9. THE IMPACT OF TOURISM, ECONOMIC GROWTH, AND FOREIGN DIRECT INVESTMENT ON CARBON DIOXIDE EMISSIONS IN THE BRICS COUNTRIES

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Abstract

Since the 2000s, the BRICS countries have been extensively researched due to their increasing economic growth rates, attractiveness for foreign direct investment (FDI), and their influence on the global economic system. BRICS countries, which constitute 24% of the global gross domestic product (GDP), increased their influence on the global economy with a growth rate of 6.21% while causing environmental degradation due to excessive use of resources. The rise in carbon dioxide (CO2) emissions is a significant indicator of environmental deterioration. Studies analyzing the relationship between tourism and economic indicators are relatively rare, despite the abundance of research on the impact of economic growth on carbon emissions. To fill this gap in the literature, this study was conducted. Using a panel data analysis approach, this study aims to examine the impact of tourism, economic growth, and FDI on carbon emissions in BRICS countries between 1995 and 2020. The results from the Westerlund cointegration test suggest a long-term relationship between CO2 emissions, GDP, FDI, and international tourist arrivals, indicating a cointegration relationship. According to the panel Dynamic Ordinary Least Squares (DOLS) test statistic, all the coefficients are statistically significant at either the 1% level or the 5% level. The DOLS test indicates that a one-unit increase in GDP leads to a 0.10% rise in CO2 emissions. Based on the results of the research, managerial implications are discussed and suggestions for future research are presented.

Keyword: CO2 Emissions; BRICS; Tourism; Economic Growth; Foreign Direct Investment; Panel Data Analysis

JEL Classification: C50, Q50, Z32

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1. Introduction

With its consistent growth in recent years, the tourism industry has become a significant player in both advanced and emerging economies, largely due to its substantial contribution to the GDP (UNWTO, 2021). Ranked as the world's third-largest export sector, tourism not only improves the balance of payments for countries but also serves as a major source of employment. Through its direct, indirect, and induced impacts, the tourism sector is responsible for one in four new jobs worldwide, 10.3% of all employment, and 10.3% of global GDP (USD 9.6 trillion). In 2019, spending by international visitors amounted to USD 1.8 trillion, making up 6.8% of total exports (WTTC, 2019). As domestic and international visitor numbers are expected to reach 15.6 billion and 1.8 billion respectively by 2030, the tourism industry is set to continue its significant contributions to global socio-economic development and job creation. However, this ongoing growth is also anticipated to have environmental consequences, including an increase in CO2 emissions (WTO & ITF, 2019).

Tourism, like agriculture, insurance, energy, and transportation, is an economic sector that is highly sensitive to climate and environmental changes. The tourism industry plays a significant role in climate change, mainly due to the greenhouse gas emissions from tourist transportation and accommodation (Scott *et al.,* 2008). According to the UNWTO, tourism is responsible for 5% of global CO2 emissions and contributes to 4.6% of global warming. Around the world, the first assessment of emissions from tourism was carried out in 2007 during the "Second International Conference on Climate Change and Tourism" in Switzerland. The urgency of the tourism sector's response to climate change was emphasized in the "Davos Declaration on Climate Change and Tourism Responding to Global Challenges", which was adopted at this conference (WTO & ITF, 2019). Climate change is expected to bring about significant changes in the tourism industry. Given the projected growth rate of 4% beyond 2025, the importance of continuous monitoring of carbon emissions related to tourism becomes evident (Lenzen *et al.,* 2018).

Given their impact on global warming, CO2 emissions have become a significant concern for researchers. As economies develop, issues related to environmental degradation are increasingly coming to the forefront. Numerous studies have established a connection between economic growth and CO2 emissions (Selden and Song, 1994; Saboori, Sulaiman, and Mohd, 2012; Azam *et al.,* 2015). As energy is a vital component of economic growth, studies on CO2 emissions have also centered around energy (Dogan and Aslan, 2017; Shahbaz, Nasir and Roubaud, 2018; Kwakwa and Alhassan, 2018; Danish and Wang, 2019; Liu *et al.,* 2022). These studies collectively agree that an increase in energy consumption leads to a rise in CO2 emissions. Furthermore, FDI, which is viewed as a stimulant for competition and economic growth (Benetrix, Pallan and Panizza), was found to be connected to both energy consumption and environmental harm (Rafindadi, Muye and Kaita, 2018). The environmental impact of FDI is a key concern in both developed and developing countries. Indeed, given the established link between FDI, energy consumption and CO2 emissions, it becomes crucial to investigate the impact of FDI on CO2 emissions. This could provide valuable insights both for policy-making and sustainable economic strategies.

BRICS, an influential collaboration in the global system, initially came into existence as BRIC which includes Brazil, Russia, India, and China, in 2006. With the addition of South Africa to the group in 2010, it became known as BRICS. These countries, as the world's leading emerging economies, have been the driving force of the global economy since their inception (BRICS, 2021). In recent years, BRICS countries have experienced rapid development in terms of economic development, increases in FDI, energy consumption, tourism, and CO2 emissions. As their economies dramatically expand, they consume large amounts of natural resources to meet market demand. To meet their energy needs for mass production, these growing economies are consuming more natural energy resources such as crude oil, natural gas, and coal. This rapid economic growth poses new environmental challenges (Danish and Wang, 2019). According to the World Bank, the GDP of the BRICS countries has risen from 18% in 2010 to 26% in 2021, with China being the largest contributor to this growth by accounting for over 70% of the BRICS GDP in 2021. In terms of per capita GDP, the BRICS countries had a nominal value of $7,666 in 2021. Since 2021, foreign investment has been a crucial catalyst for the growth of the BRICS economies. Over the last two decades, there has been a notable increase in their yearly FDI inflows. The total FDI inflow was $84 billion in 2001, which escalated to $355 billion by 2021. Furthermore, their proportion of global FDI inflows saw a twofold increase, moving from 11% in 2001 to 22% in 2021 (United Nations Conference on Trade and Development -UNCTD, 2023). Developing economies often associate FDI with rapid economic growth, job creation, industrialization, and improved living standards (Hudea and Stancu, 2012; Balsalobre-Lorente *et al.,* 2019). While FDI inflows to developing economies continue to grow, the environmental impacts of these inflows are a subject of ongoing debate. Like FDI, tourism is often seen as a catalyst for economic growth (UNWTO, 2020), generating revenue through tourist spending, taxes, and job opportunities in service industries (Min, Kung and Chang, 2019). However, other factors need to be considered as this growth takes place. The BRICS countries, which consume 40% of the world's energy, significantly influence global CO2 emissions (Danish and Wang, 2019). Notably, in 2020, China accounted for the largest share of global carbon emissions, accounting for 28.8%. India was the third largest contributor at 7.3%, while Russia, Brazil and South Africa contributed 4.5%, 1.3% and 1.4%, respectively. Together, these BRICS countries accounted for 43.3% of the world's total CO2 emissions (Li *et al.,* 2022). From 2006 to 2019, BRICS countries emitted 5.9 metric tons of CO2 per capita annually, with a slight decrease in 2009 due to the global financial crisis (WB, 2022). However, when it comes to the impact of tourism on CO2 emissions, different perspectives emerge. For example, a study by Le and Nguyen (2020), which evaluated 95 countries from 1998 to 2014 found that tourism decreases total CO2 emissions from electricity and heat production in destination countries but increases CO2 emissions from transportation. In a similar vein, Lee and Brahmasrene (2013) found that both FDI and tourism significantly reduce CO2 emissions. On the other hand, some research finds that tourism raises carbon emissions (Lenzen *et al.,* 2018; Huang and Tang, 2021; Sarıtaş and Akar, 2022). The fundamental explanation for these disparities is that the countries studied have distinct characteristics from one another. For instance, research by Doğan and Aslan (2017) on the European Union (EU) and candidate countries revealed that the tourism sector was not a significant source of environmental pollution. More importantly, they found that an increase in tourist arrivals reduced the level of emissions. This result may be a consequence of the climate policies implemented by EU countries since 1992.

Indeed, population density is a significant factor influencing CO2 emissions. As of 2022, BRICS countries constitute 41.13% of the world population. Globalization, population growth, and economic activities all contribute to the amount of CO2 emissions. Population size and CO2 emissions have been found to be positively correlated, suggesting that an increasing population can lead to increased CO2 emissions. Population growth can stimulate GDP growth by amplifying the demand for goods and services. This surge in GDP can subsequently influence the volume of CO2 emissions. Essentially, the increased demand for goods and services triggered by population growth can lead to elevated energy consumption due to increased production, and consequently, a rise in CO2 emissions (Mohammadi, Burhan and Mangal, 2020). Consistent with the assumption that environmental degradation increases with economic growth, several studies suggest a positive relationship between economic growth and CO2 emissions (Lee and Brahmasrene, 2013; Azam *et al.,* 2015; Shahbaz, Nasir, and Roubaud, 2018). As economies grow, the increase in production scale translates into environmental deterioration, which becomes a political and economic concern for countries. The issue of climate change has been a focal point in various global conferences, including those held in Stockholm in 1979, Rio de Janeiro in 1992, Johannesburg in 2002, Copenhagen in 2009, and Durban in December 2011 (Ghouali *et al.,* 2015). The United Nations (UN), along with other global entities, has been working towards reducing greenhouse gas emissions to as close to zero as possible. This effort is part of the “net zero” goal aimed at addressing climate change. Over 70 countries, including major polluters like China, the USA, and the EU, committed to this net zero goal. These countries account for approximately 76% of global emissions (UN: Climate Action, nd). In this context, Xí Jìnpíng, the President of the People’s Republic of China, first announced China’s “double carbon” targets at the United Nations General Assembly in September 2020. Since then, the “double carbon” target has guided Chinese government organizations and private companies that want to benefit from government plans. The G20 nations which include Argentina, Australia, Brazil, Canada, China, France, Germany, India, Indonesia, Italy, Japan, the Republic of Korea, Mexico, Russia, Saudi Arabia, South Africa, Turkey, the United Kingdom, United States of America, and the EU account for approximately 75% of the world's greenhouse gas emissions, according to the emission gap report. If CO2 emissions were reduced by 45% by 2030, global warming can be ensured not to exceed 1.5 °C (UNEP, 2022). Countries that want to accomplish their commitments regarding “net zero” need to act in cooperation with non-state institutions such as businesses, investors, cities, and regions. Recently, a large number of academic studies have been conducted to determine the relationship between CO2 emissions and economic growth.

In summary, this research aims to examine the impact of FDI, economic growth, and tourism on CO2 emissions using annual data from BRICS countries. The selection of BRICS countries for this study is based on their high population density and significant economic growth indicators. While several studies, such as those by Saboori *et al.* (2012), Omri *et al.* (2014), and Aye *et al.* (2017), examined the relationship between economic growth and CO2 emissions, few studies examined the relationship between CO2 emissions, FDI, and tourism in the BRICS countries. In the context of the BRICS countries, various studies examined the impact of tourism and renewable energy on CO2 emissions (Aziz *et al.,* 2020), the impact of agricultural activities on CO2 emissions (Balsalobre-Lorente *et al.*, 2019), the environmental impact of tourism (Banday and Ismail, 2017) and the correlation between health expenditure, economic growth and carbon emissions (Li *et al.,* 2022). However, there is a lack of research on the impact of FDI, economic expansion, and tourism on CO2 emissions in BRICS countries over the period 1995-2020. This research seeks to add fresh empirical data to the existing body of knowledge on how economic growth, FDI, and tourism affect CO2 emissions in BRICS countries. In recent years, environmental experts and policymakers have raised concerns about climate change and global warming as economic growth, industrialization and urbanization rely on traditional fossil fuels. Therefore, another important contribution of this study is that it will provide policymakers with recommendations based on the study results to address these concerns.

The structure of the study is as follows. The subsequent section will provide the literature framework. Section 2 will present the data and research methodology. The empirical results of the study will be included in Section 3. Section 4 will provide a discussion. The final section will present the conclusion.

2. Related Literature

There are two subsections in the literature review. The link between FDI, CO2 emissions, and economic growth is covered in the first section. The second part incorporates tourism and presents the relationship between tourism, economic growth, and CO2 emissions.

2.1. Relationship Between Economic Growth, FDI and CO2

In studies of economic growth, GDP is often used as the primary indicator. However, in recent years, FDI has also been incorporated into studies related to economic growth. For developing countries, emerging economies, and transition economies, FDI is viewed as a source of economic development, modernization, income growth, and employment. Through the transfer of cleaner technologies and the implementation of more socially responsible institutional policies, FDI significantly contributes to the improvement of social and environmental conditions in the host country, in addition to its economic benefits (Vitalis, 2002). Indeed, The Pollution Haven Hypothesis is a topic of recent research interest. This hypothesis suggests that FDI is attracted to host economies with lenient environmental regulations, potentially leading to environmental degradation in those countries. Research conducted by Sun, Zhang, and Xu (2017), Shahbaz, Nasir, and Roubaud (2018), and Essandoh, Islam, and Kakinaka (2020) supports this hypothesis, indicating a positive correlation between FDI and carbon emissions in certain regions or countries. This underscores the complex interplay between economic activities and environmental impacts, and the need for sustainable practices in FDI. The literature explores the relationship among economic growth, FDI, and CO2 emissions from three perspectives. The first perspective investigates the Environmental Kuznets Curve (EKC) hypothesis. The second perspective delves into the dynamic interaction among these factors, while the third perspective employs causality testing for their research. According to the results of the study, which examined environmental degradation in France within the scope of FDI, financial development, and energy innovations variables for the years 1995-2016, the existence of cointegration between time series was determined. According to the study, FDI has a positive effect on carbon emissions, while energy research innovations have a negative effect. While FDI degrades the environment and supports the pollution haven hypothesis, the relationship between economic growth and CO2 emissions is an inverted U shape, confirming the EKC (Shahbaz, Nasir and Roubaud, 2018). According to the EKC hypothesis, there exists a positive relationship between CO2 emissions and income up to a certain threshold of development or income level. However, beyond this threshold, CO2 emissions are expected to decrease due to the influence of structural and technological factors (Saboori and Sulaiman, 2013 cited in Fodha and Zaghdoud, 2010). A study was carried out to examine the EKC hypothesis, with a focus on the relationship between CO2 emissions, energy consumption, and economic growth within the tourism sector in Turkey. The study, which used annual data from 1965 to 2019, found a long-term equilibrium relationship among these variables. In another study that applied the Granger causality panel for the years from 1990 to 2012 in BRICS countries, a cointegration relationship emerged between CO2 emissions and GDP, FDI, and energy consumption. Interestingly, the study found that FDI influences economic growth but does not have a direct impact on CO2 emissions (Ghouali *et al*., 2015). In contrast to this study, another research conducted in BRICS countries from 2000 to 2018 revealed a two-way causality relationship between carbon emissions and economic growth, as well as between economic growth and FDI. This relationship suggests that an increase in both carbon emissions and FDI stimulates economic growth. Conversely, economic growth also leads to a rise in both CO2 emissions and FDI (Iqbal, Tang and Rassoul, 2023). Omri, Nguyen and Rault (2014) utilized dynamic simultaneous equation panel data models to explore the causal relationships among CO2 emissions, FDI, and economic growth. Their study covered 54 countries and three regional sub-panels (Europe and North Asia regions; Latin America and the Caribbean; Middle East, North Africa, and Sub-Saharan), spanning the period from 1990 to 2011. The findings of their research revealed a bidirectional causality relationship between FDI inflows and economic growth across all panels, with the exception of Europe and North Asia. Based on the EKC hypothesis, Tang and Tan (2015) investigated the dynamic relationship among CO2 emissions, energy consumption, income, and FDI in Vietnam for the period from 1976 to 2009 by applying Johansen cointegration and Granger causality methods. As a result of their study, they found that there is a long-run relationship among CO2 emissions, energy consumption, income, and FDI. Lee and Brahmasrene (2013) reveal that FDI can reduce CO2 emissions in the EU. This situation may arise from the technological innovation applied to reduce CO2 emissions in the EU and the support of energy efficiency through new technologies.

While the EKC hypothesis is commonly used in studies examining the relationship between economic growth and CO2 emissions, there are also studies that employ the Brundlant Curve Hypothesis (BCH). The BCH posits that poor countries initially cause high levels of environmental degradation, which decreases when economies reach a turning point, only to increase again thereafter. For example, a study conducted in Kenya found that environmental pollution tended to decrease initially, but began to increase after the income level reached a turning point, confirming the validity of the U-shaped BCH in Kenya (Onyango, Kiano and Saina, 2021). The economic growth models of emerging countries require significant energy, leading to changes in carbon dioxide emissions (Li *et al.,* 2022). While many studies focus on industrialized countries such as the EU, BRICS, China, and France, there are also various studies that include a range of countries, such as Ghana. The results of these studies are influenced by different econometric models (e.g., EKC, BCH), countries and variables (e.g., GDP, FDI), which can have either a positive or negative impact.

2.2. The Relationship Between Tourism, Economic Growth and CO2

Tourism significantly contributes to the GDP of both developed and developing countries (UNWTO, 2021). As the economy grows, the development of international tourism and the increase in tourist numbers lead to a surge in energy consumption. Energy from fossil fuels is used directly in tourism activities, or indirectly through the production of electricity from the burning of coal, oil, and gas. High energy consumption from motorized vehicles and fossil fuels results in the release of greenhouse gases (Danish and Wang, 2018). The WTO & ITF (2019) report indicates that emissions caused by transportation in tourism increased by at least 60% between 2005 and 2016. In 2016, CO2 emissions from transportation accounted for 5% of global emissions. The report suggests that despite ongoing decarbonization efforts, CO2 emissions from the tourism sector could increase by at least 25% by 2030 compared to the levels in 2016. Therefore, monitoring and analyzing carbon emissions related to tourism is crucial for its sustainability. Studies on the impact of tourism on CO2 emissions are divided into two categories. Some studies suggest that tourism reduces CO2 emissions (Lee and Brahmasrene, 2013; Le and Nguyen, 2020; Ullah, Raza and Mehmood, 2023), while others conclude that tourism increases CO2 emissions (Lenzen *et al*., 2018; Shun Zhang and Liu, 2019; Eyuboglu and Uzar, 2020; Huang and Tang, 2021; Ullah *et al.,* 2022).

Studies examining the relationship between economic growth, tourism, and the environment typically focused on either EU member countries (Lee and Brahmasrene, 2013; Dogan and Aslan, 2017) or developed countries (Azam *et al.,* 2015; Aye, Edoja and Charfeddine, 2017; Jiekuan Zhang and Zhang, 2020). It’s reasonable to suggest that the primary focus of research on these countries is due to their increased energy demands, which are a result of their level of development. The developmental stage these countries are in often necessitates more energy, potentially leading to a surge in greenhouse gas emissions. In a study conducted in the Northeast and Southeast Asia region, one of the regions with the fastest growth in CO2 emissions, real GDP, energy consumption, and international tourism covering the years 1995-2014, the EKC hypothesis was disproved. The study found that the primary source of CO2 emissions was non-renewable energy. Furthermore, it was observed that a one-unit increase in tourism led to an increase in CO2 emissions by 0.222%. Dogan and Aslan (2017) conducted a study exploring the relationship between carbon emissions, real income, energy consumption, and tourism across a panel of EU and candidate countries from 1995 to 2011. For their analysis, they used heterogeneous panel estimation techniques with cross-sectional dependence. The LM bootstrap panel cointegration test indicated a long-term relationship among the variables analyzed. Additionally, the findings revealed that while energy consumption increased emission levels, real income and tourism contribute to the reduction of CO2 emissions. This suggests that both economic growth and sustainable tourism practices can play a significant role in mitigating carbon emissions. Ullah *et al.* (2022) conducted a study using the ARDL model to investigate the relationship between tourism, economic growth, and CO2 emissions in Brazil from 1995 to 2018. The study found both short-term and long-term associations between these variables. Interestingly, the findings suggest that both GDP and tourism can contribute to CO2 emissions, either negatively or positively, as indicated by non-linear ARDL estimations. This underscores the complex dynamics among economic activities, tourism, and environmental impacts. In a study conducted by Zhu *et al.* in 2021, the EKC hypothesis was confirmed within the context of China. They found that an increase in tourist arrivals contributed to a reduction in CO2 emissions over the long term. Another study conducted in China verified the EKC hypothesis and demonstrated that, similar to the findings of Zhu *et al.* 2021, tourist arrivals reduced CO2 emissions in the long run. However, in the same study, FDI and environmentally friendly electricity were shown to be substantial factors contributing to the growth in CO2 emissions (Wang *et al.,* 2022), Research examining the relationship between tourism, economic growth, and CO2 emissions within the context of BRICS countries appears to be relatively sparse. Aziz *et al.* (2020) conducted a study examining the relationship between tourism, renewable energy, economic growth, and CO2 emissions using annual data from BRICS countries spanning from 1995 to 2018. The distinctiveness of their research lies in the application of moments quantile regression (MMQR). The findings of the study indicate that tourism has more noticeable negative effects from the 10th to the 40th quantile, with the effects not being significant in other quantiles. An inverted U-shaped EKC is observed in all quantiles except the 10th and 20th. Balsalobre-Lorente *et al.* (2019) conducted a study testing the EKC hypothesis for the period from 1990 to 2014 in the BRICS countries, taking into account factors such as agricultural activities, energy use, trade openness, and mobile use. The study found an inverted U-shaped relationship between CO2 emissions and economic growth. Agriculture, electricity consumption, and trade openness increase carbon emissions, while mobile use reduces pollution. Banday and Ismail (2017) conducted a study analyzing the impact of both economic growth and tourism on the environment in the BRICS countries from 1995 to 2013. They used the ARDL cointegration model to investigate the relationships among these variables. The study found that while tourism growth could have both positive and negative effects on the economy, it also contributed to environmental pollution. However, a separate study covering the period from 1995 to 2018 in the BRICS countries found that a 1% increase in tourism would lead to a 0.39% reduction in CO2 emissions. This suggests that the impact of tourism on CO2 emissions can significantly vary depending on the specific context and time period. The study also found that other variables, such as technical innovation, natural resources, and economic growth, increased CO2 emissions in both the short and long run (Ullah, Raza, and Mehmood, 2023).

The aforementioned studies present diverse outcomes for aspects such as tourism, FDI, GDP, and CO2 emissions. These variations are influenced by several factors including the level of a country's development, specific conditions and variables, the methodological approaches employed, and the time frames considered. Despite these differences, a common thread in most studies is the long-term relationships between these variables. Recognizing that outcomes can vary based on the selection of countries and time period, this study intends to explore the relationship between tourism, economic growth, and CO2 emissions during the period from 1995 to 2020. It's important to note that the findings may offer unique insights due to the specific context and time frame under analysis.

3. Materials and Methods

3.1. Data Sources and Processing

This research employs data that includes tourism arrivals, FDI, GDP, and CO2 emissions. The data, covering the period from 1995 to 2020, was primarily sourced annually from the World Bank (WB). However, as the WB's CO2 emissions data is only available up to 2019, the data for 2020 was procured from the ourworldindata.org website. In line with previous studies, international tourist arrivals were used to represent tourism (Dogan and Aslan, 2017; Aziz *et al.,* 2020). To maintain a balanced panel, 1995 was selected as the base year for the other data.

In the study, CO2 emissions are the dependent variables, while FDI, GDP, and the number of tourists are the independent variables. According to World Bank, 'FDI refers to the investment made by an entity to acquire a controlling interest or management control over a business operating in a foreign economy. This investment includes equity capital, reinvested earnings, other long-term capital, and short-term capital, as reflected in the balance of payments'. GDP is measured in current US dollars and represents economic growth. The number of tourists who travel abroad, away from their home country, for a duration of no more than 12 months, with the primary intention of engaging in non-remunerated activities within the destination country, is known as international tourist. CO2 emissions, which are emissions from the combustion of fossil fuels and cement production, are measured in metric tons per capita (World Bank, n.d.). The analysis was performed by taking the natural logarithm of the data used in the study. The descriptive statistics and correlation matrix of the variables are displayed in Table 1.

Table 1. Descriptive statistics and correlation matrix

	lnCO2	lnFDI	lnGDP	lnT_Arr
Mean	1.357926	23.61492	8.158701	16.42093
Median	1.680889	24.04731	8.338235	16.27452
Minimum	-.2672652	20.12605	5.923641	14.50415
Maximum	2.475276	26.39634	9.678758	18.90642
Std. Dev.	.8724986	1.586354	1.004099	1.234039
Observations	130	130	130	130
Correlation Matrix				
lnCO2	1			
lnFDI	-0.0784	1		
lnGDP	0.6099	0.2563	1	
lnT_Arr	0.5281	0.5563	0.1837	1

Note: lnCO2 = Carbon dioxide emissions; lnFDI = foreign direct investment; lnGDP = Gross domestic product; lnT_Arr=international touist arrivals

The correlation matrix presents the correlation coefficients which quantify the extent of the linear association between every pair of variables, with values varying from -1 to +1. As shown in Table 1, there exists a weak correlation between CO2 and FDI, whereas a strong correlation is observed between GDP and CO2. However, it is important to note that a correlation matrix only provides a summary of the dataset, and further inferential statistics are necessary to comprehend the relationship between variables.

3.2.Results

Initially, homogeneity, cross-sectional dependence, and unit root tests were performed on the series representing CO2, FDI, GDP, and international tourist arrivals for the BRICS countries during the period from 1995 to 2020. The data pertaining to the study variables were analyzed using the Stata 15 statistical software.

Cross-sectional dependence and panel unit root test

The homogeneity of the slope coefficients was evaluated using the Delta test, which was introduced by Pesaran and Yamagata (2008). The test result led to the rejection of the null hypothesis (H0: The slope coefficient is homogeneous), given that the p-value was 0.00. This implies that the slope coefficients are heterogeneous. In econometric analysis, the initial step is to check the stationarity of the series to ensure the reliability of the estimates. Before conducting unit root tests, this empirical study first utilized Pesaran's (2004) CD test to determine whether there was cross-sectional dependence or independence in the panel data. This step is crucial as neglecting the issue of cross-sectional dependence can lead to biased results. The outcomes of the cross-sectional independence test are presented in Table 2.

Table 2. Results of the cross-sectional dependence test

Variables	lnCO2	lnFDI	lnGDP	lnT_Arr
Statistic	11.521	11.220	14.263	12.348
p-value	.000	.000	.000	.000

If the p-value falls below a certain level based on the CD test findings, it provides substantial evidence to suggest the presence of cross-sectional dependence. As indicated in the table, since the p-value is less than .01, it suggests that the cross-section is dependent on CO2, FDI, GDP, and tourism (T_Arr) variables. Given the existence of cross-sectional dependence among the series forming the panel, it is recommended to apply second-generation unit root tests. Panel unit root tests can be divided into two generations: first-generation and second-generation. First-generation unit root tests include estimators such as Levin-Lin and Chu (LLC), Breitung, Im-Pesaran and Shin (IPS), Fisher ADF, Fisher PP, and Hadri unit root tests. These tests operate under the assumption that the cross-sectional units are independent and that a shock to any of the units in the panel impacts all cross-section units equally. In contrast, second-generation unit root tests were developed to analyze unit roots while considering the cross-sectional dependence between the series (Altıntaş and Mercan, 2015). In this research, the Pesaran CIPS test, which is a second-generation unit root test, was employed to ensure predictions were consistent and reliable when there was cross-section dependence. In the unit root test, the alternative hypothesis suggests that the panel is stationary, while the null hypothesis suggests that the panel has unit roots (Pesaran, 2007).

Table 3. Results of second generation unit root tests (CIPS)

	CIPS	
	Level	Δ
lnCO2	-3.200	-3.660*
lnFDI	-2.878	-5.744*
lnGDP	-2.302	-4.405*
lnT_Arr	-2.885	-4.216*

*Note: * represent %1 significance level.*

The findings from the Pesaran CIPS test, as shown in Table 3, indicate that CO_2, FDI, GDP, and Tourism have unit roots at their levels, but become stationary at the first difference (Δ). To proceed with the study, the variables were tested for stationarity by taking first-order differences. Since all of the series are I(1), co-integration analysis can be initiated. This is because it is a prerequisite for the co-integration analysis that the series are I(1).

Table 4. The results of Westerlund Cointegration Test

	Statistic	Probability
Westerlund	11.4554	.000

In the literature, there are several co-integration tests such as Johamsen-Fisher, Kao, Pedroni, and Westerlund. However, in this study, the Westerlund co-integration test was utilized, which accounts for cross-section dependence and allows for the analysis of the co-integration relationship when the series are at different levels of stationarity (Westerlund, 2007). According to the output given in Table 4, the existence of a cointegration relationship between the series was determined. Therefore, it is concluded that there is a long-term relationship between CO_2, FDI, GDP, and tourism variables for the BRICS group.

After determining the existence of cointegration among the variables, the long-term coefficients need to be estimated. In this study, OLS with random effects, DOLS (dynamic least squares), and FMOLS (fully corrected least squares) estimators were applied to find coefficient estimates between economic growth, FDI and international tourist numbers for CO_2 emissions (Table 5). Since the coefficients of the variables are taken as natural logarithms, they are considered as long-run elasticities. According to the statistics obtained from RE_OLS, the GDP variable has a positive and significant effect on CO_2 emissions. A one-unit increase in GDP increases CO_2 emissions by 0.07%. However, the variables of FDI and tourism arrivals were not statistically significant. All of the coefficients reported in the DOLS test statistic are statistically significant at either the 1% level or the 5% level. According to DOLS, the most significant contribution to CO_2 emissions among the variables was made by the GDP variable. A one-unit increase in GDP increases CO_2 emissions by 0.10%. A one-unit increase in FDI increases CO_2 emissions by 0.01%. A one-unit increase in the number of tourists causes an increase of 0.008% in CO_2 emissions. However, the impact of tourism on CO_2 is rather weak compared to other variables. According to FMOLS test statistics, the effect of GDP on CO_2 emissions was significant, while FDI and tourism numbers were insignificant. Among the estimators, it was determined that the most significant contribution to CO_2 emissions was performed by the GDP variable. The impact of GDP on CO_2 emissions aligns with the findings of prior research (Omri, Nguyen and Rault, 2014; Ghouali *et al.,* 2015; Banday and Ismail, 2017; Dogan and Aslan, 2017; Mohammadi, Burhan and Mangal, 2020; Aziz *et al.,* 2020). The FDI variable was not significant, with the exception of the DOLS statistics. This is in line with the research by Danish and Wang (2019), who found an insignificant effect of FDI on environmental pollution in their study of BRICS countries. However, research found that FDI could either decrease (Lee and Brahmasrene, 2013) or increase CO_2 emissions (Shahbaz, Nasir, and Roubaud, 2018). This suggests that a variety of factors, such as the type of industry, the environmental policies of the host country, and the technologies used, could lead to different outcomes in terms of the impact of FDI on CO_2 emissions.

Table 5. Results from long run estimators

	RE-OLS		DOLS		FMOLS	
	Coefficient	p-value	Coefficient	p-value	Coefficient	p-value
FDI	.008	.125	.019	.002*	.007	.359
GDP	.079	.002*	.101	.000*	.097	.009*
Tourism	.019	.122	.008	.000*	.020	.283
Hausman test	2.22					

*Note: * represent %1 significance level*

The variable representing tourist arrivals was found to be insignificant, with the exception of the DOLS statistics. However, upon examining the coefficients, it appears that an increase in the number of tourists leads to an increase in CO2 emissions. The impact of tourism on CO2 emissions is a topic of ongoing debate in research. Some studies suggest that tourism reduces CO2 emissions (Lee and Brahmasrene, 2013; Le and Nguyen, 2020; Zhu *et al.,* 2021), while others argue that tourism increases CO2 emissions (Lenzen *et al.,* 2018; Shun Zhang and Liu, 2019; Eyuboglu and Uzar, 2020; Huang and Tang, 2021; Ullah *et al.,* 2022). According to the DOLS statistics in this study, the effect of tourism on CO2 emissions is insignificant. The study provides important insights on the impact of GDP and FDI - two crucial indicators of economic growth - on CO2 emissions. This finding was expected as developing nations' economic growth model heavily relies on energy consumption (Li *et al.,* 2022).

4. Conclusions and Policy Implications

In recent years, the relationship between CO2 emissions and economic growth has become a popular topic among researchers due to global warming. However, in the context of tourism, it is determined that there are very few studies covering CO2 emissions, economic growth, and tourism. Therefore, in this study, the effect of GDP, FDI and Tourism on CO2 emissions for the BRICS countries for the 1995 - 2020 period was examined.

In the empirical part of the study, according to the Westerlund cointegration test, the existence of a long-term relationship between the variables was revealed. According to DOLS test statistics, all of the coefficients reported are significant at the 1% and 5% level, and the most significant contribution on CO2 emissions is performed by the GDP variable.

Considering the result that all of the three variables in the BRICS countries affect CO2 emissions, policymakers should encourage programs that take into account energy efficiency and increase renewable energy sources. Although tourism is considered as a smokeless industry, since transportation is the most influential factor on CO2 emissions in the tourism sector, the use of environmentally friendly transportation practices (for instance the use of electric vehicles) in the destination can be ensured. Supporting the net zero carbon target by 2050 implemented by IATA as transport-related emissions from international tourism are expected to reach 665 million tons of CO2 in 2030 (45% increase) from 458 million tons of CO2 in 2016 (WTO & ITF 2019) and in this context, choosing low-emission aircraft models will be an important step. It can be ensured to promote sustainable tourism for both businesses and consumers, to carry out informative and promotional activities on the subject in print and social media, and to inform all stakeholders in this context. Encouraging tourists to consider climate, economic, social and environmental impacts when selecting a travel destination is crucial. Travel companies should prioritize including eco-friendly activities that protect the environment and cultural heritage in their travel programs, such as bird watching, rural tourism, and hiking. This will encourage tourists to choose these options and thereby support sustainable tourism.

Although FDI stimulates economic growth, it increases CO2 emissions. Therefore, it’s essential to promote investments in environmentally sustainable sectors and consider their environmental impact when planning for FDI. Research shows that implementing innovative technologies powered by renewable energy can significantly reduce production-based emissions by up to 67.1% in the long term. Moreover, it can boost GDP by 10.9% and FDI by 14.2% (Ma *et al*., 2023). Therefore, promoting the use of renewable and efficient energy sources, through technology transfer or structural regulations (such as incentives or criminal sanctions), will reduce the negative impact of FDI on CO2 emissions. It is also possible to ensure that companies reduce their carbon emissions by introducing a carbon tax.

The BRICS countries have recently made joint commitments to combat climate change and promote sustainable development by holding numerous high-level environmental conferences. These nations, which account for about 42% of the world's population and 24% of its GDP, provide a strong framework for international climate policy by taking decisive action to cut carbon emissions and working together pragmatically to promote green growth (Xinhua, 2022). This is a critical step towards lowering CO2 emissions. According to the International Labour Organization (ILO) Report (2022), Brazil has reaffirmed its commitment to reducing its total net greenhouse gas (GHG) emissions by 37% in 2025, with 2005 as the reference year. In addition, the country has officially committed to reducing its emissions by 43% by 2030 to achieve climate neutrality or net zero emissions by 2060. The Russian Federation has set a target to limit greenhouse gas (GHG) emissions to 70 percent of the levels recorded in 1990 by the year 2030. The country is focusing its efforts on implementing fiscal measures to encourage GHG reductions, enhancing energy efficiency across all sectors, and promoting the use of non-fuel and renewable energy sources. India intends to reach net zero emissions by 2070, while China intends to peak its CO2 emissions before 2030 and achieve carbon neutrality before 2060. India aims to achieve net zero emissions by 2070, while South Africa targets 2050 and China aims for carbon neutrality before 2060. Cooperation between countries on energy efficiency and renewable energy will help achieve these goals. In addition, it is crucial that the EU, the Shanghai Cooperation Organization, or other cooperation organizations such as the BRICS group exchange information and develop common strategies on clean energy, low-carbon technology, sustainable and resilient infrastructure construction, the carbon market, etc.

In future studies, studies on CO2 emissions in the BRICS group can be done by using other variables such as tourism revenues and transportation. Since the five countries in the BRICS group have different characteristics, comparisons can be made by conducting studies on individual countries in the future.

References

Altıntaş, H. and Mercan, M., 2015. Ar-Ge harcamaları ve ekonomik büyüme ilişkisi: OECD ülkeleri üzerine yatay kesit bağimliliği altinda panel eşbütünleşme analizi. *Ankara Üniversitesi SBF Dergisi*, 70(2), pp.345-376. https://doi.org/10.1501/SBFder_0000002355.

Aye, G.C., Edoja, P.E. and Charfeddine, L., 2017. Effect of economic growth on CO2 emission in developing countries: Evidence from a dynamic panel threshold model. *Cogent Economics and Finance*, 5(1), https://doi.org/10.1080/23322039.2017.1379239.

Azam, M., Khan, A.Q., Abdullah, H.B. and Qureshi, M.E., 2015. The impact of CO2 emissions on economic growth: Evidence from selected higher CO2 emissions economies. *Environmental Science and Pollution Research*, 23(7), pp.6376-6389. https://doi.org/10.1007/s11356-015-5817-4.

Aziz, N., Mihardjo, L.W.W., Sharif, A. and Jermsittiparsert, K., 2020. The role of tourism and renewable energy in testing the Environmental Kuznets Curve in the BRICS countries: Fresh evidence from methods of moments quantile regression. *Environmental Science and Pollution Research*, 27(31), pp.39427-39441. https://doi.org/10.1007/s11356-020-10011-y.

Balsalobre-Lorente, D., Driha, O.M., Bekun, F.V. and Osundina, O.A., 2019. Do agricultural activities induce carbon emissions? The BRICS experience. *Environmental Science and Pollution Research*, 26(24), pp.25218-25234. https://doi.org/10.1007/s11356-019-05737-3.

Banday, U.J. and Ismail, S., 2017. Does tourism development lead positive or negative impact on economic growth and environment in BRICS countries ? A panel data analysis. *Economics Bulletin*, 37(1), pp.553-567.

Benetrix, A., Pallan, H. and Panizza, U., 2023. *The elusive link between FDI and economic growth.* Available at: <https://blogs.worldbank.org/developmenttalk/elusive-link-between-fdi-and-economic-growth>.

BRICS, 2021. Evolution of BRICS. Available at: <https://brics2021.gov.in/about-brics>.

Canpolat Gökçe, E. and Kızılkaya, F., 2022. Türkiye için turizm kaynaklı EKC hipotezinin test edilmesi. *Kahramanmaraş Sütçü İmam Üniversitesi Sosyal Bilimler Dergis*i, 19(1), pp.352-362. https://doi.org/10.33437/ksusbd.875357.

Danish and Wang, Z., 2019. Does biomass energy consumption help to control environmental pollution? Evidence from BRICS countries. *Science of The Total Environment,* 670, pp.1075-1083. https://doi.org/10.1016/j.scitotenv.2019.03.268.

Dogan, E. and Aslan, A., 2017. Exploring the relationship among CO2 emissions, real GDP, energy consumption and tourism in the EU and candidate countries: Evidence from panel models robust to heterogeneity and cross-sectional dependence. *Renewable and Sustainable Energy Reviews*, 77, pp.239-245. https://doi.org/10.1016/j.rser.2017.03.111.

Essandoh, O.K., Islam, M. and Kakinaka, M. 2020, Linking international trade and foreign direct investment to CO2 emissions: Any differences between developed and developing countries? *Science of The Total Environment,* 712, 136437, https://doi.org/10.1016/j.scitotenv.2019.136437.

Eyuboglu, K. and Uzar, U., 2020. The impact of tourism on CO2 emission in Turkey. *Current Issues in Tourism,* 23(13), pp.1631-1645. https://doi.org/10.1080/13683500.2019.1636006.

Ghouali, Y.Z., Belmokaddem, M., Sahraoui, M.A. and Guellil, M.S., 2015. Factors affecting CO2 emissions in the BRICS countries: A panel data analysis. *4th World Conference on Business, Economics and Management (Wcbem-2015*), 26, pp.114-125.

Huang, T. and Tang, Z., 2021. Estimation of tourism carbon footprint and carbon capacity. *International Journal of Low-Carbon Technologies*, 16(3), pp.1040-1046. https://doi.org/10.1093/ijlct/ctab026.

Hudea (Caraman), O. S. and Stancu, S., 2012. Foreign direct investments, technology transfer and economic growth. A panel approach. *Romanian Journal of Economic Forecasting*, 15(2), pp.85-102.

Kwakwa, P.A. and Alhassan, H., 2018. The effect of energy and urbanisation on carbon dioxide emissions: Evidence from Ghana. *Opec Energy Review*, 42(4), pp.301-330. https://doi.org/10.1111/opec.12133.

International Labour Organization - ILO Report 2022. Employment and just transition to sustainability in the BRICS countries. Available at:

<https://www.ilo.org/wcmsp5/groups/public/---dgreports/---dcomm/documents/presentation/wcms_845711.pdf>.

Iqbal, A., Tang, X. and Rasool, S.F., 2023. Investigating the nexus between CO2 emissions, renewable energy consumption, FDI, exports and economic growth: evidence from BRICS countries. *Environment Development and Sustainability,* 25, pp.2234–2263. https://doi.org/10.1007/s10668-022-02128-6.

Le, T.-H. and Nguyen, C.P., 2020. The impact of tourism on carbon dioxide emissions: insights from 95 countries. *Applied Economics*, 53(2), pp.235-261. https://doi.org/10.1080/00036846.2020.1804051.

Lee, J.W. and Brahmasrene, T., 2013. Investigating the influence of tourism on economic growth and carbon emissions: Evidence from panel analysis of the European Union. *Tourism Management*, 38, pp.69-76. https://doi.org/10.1016/j.tourman.2013.02.016.

Lenzen, M., Sun, Y.-Y., Faturay, F., Ting, Y.-P., Geschke, A. and Malik, A., 2018. The carbon footprint of global tourism. *Nature Climate Change*, 8(6), pp.522-528. https://doi.org/10.1038/s41558-018-0141-x.

Li, F., Chang T., Wang M C. and Zhou, J., 2022. The relationship between health expenditure, CO2 emissions, and economic growth in the BRICS countries-based on the Fourier ARDL model. *Environmental Science and Pollution Research International,* 29(8), pp.10908-10927. https://doi.org/10.1007/s11356-021-17900-w.

Liu, H., Wang, K.-T., Khudoykulov, K., Tai, T.D., Ngo, T.Q. and Phan, T.T.H., 2022. Does economic development impact CO2 emissions and energy efficiency performance? Fresh evidences from Europe. *Frontiers in Energy Research*, 10, . https://doi.org/10.3389/fenrg.2022.860427.

Ma, C., Li, H., Saleem, S. F. and Mone, F., 2023. Balancing progress and sustainability: industrial innovation's impact on Europe's emission management, economic expansion, and financial growth. *Romanian Journal of Economic Forecasting,* 23(3), pp.129-147.

Min, J. C. H., Kung, H-H and Chang, T., 2019. Testing the structural break of Taiwan inbound tourism markets. *Romanian Journal of Economic Forecasting*, 22 (2), pp.117-130.

Mohammadi, A., Burhan, A.A. and Mangal, R., 2020. Impact of population and economic growth on CO2 emission (case of Afghanistan). *Journal of Emerging Technologies and Innovative Research,* 7(10), pp.368-378.

Omri, A., Nguyen, D.K. and Rault, C., 2014. Causal interactions between CO2 emissions, FDI, and economic growth: Evidence from dynamic simultaneous-equation models. *Economic Modelling*, 42, pp.382-389. https://doi.org/10.1016/j.econmod.2014.07.026.

Onyango, J., Kiano, E. and Saina, E., 2021. Environmental damage theory applicable to Kenya. *Journal of Business, Economics and Environmental Studies* 11(1), pp.39-50

Pesaran, M.H., 2004. General diagnostic tests for cross section dependence in panels. *IZA Discussion Paper,* 60, pp.13-50. https://doi.org/10.1007/s00181-020-01875-7.

Pesaran, M.H., 2007. A simple panel unit root test in the presence of cross-section dependence. *Journal of Applied Econometrics*, 22(2), pp.265-312.

Pesaran, M.H and Yamagata, T., 2008. Testing slope homogeneity in large panels. *Journal of Econometrics*, 142(1), pp.50-93. https://doi.org/10.1016/j.jeconom.2007.05.010.

Rafindadi, A.A., Muye, I.M. and Kaita, R.A., 2018. The effects of FDI and energy consumption on environmental pollution in predominantly resource-based economies of the GCC. *Sustainable Energy Technologies and Assessments,* 25, pp.126-137, https://doi.org/10.1016/j.seta.2017.12.008.

Saboori, B., Sulaiman, J. and Mohd, S., 2012. Economic growth and CO2 emissions in Malaysia: A cointegration analysis of the Environmental Kuznets Curve. *Energy Policy*, 51, pp.184-191. https://doi.org/10.1016/j.enpol.2012.08.065.

Sarıtaş, T. and Akar, G., 2022. Turizmin CO2 emisyonuna etkisi: Panel veri analizi *Ekonomi Maliye İşletme Dergisi*, 5(1), pp.104-117. https://doi.org/10.46737/emid.1109310.

Scott D, Amelung B, Becken S, Ceron JP, Dubois G, Gössling S, Peeters P and M, S., 2008. Climate change and tourism: Responding to global challenges. *World Tourism Organization*, Madrid, 230, pp.1-38. https://doi.org/10.18111/9789284412341.

Selden, T.M. and Song, D., 1994. Environmental quality and development: Is there a Kuznets curve for air pollution emissions? *Journal of Environmental Economics and Management*, 27(2), pp.147-162. https://doi.org/10.1006/jeem.1994.1031.

Shahbaz, M., Nasir, M.A. and Roubaud, D., 2018. Environmental degradation in france: the effects of FDI, financial development, and energy innovations. *Energy Economics*, 74, pp.843-857. https://doi.org/10.1016/j.eneco.2018.07.020.

Sun, C.W., Zhang, F. and Xu, M.L., 2017. Investigation of pollution haven hypothesis for China: An ARDL approach with breakpoint unit root tests. *Journal of Cleaner Production*, 161, pp.153-164. https://doi.org/10.1016/j.jclepro.2017.05.119.

Tang, C.F. and Tan, B.W., 2015. The impact of energy consumption, income and foreign direct investment on carbon dioxide emissions in Vietnam. *Energy*, 79, pp.447-454. https://doi.org/10.1016/j.energy.2014.11.033.

Ullah, I., Rehman, A., Svobodova, L., Akbar, A., Shah, M.H., Zeeshan, M. and Rehman, M.A., 2022. Investigating relationships between tourism, economic growth, and CO2 emissions in Brazil: An application of the nonlinear ARDL approach. *Frontiers in Environmental Science*, 10. https://doi.org/10.3389/fenvs.2022.843906.

Ullah, A., Raza, K., and Mehmood, U., 2023. The impact of economic growth, tourism, natural resources, technological innovation on carbon dioxide emission: evidence from BRICS countries. *Environmental Science and Pollution Research,* 30, pp.78825–78838. https://doi.org/10.1007/s11356-023-27903-4.

United Nations: Climate Action, nd. Most emissions come from just a few countries. Available at: https://www.un.org/en/climatechange/net-zero-coalition.

UNCTD - United Nations Conference on Trade and Development 2023. *BRICS Investment Report* Available at: <https://unctad.org/publication/brics-investment-report>.

UNEP - United Nations Environment Programme, 2022. *Emissions Gap Report 2022: The Closing Window — Climate crisis calls for rapid transformation of societies.* Nairobi. Available at: <https://www.unep.org/emissions-gap-report-2022>.

UNWTO, 2021. *International tourism highlights*, 2020 Edition. https://doi.org/10.18111/9789284422456.

Vitalis, V., 2002. *Preparing for the world summit on sustainable development*. Available at: <https://www.oecd.org/sd-roundtable/papersandpublications/39365131.pdf>.

Wang, H., Xu, D., Mufarreh, E.Z., Juan, Z., Ahmad, M., Ali A., Khan, Y.A. and Saghir, A., 2022. The influence of foreign direct investment and tourism on carbon emission in China. *Frontiers in Environmental Science,* 10. https://doi.org/10.3389/fenvs.2022.959850.

World Bank (WB), 2022. *The 5 BRICS countries* Available at: <https://www.worlddata.info/alliances/brics.php#:~:text=The%205%20BRICS%20countriesandtext=A%20total%20of%203.22%20billion,the%20largest%20share%20by%20far>.

World Bank, n.d., *Metadata glossary*, Available at: <https://databank.worldbank.org/metadataglossary/world-development-indicators/series/EN.ATM.CO2E.PC>.

Westerlund, J., 2007. Testing for error correction in panel data. *Oxford Bulletin of Economics and Statistics,* 69(6), pp.709-748. https://doi.org/10.1111/j.1468-0084.2007.00477.x.

World Tourism Organization and International Transport Forum (WTO & ITF), 2019. *Transport-related CO2 emissions of the tourism sector – modeling results,* UNWTO, Madrid. https://doi.org/10.18111/9789284416660.

World Travel and Tourism Council (WTTC), 2019. *Economic impact reports*. Available at: https://wttc.org/research/economic-impact.

Xinhua, 2022. *Forging solid BRICS foundation for tackling global climate change.* Available at: <http://english.scio.gov.cn/in-depth/2022-05/26/content_78237976.htm>.

Zhang, J. and Zhang, Y., 2020. Tourism, economic growth, energy consumption, and CO2 emissions in China. *Tourism Economics*, 27(5), pp.1060-1080. https://doi.org/10.1177/1354816620918458.

Zhang, S. and Liu, X., 2019. The roles of international tourism and renewable energy in environment: New evidence from Asian countries. *Renewable Energy*, 139, pp.385-394. https://doi.org/10.1016/j.renene.2019.02.046.

Zhu, S., Luo, Y., Aziz, N., Jamal, A. and Zhang, Q., 2021. Environmental impact of the tourism industry in China: Analyses based on multiple environmental factors using novel Quantile Autoregressive Distributed Lag Model. *Economic Research-Ekonomska Istraživanja*, 35(1), pp.3663-3689. https://doi.org/10.1080/1331677X.2021.2002707