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The impact of carbon dioxide (CO_2) emissions on tourism: Does the source of emission matter?[1]

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Abstract. *Tourism is often cited as an important driver of environmental degradation worldwide by previous literature. Butler (2000) alleges that tourists will not travel back to polluted and dirty destinations if they have alternative destinations available at comparable prices. It is thus likely that carbon emissions affect tourism industry as well. The goal of this paper is therefore to investigate the impact of carbon emissions on tourism receipts in the top ten country destinations around the world. We employ panel ARDL approach using the annual data for the period 1995-2010. Findings show that emissions from gaseous fuel have a positive impact whereas total emissions, emissions from solid fuel (only in the short-run) and liquid fuel have negative impact on tourism receipts. Policy implications depending on these results are also discussed.*

Keywords: environmental degradation; tourism; carbon dioxide emission; panel ARDL.

JEL Classification: L83, Q51, Q53.

1. Introduction

The current and future potential of tourism-oriented mobility, and therefore tourism-oriented activities, have posed an even more serious challenge for environment ever before. The World Tourism Organization's 2008 report (UNWTO, 2008) on Climate Change and Tourism propound an urgent requirement of an adoption of a range of policies which encourages truly sustainable tourism that reflects a quadruple bottom line of environmental, economic, social and climate responsiveness. To address this, tourism economics frequently draws attention to the interaction between tourism and the environment. Cadarso et al. (2014) remark that intensive use of energy required for tourism production activities leads to the emission of high amounts of greenhouse gases. In addition, UNWTO (2008) estimates indicate that emissions generated by tourism sector are at around 5% across the globe.

The impact of tourism on environmental degradation is certainly well-documented (see, literature review). In those studies, it is illustrated that carbon (CO_2) emission is an appropriate indicator for representing the level of degradation. CO_2 emissions stemming from burning fossil fuels are perceived as the main source of environmental degradation such as air and/or water pollution, climate change and soil erosion. Thus, in a country where tourism makes major contributions to economic activity, one might also expect CO_2 emissions to affect tourism. The question has to be answered hereunder should be as follows: What if environment really matters for tourism as well? The goal of this paper is therefore to investigate the impact of CO_2 emissions on tourism receipts. To this end, empirical models are estimated using panel ARDL approach. The analysis is conducted on annual panel data observations ranging from 1995 to 2010 and considers 10 countries that are mostly visited around the world in the last decade.

The contribution of this paper to existing literature is two-fold. First, we model tourism receipts as a function of CO_2 emissions unlike the bulk of the studies in which CO_2 emissions are described as a function of tourism activities (see, literature review). Butler (2000) states that although determinants like price, infrastructure and marketing are still more likely to attract more tourists, are not enough to deny the importance of quality of the environment. He notes that tourists will not return to polluted, dirty and unattractive destinations if they have alternative destinations available at comparable prices. In addition, energy economics literature provides some evidences indicating the impact of CO_2 emissions on GDP (Halicioglu, 2009; Pao and Tsai, 2011; Tang and Tan, 2015 among others) as well as tourism economics literature indicating the significant impact of GDP on tourism (Tang and Jang, 2009; Apergis and Payne, 2012; Caglayan et al., 2012). It therefore makes sense that one should expect CO_2 emissions to significantly affect tourism sector given the implicit role of income.

Second, we use disaggregated data for CO_2 emissions with regard to source. Although environmental degradation per se has a detrimental impact on tourism, main point here should be the degree of degradation. If consumption is resulted from the burning of a fuel which emits lower quantities of greenhouse gases than do other fuels, this might even leave a favorable impact given that energy has to be consumed anyway. Under such a positive impact, economic impact of CO_2 emissions distinguishes oneself as well in addition to the environmental impact on tourism industry. Therefore, by decoupling the impact of CO_2 emissions, we measure how volatile the impact is across different fuels of CO_2 emissions as well as what kind of impact they have on tourism income.

The balance of the paper appears as follows: the next section reviews related literature motivating the empirical framework. The data, methodology and results come into view in section 3. The final section concludes with the key remarks.

2. Review of literature

As tourism has attained new levels of importance with 1980s, its engagement with social, cultural and environmental issues has paid special attention. Pioneer theoretical explanations have put forward a sustainable relationship between tourism and the environment (see, Pigram, 1980; Hunter and Greene, 1995; Lukashina et al., 1996; Hughes, 1996; Butler, 2000 among others). Accordingly, the literature that looks into this relationship is voluminous and the bulk of these studies designate CO_2 emissions as a function of tourism activities. One and expanded stream of studies intends to measure how much imprint tourism leaves on the environment. Gossling (2002) argues the global environmental consequences that tourism causes and lists 5 major aspects that tourism promotes: (i) change of land cover and land use, (ii) energy consumption, (iii) biotic exchange and extinction of wild species, (iv) exchange and dispersion of diseases, and (v) changes in the perception and understanding of the environment via travel. Gossling (2013) calculates national emissions resulted from tourism sector in different economies and reach the conclusion that emissions from tourism matter more day by day which are equivalent to 5-150% of official national emissions. Gossling and Peeters (2015) assess the tourism sector's global environmental impact and note that one night in accommodation cause greenhouse gas emissions of between 0.1 and 260 kg CO_2. Furthermore, they conclude that global tourism system have caused 1.12 Gt (gigatones) CO_2 over 1900-2010. Gossling et al. (2015) analyze the impact of carbon emissions that are caused by air travel from international tourism markets on 11 selected economies over 1995-2010 periods. Results reported by the author show that if comparing individual markets for the whole range of destinations, variations in inter-market emission intensities of up to a factor 30 (127-3930 kg CO_2/tourist). On the other hand, if comparing average emission intensities between destinations, they are up to a factor 5 (370-1830 kg CO_2/tourist). Becken et al. (2003) examine the impact of different travel choices like transport, accommodation, and attraction on the total energy bill of international and domestic tourists in New Zealand. It is found that the dominant impact comes from transportation whose contribution to international tourists 65% while it is nearly 73% for domestic tourists. Dubois et al. (2011) discuss how it would be possible to reduce emissions in the tourism sector and the possible consequences of mitigation for global mobility induced by tourism by 2050. They conclude that if we change the way we travel considerably, this might reduce emissions in a situation where the tourism and transportation related to tourism are required to reduce emissions by a percentage as high as in all other economic sectors. Stefanica and Butnaru (2015) who believe tourism depends on environment argue that environmental issues like pollution, global warming, waste increase etc., affect tourism as much as other global indicators like economic crisis or terrorism. One stream of studies, on the other hand, tackles with carbon footprint of tourism activities (Becken and Patterson, 2006; Dwyer et al., 2010; Munday et al., 2013; Sun, 2014 among others).

Deriving from tourism-induced energy function, there appears a few empirical studies as well, which econometrically measures the impact that tourism-related variables have on CO_2 emissions. In the case of a popular destination with more than 30 million tourists per year, Katircioglu (2014) finds an evidence of a long-run equilibrium among tourism, CO_2 emissions and energy consumption in Turkey and a 1% change in tourist arrivals to Turkey leads to a 0,10% change in CO_2 emissions in the long-run. Looking into the same issue in a different attractive tourism destination, Katircioglu et al. (2014) find CO_2 emissions, energy consumption and tourism are cointegrated in Cyprus and a 1% increase in tourist arrivals increases CO_2 emissions by 0.03%. In addition, there exists uni-directional causality from CO_2 emissions to tourist arrivals in the short-run while causality runs from tourist arrivals to CO_2 emissions in the long-run. Including foreign direct investments into the model, Lee and Brahmasrene (2013) study with the data of 27 European Union countries. Their findings show that variables under question are cointegrated and a 1% increase in tourism receipts decreases CO_2 emissions by 0.10% (Lin, 2010).

According to UNWTO (2008) estimates, 75% of tourism sector CO_2 emissions are being caused by transportation (in particular, 40% air transport, 30% car transport, and 3% other transport) while 21% and 4% of those by accommodation and tourist activities, respectively. Given these estimates, recent attempts on decoupling the influences of tourism-related CO_2 emissions have become attractive as well. Adopting bottom-up approach, Tang et al. (2014) find for China that CO_2 emissions from tourism industry in 2012 are approximately 8 times higher than in 1990. Moreover, CO_2 emissions from tourism industry are dominated by tourism transport (80% of total emissions) in China. In one of the provinces of China, Heilongjiang, Tang (2015) investigates the relationship between tourism and the environment by developing a combining method using the coupling coordination degree model and information entropy weight. Results reveal that the degree of coupling coordination shows an upward tendency. Robaina-Alves et al. (2015) focus to identify the effects of tourism on CO_2 emissions in five tourism subsectors in Portugal. Results, in general, indicate that tourism activity has the most important effect. Applying bottom-up approach, Lin (2010) determines the amount of CO_2 emissions from domestic tourism transport in five national parks in Taiwan. The results indicate that CO_2 emissions per person are different in each national park, influenced by the attributes of travel distance and transport mode.

The above having been mentioned, what we have learnt in this section so far is that there is a large body of literature examining the impact of tourism on CO_2 emissions. The vice versa, however, still remains unanswered and can only be resolved through empirical analysis.

3. Data, methodology and results

3.1. Data

The data set includes international tourism receipts in current US dollars, CO_2 emissions from total energy consumption (kt), CO_2 emissions from solid fuel (coal) consumption (kt), CO_2 emissions from liquid fuel (petroleum) consumption (kt), CO_2 emissions from gaseous fuel (natural gas) consumption (kt), GDP in current US dollars, consumer price index (2010 = 100) and real effective exchange rate index (2010 = 100). All the data are sourced from the World Bank, World Development Indicators database. The data set covers annual panel data for the period 1995-2010. The sample panel(2) was constructed under the available data constraint according to information attained from the UNWTO.

3.2. Methodology

The present study employs a panel ARDL methodology for investigating the impact of CO_2 emissions on tourism receipts in top ten country destinations. Our model incorporates with the Pooled Mean Group estimator (PMG) that was developed by Pesaran et al. (1999). The considered model is formulated in the following manner:

$$lnRCPT_{it} = \alpha_i + \sum_{j=1}^{ki} \beta_{ij} lnRCPT_{i,t-j} + \sum_{j=0}^{fi} \delta_{ij} lnCO2_{i,t-j} + \sum_{j=0}^{hi} \phi_{ij} lnGDP_{i,t-j} + \\ + \sum_{j=0}^{ri} \partial_{ij} lnCPI_{i,t-j} + \sum_{j=0}^{di} \tau_{ij} lnEXCH_{i,t-j} + \varepsilon_{it} \quad (1)$$

where RCPT is international tourism receipts in current US dollars, CO2 is the vector of independent variables related to CO_2 emissions (i.e. total CO_2 emissions (TOTAL) and emissions from burning coal (COAL), petroleum (FUEL) and natural gas (GAS)). GDP, CPI and EXCH are the control variables that represent gross domestic product in current US dollars, consumer price index (2010=100), and real effective exchange rate index (2010=100), respectively. Finally, ε is the error term.

In order to see the separate effects (i.e. short and long) of CO_2 emissions on tourism receipts, the Eq (1) can be parameterized as follows:

$$\Delta lnRCPT_{it} = \alpha_i + \varpi_i lnRCPT_{i,t-1} + \delta_i^* \ln CO2_{it} + \phi_i^* \ln GDP_{it} + \partial_i^* \ln CPI_{it} + \\ + \tau_i^* \ln EXCH_{it} + \sum_{j=1}^{ki-1} \beta_{ij}^{**} \Delta lnRCPT_{i,t-j} + \sum_{j=0}^{fi} \delta_{ij}^{**} \Delta \ln CO2_{i,t-j} + \\ + \sum_{j=0}^{hi} \phi_{ij}^{**} \Delta \ln GDP_{i,t-j} + \sum_{j=0}^{ri} \partial_{ij}^{**} \Delta \ln CPI_{i,t-j} + \sum_{j=0}^{di} \tau_{ij}^{**} \Delta \ln EXCH_{i,t-j} + \varepsilon_{it} \quad (2)$$

where ϖ represents error correction coefficient, the notations $\delta^*, \phi^*, \partial^*, \tau^*$ and $\delta^{**}, \phi^{**}, \partial^{**}, \tau^{**}$ illustrates the long and short-run coefficients, respectively.

Pesaran et al. (1999) developed two estimators namely the Mean Group (MG) and the Pooled Mean Group (PMG) which both can be utilized to estimate the Eq (2). However, since the MG does not allow certain parameters to be distributed homogenously across cross-section units, this study utilizes the PMG for the estimation of Eq (2).

As both pooling and averaging, the PMG estimator allows the intercepts, short-run coefficients, and error variances to differ freely across groups, but constraints the long-run coefficients to be the same (Pesaran et al., 1999). Since the initial conditions or some structural factors may have a possibility to influence all groups in a similar way, it is suggested to utilize the PMG estimator for the purpose in consideration (Menegaki and Tugcu, 2017).

Pesaran et al. (1999) points out that, in the case of cross-country studies, the likelihood ratio that is used for testing homogeneity of error variances and/or short- or long-run slope coefficients usually rejects equality of error variances or slopes at conventional significance levels. Because of this problem, it is suggested to employ Hausman (1978)-type tests. Under long-run slope homogeneity, although the PMG and the MG estimators are supposed to be consistent, only the PMG estimator is assumed as efficient. Therefore, in this study, the effect of heterogeneity on the means of the coefficients is tested by a Hausman-type test applied to the difference between the MG and the PMG.

3.3. Results

First of all, we present descriptive statistics of the variables under consideration in Table 1. Results show that variables exhibit mixed patterns in terms of normality. They are mostly platykurtic and positively (TOTAL, COAL, FUEL, GAS) as well as negatively skewed (RCPT, GDP, CPI, EXCH).

Table 1. *Descriptive statistics*

	RCPT	TOTAL	COAL	FUEL	GAS	GDP	CPI	EXCH
Mean	23.982	13.470	12.110	12.472	11.824	27.814	4.239	4.575
Median	24.125	13.069	11.671	12.364	11.712	28.007	4.420	4.603
Maximum	25.862	15.930	15.608	14.710	14.069	30.336	4.605	4.834
Minimum	21.897	11.589	8.558	10.831	9.491	25.002	0.199	3.853
Std. Dev.	0.905	1.179	1.643	0.999	1.158	1.246	0.675	0.153
Skewness	-0.311	0.625	0.388	0.670	0.521	-0.203	-3.696	-1.726
Kurtosis	2.622	2.241	2.465	3.087	2.491	2.782	17.564	8.150
Jarque-Bera	3.535	14.258	5.938	12.029	8.962	1.422	1778.573	230.700
Probability	0.17	0.00	0.05	0.00	0.01	0.49	0.00	0.00

Prior to estimation, it is necessary to ensure that the variables in interest are level or first-difference stationary (Erdem and Tugcu, 2012). Otherwise, it gets impossible to run an ARDL model. In this context, panel unit root tests developed by Levin et al. (2002, LLC) and Im et al. (2003, IPS) were utilized and findings were reported in Table 2. Accordingly, there seems no restriction for conducting the analysis.

Table 2. *Panel unit root test results*

	LLC				IPS			
Variables	Constant		Constant Trend		Constant		Constant Trend	
RCPT	-1.332	(0.091)	-1,829	(0.033)	1.911	(0.972)	-0.799	(0.212)
TOTAL	0.092	(0.536)	-1.824	(0.034)	1.333	(0.908)	0.612	(0.729)
COAL	0.222	(0.588)	-1.365	(0.086)	1.252	(0.894)	-0.128	(0.448)
FUEL	0.360	(0.640)	-0.759	(0.223)	1.245	(0.893)	0.770	(0.779)
GAS	-2.962	(0.001)	-1.652	(0.049)	-0.767	(0.221)	-2.078	(0.617)
GDP	1.654	(0.951)	-1,697	(0.044)	3.750	(0.999)	-0.444	(0.328)
CPI	-0.838	(0.200)	-3.074	(0.001)	2.832	(0.997)	-0.286	(0.387)
EXCH	-2.099	(0.017)	-2.257	(0.012)	-1.405	(0.080)	-0.361	(0.359)
ΔRCPT	-8.213	(0.000)	-6.760	(0.000)	-6.573	(0.000)	-4.164	(0.000)
ΔTOTAL	-9.610	(0.000)	-9.678	(0.000)	-4.198	(0.000)	-7.745	(0.000)
ΔCOAL	-6.545	(0.000)	-9.294	(0.000)	-6.420	(0.000)	-7.138	(0.000)
ΔFUEL	-9.523	(0.000)	-9.301	(0.000)	-7.923	(0.000)	-7.275	(0.000)
ΔGAS	-11.832	(0.000)	-11.171	(0.000)	-4.668	(0.000)	-4.899	(0.000)
ΔGDP	-6.186	(0.000)	-5.748	(0.000)	-3.763	(0.000)	-2.402	(0.008)
ΔCPI	-3.801	(0.000)	-6.528	(0.000)	-4.758	(0.000)	-4.977	(0.000)
ΔEXCH	-6.960	(0.000)	-6.393	(0.000)	-4.962	(0.000)	-3.887	(0.000)

Δ is first-difference operator.
Numbers in parentheses are p-values.
Spectral estimation was conducted by using Newey-West bandwidth selection with Bartlett kernel for the LLC.

The optimal lag lengths were determined by the SBC.

Following the unit root analysis, estimation was conducted by running Eq (2) with the PMG estimator and findings were reported in Table 3. As seen, the joint Hausman test statistics prove that the null of the long-run homogeneity is accepted at 1% level of significance in each model indicating the PMG estimator is consistent and efficient under the long-run homogeneity assumption. This also supports that the interpretation of the coefficients obtained from the PMG estimator rather than the MG is an appropriate choice.

Table 3. *Panel ARDL estimation results*

Dependent Variable: RCPT	CO2 from			
Long-run coefficients	Total	Coal	Fuel	Gas
TOTAL	-0.547 (-3.696)**			
COAL		-0.011 (-0.239)		
FUEL			-0.937 (-23.886)*	
GAS				0.526 (7.733)*
GDP	0.401 (5.752)*	0.322 (3.357)**	1.561 (30.671)*	0.015 (0.228)*
CPI	-0.292 (-2.387)***	-0.650 (-11.954)*	-0.837 (146.698)*	-0.332 (-6.972)*
EXCH	-0.857 (-4.728)*	-0.668 (-3.858)**	-3.255 (-34.687)*	-0.500 (-6.580)*
Joint Hausman Test	10.27 [0.04]	8.20 [0.08]	11.47 [0.02]	4.55 [0.34]
Error correction parameter	-0.532 (-3.112)**	-0.398 (-2.715)**	-0.715 (-1.698)***	-0.413 (-3.072)**
Short-run coefficients				
TOTAL	-0.291 (-3.095)**			
COAL		-0.004 (-2.000)***		
FUEL			-0.671 (-1.698)***	
GAS				0.217 (3.056)**
GDP	0.214 (3.101)**	0.128 (2.723)**	1.117 (1.700)***	0.006 (3.000)**
CPI	-0.156 (-3.120)**	-0.259 (-2.726)**	-0.599 (-1.696)***	-0.137 (-3.044)**
EXCH	-0.456 (-3.102)**	-0.266 (2.714)**	-2.329 (1.698)***	-0.206 (-3.074)**

Numbers in parentheses are t-statistics and in brackets are p-values.
The Newton-Raphson method which uses both the first and the second derivative of the log-likelihood function was utilized.
In order to avoid common factor problem, demeaned data were used for the estimations.
*, **and *** indicate 1, 5 and 10 percent levels of significance, respectively.

According to findings illustrated in Table 3, models that we try to solve have stable equilibrium. It is proved by negative and statistically significant error correction coefficients. Besides, estimates reveal that, either in the long or in the short-run, CO_2 emissions caused by natural gas consumption positively affects tourism receipts, whereas emissions originated from the consumption of total energy, coal (just for short-run) and petroleum have negative impacts. As expected, higher prices and real exchange rate indexes(3) are the factors that decrease the receipts, and increases in GDP which basically denotes the improvement in the quality or quantity of services provided by tourism industry let to an increase in tourism receipts.

4. Concluding remarks

The literature on tourism and the environment is large and still growing. To the best of our knowledge, most of this literature has described environment as a function of tourism activities. As discussed earlier, however, tourists will not be willing to travel back to dirty and polluted destinations. Given this learning, the goal of this paper is to investigate the impact of CO_2 emissions on tourism receipts. To this end, we estimate how emissions omitted by different fuels affect tourism receipts in top ten country destinations by using a dynamic panel data analysis.

Empirical analysis has ended with expected results in terms of control variables. One might expect that countries with higher GDPs are better able to provide services such as transportation, accommodation and catering. These countries also have an advantage to market and protect tourist attractions relative to their competitors with less income. Thus, ceteris paribus, the more GDP they have, the more tourism receipts they earn. On the other hand, tourists are not willing to visit countries where prices are higher and foreign currency is worthless. In this sense, stabilizing prices and exchange rates may help policy makers in increasing tourism income.

Emissions from petroleum consumption have a significant negative impact on tourism receipts either in the short or in the long-run. This evidence clearly points out that consuming liquid fuels leaves only an environmental-based impact on tourism industry and increasing usage of petroleum decreases tourism receipts(4) through the channel stressed in Butler (2000). In the meantime, it is very understandable if one would expect emissions omitted by liquid fuels to affect tourism receipts positively given the importance of liquid fuels in transportation services as a crucial stakeholder of tourism industry. However, the main purpose of this study is to measure the impact of CO_2 emissions on tourism receipts in an environmental perspective. The main model presented in Eq (1) therefore includes GDP variable in order to avoid double counting based upon the expansion of economic activity. Thus, the negative impact either in the short-run or in the long-run is a sole and exclusive sign of environmental degradation on tourism industry.

The impact of emissions from natural gas consumption on tourism receipts is positive and statistically significant. At the first glance, this might be a bit surprising given the epiphany that larger values of emissions are supposed to leave a detrimental impact in any case, regardless of which fuel is burnt[(5)]. However, it makes sense after clutching that emissions of greenhouse gases are much lower with the consumption of natural gas compared to other fossil fuels'. Unlike the case in the consumption of petroleum, in addition, results prove that economic impact of natural gas consumption is dominant over its environmental impact on tourism industry because the estimated coefficient on natural gas consumption is positive even with the presence of GDP variable.

Although the impact of CO_2 emissions from coal consumption on tourism receipts is negative in the long run, it is not statistically significant. This insignificant relationship, however, gives way to a negative significant relationship in the short-run with a very small coefficient. This evidence basically shows that emissions from coal consumption have little short-run environmental impacts on tourism receipts in the countries under investigation.

The strongest result supporting the hypothesis that environmental degradation really matters for tourism industry comes from the model using total CO_2 emissions. The estimated coefficient on total CO_2 emissions is negative and statistically significant. This is important in establishing that CO_2 emissions do impact tourism receipts in highly attractive tourism destinations in a negative and statistically significant way. In previous studies, tourism industry has been found to increase CO_2 emissions (Katircioglu, 2014; Katircioglu et al., 2014) and in this paper CO_2 emissions are found to decrease tourism receipts.

As a rapidly growing industry, tourism has positive impacts on balance of payments, employment and production. Therefore, increasing tourism receipts could be of a great concern for these countries as they are all prominent tourism destinations. Energy, on the other hand, is a key production factor for tourism industry due to growing demand so as to provide a wide range of tourism-related services. Specifically, bulk of the literature draws attention to tourism-induced CO_2 emissions either at national or global level (Holden, 2009; Filimonau et al., 2013; Filimonau et al., 2014 among others). Thereby, the results of this study assign policymakers and tourism planners some fundamental responsibilities due to the complicated relationship between CO_2 emissions and tourism receipts as well as the implications for tourism marketing and greenhouse gas emissions. One apparent implication is the encouragement of natural gas usage. Consuming natural gas does not only have less damage on the environment[(6)], but also leads to increase tourism receipts. In addition, units in tourism industry such as hotels, restaurants, shops and tourist site facilities should prefer natural gas in providing hospitality services like cooking and water and space heating considering its economic benefits as well as the property of instant heating. In a similar manner, energy conservation policies designed to reduce greenhouse gas emissions emitted from liquid and solid fuels could also assist host countries in increasing tourism receipts, concomitant with reducing environmental degradation and ecological destruction. Another implication appeared herein, which is very coherent, is related to the difference between short-run and the long-run results. If a fuel is intensively consumed in tourism industry, emissions depending on its consumption are then anticipated to exhibit a long-run impact on tourism receipts. Less-intensive fuels consumed in tourism industry, on the other hand, may affect tourism potential only in the short-run. Finally, consuming solid and liquid fuels have merely environmental impacts on tourism industry whereas consuming gaseous fuel has a preponderant economic impact in addition to environmental one.

Tourism development policies in highly attractive tourism destinations are an area where the results of this study could have an impact. Overall, this study suggests tourism planners to pay more attention on impacts of CO_2 emissions in designing tourism development policies cooperatively with energy planners. Picture drawn by the findings presented herein shows that the impact that CO_2 emissions have on tourism receipts vary across different fuels. Energy conservation policies designed to reduce greenhouse gas emissions should be directed to lessen the emissions from liquid and solid fuels, which, in turn, contribute to generate more income from tourism. In other words, findings of existing paper go with the environmental concerns towards limiting CO_2 emissions worldwide, in which natural gas is addressed as a relatively benign fossil fuel for the environment and is projected to play an important role in meeting the targets associated with the reduction of greenhouse gases.

This study makes a new way for subsequent researchers. Countries under investigation in this study are among must-see destinations for an average tourist around the world. It would be interesting to see if existing results hold for a sample in which less visited destinations fall within as well. Besides, this study does not consider the influence of aggregation bias, which is very difficult to overcome in panel data. Future studies, if done on a single-country-case, should also take this into account by appointing tourist arrivals by country as dependent variable. By doing so, it would be possible to compare the results of cross-sections with the results provided by pooled panel to see if there is any bias.

Notes

(1) The earlier brief version of this paper was presented at MAC-EMM International Conference held on August 5-6, 2016 in Prague, Czech Republic.

(2) The panel includes mostly visited ten country destinations in the last decade: France, the US, Spain, China, Italy, Turkey, the UK, Germany, Russia and Malaysia.

(3) Since it is a measure of the value of a currency against a weighted average of several foreign currencies, an increase in the real exchange rate index represents an appreciation of the local currency.

(4) A further estimation in which GDP is kept out of the regression shows that the impact of emissions from liquid fuels on tourism receipts is positive with a high correlation coefficient (0.864).

(5) Especially subsequent to eliminating the impact of economic expansion as mentioned before.

(6) The figures on how much CO_2 is produced when different fuels are burnt are provided by EIA (http://www.eia.gov/tools/faqs/faq.cfm?id=73&t=11).

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