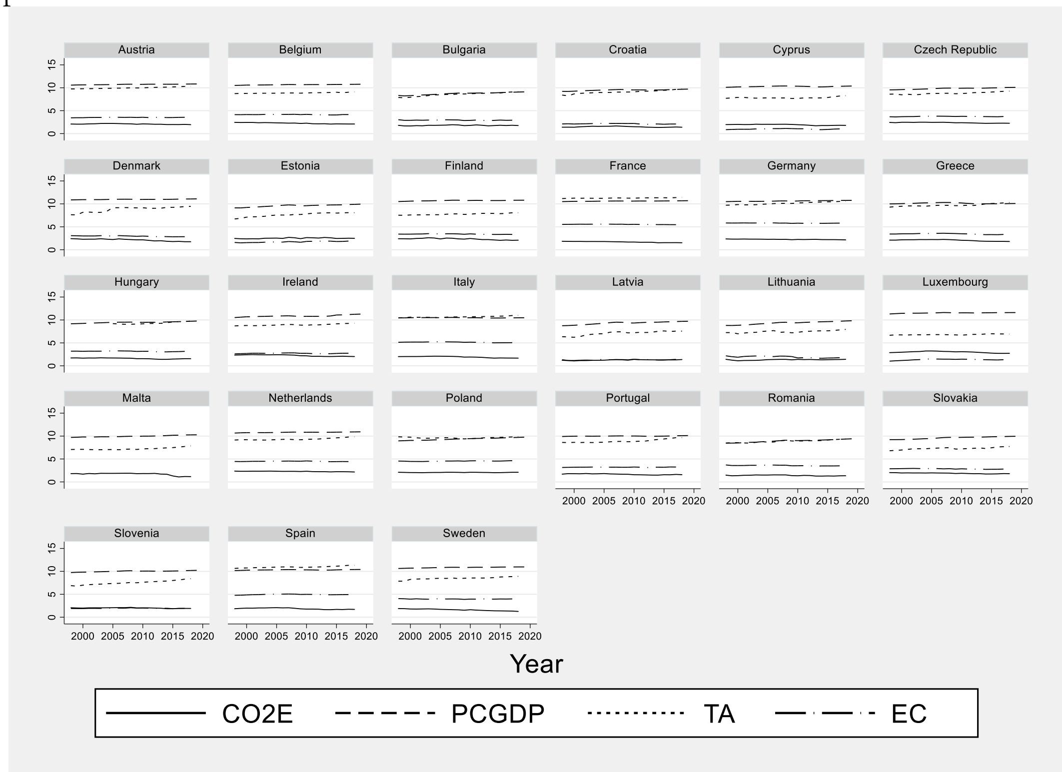
Notes: Sidak's correction has been applied, P-Values in parentheses. ***p<0.01, **p<0.05, *p<0.10.
Sources: our elaborations on WDI data.

Table B: Descriptive statistics.

Variable	Mean	Median	Std. Dev.	Skewness	Kurtosis	Range	IQR	CV
CO2E	1.9572	1.9764	0.4099	0.2909	3.1340	2.1713	0.5442	0.2094
PCGDP	10.1252	10.1807	0.7039	-0.2683	2.4928	3.3874	1.1040	0.0695
TA	8.7755	8.8188	1.2279	0.2090	2.2749	5.1676	1.8896	0.1399
EC	3.2921	3.2752	1.2942	0.0836	2.2534	4.9721	1.9974	0.3931

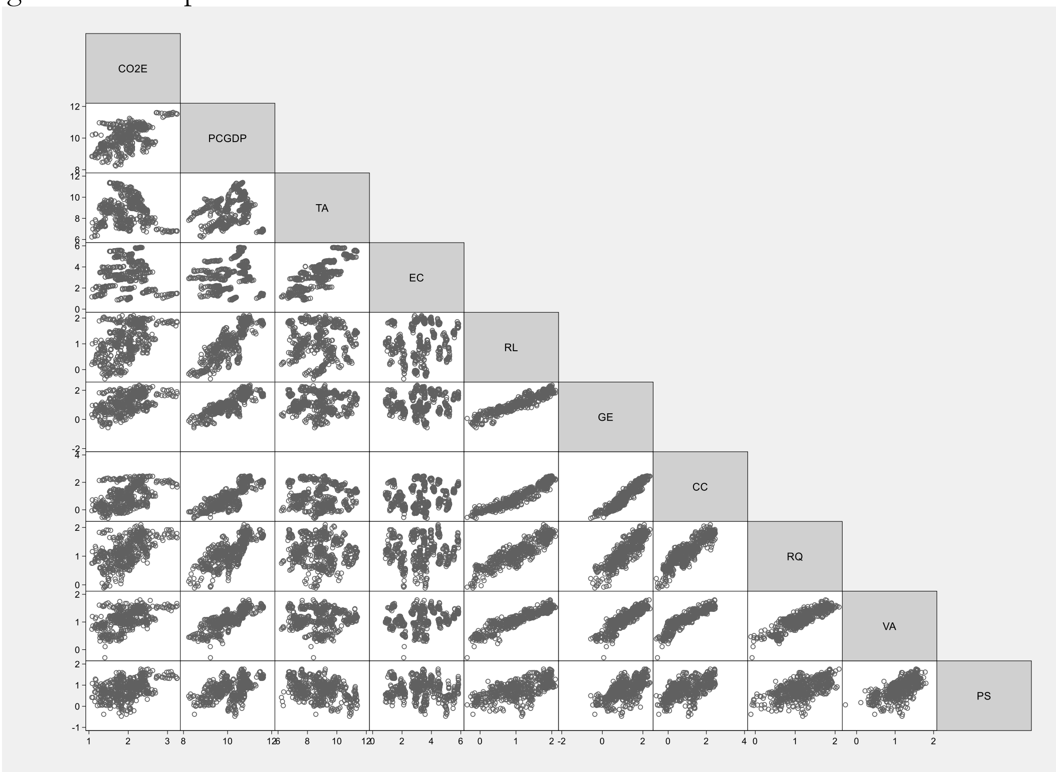
Notes: Std. Dev., Standard Deviation; IQR, Inter-Quartile Range; CV, Coefficient of Variation.
Sources: our calculations.

Figure 1. Carbon dioxide emissions, per capita GDP, tourist arrivals, and energy consumption in EU countries.



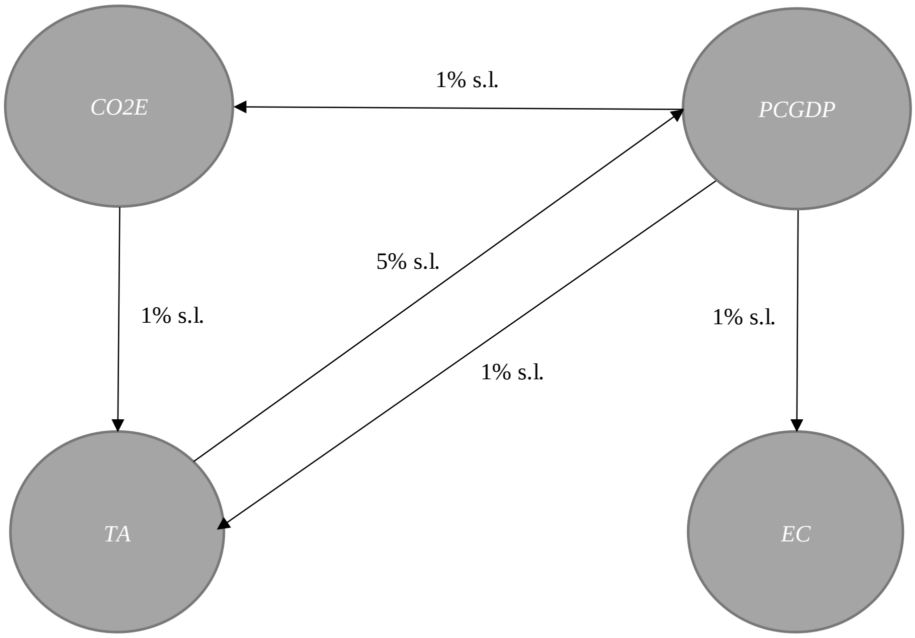
Sources: our elaborations on WDI data.

Figure 2. Scatterplot matrices.



Sources: our elaborations on WDI data.

Figure 3. Summary of causality results.



Sources: our elaborations.

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