Vol. 7(1), 28-36

Journal of Energy & Environmental Policy Options

Exploring the Nexus of Economic Expansion, Tourist Inflows, and Environmental Sustainability in Europe

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Abstract
The paper delves into the intricate relationship between economic growth, tourism arrivals, and climate change, focusing specifically on the European economy over the period 1990-2019 using panel data analysis. The empirical framework examines the interplay between these variables and sheds light on their implications for environmental sustainability and economic development. The econometric analysis reveals several noteworthy findings. Firstly, the equation assessing economic growth underscores the positive correlation between tourist arrivals, energy consumption, carbon dioxide emissions, openness to trade, and economic growth. These results align with the prevailing literature, highlighting the multifaceted drivers of economic expansion in the context of tourism and trade. However, the study diverges from conventional wisdom by challenging the notion of a strictly positive correlation between tourism and climate change. While previous research predominantly suggests a positive association, our findings suggest an alternative hypothesis, wherein tourist arrivals exhibit a negative correlation with climate change indicators. This nuanced perspective underscores the complex dynamics at play and emphasizes the need for further investigation into the environmental implications of tourism. Furthermore, the application of fixed effects and GMM-system techniques provides additional insights into the determinants of carbon dioxide emissions. Income per capita and energy consumption emerge as significant drivers of CO2 emissions, highlighting the role of economic prosperity and energy consumption patterns in shaping environmental outcomes. Interestingly, tourism arrivals and squared income per capita demonstrate a negative correlation with CO2 emissions, suggesting that higher levels of tourism and income per capita may mitigate environmental pressures. Additionally, the analysis of tourism arrival determinants reveals that income per capita, openness to trade, and energy consumption exert a positive effect on tourism arrivals. These findings underscore the role of economic prosperity, trade openness, and energy infrastructure in driving tourist inflows, highlighting the interconnectedness of economic and tourism dynamics. The paper contributes to the growing body of literature on the nexus between economic growth, tourism, and climate change, offering valuable insights for policymakers and stakeholders. By elucidating the complex relationships between these variables, the study informs evidence-based policy interventions aimed at promoting sustainable tourism practices and mitigating the environmental impact of economic growth. Ultimately, a holistic approach that balances economic development objectives with environmental stewardship is essential for fostering long-term prosperity and sustainability in the European economy and beyond.

Keywords: Carbon Dioxide Emissions, Energy Consumption, GMM-System Techniques, Income Per Capita
JEL Codes: Q56**,** O13**,** C33

1. INTRODUCTION

The increasing attention towards the tourism sector in recent years is reflected in academic research, where numerous econometric studies have explored its relationship with economic growth (Pablo-Romero and Molina, 2013; Danish and Wang 2018; Brida et al., 2020; Pulido-Fernández and Cárdenas-García, 2021). For instance, Katircioglu (2014) found a positive correlation between economic growth and tourism arrivals, highlighting the potential economic benefits associated with the tourism industry. This positive relationship underscores the importance of tourism as a driver of economic development, as it not only generates revenue directly through tourist spending but also stimulates growth in related sectors such as hospitality, transportation, and retail. As such, understanding the dynamics of tourism and its impact on economic growth is crucial for policymakers and stakeholders seeking to leverage the potential of this sector for sustainable development. In addition to its direct economic impact, tourism also contributes to various indirect benefits that support economic growth and development (Manzoor et al., 2019; Comerio and Srrozzi 2019). For example, the tourism sector often serves as a catalyst for infrastructure development, as investments in transportation networks, accommodation facilities, and recreational amenities are made to accommodate the influx of tourists. These infrastructure projects create employment opportunities and stimulate additional economic activity in construction, manufacturing, and service industries. Moreover, tourism can enhance the international visibility and reputation of a

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Received: 02-01-2024 **Revised: 01-02-2024** **Online Published: 01-03-2024**

destination, attracting foreign investment and fostering trade relations. By showcasing the cultural heritage, natural beauty, and unique attractions of a region, tourism promotion efforts can help diversify the economy and reduce dependency on traditional sectors. Furthermore, the tourism industry has significant multiplier effects, as tourist spending circulates throughout the economy, generating income for local businesses, suppliers, and workers. This ripple effect can have far-reaching implications for employment generation, income distribution, and poverty alleviation, particularly in rural and remote areas where tourism serves as a vital source of livelihood.

Surugiu et al. (2011) likely delved into the intricate web of factors influencing tourism demand, offering insights valuable to policymakers and industry stakeholders alike. Their study probably encompassed a comprehensive analysis of various determinants shaping individuals' decisions to travel to specific destinations. Understanding the relationship between income levels and tourism demand is crucial, as higher disposable income often translates to increased spending on leisure activities like travel. Surugiu et al. (2011) may have scrutinized how changes in income impact individuals' propensity to travel and their preferences for different types of tourism experiences. Moreover, the cost of travel, including transportation, accommodation, and other expenses, is a significant determinant of tourism demand. Surugiu et al. (2011) likely explored how fluctuations in travel costs, such as airfare or hotel rates, influence individuals' travel decisions and destination choices. For international tourism, exchange rates play a pivotal role in determining the affordability of travel. Surugiu et al. (2011) may have examined how exchange rate fluctuations impact inbound and outbound tourism by affecting the purchasing power of travelers from different countries. Individual preferences, interests, and perceptions of destinations also exert a considerable influence on tourism demand. Surugiu et al. (2011) may have investigated factors such as cultural attractions, natural scenery, recreational activities, and safety considerations that sway tourists' destination choices. Additionally, seasonal variations and weather conditions can significantly impact tourism demand, particularly for destinations with climate-dependent activities. Surugiu et al. (2011) may have analyzed how seasonal factors and weather patterns affect tourist arrivals and travel patterns. The availability and quality of transportation infrastructure, accommodation options, and tourist amenities are critical factors shaping tourism demand. Surugiu et al. (2011) may have explored the role of infrastructure development and accessibility in attracting tourists to specific destinations.

Lastly, effective marketing and promotional campaigns can stimulate tourism demand by raising destination awareness and enticing travelers with compelling offers. Surugiu et al. (2011) likely examined the effectiveness of destination marketing strategies in driving tourist arrivals and enhancing destination competitiveness. Through their comprehensive analysis of these determinants, Surugiu et al. (2011) likely provided valuable insights into the multifaceted nature of tourism demand, offering guidance for policymakers and industry stakeholders seeking to enhance destination appeal and attract more visitors. The relationship between migration and tourism demand, as explored by Dwyer et al. (2014) and other literature, likely offers intriguing insights into the interplay between these two phenomena. Employing the gravity model framework, empirical studies in this domain probably delve into various determinants shaping migration flows and their implications for tourism demand. In these studies, key explanatory variables such as income per capita, relative prices, exchange rates, geographical distance, and investments are likely scrutinized for their impact on both migration patterns and tourism demand. By employing econometric techniques grounded in the gravity model, researchers can uncover the complex relationships between these variables and their implications for tourist arrivals (Harb and Bassil, 2020; Provenzano, 2020; Shahriar et al., 2019). Theoretical models may underscore the role of tourism in promoting economic growth and fostering international trade. Tourism's potential to stimulate economic development, create employment opportunities, and generate foreign exchange earnings is likely a focal point of theoretical discussions in this context (Calero and Turner 2020; Song et al., 2012). Moreover, the reciprocal relationship between migration and tourism demand may be explored, with migration patterns influencing tourist flows and vice versa. Additionally, the connection between tourism and climate change is a pertinent area of investigation, with studies examining the environmental implications of tourism activities. Factors such as energy consumption, greenhouse gas emissions, and pollution associated with tourism may be analyzed to understand the sector's environmental footprint and its implications for climate change mitigation and adaptation efforts. By shedding light on these complex interrelationships, studies on migration, tourism demand, and their environmental implications contribute to a deeper understanding of the dynamics shaping global mobility patterns and their broader socio-economic and environmental consequences. Through rigorous empirical analysis and theoretical frameworks, researchers aim to inform policy decisions and industry strategies aimed at fostering sustainable tourism development while mitigating adverse environmental impacts.

Examining the relationship between the tourism sector and climate change is pivotal, given the potential interaction and mutual influence between these two domains (Chen et al., 2017). Existing literature posits a complex interplay between tourism arrivals, climate change impacts on economic growth, and the association between the tourism sector and carbon dioxide emissions. This research endeavors to make two primary contributions to the existing body of literature in this field. Firstly, it aims to revisit recent empirical studies that delve into the intricate linkages between tourism and climate change. By synthesizing and critically analyzing these studies, this research seeks to offer insights into the evolving dynamics and nuanced relationships within this domain. Understanding how tourism activities intersect with climate change phenomena can provide valuable insights for policymakers, industry stakeholders, and researchers striving to address sustainability challenges in the tourism sector. Secondly, this research endeavors to contribute to the literature through the analysis of panel data. Leveraging panel data methodologies allows for a comprehensive examination of the dynamics between tourism, climate change, and associated economic and environmental variables over time and across different geographic regions. By employing panel data analysis techniques, this research aims to

uncover nuanced patterns, trends, and causal relationships that may not be apparent in cross-sectional or time-series analyses alone (Kusano and kemmelmeler, 2020; Bennett and Smith, 2017; Vogl, 2023; Hamaker et al., 2020). Through these dual contributions, this research endeavors to advance our understanding of the complex interactions between the tourism sector and climate change. By elucidating the multifaceted relationships and potential implications for economic, environmental, and social systems, this study seeks to inform evidence-based decision-making and policy formulation aimed at promoting sustainable tourism development and mitigating the adverse impacts of climate change on tourism-dependent economies.

2. LITERATURE REVIEW

This section delves into the multifaceted relationship between economic growth, tourism arrivals, and climate change, offering a comprehensive analysis of their interconnected dynamics. Notably, the research also explores the association between carbon dioxide emissions and tourism arrivals, shedding light on their intricate interplay. Empirical studies, such as that by Tiwari et al. (2013), have pursued this avenue of research, further elucidating the complex relationships within this domain. It is pertinent to highlight that within the framework of ecological economics, factors such as climate change, migrations, and economic growth are intimately linked to the tourism sector, underscoring the holistic nature of these interconnections. Sequeira and Nunes (2008) conducted a seminal study on the impact of the tourism sector on economic growth, employing robust econometric techniques such as the fixed effects estimator and GMM-system. Their findings provide compelling evidence that the tourism sector plays a pivotal role in fostering economic growth, thereby emphasizing the significance of sustainable tourism development as a driver of broader economic prosperity. By synthesizing insights from empirical studies and theoretical frameworks within the realm of ecological economics, this research seeks to deepen our understanding of the intricate relationships between economic growth, tourism dynamics, and climate change. Through rigorous analysis and interpretation of empirical evidence, this section aims to contribute valuable insights to the discourse surrounding sustainable tourism development and its implications for economic and environmental sustainability.

In a pertinent study by Brida and Risso (2011), the focus is on evaluating German tourism demand specifically within South Tyrol, Italy. Employing the gravity model framework, the authors leverage a GMM estimator, as proposed by Arellano and Bond, to discern the dynamics of tourism demand. Their findings reveal compelling insights, indicating that lagged tourism arrivals exert a positive influence on the long-term trajectory of tourism demand within the region. This empirical investigation underscores the importance of understanding the temporal dynamics and determinants of tourism demand, particularly within the context of specific geographic locales and visitor demographics. Brida and Risso (2011) found that variables such as crude oil price and relative price exhibited a negative impact on tourism arrivals. This highlights the sensitivity of tourism demand to external economic factors, such as fluctuations in oil prices and changes in relative prices. Understanding these dynamics is crucial for policymakers and industry stakeholders seeking to navigate the complexities of tourism markets and effectively manage demand in response to economic and market conditions. The negative impact of crude oil prices and relative prices on tourism arrivals underscores the importance of considering economic factors in analyzing tourism demand. Fluctuations in oil prices can affect travel costs, transportation expenses, and overall consumer spending patterns, influencing individuals' decisions to travel. Similarly, changes in relative prices, such as shifts in currency exchange rates, can impact the affordability of travel destinations for international tourists. These findings have significant implications for tourism policymakers and industry stakeholders. They suggest that strategies to stimulate tourism demand should not only focus on marketing efforts and destination attractiveness but also take into account broader economic trends and external factors affecting travel behavior. Moreover, efforts to mitigate the negative effects of oil price fluctuations and exchange rate volatility on tourism demand may involve implementing proactive measures such as diversifying tourism offerings, enhancing destination competitiveness, and implementing pricing strategies to offset cost increases associated with external economic factors. Furthermore, understanding the complex interplay between economic variables and tourism demand can inform more effective policy interventions aimed at promoting sustainable tourism development. By considering the economic drivers of tourism demand alongside environmental and social factors, policymakers can develop holistic strategies that balance economic growth with environmental conservation and community well-being. This integrated approach is essential for fostering resilient and sustainable tourism sectors that contribute positively to both economic development and environmental stewardship.

Gokovali's (2010) examination of the relationship between tourism and economic growth in Turkey offers valuable insights into the dynamics of the country's tourism sector and its impact on overall economic performance. By analyzing data from the period 1985 to 2005 and employing the Ordinary Least Squares (OLS) estimator, Gokovali (2010) explores how tourism arrivals and investments contribute to Turkey's economic growth. The positive correlation between tourism arrivals, investments, and economic growth revealed in Gokovali's (2010) analysis underscores the significant role played by the tourism sector in driving Turkey's economic development during the studied period. As tourism arrivals increase, they stimulate economic activity across various sectors, including hospitality, transportation, retail, and entertainment. This influx of tourists not only generates direct revenue from expenditures on accommodations, dining, and attractions but also spurs indirect economic benefits through multiplier effects, such as increased demand for goods and services supplied by local businesses. Moreover, Gokovali's (2010) findings highlight the importance of investments in the tourism industry as a catalyst for economic growth. Infrastructure development, hotel construction, tourism marketing initiatives, and other investments contribute to enhancing Turkey's attractiveness as a tourist destination, thereby attracting more visitors and fostering economic expansion. Additionally, investments in

tourism-related infrastructure and amenities improve the overall quality of the tourism experience, leading to higher visitor satisfaction and increased repeat visitation, which further bolster economic growth. By demonstrating the positive relationship between tourism, investments, and economic growth, Gokovali's (2010) analysis provides valuable insights for policymakers, tourism authorities, and industry stakeholders seeking to leverage the potential of the tourism sector for sustainable economic development in Turkey. The findings underscore the importance of strategic planning, investment promotion, and destination management practices aimed at enhancing Turkey's tourism competitiveness, diversifying tourism offerings, and ensuring the long-term sustainability of the tourism industry as a key driver of economic prosperity.

Fawaz et al.'s (2014) empirical investigation into the relationship between tourism and economic growth offers a comprehensive analysis spanning 144 countries over the period from 1975 to 2010. In their study, the authors delve into the intricate dynamics between tourism activity and various factors influencing economic growth across a diverse range of nations. The key finding of Fawaz et al.'s (2014) research is the identification of a positive correlation between tourism and economic growth. This suggests that countries experiencing higher levels of tourism activity tend to exhibit stronger economic performance over time. The presence of this positive association underscores the significant role played by the tourism sector as a driver of economic development on a global scale. Moreover, Fawaz et al.'s (2014) highlight several additional factors that contribute to fostering economic growth alongside tourism. These include human capital development, investment inflows, trade openness, and other aspects of economic globalization. By incorporating these variables into their analysis, the authors provide a more nuanced understanding of the multifaceted relationship between tourism and broader economic indicators. The positive correlation observed between tourism, human capital, investment, openness to trade, and economic growth underscores the interconnected nature of these factors within the context of national economic development. Tourism not only generates direct revenue and employment opportunities but also contributes to the enhancement of human capital through skills development, fosters investment inflows by creating attractive business environments, and promotes economic integration through increased international trade and exchange. Fawaz et al.'s (2014) empirical study contributes valuable insights into the complex interplay between tourism and economic growth, offering policymakers and stakeholders a deeper understanding of the mechanisms driving economic development in countries with vibrant tourism sectors. By recognizing the positive impact of tourism and its synergies with other drivers of economic growth, policymakers can formulate more effective strategies to harness the potential of the tourism sector as a catalyst for sustainable development and prosperity.

Panahi et al. (2014) conducted a comprehensive analysis of the relationship between the tourism sector and economic growth using time series data. Focusing on Turkey over the period from 1970 to 2011, the authors examined various factors influencing economic growth, with a particular emphasis on the contributions of tourism-related variables. In their study, Panahi et al. (2014) identified several independent variables believed to impact economic growth. These variables included tourist spending, human capital development, government consumption expenditures, and exchange rates. By incorporating these factors into their analysis, the authors sought to elucidate the complex interactions between tourism activity and broader economic performance within the context of Turkey's evolving economy. The empirical findings of Panahi et al. (2014) research shed light on the multifaceted nature of the relationship between tourism and economic growth in Turkey. Specifically, the study revealed several key insights regarding the impacts of different variables on economic expansion. Firstly, tourist spending exerted a positive effect on economic growth. This suggests that increased expenditure by tourists within the Turkish economy contributes positively to overall economic performance, driving growth in sectors catering to tourism-related activities. Similarly, investments in human capital were found to have a positive correlation with economic growth. This underscores the importance of education, skills development, and workforce training in enhancing productivity and driving long-term economic expansion. Government consumption expenditures were also identified as a factor positively influencing economic growth. This implies that public investment and expenditure in key sectors of the economy contribute to overall growth and development.

In contrast, the exchange rate was found to be negatively correlated with economic growth. This suggests that fluctuations in exchange rates may pose challenges to economic stability and hinder overall growth prospects, potentially affecting factors such as trade competitiveness and foreign investment. The findings of Panahi et al. (2014) study provide valuable insights into the complex dynamics shaping Turkey's economic growth, particularly within the context of the tourism sector. By identifying the impacts of various factors on economic performance, the research offers policymakers and stakeholders valuable information for formulating strategies aimed at fostering sustainable and inclusive growth in Turkey's economy, leveraging the potential of the tourism sector as a driver of development. Akinboade and Braimoh (2010) delved into the relationship between tourism arrivals and economic growth, focusing on the period from 1980 to 2005. Employing Granger causality methodology, the authors sought to uncover the causal linkages between tourism activity and overall economic performance within the context of their study.

Granger causality analysis is a statistical technique commonly used in econometrics to assess the direction of causality between two time series variables. By applying this methodology, Akinboade and Braimoh (2010) aimed to discern whether tourism arrivals Granger-cause changes in economic growth, or vice versa, or whether a bidirectional causality exists between these variables. Their research methodology allowed them to explore the temporal dynamics and potential causal relationships between tourism arrivals and economic growth over the specified period. By analyzing the patterns and interactions between these variables, the authors aimed to provide insights into the extent to which tourism activity influences economic growth, and vice versa, within the context of their study timeframe. Through their investigation, Akinboade and Braimoh (2010) aimed to contribute to the existing body of literature on tourism and

economic development by offering empirical evidence and insights derived from their Granger causality analysis. Their findings would have implications for policymakers, stakeholders, and researchers seeking to understand the dynamics of the tourism sector and its impacts on broader economic performance, particularly within the context of the specific time period examined in their study.

Jebli et al. (2014) adopted Granger causality methodology in their study, which explored the intricate relationship between carbon dioxide emissions, economic growth, renewable energy, and tourism arrivals. By utilizing panel data spanning the period from 1995 to 2010, the authors sought to uncover the causal linkages and dynamic interactions among these key variables. Their empirical analysis yielded intriguing findings regarding the impact of renewable energy and tourism arrivals on carbon dioxide emissions. The results revealed a negative relationship between renewables, tourist arrivals, and CO2 emissions. This suggests that higher levels of renewable energy adoption and increased tourism activity were associated with reduced carbon emissions, pointing towards the potential role of these factors in mitigating environmental impacts. Through their application of Granger causality methodology and analysis of panel data, (Jebli et al., 2014). provided valuable insights into the complex interplay between economic growth, renewable energy utilization, tourism activity, and environmental sustainability. Their findings underscored the importance of considering multiple factors and their dynamic interactions when examining environmental issues and formulating policy responses aimed at promoting sustainable development.

Xiao et al. (2011) shed light on the long-term implications of tourism arrivals, emphasizing their potential contribution to reducing carbon dioxide emissions. Their empirical investigation delved into the intricate relationship between mitigation efforts and the strategies employed to curb carbon dioxide levels in the city of Lijiang. The study revealed significant impacts of carbon dioxide emissions on various sectors, including water, agriculture, and tourism. Through meticulous analysis, the authors identified behavioral changes as a critical component in the endeavor to mitigate CO2 emissions and promote sustainable development. By advocating for investment in sustainable practices and emphasizing the importance of behavioral shifts, Xiao et al. (2011) underscored the role of proactive measures in addressing environmental challenges. Their findings underscored the need for comprehensive strategies that encompass diverse sectors and prioritize long-term sustainability to effectively combat carbon emissions and mitigate their adverse effects on the environment.

Jiang's (2009) research highlights the pivotal concept of sustainability in the context of tourism development. The study underscores the significance of achieving harmony between tourists and local communities, with Lijiang emerging as a focal point for this endeavor. By emphasizing the need for sustainable tourism practices, Jiang underscores the importance of fostering positive interactions between tourists and local residents. This harmonization is deemed essential for ensuring the long-term viability and success of tourism initiatives in Lijiang and similar destinations. Through comprehensive analysis, Jiang's (2009) research contributes valuable insights into the complex dynamics of tourism sustainability. By advocating for strategies that prioritize the well-being of both tourists and local communities, the study lays the groundwork for fostering sustainable tourism development that benefits all stakeholders involved.

The empirical study conducted by Ozturk and Uddin (2012) suggests a positive relationship between energy consumption and carbon dioxide emissions. This finding aligns with the broader literature, which indicates a positive correlation between carbon dioxide emissions, energy consumption, and economic growth. However, the relationship between trade and economic growth remains ambiguous and warrants further investigation. By shedding light on the linkages between energy consumption, carbon dioxide emissions, and economic growth, Ozturk and Uddin (2012) study contributes to a deeper understanding of the complex interplay between these variables. Their findings underscore the importance of addressing energy-related challenges within the broader context of sustainable development and environmental conservation.

Grossman and Helpman (1991) present a contrasting view, arguing that international trade actually stimulates economic growth. Their argument suggests that trade can lead to increased specialization, efficiency gains, technological diffusion, and enhanced productivity, all of which contribute to overall economic growth. This perspective highlights the potential positive impact of trade on economic development and underscores the importance of considering trade policies in the context of broader growth strategies. In light of Grossman and Helpman (1991) argument, it becomes apparent that the relationship between trade and economic growth is multifaceted and subject to various factors and conditions. While trade may indeed promote growth through the channels they describe, the extent to which this occurs may depend on factors such as trade policies, market structures, institutional frameworks, and global economic conditions.

3. METHODOLOGY AND DATA

In this research, panel data methodology is employed, utilizing a sample comprising 27 countries of the European Union over the period from 1990 to 2019. Building on the empirical approaches of previous studies such as Faustino and Leitão (2007), both static panel methods (OLS, fixed effects, and random effects) and dynamic panel data techniques (GMM-system) are applied. This methodological choice is consistent with the recommendations put forth by Faustino and Leitão (2007), as well as Thorpe and Leitão (2014), who suggest that such approaches are effective in addressing issues of serial correlation and endogeneity of independent variables. By employing panel data techniques, this study aims to capture both cross-sectional and temporal variations across the selected countries and time periods. The use of dynamic panel data methods allows for the examination of how changes in explanatory variables over time impact the dependent variable, while also accounting for potential feedback effects and addressing concerns related to endogeneity. Overall, the methodology adopted in this study is designed to provide robust empirical insights into the

relationship between the variables under investigation, taking into account the complexities and dynamics inherent in the data. Through careful consideration of the assumptions underlying the empirical analysis, this research seeks to generate reliable findings that contribute to the existing literature on the subject.

4. RESULTS AND DISCUSSIONS

The provided table 1 delineates the definitions of various variables alongside their respective data sources. The variable denoted as "Y" signifies the gross domestic product divided by the population, offering insight into the economic output per person. This data is sourced from the World Bank. "Tour" represents the number of tourism arrivals, indicating the volume of tourists visiting a particular region or country. The data for this variable is sourced from the World Bank and the World Tourism Organization's Yearbook of Tourism Statistics. "CO2" refers to carbon dioxide emissions per capita, which signifies the average emissions of carbon dioxide per person. Data for this variable is obtained from the World Bank and the Environmental Sciences Division, USA. "EC" denotes energy consumption per capita, providing information on the average energy consumed per person. This variable's data sources include the World Bank and the International Energy Agency. Lastly, "Trade" represents the total value of exports plus imports of goods and services as a percentage of gross domestic product (GDP). The data sources for this variable encompass the World Bank, national accounts, and the Organisation for Economic Co-operation and Development (OECD).

Table 1: Definition of each variable

Variables	Definition	Source
Y	Gross domestic product divided by population	Word Bank
Tour	Number of tourism arrivals	World Bank, and World Tourism Organization, Yearbook of Tourism Statistics
CO_2	Carbon dioxide emissions per capita	World Bank, and Environmental Sciences Division, USA
EC	Energy consumption per capita	World Bank, and International Energy Agency
Trade	Exports plus imports of goods and services % GDP	World Bank , national accounts, and OECD

The table 2 presents the Phillips-Perron unit root test results for various variables. For the variable "Y," the test statistic is 36.88 with a corresponding p-value of 0.963, suggesting weak evidence against the null hypothesis of a unit root, indicating non-stationarity. The "Tour" variable yields a test statistic of 78.91 with a p-value of 0.01, indicating strong evidence against the null hypothesis of a unit root, suggesting stationarity. Similarly, for the "CO2" variable, the test statistic is 86.09 with a p-value of 0.00, providing strong evidence against the null hypothesis of a unit root, implying stationarity. The "EC" variable produces a test statistic of 123.35 with a p-value of 0.00, indicating strong evidence against the null hypothesis of a unit root, suggesting stationarity. Lastly, for the "Trade" variable, the test statistic is 73.25 with a p-value of 0.04, suggesting weak evidence against the null hypothesis of a unit root, indicating non-stationarity.

Table 2: Phillips-Perron unit root

Variables	Unit root test
Y	36.88
Tour	78.91**
CO_2	86.09***
EC	123.35***
Trade	73.25**

Table 3: Model 1

	Dependent Variable: Economic growth		
Variables	OLS	Fixed Effects	Random Effects
Tour	0.11***	0.78***	0.75***
CO_2	1.03***	1.65***	0.60***
EC	-0.12***	2.39***	0.27***
Trade	0.23***	0.03*	0.05**
C	2.89***	-10.21**	-0.25

The table 3 presents the regression results for Model 1, with economic growth as the dependent variable. Three different estimation techniques are used: Ordinary Least Squares (OLS), Fixed Effects, and Random Effects. For the OLS estimation, the coefficient estimates are as follows: Tour (0.11, p-value 0.00), CO2 (1.03, p-value 0.00), EC (-0.12, p-value 0.00), Trade (0.23, p-value 0.00), and the intercept (2.89, p-value 0.00). The adjusted R-squared value for this model is 0.54. In the Fixed Effects estimation, the coefficient estimates are: Tour (0.78, p-value 0.00), CO2 (1.65, p-value 0.00), EC (2.39, p-value 0.00), Trade (0.03, p-value 1.99), and the intercept (-10.21, p-value 0.00). The adjusted

R-squared value for this model is 0.47. In the Random Effects estimation, the coefficient estimates are: Tour (0.75, p-value 0.00), CO2 (0.60, p-value 0.00), EC (0.27, p-value 0.00), Trade (0.05, p-value 0.00), and the intercept (-0.25, p-value 0.59). The adjusted R-squared value for this model is 0.34. Additionally, the Hausman Test is conducted to determine the appropriate model between Fixed Effects and Random Effects. The test statistic is 100.23 with a p-value less than 0.01 (***), indicating that the Fixed Effects model is preferred over the Random Effects model due to the endogeneity of the explanatory variables.

The table 4 presents the results of Model 1 with economic growth as the dependent variable, estimated using the Generalized Method of Moments (GMM) with both System 1-step and System 2-step approaches. In the System 1-step GMM estimation, the coefficient estimates are as follows: Yt-1 (lagged dependent variable) (0.89, p-value 0.00), Tour (0.19, p-value 0.00), CO2 (0.99, p-value 0.00), EC (economic consumption) (-0.39, p-value 0.00), TRADE (trade variable) (0.06, p-value 1.24), and the intercept (0.36, p-value 0.41). The model's adjusted R-squared value is 0.63. In the System 2-step GMM estimation, the coefficient estimates are: Yt-1 (0.91, p-value 0.00), Tour (0.19, p-value 0.01), CO2 (1.08, p-value 0.00), EC (-0.40, p-value 0.03), TRADE (0.06, p-value 0.17), and the intercept (-0.02, p-value 0.98). The adjusted R-squared value for this model is not provided. Furthermore, the Sargan Test is conducted to assess the overidentification restrictions. The test statistic is 1.00, suggesting that the instruments used in the estimation are valid as the p-value is not significant.

Table 4: Model 1

Dependent Variable: Economic growth		
Variables	GMM–System 1step	GMM-System 2 step
Y_{t-1}	0.89***	0.91***
Tour	0.19***	0.19**
CO_2	0.99***	1.08***
EC	-0.39***	-0.40**
TRADE	0.06	0.06

The table 5 presents the results of Model 2 with carbon dioxide emissions as the dependent variable, estimated using Ordinary Least Squares (OLS), Fixed Effects, and Random Effects models. In the OLS estimation, the coefficient estimates are as follows: Y (-0.79, p-value 0.00), Y2 (0.13, p-value 0.00), Tour (-0.05, p-value 0.00), EC (economic consumption) (0.21, p-value 0.20), and the intercept (2.22, p-value 0.00). The model's adjusted R-squared value is 0.33. In the Fixed Effects estimation, the coefficient estimates are: Y (0.65, p-value 0.00), Y2 (-0.08, p-value 0.00), Tour (-0.04, p-value 0.00), EC (1.02, p-value 0.00), and the intercept (-4.54, p-value 0.00). The adjusted R-squared value for this model is 0.68. In the Random Effects estimation, the coefficient estimates are: Y (3.81, p-value 0.00), Y2 (-0.45, p-value 0.00), Tour (-0.05, p-value 0.00), EC (0.57, p-value 0.00), and the intercept (-1.88, p-value 0.00). The adjusted R-squared value for this model is 0.65. Additionally, the Hausman Test is conducted to assess the choice between Fixed Effects and Random Effects models. The test statistic is 1468, with a p-value of 0.00, indicating that the Fixed Effects model is preferred over the Random Effects model.

Table 5: Model 2

Dependent Variable: Carbon dioxide emissions			
Variables	OLS	Fixed Effects	Random Effects
Y	-0.79***	0.65***	3.81***
Y^2	0.13***	-0.08***	-0.45***
Tour	-0.05***	-0.04***	-0.05***
EC	0.21	1.02***	0.57***

Table 6: Model 2

Dependent Variable: Carbon dioxide emissions		
Variables	GMM –System 1step	GMM-System 2 step
CO_{2t-1}	0.85***	0.65***
Y	0.28***	0.45***
Y^2	-0.03***	-0.05***
Tour	-0.05***	-0.13***
EC	0.04***	0.36**

Table 6 presents the results of Model 2 with carbon dioxide emissions as the dependent variable, estimated using the Generalized Method of Moments (GMM) with both System 1-step and System 2-step approaches. In the System 1-step GMM estimation, the coefficient estimates are as follows: CO2t-1 (0.85, p-value 0.00), Y (0.28, p-value 0.00), Y2 (-0.03, p-value 0.02), Tour (-0.05, p-value 0.00), EC (economic consumption) (0.04, p-value 0.00), and the intercept (-

0.27, p-value 0.26). The model's adjusted R-squared value is 0.47. In the System 2-step GMM estimation, the coefficient estimates are: CO2t-1 (0.65, p-value 0.00), Y (0.45, p-value 0.00), Y2 (-0.05, p-value 0.00), Tour (-0.13, p-value 0.00), EC (0.36, p-value 0.01), and the intercept (-1.37, p-value 0.02). The adjusted R-squared value for this model is not provided. Additionally, the Sargan Test is conducted to assess the validity of overidentifying restrictions in the model. The test statistic is 1.00 with a chi-squared distribution, indicating that the instruments used in the GMM estimation are valid.

5. CONCLUSIONS

This study seeks to evaluate the interconnectedness between economic growth, tourism arrivals, and climate change through the formulation of three distinct equations. In the first model, we focus on examining the relationship between economic growth and tourism arrivals. The second model delves into the dynamic interplay between climate change and tourism arrivals. Finally, the third equation is dedicated to identifying and analyzing the determinants that influence tourism arrivals. By structuring our analysis across these three equations, we aim to comprehensively capture the multifaceted relationships and dependencies that exist within the context of economic growth, tourism dynamics, and environmental factors such as climate change. Through this approach, we endeavor to provide a nuanced understanding of the complex interactions and underlying mechanisms driving these phenomena, thereby contributing to the broader discourse on sustainable development and environmental management. In revisiting the empirical literature pertaining to economic growth, tourism arrivals, and climate change, this article employs a panel data approach encompassing various estimation techniques such as OLS, fixed effects, random effects, and GMM-system. Focusing on the equation representing economic growth, our analysis reveals a noteworthy finding: tourism arrivals exert a positive impact on economic growth. Through meticulous examination and application of diverse econometric methods, we unveil the significant role played by tourism arrivals in fostering economic growth. This empirical insight underscores the potential economic benefits derived from tourism activity, thereby highlighting its importance as a driver of economic development.

The econometric model employed in this study elucidates several key relationships pertaining to economic growth. Specifically, our analysis reveals positive correlations between energy consumption, carbon dioxide emissions, trade openness, and economic growth. However, it is important to note that while economic growth is positively influenced by energy consumption and carbon dioxide emissions, there are associated costs. The positive impact of energy consumption and carbon dioxide emissions on economic growth underscores the role of these factors in driving economic activity. Nevertheless, it is imperative to acknowledge the potential costs and externalities associated with increased energy consumption and carbon emissions. As economies grow, the environmental implications of heightened energy consumption and carbon emissions become increasingly pronounced, necessitating careful consideration and mitigation strategies to address these challenges.

The analysis of carbon dioxide (CO2) emissions as the dependent variable yielded several noteworthy findings. Income per capita and energy consumption exhibited a positive association with CO2 emissions, corroborating the anticipated impact of these factors on climate change. Interestingly, the inclusion of squared income per capita revealed a negative correlation with CO2 emissions, aligning with the Environmental Kuznets Curve (EKC) hypothesis, which suggests an inverted U-shaped relationship between income and environmental degradation. Furthermore, the examination of tourism arrivals in relation to CO2 emissions uncovered a negative impact, indicating that tourism arrivals are inversely related to carbon dioxide emissions. This finding underscores the existence of a negative externality associated with tourism, wherein increased tourism activity coincides with reduced CO2 emissions. Additionally, the equation assessing the determinants of tourism arrivals revealed several factors influencing tourism activity. Income per capita, trade openness, and energy consumption were found to exert a positive effect on tourism arrivals, indicating that higher levels of income, greater trade openness, and increased energy consumption are associated with heightened tourism activity. These insights contribute to a comprehensive understanding of the intricate relationships between economic factors, tourism, and climate change.

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