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Tourism development, energy consumption and environmental quality in Tunisia, Egypt and Morocco: a trivariate analysis

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Abstract Prior research address socio-economic aspects of tourism industry and little attention has been paid to investigate the impact of tourism development on economic growth, and environmental quality. Accordingly, this study examines the impact of tourism development on economic growth, CO_2 emissions and environmental quality in Tunisia, Egypt and Morocco (Muslim majority countries). An autoregressive distributed lag model is used to analyze data for the period 1980–2014. The study further examines the long and short-term relationship between tourism and economic growth; and tourism and environmental quality. The study reveals that economic growth converges to its long-run equilibrium at an adjusting speed of about 25.7% in Morocco, 5.8% in Egypt, and 2.1% in Tunisia. The findings of the study confirm that tourism growth is linked to environmental quality. The study reveals that tourism has a negative effect on the environment quality in Egypt whereas a positive effect in Tunisia and neutral in Morocco. Using the EKC hypothesis tests, the study concludes the existence of an inverted U-shaped relationship between CO_2 emissions and the level of income for Morocco and Egypt, whereas for Tunisia, this relationship is U-shaped. The study also offers policy implications.

Keywords International tourism · Economic growth · Environment quality · Trivariate analysis

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Introduction

Tourism, the world's largest service sector industry, directly employs 292 million people globally (equating to around 1 in 10 jobs on the planet), and accounts for a total of 10.2% of world GDP (US$7.6 trillion) (WTTC 2017). In terms of the regional growth of tourism industry, Fig. 1 shows that the Oceania contributes to the growth by 12.2%, followed Southeast Asia at 11.8%, and Europe at 9.9%. The total GDP

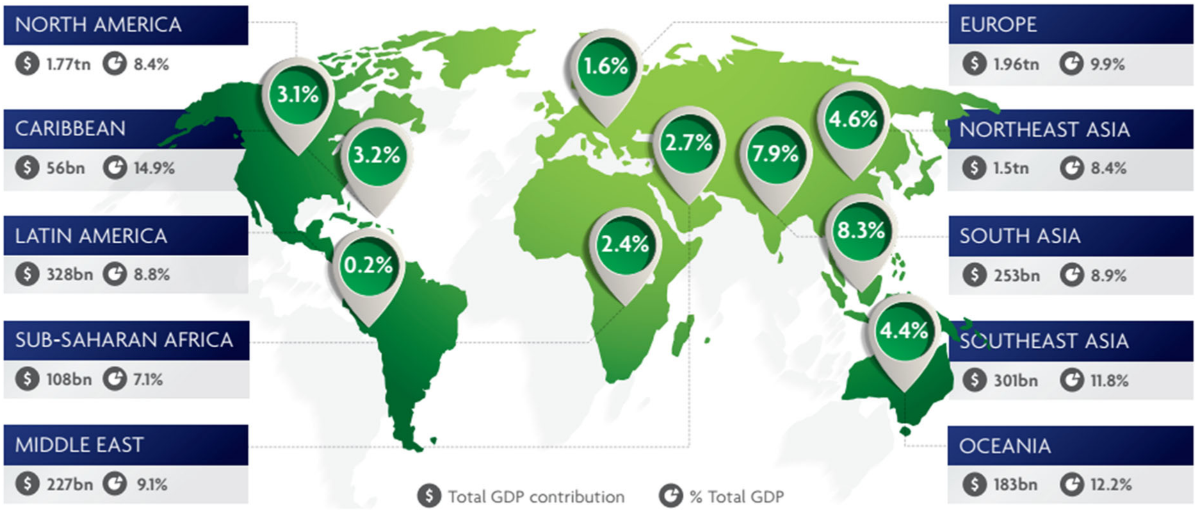

Fig. 1 Regional growth of tourism industry in 2016. *Source:* WTTC (2017)

contribution of Europe was US$ 1.96tn. Nevertheless, while the tourism industry can bring great environmental, social and economic benefits it also has great costs (Read 2013). An increase in tourism activities is accompanied by an increased demand for energy. The tourism sector in the Middle East and North Africa (MENA) is characterized by a fragmented structure, consisting mainly of small and micro enterprises, and negative effects on environmental quality.

The relationship between energy consumption and tourism has, however, received little consideration in the literature to date (Katircioğlu 2014a, b; Amelung and Nicholls 2014). Zaman and Moemen (2017, p. 1119) recently state that "Pursuit of excellence in economic development, in the midst of damaging the natural environment, is a shameless growth. The economic impacts on environmental degradation are quite visible in industrialized economies where human health is compromised by rapid economic growth and energy induced emissions".

Tourism development has been regarded as a crucial factor for economic growth (Matarrita-Cascante 2010; Lee and Brahmasrene 2013; Antonakakis et al. 2015; Avraham 2015; Perles-Ribes et al. 2017). Over the last decade, environmental issues relating to the tourism sector have been the concern of economists and politicians. An increase in tourism activities is accompanied by an increasing demand for energy within various functions. Some studies have explored the impact of tourism on the environment and greenhouse gas emissions and global warming (Becken et al. 2003; Gössling 2002; Becken 2005; Bode et al. 2003, Nielsen et al. 2010; Simpson et al. 2008). On the other hand, several studies have focused on the relationship between tourism and energy consumption (Tabatchnaia-Tamirisa et al. 1997; Gössling 2000; Becken and Simmons 2002). Several studies have dealt with the effect of the tourism industry on environmental quality (Xuchao et al. 2010; Liu et al. 2011). From social dilemma theoretical perspective, Antimova et al. (2012), stress that "environmentally friendly behavior could be restrained when the costs of cooperation are perceived as too high……the gap might be advantageous in the long term for the reason that communities and individuals interact, consequently establishing new social norms".

Tang et al. (2011) suggest that low-carbon tourism is a new way of sustainable development for achieving the greater tourism economic, social and environmental benefits. "*A* number of countries have initiated sustainable tourism investments into tourism sector to promote the tourism industry without damaging the environment. However, there is no empirical evidence on the role of tourism investment on tourism development and CO_2 emissions" (Alam and Paramati 2017, p. 213). Katircioğlu (2014a) argues that tourism development may have a statistically significant impact on environment quality, as mentioned above.

This study aims to examine the impact of tourism development on economic growth, and environmental quality in Morocco, Egypt and Tunisia in Tunisia using annual time series data. Accordingly, the research question is as follows:

> What is the impact of tourism development on economic growth, CO_2 emissions and environmental quality in Tunisia, Egypt and Morocco (Muslim majority countries)?

To achieve the objectives of this research note, this study builds Model based on the prevailing empirical literature. The considered sample countries are Tunisia, Egypt and Morocco. There is a current lack of research into the relationship between tourism and economic growth in these countries. Among the sample countries, the highest contribution of tourism to the GDP is in Morocco (8.1%). In Tunisia, the direct contribution of Travel and Tourism to GDP was (US$ 2726.9mn), and 6.6% of total GDP in 2016. In Egypt, the direct contribution of Travel and Tourism to GDP was US$ 8.7bn, 3.2% of total GDP in 2016. In Morocco, the direct contribution of Travel and Tourism to GDP was MAD81.3bn US$ 8.3bn, 8.1% of total GDP in 2016 (WTTC 2017). In addition, the sample three countries are Muslim majority counties (e.g. more than 90% of population are Muslims. The number of Western tourists traveling to this area began to fall, especially in Tunisia, Morocco and Egypt (WTTC 2017). This situation had adverse consequences, such as increased unemployment and negative economic growth. The study reveals that economic growth converges to its long-run equilibrium at an adjusting speed of about 25.7% in Morocco, 5.8% in Egypt, and 2.1% in Tunisia. The analysis confirms that tourism growth is a factor in climate change. It also indicates that tourism negatively affects environmental quality in the long term in Egypt whereas the effect is positive in Tunisia and neutral in Morocco.

The remaining part of this paper is organized as follows: "Prior research" section provides a literature review; Section 3 describes the methodology and the data used in this study; "Findings" section contains the results of the analysis and Section 5 presents "Conclusion, limitations and policy agenda".

Prior research

Several researchers address socio-economic aspects of tourism industry and investigate the link between economic growth and environmental quality (Franzoni 2015; Coles et al. 2013; Read 2013; Moutinho et al. 2015; Doiron and Weissenberger 2014; Ahmad 2014; Qian et al. 2016; Ghani 2016). However, empirical studies have provided conflicting results. In the following sub-sections, we provide a brief review of studies that have addressed the nexus of tourism development, energy consumption, environment quality, and economic growth.

Tourism development

Studies have been conducted on country-specific or cross-country setting using various methodologies, however, it remains unclear whether or not tourism development could effectively stimulate sustainable growth. Tang et al. (2011) argue that low-carbon economy is an effective solution to the sharp conflict between rapid economic growth and high CO_2 emission. They emphasize that the core of low-carbon tourism is to obtain a higher quality of tourism experience. Some issues were identified in the experience of China including tourist administration, tourism enterprises, tourism attractions and tourists in order to achieve greater socio-economic and environmental benefits with energy saving and emission reduction. Using panel data of 24 countries in the Middle East and North African (MENA) region from 2001 to 2009, Tang and Abosedra (2014) examine the impacts of tourism, energy consumption and political instability on economic growth within the neoclassical growth framework. They reveal that political instability impedes the process of tourism development and growth and macroeconomic policies to promote expansion in tourism and energy consumption may directly stimulate economic growth. Moutinho et al. (2015) uses the decomposition analysis of CO_2 emissions for the period from 2000 to 2012 in Portuguese tourism industry. In terms of tourism development, they find statistical significance of the important effects in accommodation, food and beverage services including energy over fixed capital, capital over labour productivity, and the tourism intensity.

Gamage et al. (2017) investigate whether energy consumption and tourism development provide evidence to support the Environmental Kuznets Curve (EKC) in Sri Lanka. Their findings reveal that carbon emissions, income, tourism development, and energy consumption are cointegrated in the long run and tourism development aggravates environmental degradation in the long run. They suggest that a country like Sri Lanka can reduce environmental degradation without deterring the economic growth. Data were collected from Based on self-administered questionnaires from 407 residents (30 nationalities) residing in Abu Dhabi, Hammad et al. (2017), find the differences in perceptions of the impacts of tourism between national and expatriate residents, but both groups reported support of tourism development in the UAE.

On the other hand, from cross-country perspective, several recent studies like Alam and Paramati (2017) argue that tourism investments play considerable role for tourism development and to improve the environmental quality by reducing CO_2 emissions. They report that 1% increase in tourism investment raises tourism development by 0.982% and growth in per capita income and trade openness positively contributes for tourism development in the sample countries. They conclude that 1% raise in tourism investment reduces CO_2 emissions by 0.098%.

Energy consumption

Energy consumption is an obvious choice as a variable in the study of environmental conditions due to its impact on the generation of pollution. Indeed, energy consumption is regarded as the major source of pollution and environmental degradation in various empirical research studies (Ang 2008; Soytas and Sari 2009; Apergis and Payne 2010; Arouri et al. 2012). Tang and Abosedra (2014) find that energy consumption and tourism significantly contribute to the economic growth of countries in the MENA region. They also confirm the existence of the tourism-led growth and energy-led growth hypotheses in the MENA. Katircioğlu (2014a, b) noted that the growth of tourism leads to a significant increase in both energy consumption and the rate of climate change. Based on the data of the European Union (EU) to examine the impact of tourism on both economic growth and CO_2 emissions, Lee and Brahmasrene (2013) find that tourism has a negative and significant impact on levels of CO_2 emissions. In the case of Cyprus (a tourist destination in the Mediterranean), Katircioglu et al. (2014) also find that tourism development is a catalyst for increased energy consumption and carbon emissions. On the other hand, Katircioğlu (2014a) examined the relationship between tourism development and carbon emissions in Singapore using the EKC hypothesis tests. The study concludes that there is a long-term balanced relationship between carbon emissions and tourism development. In fact, CO_2 emissions converge in the long term towards their balanced level at an adjustment speed of 76.0%. and tourist arrivals have a negative and significant impact on levels of CO_2 emissions, both in the short and long term.

Environmental quality

Over the past three decades, the study of environmental quality has been a major concern in the field of environmental economics, and there has been much focus on attempting to identify the factors that may affect environmental quality. In general, environmental quality and the links between energy consumption, economic growth and CO_2 emissions have been considered in various lines of research. The CO_2 emissions, used in the literature as a proxy for the measurement of environmental quality, are a key concern of both developing and developed countries (Chebbi et al. 2011; Alam et al. 2011; Abosedra et al. 2009; Zhang and Chen 2009; Stern 2011; Sekrafi and Sghaier 2016; Achour and Belloumi 2016). Some researchers, such as Fuinhas and Marques (2011), Ahmad et al. (2017), Alam et al. (2016), and Bouznit and Pablo-Romero (2016), analyzed the relationship between energy consumption and economic growth. A second group of researchers, such as Dinda (2004), Luzzati and Orsini (2009), Costantini and Martini (2010), and Fodha et al. (2010), analyzed the relationship between income levels and CO_2 emissions using the EKC. A third group of researchers, including Zhang and Chen (2009), and Arouri et al. (2012) examined the joint relationship between energy consumption, economic growth and pollution.

In fact, the importance of energy for the tourism sector is indisputable, and an increase in energy consumption due to tourism development can have a negative impact on environmental quality. It is obvious that environmental degradation is likely to occur due to the development of tourism, through the construction of hotels and other tourism facilities at the expense of green spaces, and also as a result of the extra consumption of energy. It has been argued that most tourist activities create a pressure on the environment (Day and Cai 2012; Duffy 2001).

In a similar vein, urbanization is seen as a factor that affects environmental quality, with the results of previous studies showing mixed effects on environmental conditions. Urbanization can have a positive effect on the quality of the environment because there are economies of scale in deploying emission reduction technology in urban zones compared to rural areas (Torras and Boyce 1998). A high level of urbanization increases the quantities of pollutants emitted due to industrial concentration and traffic congestion in urban areas (Panayotou 1997). In addition, people in urban areas are more likely to mobilize in calling for environmental protection policies (Rivera-Batiz 2002; Farzin and Bond 2006).

Economic growth

The relationship between economic growth and environmental quality was explored with the introduction of variables other than GDP and pollution levels (Katircioğlu 2014a, b); Sbia et al. 2014; Katircioğlu et al. 2014; Hsieh and Kung 2013). the study of the environmental Kuznets curve (EKC), which predicts that environmental quality deteriorates with economic development when income levels are low, but improves with economic development while income levels are higher. In this context, Grossman and Krueger (1991) conclude that air pollution increases in the early stages of growth as income increases, but, once the per capita GDP reaches a certain threshold value, the relationship will be reversed (Selden and Daqing 1994; Holtz-Eakin and Selden 1995; Dinda 2004; Luzzati and Orsini 2009; Fodha et al. 2010; Foon and Abosedra 2014; Alam et al. 2016).

This multivariate framework helps to clarify the way several factors contribute to the degradation of the environment. The most commonly used variables are energy consumption, international trade, and urbanization. The tourism sector also contributes to the creation of jobs and the GDP. Specifically, any increase in the number of international tourists not only generates economic growth but also leads to increased energy consumption (Liu et al. 2011). As a consequence, an increase in tourist activities can contribute to a rise in energy demand within various functions, such as transportation, catering, accommodation and management of tourist attractions (Becken et al. 2003; Foon and Abosedra 2014; Perles-Ribes et al. 2017). The consideration of the tourism sector as a source of pollution was confirmed at the World Summit on Sustainable Development in Johannesburg in 2002 which recognized international tourism as one of the world's major energy consumers (Nepal 2008). The openness to international trade is also considered as a determinant of environmental quality and economic growth; however, the ambiguity of the impact of trade on environmental quality is well reflected in the literature. In fact, some researchers (such as Ang 2008; Jalil and Feridun 2011; Nasir and Rehman 2011) conclude that international trade negatively affects environmental quality. In particular, based on autoregressive distributed lag (ARDL) models, other researchers report trade to negatively affect environmental quality in the long term (Jalil and Mahmud 2009).

However, some studies (such as Birdsall and Wheeler 1993; Ferrantino 1997; Grether et al. 2007) find a positive effect. Zaman et al. (2016) test the validity of the EKC hypothesis in the panel of three diversified World's region including East Asia & Pacific, European Union and High-income OECD and Non-OECD countries for the period between 2005 and 2013. They conclude few casual relationships, such as, (a) tourism-induced carbon emissions, (b) energy induced emissions, (c) investment e induced emissions, (d) growth led tourism, (e) investment led tourism and (f) health led tourism development in the region. Zaman and Moemen (2017) examine the interrelationship between energy consumption, economic growth and CO_2 emissions under the six alternative and plausible hypotheses including EKC, Pollution Haven Hypothesis (PHH), population based emissions (IPAT), energy led emissions, sectoral growth emissions and Emissions emancipated Human Development Index (eHDI) in low and middle-income countries, high-income countries and in aggregated panel over the period of 1975–2015. Their findings confirm the EKC and IPAT hypotheses, energy induced emissions, and sectoral growth emissions in different regions of the world. They argue that the policy agenda is needed for sustainable growth in terms of key socio-economic and environmental problems.

Overall, our literature review suggests that, although there are some country-specific studies and cross-country studies available on the tourism development, energy consumption, environment quality, and economic growth. Various econometric techniques have been used to examine the relationship in the extant literature, however, there is no consensus among researchers about the nature of the relationship of such variables used. Moreover, none of the previous studies have compared the effect of tourism development, energy consumption, environment quality, and economic growth among Tunisia, Egypt and Morocco. We therefore address all of these issues in this study using econometric models.

Methodology

Data

The data used in this paper are drawn from the development indicators of the World Bank (WDI) and the World Tourism Organization (UNWTO). These data cover the period Quarter 1 of 1980 and Quarter 4 of 2014. In fact, the annual data are converted into quarterly data using the "quadratic sum game" method. The variables used in our study are the number of the tourist arrivals in logarithm TOURI (lnTOURI), the gross domestic product per capita in logarithm GDP (lnGDP), the energy consumption per capita in logarithm EC (lnEC), and the per capita CO_2 emissions in logarithm CO_2 ($lnCO_2$). Our data cover a sample of three countries in North Africa, namely Tunisia, Morocco and Egypt.

Econometric model

In this study, the starting point of the theoretical analysis is to take account of international tourist arrivals as a determinant of growth and CO_2 emissions. The study builds on the model used by Katircioğlu (2014a, b). As a consequence, the following "tourism-induced" relationships will be used in this study.

$$CO_{2t} = f\left(GDP_t, GDP_t^2, EC_t, TOURI_t\right) \quad (1)$$

$$GDP_t = f(EC_t, CO2_t, TOURI_t) \quad (2)$$

These functional relationships in Eqs. (1) and (2) can be expressed in logarithmic form to capture the elasticity of our variables in the long term (Katircioğlu 2010):

$$\ln CO_{2t} = \beta_0 + \beta_1 \ln GDP_t + \beta_2 \ln GDP_t^2 + \beta_3 \ln EC_t + \beta_4 \ln TOURI_t + \varepsilon_t \quad (3)$$

$$\ln GDP = \alpha_0 + \alpha_1 \ln EC_t + \alpha_2 \ln CO_{2t} + \alpha_3 \ln TOURI_t + \varphi_t \quad (4)$$

where t is the time period, $lnCO_2$ is the logarithm of the CO_2 emissions, lnGDP is the logarithm of the level of GDP, lnEC is the logarithm of the used energy and lnTOURI is the logarithm of the number of international tourist arrivals.

However, the dependent variable in Eqs. (1) and (2) may not achieve their resort to long-term equilibrium levels immediately if there is a change in one of its determinants. Therefore, the adjustment speed between the short and long term levels of the dependent variables can be captured by estimating the following error correction model (ECM): Where Δ represents the first difference operator, and represent respectively the terms of fixed error (ECT) of the two models. The ECTs for both equations show the adjustment speed of the imbalance between the short and the long term of the dependent variable. Therefore, the ECTs are expected to have a negative and significant sign (Gujarati 2003).

To study the long-term relationship between the variables, the ARDL method is used in our study. The ARDL cointegration technique was introduced by Pesaran and Shin (1999), and Pesaran et al. (2001). The use of the Bounds Testing Approach to Cointegration was coined by Engle and Granger (1987), Johansen (1991), and Johansen and Juselius (1990). In fact, according to Pesaran et al. (2001), the first advantage of this method is that this approach is applicable even if the explanatory variables are perfectly I (0) and I (1), or are mutually cointegrated. This method does not require that the series be integrated to the same order to seek a possible cointegration relationship between the variables. The second advantage is that this method has better statistical properties when used with small samples. The estimators derived from Johansen and Juselius's approach are not robust when the sample studied is small, as in this study. Moreover, Pesaran and Shin (1999) showed that when using an ARDL model, the estimators of ordinary least squares of the short-term $\sqrt{T}$ parameters are consistent, whereas the estimators of the long-term coefficients of the ARDL model are are more consistent consistent in small samples (Narayan and Peng 2007; Phillips and Perron 1988; Pesaran et al. 2001).

Findings

We determined the order of integration of all the variables using unit root tests. This makes sure that the variables are not I (2) so that erroneous results will be avoided. In the presence of the second-order integrated variables, the values of the F-statistics provided by Pesaran et al. (2001) cannot be interpreted.

The unit root test

Our study uses Dickey–Fuller (ADF) (Dickey and Fuller 1979) and Phillips–Perron (PP) tests to analyze the stationarity and the integration levels of our variables. Table 1 shows the results of the ADF and PP unit root tests at level and first difference for the variables of the study. The results show that all the variables are non-stationary at level for the three countries of our study, namely Morocco (Panel A) Egypt (Panel B) and Tunisia (Panel C). However, the fact that variables are stationary is well justified at first difference for the three mentioned countries. Therefore, the ARDL approach and the application of the bounds test can be used to study the long-term relationship between growth, environmental quality, and tourism and energy consumption.

Bounds testing approach to cointegration

To study the long-term relationship between our variables, the Bounds Testing Approach to Cointegration is used in an ARDL model. This approach was developed by Pesaran et al. (2001) and can be applied whatever the order of the variables' integration is (regardless of whether the explanatory variables are purely I (0); I (1) or mutually cointegrated). The use of the ARDL model implies the following error correction model estimate:

To test the existence of a cointegration relationship between the variables, the underlying statistical procedure used is a Wald test. The hypothesis of the F-statistics is formulated as follows:

$$H_0 : \gamma_1 = \gamma_1 = \gamma_1 = \gamma_1 = \gamma_1 = 0 \quad (5)$$

$$H_0 : \lambda_1 = \lambda_1 = \lambda_1 = \lambda_1 = \lambda_1 = 0 \quad (6)$$

The F-statistics calculated in this study is compared to the critical values of the table presented by Pesaran et al. (2001). The decision about the existence of a cointegrating relationship will be confirmed if the computed F-statistic is above the upper tabulated limit. However, if the F-statistic is between the terminals, no conclusions can be reached, but if it is below the lower limit, the null hypothesis of no cointegration is accepted. Table 2 shows the results of the Bounds Testing Approach to Cointegration.

The results in Table 3 show that the F-statistics for both models are greater than the upper bound at 5% and 1% for the three countries (see panels A, B and C), which makes us reject the null hypothesis of no cointegration relationship between the variables. Therefore, it can be concluded that there is at least one cointegration relationship between CO_2 emissions and other explanatory variables in the first relationship, and at least one cointegration relationship between GDP and other variables in the second relation for the three countries.

The results of the first relationship show that the coefficients associated with GDP are significant in the three countries studies. In fact, an increase in the long-term income level by 1 point increases CO_2 emissions by 7.29 points in Morocco and 5.97 points in Egypt whereas in Tunisia it reduces it by 6.16 points. Regarding the coefficients associated with energy consumption, it appears that they are significantly positive in all three countries, with any increase in the levels of energy consumed raising the quantity of pollutants and worsening the environmental situation. Therefore, the results of the study are compatible with the various empirical studies of Chebbi (2010), Jebli and Youssef (2015), and Achour and Belloumi (2016).

The coefficient of the GDP2 variable seems to be negatively significant in Morocco and Egypt but positively significant in Tunisia. This result may help

Table 1 Stationarity of variables

Panel A: Morocco					Panel B: Egypt				Panel C: Tunisia			
Variables	ADF test		PP test		ADF test		PP test		ADF test		PP test	
	In level	First difference	In level	First difference	In level	First difference	In level	First difference	In level	First difference	In level	First difference
ln(TOURI)	− 1.52	− 6.51	− 1.56	− 4.88	− 0.72	− 3.61	− 0.8	− 6.96	− 0.72	− 3.61	− 0.8	− 6.96
	[9]	[7]***	[7]	[11]***	[9]	[8]***	[10]	[38]***	[9]	[8]***	[10]	[38]***
ln(CO_2)	− 0.22	− 3.62	0.37	− 6.01	− 0.24	− 3.6	− 1.09	− 9.02	− 1.9	− 3.43	− 0.65	− 9.76
	[9]	[8]***	[2]	[22]***	[9]	[8]***	[10]	[18]***	[9]	[8]***	[20]	[82]***
ln(EC)	1.24	− 3.43	1.83	− 6.02	− 0.82	− 3.62	− 2.56	− 5.67	− 1.09	− 2.9	− 1.06	− 7.02
	[9]	[8]***	[2]	[25]***	[9]	[12]***	[6]	[18]***	[13]	[12]**	[22]	[61]***
ln(GDP)	− 0.44	− 7.37	1.13	− 8.1	− 1.44	− 3.10	− 0.89	− 5.12	0.11	− 3.14	0.61	− 6.19
	[13]	[4]***	[42]	[37]***	[5]	[4]***	[7]	[9]***	[9]	[8]***	[1]	[20]***
ln(GDP)2	− 0.33	− 7.32	1.35	− 7.93	− 1.32	− 3.02	− 0.72	− 5.06	0.18	− 3.08	0.75	− 6.1
	[13]	[11]***	[44]	[37]***	[5]	[4]***	[8]	[9]***	[9]	[8]***	[1]	[20]***

SC is used, selecting the optimal number of delays for ADF tests, while "Bandwidh" is used for PP testing. The critical values for the ADF and PP tests were provided by MacKinnon (1996)

The numbers in brackets represent the number of lags selected automatically using the "Bartlett kernel". Only the constant is included in the tests

***, ** and * indicate statistical significance at 1, 5 and 10% respectively

Table 2 Bounds testing approach to cointegration

Dependent variable	Lag selection	F-statistic	Decision
Panel A: Morocco			
F (CO_2/GDP, GDP2, TR, EC)	(11, 0, 2, 0, 6)	5.4987	Cointegrated
F (GDP/EC, TOURI, CO_2)	(6, 0, 2, 7)	6.8711	Cointegrated
Panel B: Egypt			
F (CO_2/GDP, GDP2, TOURI, EC)	(6, 6, 9, 1, 1)	6.2521	Cointegrated
F (GDP/EC, TOURI, CO_2)	(3, 1, 4, 0)	6.3950	Cointegrated
Panel C: Tunisia			
F (CO_2/GDP, GDP2, TOURI, EC)	(3, 2, 2, 1, 3)	8.4832	Cointegrated
F (GDP/EC, TOURI, CO_2)	(2, 2, 1, 2)	5.7524	Cointegrated
		k = 4	k = 3
Lower-bound critical value at 5%		2.86	3.23
Upper-bound critical value at 5%		4.01	4.35
Lower-bound critical value at 1%		3.74	4.29
Upper-bound critical value at 1%		5.06	5.61

Table 3 Long-term relationship

Variable	Dependent variable CO_2		Dependent variable GDP	
	Coefficient	T-ratio	Coefficient	T-ratio
Panel A: Morocco				
GDP	7.2999	2.8741**		
GDP2	− 0.4668	− 2.975***		
EC	1.7979	3.7941***	0.4638	2.9541***
TOURI	0.2145	1.7495	0.1337	5.8582***
CO_2			0.1978	1.2997
Panel B: Egypt				
GDP	5.9698	3.1420***		
GDP2	− 0.3262	− 2.4154***		
EC	0.3551	3.6391***	− 0.0721	− 0.8070
TOURI	− 0.1589	− 3.1330***	0.2122	6.3910***
CO2			0.2919	4.2726***
Panel C: Tunisia				
GDP	− 6.1642	− 1.8365**		
GDP2	0.3890	1.9151**		
EC	0.7440	3.5793***	1.1704	2.1934***
TOURI	0.0542	1.9765**	0.0911	2.3443***
CO_2			0.3224	0.2299

***, ** and * indicate statistical significance at 1, 5 and 10%, respectively

explain the shape of the curvature showing the relationship between CO_2 emissions and income levels, i.e. it may verify the EKC. The GDP2 negative sign in Morocco and Egypt confirms that the relationship takes the form of an Inverted-U whereas it is in the form of U in Tunisia. This result seems consistent with that previously reported by Jebli and Youssef (2015) for Tunisia.

Finally, the tourism variable seems to show a significantly negative coefficient in Egypt, a significantly positive coefficient in Tunisia and a positive and neutral coefficient in Morocco. Actually, a 1% increase in tourist arrivals in Egypt reduces emitted

CO_2 by 0.15%. This can be explained by the fact that tourism in Egypt is dominated by cultural tourism characterized by visits to archeological sites. The positive impact of tourism on environmental quality in Egypt can also be explained by its effect on long-term economic growth: the growth of the tourism sector raises income levels which, in turn, reduces the amount of long-term pollutants since the environment–growth relationship in the long term takes the form of a decreasing curve.

Zaman and Moemen (2017) argue that there will be an inverted U-shaped relationship between CO2 emissions per capita and per capita income in the context of low, middle, countries. Figure 2 shows the inverted U shaped EKC relationship as per estimated results.

According to the logic of the inverted U-shaped EKC, the rise in income levels reduces CO_2 emissions in the long term. However, the relationship between growth and the environment takes the form of a U in Tunisia, with an increase in income in the long-term causing changes to CO_2 emissions in the same direction. As a consequence, the increase in the number of tourists raises the per capita income and stimulates environmental degradation in Tunisia. Moreover, tourism in Tunisia is characterized by seasonality. The hotter months of the year are the high season for tourism, which means that greater amounts of energy are required for transportation and air conditioning. The arrival of tourists acts as a catalyst, with growth in numbers leading to an increase in energy consumption which, in turn, raises the amount of CO_2 emitted into the atmosphere. The results confirmed the existence of EKC hypothesis by using panel. This result provides good insight about the existence of carbon—EKC hypothesis across countries. Zaman and Moemen (2017, p. 1128) therefore highlight that "there is a strong need to set an optimistic target for growth that would easily be achieved without the cost of environmental degradation across the globe".

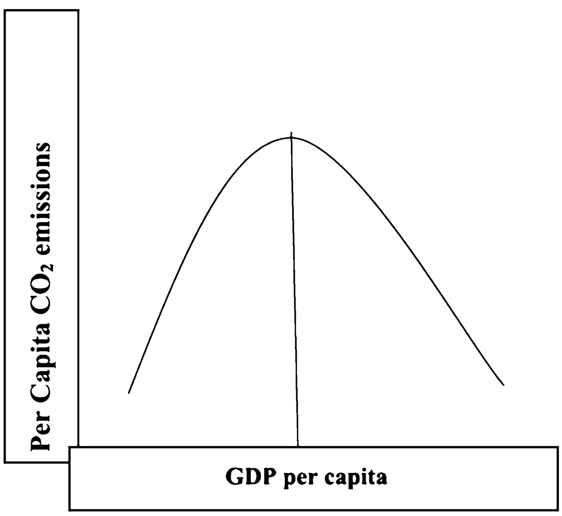

Fig. 2 Inverted U shaped EKC relationship in Morocco, Egypt and Tunisia

In the second relationship, where the level of income is a dependent variable, we notice that a 1% increase in energy consumption increases the level of economic growth by 0.46% in Morocco and 1.17% in Tunisia. This positive relationship is explained by the fact that these countries are in a growth phase, and any economic development requires additional amounts of energy. Regarding the tourism variable, it is worth noting that it shows positively significant coefficients in all three countries. A 1% increase by in international tourist arrivals increases long-term income levels by 0.13% in Morocco, 0.21% in Egypt and 0.09% in Tunisia.

In a second stage, the ECM conditional regression associated with the relationship level in Eqs. (5) and (6) is estimated. These ECM estimates are presented in Tables 4 and 5. The results presented in Table 4 show that the ECT term associated with Eq. (5) is statistically significant and negative, which confirms the bounds test results showing the existence of at least a long-term relationship between the model variables. The ECT values presented in Table 4 are of the order of -0.590 for Morocco, -0.2025 for Egypt, and -0.2797 for Tunisia, which implies that CO_2 emissions converge towards the long-term equilibrium at a speed of 5.8% in Morocco, 20% in Egypt and 27.9% in Tunisia through the economic growth, energy consumption and tourism channels. The speed of the equilibrium adjustment in Tunisia is greater than in Egypt and Morocco. Regarding the short-term energy coefficients, it should be noted that they are positive and statistically significant at date *(t)* while they are negative and statistically significant for previous periods. However, the short-term coefficients associated with economic growth (GDP) are negative and statistically significant in period (t), but become positive in the subsequent periods. Finally, we notice that the tourist variable shows a negative but not

Table 4 Short-term relationship (CO_2/GDP, GDP2, EC, TOURI)

Panel A: Morocco				Panel B: Egypt				Panel C: Tunisia			
Lag structure: (6, 6, 9, 1, 1)				Lag structure: (11, 0, 2, 0, 6)				Lag structure: (3, 2, 2, 1, 3)			
Variable	Coefficient	t-statistic	Prob.	Variable	Coefficient	t-statistic	Prob.	Variable	Coefficient	t-statistic	Prob.
D(lnCO_2(− 1))	0.6133	8.2978	0.0000	D(lnCO_2(− 1))	0.7482	9.4071	0.0000	D(lnCO_2(− 1))	0.4996	6.4034	0.0000
D(lnCO_2(− 2))	0.1408	2.1839	0.0313	D(lnCO_2(− 2))	0.3588	3.5266	0.0006	D(lnCO_2(− 2))	0.2653	3.1562	0.0020
D(lnCO_2(− 3))	0.0806	1.2326	0.2206	D(lnCO_2(− 3))	0.1874	2.2752	0.0250	D(lnGDP)	− 14.3856	− 2.7207	0.0075
D(lnCO_2(− 4))	− 0.6761	− 9.0429	0.0000	D(lnCO_2(− 4))	− 0.9259	− 11.160	0.0000	D(lnGDP(− 1))	10.6407	2.0369	0.0439
D(lnCO_2(− 5))	0.4551	5.6537	0.0000	D(lnCO_2(− 5))	0.7239	6.1430	0.0000	D(lnGDP2)	0.9129	2.6760	0.0085
D(lnEC)	1.2165	14.5776	0.0000	D(lnCO_2(− 6))	0.3454	2.6769	0.0087	D(lnGDP2(− 1))	− 0.6749	− 1.9974	0.0481
D(lnEC(− 1))	− 0.5715	− 3.4044	0.0010	D(lnCO_2(− 7))	0.0847	1.1489	0.2532	D(lnEC)	− 0.1058	− 0.9932	0.3226
D(lnEC(− 2))	− 0.0736	− 0.4977	0.6198	D(lnCO_2(− 8))	− 0.4948	− 6.6577	0.0000	D(lnTOURI)	0.1356	4.6750	0.0000
D(lnEC(− 3))	− 0.4998	− 2.9213	0.0043	D(lnCO_2(− 9))	0.3660	4.2834	0.0000	D(lnTOURI(− 1))	− 0.0216	− 0.4715	0.6381
D(lnEC(− 4))	0.7140	3.4065	0.0009	D(lnCO_2(− 10))	0.1761	2.1286	0.0357	D(lnTOURI(− 2))	− 0.0532	− 2.1554	0.0332
D(lnEC(− 5))	− 0.3201	− 2.7789	0.0065	D(lnEC)	0.0719	3.2584	0.0015				
D(lnGDP)	− 5.7011	− 3.2063	0.0018	D(lnGDP)	− 0.0986	− 0.1808	0.8569				
D(lnGDP(− 1))	0.1213	1.2435	0.2166	D(lnGDP(− 1))	0.9225	2.5121	0.0136				
D(lnGDP(− 2))	0.0395	0.4086	0.6837	D(lnGDP2)	− 0.0660	− 2.4739	0.0150				
D(lnGDP(− 3))	0.1263	1.0573	0.2929	D(lnTOURI)	0.0797	2.6743	0.0087				
D(lnGDP(− 4))	− 0.2152	− 1.8619	0.0656	D(lnTOURI(− 1))	− 0.0684	− 1.7670	0.0802				
D(lnGDP(− 5))	0.1030	1.1281	0.2620	D(lnTOURI(− 2))	0.0083	0.2831	0.7777				
D(lnGDP(− 6))	0.0317	0.3502	0.7269	D(lnTOURI(− 3))	− 0.1421	− 3.8997	0.0002				
D(lnGDP(− 7))	− 0.0798	− 0.8574	0.3933	D(lnTOURI(− 4))	0.2525	5.2752	0.0000				
D(lnGDP(− 8))	0.1044	1.8901	0.0616	D(lnTOURI(− 5))	− 0.0946	− 3.2203	0.0017				
D(lnGDP2)	0.3748	3.0726	0.0027								
D(LNTOURI)	− 0.0237	− 1.2786	0.2040								
ECT	− 0.0590	− 2.9094	0.0045	ECT	− 0.2025	− 4.7835	0.0000	ECT	− 0.2797	− 6.0805	0.0000

Table 5 Short-term relationship (GDP/CO_2, EC, TOURI)

Panel A: Morocco				Panel B: Egypt				Panel C: Tunisia			
Lag structure: (3, 1, 4, 0)				Lag structure: (6, 0, 2, 7)				Lag structure: (2, 2, 1, 2)			
Variable	Coefficient	t-statistic	Prob.	Variable	Coefficient	t-statistic	Prob.	Variable	Coefficient	t-statistic	Prob.
D(lnGDP(− 1))	0.4313	5.2277	0.0000	D(lnGDP(− 1))	0.5426	6.2617	0.0000	D(lnGDP(− 1))	0.4897	6.4321	0.0000
D(lnGDP(− 2))	0.2044	2.2534	0.0260	D(lnGDP(− 2))	0.2006	2.1783	0.0315	D(lnEC)	0.2788	6.8184	0.0000
D(lnCO_2)	− 0.2490	− 1.6961	0.0924	D(lnGDP(− 3))	0.0513	0.5840	0.5604	D(lnEC(− 1))	− 0.1320	− 2.9846	0.0034
D(lnEC)	0.8565	4.3119	0.0000	D(lnGDP(− 4))	− 0.3755	− 3.8758	0.0002	D(lnCO_2)	− 0.0490	− 1.6625	0.0989
D(lnEC(− 1))	− 0.0842	− 0.2995	0.7651	D(lnGDP(− 5))	0.2427	2.9056	0.0044	D(lnTOURI)	0.0282	2.3607	0.0198
D(lnEC(− 2))	0.0141	0.0519	0.9587	D(lnEC)	− 0.0042	− 0.8255	0.4109	D(lnTOURI(− 1))	− 0.0208	− 1.901	0.0597
D(lnEC(− 3))	− 0.2332	− 1.5485	0.1241	D(lnCO_2)	− 0.0117	− 0.7949	0.4284				
D(lnTOURI)	0.0344	3.7604	0.0003	D(lnCO_2(− 1))	0.0050	0.3348	0.7384				
				D(lnTOURI)	0.0385	5.6582	0.0000				
				D(lnTOURI(− 1))	− 0.0061	− 0.4521	0.6521				
				D(lnTOURI(− 2))	− 0.0132	− 1.2599	0.2104				
				D(lnTOURI(− 3))	− 0.0356	− 3.6017	0.0005				
				D(lnTOURI(− 4))	0.0515	4.1029	0.0001				
				D(lnTOURI(− 5))	− 0.0093	− 0.7426	0.4593				
				D(lnTOURI(− 6))	− 0.0124	− 1.8065	0.0735				
ECT	− 0.2572	− 5.0956	0.0000	ECT	− 0.0588	− 5.0182	0.0000	ECT	− 0.0210	− 2.1472	0.0337

significant coefficient in Morocco and a positive and statistically significant coefficient in Egypt and Tunisia.

The results presented in Table 5 for the estimated ECM Eq. (6) show that the ECTs are negative and statistically significant at the 5% threshold, which confirms the existence of at least one long-term relationship between the model variables. Economic growth converges to its long-run equilibrium by adjusting at a speed of around 25.7% in Morocco, 5.8% in Egypt and 2.1% in Tunisia. The coefficients associated with tourism are positive and statistically significant at the 5% threshold at time (t). Regarding the power consumption variable, its coefficient is positive and statistically significant in Morocco and Tunisia; however, in Egypt, it is not significant. In fact, the model shows economic growth in the three countries to be significantly associated with tourism.

Conclusion, limitations and policy agenda

The objective of this study is to examine the impact of the impact of tourism development on economic growth, CO_2 emissions and environmental quality in three Muslim majority countries: Morocco, Egypt and Tunisia. The study first assessed the EKC hypothesis by integrating economic growth (GDP per capita), carbon emissions, tourist arrivals and energy consumption. Then, the study examined the impact of energy consumption, environmental quality and tourist arrivals on economic growth. The introduction of energy consumption into the analysis is intended to clarify the transmission channels of the effects of tourism on environmental quality. Furthermore, this study is the first of its kind in the relevant literature to investigate the interaction between tourism development and economic growth using the theoretical EKC hypothesis in three Muslim majority countries, to the best of the author's knowledge.

The results of the study show that tourism has a direct and statistically significant impact in the long run on the level of CO_2 emissions and economic growth of the sample economies. Moreover, the results confirm the existence of an inverted U-shaped relationship between CO_2 emissions and the level of income for Morocco and Egypt, whereas for Tunisia, this relationship is U-shaped. The error correction models in this study showed that CO_2 emissions converge towards their long-term equilibrium at a speed of around 5.8% in Morocco, 20% in Egypt and 27.9% in Tunisia, through economic growth, energy consumption and tourism channels. This result reveals that tourism growth is linked to significant climate change. Similar to the study of Lee and Brahmasrene (2013), Katircioğlu (2014a), Paramati et al. (2017), our study show that economic growth converges to its long-run equilibrium at an adjusting speed of about 25.7% in Morocco, 5.8% in Egypt, and 2.1% in Tunisia.

Although this study examines investigates the impact of tourism development on economic growth, CO_2 emissions and environmental quality, it does not explain the perceptions of tourists. Future study could be conducted based on the survey from the tourists of these countries regarding the sustainable tourism experiences. In addition, these findings can be explained by the fact that Tunisia, Egypt and Morocco are Muslim majority countries and lack of extant studies in tourism in Muslim majority countries limits comparison opportunities (Hammad et al. 2017). The future studies could examine the same issue discussed in this paper across the Muslim majority countries which will add considerable value to the literature and also to the policy (Alam and Paramati 2017). This study uses a quantitative method, though it would be useful to use mixed methods to explore other factors that influence tourism development.

The results of this study have major implications for policymaking. The overall policy implications in this study is the wakeup call for the environmentalists and policymakers, in order to promote sustainable tourism in Morocco, Egypt and Tunisia.

(a) The results of the study showed that there is a statistical significant relationship between CO_2 emissions and economic growth. This implies that Morocco, Egypt and Tunisia have initiated effective sustainable tourism initiatives to alleviate the adverse effect of tourism on the environment. However, the sample countries' sustainable tourism investment is needed for improving the energy efficiency and using renewable energy sources to further this effort and to promote the tourism industry.

(b) The environmental conservation policies should be well-balanced with macroeconomic targets (e.g. economic growth and environmental effects and protection). This policy is being used in the case of Singapore and in the case of EU countries.

(c) The policymakers should include tourism stakeholders in terms of sustainable tourism policy like of attracting international tourists and avoiding further increases in the emission levels.

(d) In terms of energy consumption, Renewable energy systems should be addressed in the tourism industry of Morocco, Egypt and Tunisia.

(e) The energy-performance certification schemes and effective enforcement of tourism regulations should be needed. Like Portugal, small and micro scale companies are needed in the tourism industry to play a key role in strengthening the economic growth.

Finally, the political stability is needed for tourism development and economic growth. For instance, the north African region has been shaken by violence and political instability for many years. This could have the negative consequences of uncertainty associated with political instability and the growth of Morocco, Egypt and Tunisia. Unless corrective measures are taken by local and international policymakers in Morocco, Egypt and Tunisia, it is bound to have negative environmental impact on the communities. Nevertheless, the promotion of sustainable tourism is problematic and should not be viewed as an ultimate solution. Some challenges including poverty reduction at the center of tourism planning, development and management require genuine community participation, financial assistance, and institutional capacity building.

Compliance with ethical standards statement

Conflict of interest The authors declare no conflict of interest.

Human rights This study does not contain any studies with human participants performed by any of the authors

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