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Does tourism increase energy consumption in BRICS countries?

Hubert Visas[1]
Raja Rehan[2]
Jabbar Ul-Haq[3+]
Ahmed Raza Cheema[4]
Sana Khanum[5]
Qazi Muhammad Adnan Hye[6]

[1]*School of International Trade & Economics, University of International Business and Economics, Beijing 100029, China.*
[1]*Email: hubertvisas@uibe.edu.cn*
[2]*Department of Business Administration, ILMA University, Karachi, Pakistan.*
[2]*Email: rajarehan3@hotmail.com*
[3,4,5]*Department of Economics, University of Sargodha, Sargodha, Pakistan.*
[3]*Email: jabbar.ulhaq@uos.edu.pk*
[4]*Email: ahmed.raza@uos.edu.pk*
[5]*Email: sanakhanam261@gmail.com*
[6]*Academic Research and Development Wing, Dubai, United Arab Emirates.*
[6]*Email: Adnan.econ@gmail.com*

(+ Corresponding author)

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ABSTRACT

Tourism has been the fastest-growing sector in the world over the last decade, contributes to employment opportunities, and generates earnings in foreign currencies. Tourism intensively needs energy to promote tourist activities, which in turn causes economic growth. However, as almost all tourist activities, like hotel accommodations and transportation, strongly depend on energy use, it may contribute to increased energy consumption. Our study explores the impact of tourism on energy consumption in the BRICS (i.e., Brazil, Russia, India, China, and South Africa) by using the panel data set of 1995–2014. In this study, feasible generalized least squares (FGLS) and Panel corrected standard error (PCSE) panel regression techniques are used for empirical analysis. The results reveal that tourism has a positive and significant impact on energy consumption. Our findings are robust and unaffected by the use of various energy consumption proxies and econometric techniques. Furthermore, our findings are robust and significant due to the inclusion of various controls such as financial development, gross fixed capital formation, total population, and gross domestic product. The policy implication is that governments should promote the tourism sector as a way to boost the growth of their economies. Sustainable tourism can help these economies achieve sustainable development.

Contribution/Originality: This study examines the impact of tourism on energy consumption. There are three proxies for energy consumption: primary energy intensity (Energy intensity level of primary energy (MJ/$2011 PPP GDP), energy use (kg of oil equivalent per capita), and electricity consumption (kwh per capita), which have not been used in previous studies on the BRICS.

1. INTRODUCTION

Tourism is considered the most prominent sector and vital industry in the world (Khanal, Rahman, Khanam, & Velayutham, 2021). The World Economic Forum has exposed the 67% recovery of the tourism sector, but it is still below 2019 (Davos, 2022). 2022 has been proposed as the International Year of Sustainable Tourism by the World Tourism Organization. The year 2022 offered a unique opportunity for tourism to be organized and address the challenges set out in the Sustainable Development Goals (UNWTO, 2022). As opined by the World Tourism Organization, tourism is currently one of the largest industries in the world and a key source of income. Being a

people-oriented sector, tourism also offers jobs that may help to revive local economies (Stojanovska-Stefanova, Magdinceva Sopova, & Aleksoski, 2021). The tourism sector has grown like sunshine in both developed and less developed nations over the last few decades, and it now ranks among the biggest industries (WEF, 2022). However, tourism, along with its positive role in economic development, also causes more energy use, social dislocation, cultural heritage loss, and ecological degradation (Usman et al., 2022).

The tourism industry possesses the capacity to create employment opportunities, as evidenced by the nearly 330 million job openings it produced worldwide in 2019. Furthermore, it contributed a substantial amount of US$8.9 trillion to the global gross domestic product (GDP), accounting for 10.3 percent of the world's GDP. This suggests that the industry's revenue generation, particularly through tourist arrivals, has had a positive impact on economic growth, even in times of recession. (Kyara, Rahman, & Khanam, 2021). The increase in the number of foreign and domestic tourist arrivals boots the country's income. Moreover, the tourism sector transfers income from developed nations to developing nations. Although tourism plays a positive role in the growth of a county, it also impairs environmental quality (Rauf et al., 2021). International tourism development and the enhancement of international tourists not only stimulate the growth of an economy but also enhance energy consumption (henceforth EC) by augmenting tourism activities like transportation and hotel stays (Dogan & Aslan, 2017; Koçak, Ulucak, & Ulucak, 2020). Tourism activities, particularly air transportation, have been linked to an increase in EC and, as a result, cause environmental pollution (Sobieralski, 2021). Thus, it is interesting to know how tourism leads to an increase in EC (Khanal, 2021). However, in existing research, the impact of tourism on EC is inconclusive (Petrović & Dimitrijević, 2020; Selvanathan, Jayasinghe, & Selvanathan, 2021).

The BRICS countries are considered to have exceptionally strong tourist industries. In addition, according to Future Markets Insight (Tradings, 2020), BRICS countries are progressively flourishing as they not only play a positive role in the economic outlook (Azevedo, Sartori, & Campos, 2018; Baloch, Mahmood, & Zhang, 2019), but they also have more potential for tourism development and provide more options for tourist destinations (Tradings, 2020). Moreover, the BRICS economies are expected to account for 37.7 percent of global gross national product by 2030, which is higher than the 15% and 15.3% of the USA and Europe, respectively (Bank, 2017). As the growing economic prosperity of the BRICS countries steers tourism development (Aziz, Mihardjo, Sharif, & Jermsittiparsert, 2020), EC rises as a consequence (Tang, 2015; Tang, Shang, Shi, Liu, & Bi, 2014). The tourism sector was the core focus of the 2017 BRICS Xiamen Summit in China. These countries, which are also popular tourist destinations around the world, have robust growth rates as well (Rasool, Maqbool, & Tarique, 2021). Between 1990 and 2014, these nations increased their share of global GDP from 11% to approximately 30% (Mminele, 2016). Among the BRICS countries, China is ranked the most attractive destination (Whiting, 2018; WTTC, 2012).

In existing research, tourism has been found to have a negative impact on the environment in Greece (Işik et al., 2020). Also, various nations have revealed both negative and positive tourism effects on carbon emissions (Dogru et al., 2020). Moreover, Turkey and China have practiced tourism-led growth, whereas Russia and Spain have experienced growth-led tourism (Işik, Doğan, & Ongan, 2017). Globalization and international trade have prompted many studies to explore the association between trade, energy, and emissions in various regions (Rahman & Miah, 2017), and EC and economic growth (Karanfil & Li, 2015; Shahbaz, Mallick, Mahalik, & Loganathan, 2015). The effects of energy and tourism on CO2 emissions have been explored in existing studies (Işik et al., 2020). However, there are few studies relating to the effect of tourism on EC (Gia, 2021), and the literature has not covered this important relationship in the case of BRICS countries, which are the main destinations for tourists and consume greater energy for the management of tourist activities. The BRICS studies of Banday and Ismail (2017), Aziz et al. (2020), Zhang and Wang (2019), and Danish and Wang (2018) investigated the impact of tourism, GDP, gross fixed capital formation (GFCF), total labor force, renewable EC, total investment in tourism, and globalization on carbon emissions. Moreover, Kongbuamai, Bui, and Nimsai (2021) explored the real GDP PC,

renewable EC (REC), nonrenewable EC (NREC), industry share (IS), and environmental policy stringency impact on the ecological footprint in BRICS, and Rasool et al. (2021) explored the financial development and tourism effects on the economic growth of BRICS economies. To our best knowledge, no study has investigated the effect of tourism on EC as a major contributor to the tourism industry. Now the researchers are focusing on the BRICS nations because they have enormous potential to become global leaders, particularly in tourism. Tourism is a rising sector that deserves attention, and it contributes to the strength of the BRICS economies by providing a variety of opportunities (Datta, 2014). Our work adds to existing studies in two ways: First, following Gokmenoglu and Eren (2020) and Khanal et al. (2021), we investigate the influence of tourism on EC in BRICS nations. Second, our study uses three proxies for energy consumption, including primary energy intensity (Energy intensity level of primary energy (MJ/$2011 PPP GDP), energy use (kg of oil equivalent per capita), and electricity consumption (kWh per capita), which are not currently used in studies on BRICS countries. The rest of this paper is organized as follows: The second section is devoted to a review of the literature. Section 3 discusses the data and methodology used to study the relationship between the EC and tourism in the BRICS countries. The results are discussed in Section 4, and the study conclusion is presented in Section 5.

2. LITERATURE REVIEW

The prevailing studies on energy economies focus on the association among tourism, energy, carbon emissions, and economic growth (Ali et al., 2020; Ben Jebli & Hadhri, 2018; Gökmenoğlu & Taspinar, 2016; Katircioglu, 2014; Katircioglu, Feridun, & Kilinc, 2014; YaPing Liu, Kumail, Wajahat, & Sadiq, 2019; Naradda Gamage, Hewa Kuruppuge, & Haq, 2017; Nepal, Al Irsyad, & Nepal, 2019; Selvanathan et al., 2021; Sghaier, Guizani, Ben Jabeur, & Nurunnabi, 2019; Zhang & Gao, 2016). Based on a literature review, limited studies have been conducted on the nexus between energy and tourism in this research area (Amin, Kabir, & Khan, 2020; Gokmenoglu & Eren, 2020; Isik, Dogru, & Turk, 2018; Petrović & Dimitrijević, 2020; Tang, Tiwari, & Shahbaz, 2016). For instance, in the existing literature, few studies have concentrated on the association between EC and tourism (Becken & Simmons, 2002; Becken, Simmons, & Frampton, 2003; Ceron & Dubois, 2003; Kelly & Williams, 2007; Kumar, 2005; Nepal, 2008; Tabatchnaia-Tamirisa, Loke, Leung, & Tucker, 1997; Warnken, Bradley, & Guilding, 2004). Empirical work on tourism and EC is not as much as tourism-energy growth. Lai, To, Lo, Choy, and Lam (2011); Tiwari, Ozturk, and Aruna (2013); Katircioglu (2014); Katırcıoğlu (2014b); Katircioglu et al. (2014); and Yorucu and Mehmet (2015) are the studies that empirically analyzed the link between the EC and tourism. Lai et al. (2011) investigated the correlation among tourism, electricity consumption, and related controls in China. The study indicated that tourism does not play any significant role in electricity consumption, and thus eliminated tourism from the model. Tiwari et al. (2013) used a vector autoregressive (VAR) model to evaluate the connection between tourism, CO_2 emissions, and EC in Organization for Economic Co-operation and Development (OECD) nations. Contrary to the study of Lai et al. (2011), this study found a positive effect of tourism on OECD energy consumption.

The study of Khanal et al. (2021) for Australia explored the long-run cointegration relationship between tourism and EC. The study revealed a positive effect of tourism on EC. Moreover, Lee's (2013) study examined the impact of tourists and industrial production on EC in Singapore, using electricity consumption as a proxy for EC. The outcome revealed that "total international inbound tourists" and industrial production have positive impacts on EC. Muhammad, Khan, Razzaq, and Karim (2021) discovered the influence of tourism and governance on CO_2 in their first model and the impact of tourism and governance on EC in their second model. In the case of the CO_2 model, the study observed that governance negatively affected CO_2 emissions while tourism positively affected CO_2 emissions. However, in the energy model, governance showed a positive association and tourism a negative correlation with energy use in a panel of Muslim countries. Similarly, in India, Tang et al. (2016) investigated the dynamic causal and inter-relationship between economic growth, EC, and tourism utilizing yearly data from 1971-2012. The study exhibited that economic growth, EC, and tourism were cointegrated in India. Tourism and

economic growth strongly influenced EC in the long run. The study also revealed that economic growth and tourism are interrelated, but the casual effect of tourism on economic growth was stronger as compared to the other way around in the long and short run. Thus, the tourism-led growth hypothesis is valid, while the energy-led growth hypothesis is invalid for India. Zhang and Zhang (2021) studied the causal relationship between economic growth, tourism, carbon emission, and tourism for the Chinese provinces and revealed a long-run association among the concerned variables, a unidirectional causality in the short-run running from EC to the concerned variables, and a bidirectional causality among CO_2 and GDP, tourism, and GDP and tourism in the long-run. Further, Pablo-Romero, Sánchez-Braza, and Sánchez-Rivas (2017) also examined the relationship between hotel and restaurant (H&R) tourism, income, electricity consumption, and temperature for the EU countries. The researchers concluded that tourism, income, and temperature played a significant role in increasing electricity consumption. Furthermore, Yorucu and Mehmet (2015) revealed that GDP growth and tourist arrivals cause a 0.74% and 0.045% increase in electricity consumption, respectively, in Turkey.

Utilizing data from India from 2006 to 2014, Akkinapalli (2018) investigated the impact of international and domestic tourists, steel, and population on EC. The study found a direct association among the related variables, implying that an increase in tourism causes a deviation from the goal of sustainable tourism. Katircioglu (2013) showed that international tourism has a significant and positive long term impact on the EC in Northern Cyprus. Katircioglu et al. (2014) and Katircioğlu (2014b) also argued that tourism has increased EC and exacerbated environmental quality. According to Wu and Shi (2011), China's tourism sector consumed 0.51 percent of its energy and triggered 0.86 percent of its CO_2 emissions. Katircioglu, Gokmenoglu, and Eren (2019) confirmed the long-term positive influence of tourism growth on EC for top tourist nations. The study also discovered that tourism acts as a mediator between changes in exchange rates and an increase in EC, as changes in exchange rates affect both tourism and energy use.

3. DATA AND METHOD

3.1. Data

This study examines the impact of international tourist arrivals on EC in the BRICS countries. Our study used panel data from 1995 to 2014. Table 1 presents the variables code, description, and data sources. The variables were selected based on the study of Khanal et al. (2021).

Table 1. Variables description.

Code unit		Sources	Code	Description
Dependent				
Energy intensity	Energy intensity level of primary energy	(MJ/$2011 PPP GDP)	ENIN	WDI
Energy use	Energy use	(kg of oil equivalent per capita)	ENUS	WDI
Electricity Consumption	Electricity consumption (Log)	(kwh per capita)	LELC	WDI
Independent				
Tourism	International tourists, number of arrivals (Log)		LTOUR	WDI
Controls				
Economic growth	Gross domestic product (Log)	(constant 2015 US$)	LGDP	WDI
Investments	Gross fixed capital formation (Log)	(constant 2015 US$)	LGFCF	WDI
Population	Population (Log)	Total	LTP	WDI
Financial development	Domestic credit to the private sector (Log)	(GDP %)	LFD	WDI

Note: Energy intensity (ENIN), energy use (ENUS), electricity consumption (LELE) are the measures of energy consumption. WDI stands for world development indicators of the worldbank.

3.2. Methodology

This paper investigates the association between the EC and international tourist arrivals in BRICS countries. EC is the dependent variable, while tourism is the core independent variable of our study. The empirical analysis is divided into three models with different proxies of EC.

Following Pablo-Romero, Sánchez-Braza, and Sánchez-Rivas (2021); Isaeva, Salahodjaev, Khachaturov, and Tosheva (2022); Katircioglu (2013); and Yorucu and Mehmet (2015), we respectively used energy intensity, energy use, and electricity consumption in the first, second, and third models, to measure EC. Following Gokmenoglu and Eren (2020) and Khanal et al. (2021), our study estimated the following panel model by using the FGLS technique. Our core model is shown in Equation 1.

$$Energy_{it} = \beta_0 + \beta_1 LTOUR_{it} + \beta_2 X_{it} + \varepsilon_{it} \quad (1)$$

In our core model, $Energy_{it}$ is the energy consumed, proxy by energy intensity, energy use, and electricity consumption. International tourist arrivals are the core independent variable. The vector X indicates the control variables for robustness checks in our model. The model for robustness checks in our study is shown in Equation 2:

$$Energy_{it} = \beta_0 + \beta_1 LTOUR_{it} + \beta_2 LFD_{it} + \beta_2 LTPOP_{it} + \beta_2 LGFCF_{it} + \beta_2 LGDP_{it} + \varepsilon_{it} \quad (2)$$

Where energy denotes energy intensity (ENIN), energy use (ENUS), and the log of electricity consumption (LELC). LTour is the log of the number of international tourist arrivals. LFD is the log of financial development (% of GDP), LTPOP is the log of the total population, LGFCF is the log of gross fixed capital formation, and LGDP is the log of gross domestic product, which are the control variables for robustness checks. The subscript i indicates the country (i.e., BRICS), and the subscript t indicates the period. ε is the error term.

FGLS is used with the help of panel diagnostics to investigate the link between Energy and TOUR, as N=5 and T= 20. In the case of T > N, FGLS is a suitable technique in the presence of heteroscedasticity, cross-sectional dependence, and serial correlation, as proposed by Parks-Kmenta (Al-Malki, Hassan, & Ul-Haq, 2022; Shi, Visas, Ul-Haq, Abbas, & Khanum, 2022; Ul-Haq, Visas, Umair, Hussain, & Khanum, 2023; Ul-Haq, Wajid, Visas, Cheema, & Abbas, 2022).

4. RESULTS

4.1. Diagnostics Tests

As shown in Tables 2 and 3, the study performed a diagnostic test to ascertain the reliability of the estimates. The diagnostic tests listed in Table 3. The Modified Wald test indicated the issue of heteroscedasticity in the dataset. The Wooldridge test reveals the presence of a serial correlation, suggesting that the observations were not independent of one another.

Moreover, the Breusch Pagan Lagrange multiplier (henceforth BPLM) test revealed the presence of cross-sectional dependence (CSD), as shown in Table 3.

Based on our panel diagnostic tests, we used the FGLS and PCSE because when T = 20 and N = 5, the FGLS is a superior choice (by reason T is greater than N) as suggested by the Parks-Kmenta method for the empirical analysis (Hoechle, 2007; Ul-Haq, Ashraf, Cheema, Hye, & Visas, 2023; Ul-Haq, Khanum, & Raza Cheema, 2020).

Table 2. Serial correlation and heteroscedasticity panel diagnostic tests.

Test	Issues	(1)	(2)	(3)
Modified Wald ($\chi 2$)	Heteroscedasticity	862.78***	295.91***	657.84***
Wooldridge test	Serial correlation	35.882***	17.366**	26.974***

Note: Test statistics are shown in model (1-3) with energy intensity, energy use, and electricity consumption respectively. '***' & '**' shows the level of significance at 1% and 5% respectively.

Table 3. Breusch pagan LM test for cross-sectional dependence.

Unit	(1)	(2)	(3)
CD-test stat.	51.173***	72.652***	31.661***
P-values	0.000	0.000	0.000

Note: Test statistics are shown in model (1-3) with energy intensity, energy use, and electricity consumption respectively. '***' shows the level of significance at 1%

4.2. Descriptive Statistics

Descriptive statistics of the study are presented in Table 4, where statistics show that variables show a normal distribution. Moreover, the variables also indicated minimal deviation from the mean.

Table 4. Descriptive statistics.

Variable	N	Average	S.D	Mini.	Maxi.
ENIN	100	8.202	3.017	3.76	14.393
ENUS	100	2047.845	1461.042	385.09	5167.01
LELC	100	7.664	0.914	5.882	8.797
LTOUR	100	16.331	1.250	14.504	18.723
LFD	100	4.019	0.737	2.305	5.075
LTPOP	100	19.465	1.276	17.539	21.033
LGFCF	100	26.144	1.253	23.921	29.751
LGDP	100	27.713	0.990	25.896	29.966

4.3. Energy Consumption and Tourism: Empirical Analysis

We examined the nexus between EC and tourism in BRICS countries using the FGLS and PCSE techniques. The results are presented in Table 5. In our empirical analysis, we used energy intensity in models 1 and 4, energy use in models 2 and 5, and the log of electricity consumption in models 3 and 6.

Table 5. Energy consumption and tourism in BRICS countries.

Variables	FGLS			PCSE		
	(1)	(2)	(3)	(4)	(5)	(6)
LTOUR	1.151***	348.9***	0.229***	1.188***	360.5***	0.233***
	(0.054)	(10.99)	(0.005)	(0.187)	(106.5)	(0.071)
Constant	-10.66***	-3,660***	3.918***	-11.20***	-3.839**	3.853***
	(0.831)	(171.4)	(0.092)	(3.067)	(1.681)	(1.173)
Wald stat.	443.57	1008.13	1476.50	40.42	11.45	10.64
P-values	0.000	0.000	0.000	0.000	0.000	0.001
Obs.	100	100	100	100	100	100

Note: Energy consumption is the dependent variable in all models. Model (1&4) with energy intensity, (2&5) with energy use, and (3&6) with electricity consumption. Parentheses present S.E. ***, ** indicate $p<0.01$, $p<0.05$.

Table 5 shows the relationship between EC and tourism in BRICS economies. Energy consumption and tourism are associated. The FGLS results for models 1-3 (i.e., ENIN, ENUS, & LELEC) reveal that tourism is positively and significantly related to EC for BRICS. A 1% increase in the number of international tourists increases EC by 1.151%, 348.9%, and 0.229%, respectively. Furthermore, the results of PCSE in models 4-6 also revealed a positive impact of tourism on all the measures of EC. The results indicate that an increase in the number of international tourist arrivals increases EC in BRICS countries. Our findings are the same using both FGLS and PCSE methods. Moreover, our results are consistent with the existing studies of Yorucu and Mehmet (2015), Lee (2013), Katircioglu (2014), Katircioglu et al. (2014), Isaeva et al. (2022), and Katırcıoğlu (2014b), and contrast with the studies of Muhammad et al. (2021) and Petrović and Dimitrijević (2020). The positive association between EC and tourism is understandable because the augmentation of tourist arrivals enhances economic activities as well as the production of goods and services, leading to an increase in EC. For instance, Tang et al. (2016) revealed that tourism-related activities, facilities, and infrastructure require more energy, like electricity and oil, for charming operations. Also, the studies of Nepal et al. (2019) and Liu, Feng, and Yang (2011) showed that transportation is a

major contributor to EC. Subsequently, an increase in tourist arrivals enhances energy demand. Tourism in remote areas, like hiking activities, may require less energy than electricity, which is required for tourists in a built-up environment. For instance, in the UAE, tourists may require greater energy than similar tourists visiting Mount Kilimanjaro (Khanal, 2021).

4.4. Robustness Checks

For robustness checks of our core findings, we include various control variables that influence EC, such as financial development, population, GFCF, and GDP, in our main model based on prevailing studies (Khanal, 2021). We used the same proxies for EC that is, energy intensity, energy use, and the log of electricity consumption, in models 1&4, 2&5, and 3&6 respectively. The results of our robustness checks are presented in Table 6.

Table 6. Energy consumption and tourism in BRICS countries (Robustness checks).

Variables	FGLS			PCSE		
	(1)	(2)	(3)	(4)	(5)	(6)
LTOUR	3.288***	1,053***	0.414***	3.255***	1,094***	0.425***
	(0.094)	(41.90)	(0.015)	(0.123)	(75.80)	(0.015)
LFD	-1.250***	-1,007***	-0.270***	-1.384***	-1,235***	-0.245***
	(0.099)	(92.28)	(0.014)	(0.173)	(112.6)	(0.016)
LTPOP	1.097***	-806.3***	-0.871***	1.100***	-896.3***	-0.867***
	(0.079)	(53.67)	(0.007)	(0.118)	(54.75)	(0.013)
LGFCF	-0.434*	1,324***	0.576***	-0.475	1,361***	0.587***
	(0.224)	(81.13)	(0.025)	(0.383)	(128.2)	(0.029)
LGDP	-3.822***	-1,977***	-0.371***	-3.759***	-1,977***	-0.415***
	(0.432)	(174.2)	(0.058)	(0.502)	(210.6)	(0.057)
Constant	55.37***	24,702***	14.18***	55.79***	25,784***	14.74***
	(5.202)	(1,557)	(0.659)	(4.555)	(1,966)	(0.576)
Wald stat.	1831.30	6305.61	26302.34	826.47	1015.80	12730.30
P-values	0.000	0.000	0.000	0.000	0.000	0.000
Obs.	100	100	100	100	100	100

Note: Energy consumption is the dependent variable in all models. Model (1&4) with energy intensity, (2&5) with energy use, and (3&6) with electricity consumption. Parentheses present S.E. ***, * indicate p<0.01, p<0.1.

Table 6 indicates that our findings are robust and statistically significant after including the various controls. The inclusion of financial development and GDP as controls shows that financial development and GDP are negatively and significantly related to EC in all models. When energy intensity is used as a proxy for EC (columns 1&4), total population has a positive impact on energy use (León, Arana, & Hernández Alemán, 2014). Total population is negatively related to EC when energy use or the log of electricity consumption is used as a proxy for EC (columns 2-3 and 5-6). The study by Liu et al. (2011) showed that population has a negative influence on EC. Their findings indicated that a 1% increase in population would decrease energy use by 0.211% in China. Also, the author revealed that population density decreases energy use by 0.065%, 0.239%, and 0.211% in China's eastern, central, and western regions. Azam, Khan, Zaman, and Ahmad (2015) found a negative coefficient of population growth in Indonesia and Thailand. The coefficient on total population is negative, and this is logical given that as total population increases (other things remain the same), EC per capita decreases. These empirical results are in line with the existing studies on Indonesia and China (Azam et al., 2015; Yansui Liu, Zhou, & Wu, 2015). Moreover, GFCF is inversely associated with EC when energy intensity measures are used for EC (columns 1&4) and positively associated with energy when energy use is the proxy for electricity consumption (columns 2-3 and 5-6) in the above table. The study of Omri and Kahouli (2014) on the association between capital formation, EC, and financial development found a positive and significant impact of capital formation and financial development on EC. Furthermore, a positive association among the CAP, GDP, and FD was also found by the studies of Gia (2021), Khan, Hou, and Le (2021), and Soytas and Sari (2009). GDP growth needs greater EC, which leads to climate

pollution (Khanal, 2021), while FD establishes new production lines and industries, which also affect pollution and emission.

To sum up, our study finds that an increase in tourism increases EC in BRICS nations. EC and tourism are positively and significantly associated. Moreover, our findings are robust to various controls and statistically significant regardless of the measure of EC used. As no previous research has used the BRICS countries in this context, this is the first study to show that tourism has an impact on EC in the BRICS countries.

5. CONCLUSION

This study investigated the impact of tourism on EC in BRICS countries using panel data from 1995 to 2014. The study used FGLS and PCSE methods to determine the association between tourism and EC. To measure EC, our study used three proxies: energy intensity, energy use, and electricity consumption. The findings reveal that EC and tourism are associated in the BRICS. The tourism coefficient indicated a positive relationship with the EC. Tourism enhancement leads to an increase in EC in the BRICS countries. Further, our results are robust to the inclusion of various controls such as financial development, population, GDP, and GFCF as major determinants of EC. Using both approaches (i.e., FGLS & PCSE), the results show that the coefficients of financial development and GDP are negative, implying that FD and GDP reduce EC.

When energy intensity is used as a proxy for EC (columns 1&4), total population has a positive impact on energy use (León et al., 2014). It is negatively related to EC when energy use or the log of electricity consumption is used as a proxy for EC (columns 2-3 & 5-6). Our results are insensitive to various controls and statistically significant.

This study's findings have a wide range of policy consequences. Greater energy use, in particular, is strongly linked to carbon emissions and climate change, necessitating appropriate strategies to reduce tourism-related EC in the BRICS. One of the possible requirements may be that governments provide incentives to key tourist sector stakeholders to use cleaner energy, hybrid energies, and low-carbon natural transportation in order to achieve the targeted level of carbon emission reduction. Hotels, as well as other associated establishments, may be encouraged to use renewable energy sources. The government could provide tax credits or low-cost loans to encourage the purchase of ecologically friendly technologies. More research may be conducted to determine the effectiveness of policies aimed at transitioning to renewable energy sources for the BRICS tourism industry as well as the cost-effectiveness of launching green energy for the tourism industry to reduce EC in the BRICS. Policymakers, tourist-related industries, and government officials will have to conduct more studies to examine the impact of energy and tourism associations in the context of COVID-19 scenarios involving travel, air transport, and the tourism industry. This investigation of disruption by COVID would help to complete the study and might be extended in order to resolve the economic crisis.

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