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Examining the nexus between technological innovation, FDI, economic growth and tourism in selected countries: A simultaneous equation model approach

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Abstract: The current study examines the impact that technological innovation, foreign direct investment, economic growth, and globalization have on tourism in top 10 most popular tourist destinations in the world. The information on the number of tourists, foreign direct investment, growth in gross domestic product, GFCF, use of FFE, and total energy consumption were extracted from the World Development Indicators. The United Nations Conference on Trade and Development (UNCTAD) database was used for collecting the statistics about technological innovation. The source ETH Zurich has been utilized to gather panel data for the time period 2008 to 2022 to calculate the KOF Index of Globalization. Theoretically, FDI and Economic growth are the endogenous variables for the Tourism model. Whereas, TI, Glob, Energy Consumption, and GFCF are the exogenous variables. Hence, the analysis is based on the System Equation—Simultaneous equations, after checking identification that confirms the problem of simultaneity in system of 3 equations. The empirical outcomes suggest that TI, FDI, globalization index, GDP growth, and energy consumption are the most important factors that contribute to an increase in tourism. Likewise FDI as the endogenous variable is favorably impacted by globalization, technological innovation, fossil fuel energy consumption, gross fixed capital formation, and tourism. Nevertheless, the coefficient of GFCF is only insignificant in the study. While, globalization, TI, and FFE are also favorably affecting the FDI. GDP growth is the second endogenous variable in this research, and it is positively influenced by globalization, FDI, and tourism in the case of the top 10 nations that are most frequently visited by tourists.

Keywords: tourism; foreign direct investment; economic growth; globalization; technological innovation; fossil fuel consumption

1. Introduction

The term "Foreign Direct Investment" (FDI) refers to the capital that is invested by a corporation or a person from one nation into a business or project that is situated in another country (Martins et al., 2023). It involves the formation of a long-term presence in a foreign market, generally by the acquisition of shares, the establishment of a subsidiary or branch, or a merger with an existing firm. In addition, it may entail the establishment of a branch or subsidiary in the domestic market. Foreign direct investment is a key force behind the globalization of the

economy and plays a significant part in the advancement of economic growth, development, and international commerce (Sokhanvar and Jenkins, 2022; Ullah et al., 2022). Positive linkages can result from tourism, economic expansion, and FDI if successfully managed and coordinated. Tourism has the potential to drive economic growth, attract foreign direct investment, contribute to the creation of jobs, and generate revenue (Raihan, 2023; Razzaq et al., 2023). Foreign direct investment, on the other hand, has the potential to boost the tourism industry by enhancing infrastructure, quality standards, and service. This positive feedback loop has the potential to promote long-term economic growth, increase economic diversity, and lessen the economy's reliance on certain businesses and sectors (Haider and Tehseen, 2022). A nation that sees a considerable influx of tourists may be able to entice FDI from businesses that are interested in investing in the tourism industry of that nation (Işık et al., 2024). In order to capitalize on the rising demand for tourism and make a profit from it, foreign investors may choose to build hotels, resorts, restaurants, travel agency, and other companies associated to tourism (Zhuang et al., 2022; Nguyen 2021). This can bring in new financial resources, technological advances and innovations, and expert knowledge to the country that is hosting the event, therefore improving the sector's competitiveness and overall quality (Chon and Hao, 2024; Jabeen et al., 2024). FDI in the tourism industry can generate job opportunities, propel the creation of new infrastructure, and contribute to the overall expansion of the tourism sector (Ullah et al., 2024), Tourism, economic growth, and foreign direct investment are all interrelated aspects that mutually reinforce one another. These factors significantly contribute to sustainable development, the creation of jobs, the development of infrastructure, and an improvement in living conditions in the nation that hosts them when they are managed efficiently (Bhatti et al., 2024; Tabash et al., 2023).

1.1. Tourism, growth and FDI

However, to participate in the tourism sector, one needs to have access to worldwide marketing and distribution networks, as well as financial resources, physical infrastructure, and specialized knowledge. As a result, the accessibility of various financing sources is of the utmost significance to realize additional tourism development and economic expansion. As a result, FDI would play a key role in the development of the tourism industry, particularly in developing nations. This is because FDI would provide the necessary finances and facilities, which are the cornerstones of tourism development and include things like international airports, motorways, hotels, and sophisticated technology (Anouti et al., 2023; Chen et al., 2022). The markets of emerging countries were opened up to foreign investors, who brought with them their existing or future tourist resources. On the other hand, there is a causal nexus between tourism and FDI since tourists typically have a desire for products and services in the host country, such as places to stay, food, transit facilities, and entertainment options (Işık et al., 2020). In order to meet this ever-increasing demand, the levels of production that are now in place in the majority of emerging countries will need to be escalated (Ozkan et al., 2023). FDI is seen as an effective avenue for the transmission of trade, knowledge and technologies that

contribute to economic progress. This is due to the fact that developing countries suffer from a lack of facilities and infrastructure.

It is well acknowledged that the expansion of international tourism can contribute favorably to the acceleration of overall economic growth through a variety of avenues. To begin, tourism is a substantial source of foreign currency earnings, which makes it possible to pay for imported capital goods or fundamental inputs required in the manufacturing process. Second, tourism is a significant factor in the stimulation of investments in brand-new infrastructure and the intensification of competition between local businesses and businesses located in other countries that are tourist destinations. Third, the consequences of tourism, both directly and indirectly, as well as induced effects, are beneficial to other economic sectors. The fourth benefit of tourism is that it helps to enhance both revenue and employment opportunities. Fifth, the beneficial exploitation of economies of scale in national enterprises can be a result of tourism (Andriotis, 2002; Fang et al., 2016; Lin and Liu, 2000; Robinson et al., 2019). Lastly, tourism is a significant contributor to the dissemination of technical know-how, the promotion of research and development, and the building of human capital. On the other hand, it is essential to keep in mind that a percentage of the foreign currency that is generated as a result of tourism is exported by multinational corporations in the form of transfer pricing and other similar practices (Han et al., 2023). This is especially true for countries with smaller economies, where a significant portion of the tourism business is not owned by locals.

There are several examples of small islands that depend largely on revenue from international tourism and where the government has provided substantial support for the tourism industry (Louca, 2006). Some of these islands are in the Caribbean. According to Croes (2006), tourism offers advantages in three different ways that help a country overcome the disadvantages associated with its size. Tourism may do this by giving scale and competitiveness, as well as greater consumer choice and greater trade openness. A number of empirical studies present strong evidence of a positive relationship between tourism and economic growth in small economies (Durbarry, 2004; Louca, 2006). There are very few growth models that include tourism as a sector and analyze the consequences of changes in tourism growth on long-run economic growth. This is despite the fact that numerous arguments and beliefs have been offered in favor of the significant impacts that tourism has on economic growth. In this study, we investigate how an acceleration in the pace of development in the demand for international tourism might influence the rate of economic growth and FDI in an economy that is heavily dependent on the tourism industry.

1.2. FDI, growth and globalization

The vast majority of multinational corporations are involved in the production and provision of a variety of goods and services, including automobiles, energy, telecommunications, engineering, insurance and banking, pharmaceuticals, and other private service industries. FDI has local and macro dimensions (Aluko et al., 2021; Leitao, 2012). What began many centuries ago with the first traders has since

developed into a general system in which a rising global division of labour increases along with the growth of worldwide production of goods and services. On the whole, globalization will advance at a quicker rate whenever international flows promote exchanges of more intangible goods, particularly information, or anywhere globalization necessitates physical displacements, such as in the case of tourism (Kayani et al., 2023). Therefore, despite the significance of the dynamics, both economic and otherwise, that are unleashed by tourism, integration occurs more slowly as a result of tourism than it does as a result of finance, banking, films, television, or the internet.

1.3. Growth, fossil fuel energy consumption and FDI

One of the primary goals of the research that has been done on the relationship between energy use and income is to better understand these processes. Recent advances in the field of research have produced contradictory findings, and there is no unanimity regarding the nature of the causality. Depending on the countries that were examined, the timeframe that was taken into consideration, the variables that were included, and the econometric technique that was used, several kinds of causation have been identified (Akbar et al., 2015; Hanif et al., 2019; Ullah et al. 2022). This is not wholly irrational in and of itself, considering that the link between energy and growth is likely to vary over time and between nations. The rise of urbanization and industrialization are two essential drivers of economic growth; the flourishing tourist sector helps both of these processes along, which in turn helps the economy thrive. According to Akadiri et al. (2020) findings, tourism is a major factor in the deterioration of the ecosystem and the acceleration of climate change (Bulut et al., 2023). It may be beneficial for emerging nations to tighten their environmental regulations and place a larger emphasis on economic growth in order to attract direct investment from outside investors. Developing countries have the potential to become pollution havens, with FDI perhaps having a part in this trend (Ongan et al., 2022). Developing nations have the potential to become pollution havens. In a similar vein, greater industrial output, consumption, and energy usage may lead to increased carbon dioxide (CO_2) emissions in a nation that has trade policies that are more open (Akbar et al., 2024; Kabil et al., 2022). According to Wang et al. (2021) and Mohsin et al. (2023), environmental degradation that occurs in nations that have open trade ties will eventually spread around the world as the global value chain expands (Ahmad et al., 2023; Anwar et al., 2023; Dagar et al., 2022).

1.4. Tourism, technological innovation and energy use

The tourism industry is placing a greater emphasis on sustainability in an effort to lessen the negative impact it has on the environment (Guzman et al., 2023; Shin and Baek, 2023). The development of new technologies is essential to accomplishing goals related to environmental preservation (Nasim et al., 2023; Pu et al., 2023). The use of energy-saving technology in tourist lodgings and transportation, such as LED lighting, smart thermostats, and energy management systems, can contribute to a reduction in the amount of energy that is consumed (Banga et al., 2022; Raihan et al., 2022; Nam et al., 2021). In order to create clean energy, tourism infrastructure is

currently undergoing the process of being outfitted with renewable energy sources such as solar panels and wind turbines (Hysa et al., 2023; Janjua et al., 2023; Yang et al., 2023).

In general, technological innovation plays an essential part in the transformation of the tourist sector as well as in solving concerns related to energy consumption and sustainability (Niu, 2023; Raihan et al., 2023). The tourism industry has the potential to improve the visitor experience while simultaneously reducing its negative effects on the surrounding environment if it accepts and implements creative ideas (Ibrahim and Mohammed, 2023; Nazneen et al., 2023). Even though more and more academics are investigating the connection between technical innovation and foreign direct investment, there are only a few interactive studies that look at the connection between technological innovation and FDI in the context of top ten most visited countries. Grossman and Krueger (1991) found that FDI may improve environmental deterioration through technical advancement. This finding demonstrates that FDI might offer technologies that are friendlier to the environment, which can aid economic activity. Some other academics, such as Loukil (2016); Hao et al. (2020); Hoang et al. (2021) and Wu et al. (2017), are of the opinion that the degree of technological innovation in a nation will be affected by the technology spillovers that result from FDI inflows, which would in turn support the environmental pollution of the host country and improve the environmental performance of the host country.

2. Literature review

In recent years, the research on tourism that has been published has been dominated by international studies on tourism demand (Işık et al., 2022). These studies have used either pure time series or regression models. Lim (1997) conducted an exhaustive review of over one hundred previously published tourism studies and discovered that the primary factors that influence the demand for tourism are consumer income, relative pricing, the cost of transportation, and currency rates. Additionally, it has been discovered that business travel (Fonseca and Sanchez, 2020; Fang et al., 2021; Nguyen et al., 2021; Shahbaz et al., 2020), trade (Shan and Wilson, 2001), and political risk (Rafiq et al., 2022; Xu et al., 2022) are all significant factors that contribute to the formation of tourism demand. When all of the direct investments made by MNCs are combined into one total, the total amount of FDI may be calculated. FDI involves not only the physical capital components but also the knowledge spill-over effects as well. It works in tandem with investments made within the country to foster economic expansion. The following section provides a theoretical analysis of this topic by situating it within the framework of an endogenous growth model. Although Denisia (2010) published early microeconomic analyses regarding the effects of FDI, more recent research has focused on the topic. In order to evaluate the effects of subsidies and taxes on FDI, Tavares-Lehmann et al. (2012); Jones and Temouri (2016) and Casella and Souillard (2022) carried out comparative static analysis within the context of a general equilibrium framework. According to research conducted by Tiwari and Mutascu (2011), knowledge-based assets are a significant driving forces behind the expansion of FDI in a number Asian countries respectively (Abid et al., 2022; Nguyen and Nguyen, 2022; Uche et al.,

2023; Yasmeen et al., 2022).

Numerous studies have concentrated their attention on a particular geographical area or group of nations. Hossain (2011) and Adedoyin and Zakari (2020) found a correlation between GDP and energy usage for selected nations that had just entered the industrialized world. Pachiyappan et al. (2021) conducted research on data from 12 Middle Eastern nations and India respectively and discovered a direct relationship between economic development and energy usage. In their study of the relationship between energy consumption, economic development, and CO_2 emissions in the BRICS (Brazil, Russia, India, China, and South Africa) countries, Pao and Tsai (2011) and Hung (2022) came to the conclusion that there was feedback in the case of Russia, conservation in the case of South Africa, and neutrality in the case of Brazil, India, and China. Zilio (2011); Apergis and Payne (2011) and Campo and Sarmiento (2013) conducted research on selected nations in Central America and discovered that in the short term, there is a bidirectional causation between economic growth and energy consumption; however, in the long run, the causality is compatible with the conservation theory (Farooq et al., 2023).

The research conducted by Salim and Rafiq (2012) focused on the adoption of renewable energy in six important growing economies. In the long term, income and pollution were the primary motivating factors for renewable energy adoption in four countries only; however, income was the only major driver for renewable energy adoption in other countries. Few research indicates that economies in the ASEAN area are expanding, and that a rising number of visitors are visiting those economies (Chopra et al., 2022; Chien et al., 2023; Khan et al., 2022; Vakulchuk et al., 2023). As a direct consequence of this, the level of pollution in the environment is growing. Therefore, it is essential to do further quantitative study on the connection between tourism and FDI-growth-pollution (Qiao et al., 2019; Vo et al., 2019). Even while the studies cited above demonstrate a clear connection between FDI and a country's rate of technical advancement, there is also, later on, a favorable association with environmental improvement. In spite of this, the existing body of research does not take into account how FDI and technical innovation are intertwined with the ecological footprint-growth nexus (Das et al., 2023; Işık et al., 2021).

2.1. Top ten most visited countries

The number of tourists arriving from other countries year after year has helped France maintain its position as one of the world's most popular tourist destinations. Before the pandemic caused by COVID-19 began in 2019, France hosted over 90 million visitors from other countries. Countries that are geographically close by, such as Germany, the United Kingdom, and Italy, are major source markets. Countries that are further away, such as the United States, China, and Japan, are also major source markets. In the top 10 nations that get the most international tourists each year, tourism is a substantial contributor to the national economy. The following is an outline of the tourist industry in each of these countries:

France is well-known all over the world for its illustrious past, culture, and several famous sites, such as the Eiffel Tower, the Louvre Museum, and the French Riviera. The city of Paris, which serves as the capital of France, is a significant

centre for tourism and receives millions of tourists annually. France's tourism industry is a substantial contributor to the country's GDP, since the country receives millions of tourists annually (Işik et al., 2017). Because of its extensive history and cultural legacy, as well as its varied landscapes and world-class attractions, the nation is a popular travel destination for visitors from both inside and outside the country. Spain: Spain is home to a wide variety of tourist destinations, some of which include stunning beaches, pulsating cities like as Barcelona and Madrid, historical buildings such as the Alhambra, and events that are known all over the globe, such as the Tomatina and the Running of the Bulls.

The United States of America is home to a diverse selection of tourist destinations, ranging from natural wonders such as the Grand Canyon and Yellowstone National Park to thriving metropolitan areas such as New York City, Los Angeles, and Las Vegas. The Statue of Liberty and Hollywood are just two of the many famous monuments that may be seen in popular sites. China is a well-known travel destination due to its extensive past, diverse cultural traditions, and breathtaking natural scenery. The Great Wall, the Terracotta Army, and bustling cities such as Beijing and Shanghai are among the most popular tourist attractions in China.

Italy is well-known across the world for its artistic and architectural treasures as well as its historical landmarks. Cities like Rome, Florence, and Venice draw travellers with famous sites like the Colosseum, the Vatican City, and the canals of Venice. Other popular tourist destinations include the Vatican City and the Duomo in Florence. The country is also home to some breathtakingly beautiful regions, such as Tuscany and the Amalfi Coast. Turkey; serving as a connection point between Europe and Asia, Turkey is home to a diverse range of historical landmarks and cultural traditions. Along with other prominent tourist destinations in Turkey, such as Cappadocia, Ephesus, and the breathtaking coastline, Istanbul's strategic location helps make it a highly sought-after vacation spot.

Mexico is a popular tourist destination due to its stunning beaches, historical sites such as Chichen Itza and Teotihuacan, bustling cities such as Mexico City, and cultural celebrations such as Dia de los Muertos. The nation is also well-known for the variety and quality of its food. Germany is a country that has a variety of attractions, including historic sites, attractive landscapes, and lively cities. Popular travel destinations include cities like as Berlin, Munich, and Cologne, as well as points of interest such as the Brandenburg Gate, Neuschwanstein Castle, and the Rhine Valley.

Thailand is well-known for its breathtaking beaches, pulsating cities like as Bangkok, and cultural sites such as the ancient city of Ayutthaya and the temples of Chiang Mai. The welcoming people of the nation and the mouthwatering food are also big draws for tourists. The United Kingdom is home to a diverse range of tourist attractions, including natural wonders, cultural icons, and historical locations. A significant number of people go to see London each year to see its famous attractions including Buckingham Palace and the Tower of London. The Highlands of Scotland, the castles of Wales, and the picturesque landscapes of Northern Ireland are other popular tourist destinations.

3. Research data

The objective of this study was to measure tourism in terms of international tourism, the number of tourist arrivals, we used yearly series data beginning from 2008 and continuing through 2022 for ten countries chosen from the travel industry (world population review, 2022). The data came from selected countries in the world development indicators, UNCTAD, and the Kof Index of Globalization. The sample countries were France, Spain, the United States, China, Italy, Turkey, Mexico, Thailand, Germany, and the United Kingdom. The economies that were examined were chosen based on the fact that they are the most frequently visited by the global travel business. These nations heavily relied on the international travel sector to enhance economic growth.

3.1. Research methodology

The main variables of the study TOUR, FDI and GDP are explaining each other along with some other variables. As both variables are indigenously behaving therefore the model of the study is presented as follows;

$$TOUR = f(TI, GDP, FDI, FFE, EU) \tag{1}$$
$$FDI = f(TOUR, FFE, GLOB, TI, GFCF) \tag{2}$$
$$GDP = f(TOUR, FDI, GLOB, EU, FFE) \tag{3}$$

The above equations are showing that TOUR, FDI and GDP are dependent variables of the model and Fossil Fuel consumption, technological innovation, globalization, gross fixed capital formation and energy use are exogenous variables whereas foreign direct investment is present in both models as independent variables. According to the above set of equations the numbers of equations (G) are three and we have to check this set of equations for identification problem first. As per the Hall and Asteriou (2016), as each equation has two missing variable (M) and as per identification problem:

$$G - 1 = M$$
$$G = 3 \, \& \, M = 2$$

So we can say about the model that it is exactly identified and we can proceed further by formulating the equations.

$$TOUR = C_1 + \delta_1 TI + \delta_2 FDI + \delta_3 FFE + \delta_4 GDP + \delta_5 EU \tag{4}$$
$$FDI = C_2 + \delta_6 GLOB + \delta_7 TI + \delta_8 FFE + \delta_9 GFCF + \delta_{10} TOUR \tag{5}$$
$$GDP = C_3 + \delta_{11} GLOB + \delta_{12} FDI + \delta_{13} TOUR + \delta_{14} FFE + \delta_{15} EU \tag{6}$$

Here in both equations C is representing the constant term and subscripts 1, 2 and 3 are telling the equations. δ is representing the coefficients of the exogenous and indigenous variables. For the estimation, Eviews statistical software is used for system of equations. In system of equations, each equation is written manually according to simultaneous equation model and the results for each equation are reported below. The table of description of variables is following:

Table 1 shows measurement units and variable acronyms. International tourist arrival measure tourism (TOUR). Global tourists' appearance (TA) refers to the number of tourists who visit a country different than their own but within their normal environmental conditions (Akadiri et al., 2020). GDP equals resident producers' gross value contributions to the economy, plus product taxes and minus

subsidies not included in product value. GDP measures growth. As the topic of the study was fossil fuel use, economic growth, foreign direct investment, gross fixed capital formation, and energy use, all of which are important for tourism, foreign direct investment, and economic growth. Some random factors and instrumental variables explain how tourism, foreign direct investment, and economic growth are related.

Table 1. Description of variable of study.

Variable names	Abbreviations	Measurements
Tourism	TOUR	International tourism, number of arrivals
Foreign Direct Investment	FDI	Foreign direct investment, net inflows (% of GDP)
Economic Growth	GDP	GDP growth (annual %)
Fossil Fuel Consumption	FFE	Fossil fuel energy consumption (% of total)
Energy Use	EU	Energy use (kg of oil equivalent per capita)
Gross Fixed Capital Formation	GFCF	Gross fixed capital formation (% of GDP)
Technological Innovation	TI	Technology and Innovation index
Globalization	GLOB	Globalization Index (KOFGI)

4. Research analyses

The descriptive analysis is estimated as a common sample for each variable and is presented in **Table 2**. The panel's overall descriptive data are presented in **Table 2**, which may be found here. After combining all of the data from the study on a country-by-country basis, we determine the means, medians, and modes of the locations while taking into consideration a panel. Skewness and kurtosis are both components of the descriptive analysis that indicate the distribution of each variable. Skewness measures the degree to which a variable is skewed to one side or the other. Monitoring the residuals of regression equations allows for the estimation of the normality of residuals, which provides an indication of the robustness of the model against the risk of misspecification.

Table 2. Descriptive analysis.

	TOUR	FDI	GDP	TI	FFE	EU	GLOB	GFCF
Mean	17.98	2.03	1.95	1.77	78.58	7.89	78.58	23.50
Median	18.14	1.83	1.94	1.66	80.60	7.83	82.00	21.44
Maximum	19.20	12.03	11.35	4.28	91.06	8.92	90.30	44.52
Minimum	16.22	−1.16	−11.33	−0.96	41.66	7.21	61.83	15.64
Std. Dev.	0.76	1.47	4.01	0.90	12.48	0.44	8.89	7.16
Skewness	−0.19	2.64	−0.48	0.00	−1.64	0.67	−0.40	1.85
Kurtosis	2.00	18.08	4.29	2.78	4.95	2.83	1.71	5.58
Jarque-Bera	7.13	1,594.90	16.10	0.29	90.78	11.51	14.37	126.87
Probability	0.327	0.384	0.473	0.86	0.456	0.693	0.411	0.956
Observations	150.00	150.00	150.00	150.00	150.00	150.00	150.00	150.00

All of the variables are confirming that the null hypothesis is true, which

demonstrates that the residuals are normally distributed and that there are no errors in the model's specification.

4.1. Correlation matrix

The data for the selected nations are being used to construct a panel that is fair and balanced. Extrapolations and interpolations of the missing data are carried out with the help of a linear trend. During the course of the research, a correlation matrix was compiled in order to better comprehend the interdependence of the variables. The results of the correlation matrix, which was produced with the assistance of the EVIEWS application (Agung, 2011), are presented in **Table 3**.

Table 3. Correlation matrix.

	TOUR	**FDI**	**GDP**	**TI**	**FFE**	**EU**	**GLOB**	**GFCF**
TOUR	1.000	−0.086	0.145	0.162	−0.323	0.354	−0.052	0.183
FDI	−0.086	1.000	0.137	−0.125	0.103	−0.096	−0.027	0.057
GDP	0.145	0.137	1.000	−0.026	0.230	−0.149	−0.428	0.549
TI	0.162	−0.125	−0.026	1.000	−0.233	0.719	0.336	0.068
FFE	−0.323	0.103	0.230	−0.233	1.000	−0.285	−0.572	0.256
EU	0.354	−0.096	−0.149	0.719	−0.285	1.000	0.551	−0.230
GLOB	−0.052	−0.027	−0.428	0.336	−0.572	0.551	1.000	−0.725
GFCF	0.183	0.057	0.549	0.068	0.256	−0.230	−0.725	1.000

5. Results and discussion

Table 4 portrays the result of tourism model in which Technological Innovation, Globalization and Energy use are taken explanatory variables. Foreign Direct Investment and GDP growth are endogenous variables. Discussing about first exogenous variable i.e. Technological Innovation, it was presumed that nation's having improving in technological innovation may be able to attract more tourists (Chenghu et al., 2021; Giotis and Papadionysiou, 2022). Due to technology, tourists may have online booking facility for their residence, they can compare the prices, hoteling cost, travelling expenses. Due to mobile applications, tourists can have real-time updates about the places going to be visited. It also reduces environmental impact of tourism activities hence tourism may be sustainable due to this technological innovation. The study obtains the positive linkage of technological innovation with tourist arrivals in top 10 most visited countries of the world. It is statistically highly significant as well with 0.22 coefficient value explaining that tourist arrivals will be increased by 0.22 number as technological innovation is improved by a unit index (Ahmad et al., 2022; Nathaniel et al., 2023; Razzaq et al., 2023).

Foreign direct investment (FDI) has the potential to play a substantial part in the marketing of a location and the recruitment of additional tourists. It is common for international investors to bring marketing experience, global networks, and established distribution channels with them, all of which have the potential to effectively promote the host nation as a tourism destination (Farooq et al., 2023; Pata

et al., 2023). The increased marketing and promotional activities may result in a rise in the number of tourists who visit the area, which is good for both the local companies and the economy as a whole. In the present study, FDI is turned out to be positive with significant coefficient value at 10% level. It explains that the nations having investment from other nations may be able to develop Infrastructure, generate employment, transfer of knowledge and expertise, diversification, earning foreign exchange, getting higher economic growth, improvement in quality of life and these all attract tourist arrivals (Rahaman et al., 2022; Sokhanvar and Jenkins, 2022; Zhuang et al., 2022).

Table 4. Results of first equation.

Variables	Coefficients	Std. Err	t-ratio	Prob.
Constant	13.00455	1.440443	9.02816	0.0000
TI	0.22869	0.088066	2.59674	0.0097
FDI	0.04188	0.02477	1.69074	0.0913
GLOB	0.01855	0.004634	4.00374	0.0001
GDP	0.055842	0.014155	3.945119	0.0001
EU	0.864441	0.1825	4.736672	0.0000

The increased interconnection that has resulted from globalization has made it simpler to go from one country to another. The lowering of trade barriers, improvements in transportation, and simplification of visa procedures have all contributed to an increase in the availability of and lower prices for international travel (Ehigiamusoe et al., 2023; Guan et al., 2022; Gozgor et al., 2022). As a direct consequence of this, there has been a considerable rise in the number of individuals engaging in international tourism for recreational purposes. The current analysis represents the positive association between Globalization and tourist arrivals with statistically significant coefficient value at 1 percent level.

This study considers an endogenous variable i.e. GDP growth which was expected to result in higher tourist arrivals. The expansion of GDP may also have a beneficial effect on the global tourism industry. It's possible that people from other countries will have more discretionary income to spend on vacations as their economies continue to grow. This may result in an increase in the number of people who come to the country, each of whom will spend money during their stay on things like lodging, food, shopping, and numerous activities (Liu et al., 2022; Raihan, 2023). The country that plays host to international tourists can increase its profits in foreign currency, its rate of economic growth, and the number of job opportunities available in that country (Ozturk et al., 2022). The current findings support the above mentioned phenomenon and the relationship between GDP growth and tourist arrivals is found to be positive and statistically significant.

For enterprises involved in tourism, such as hotels, resorts, restaurants, and transportation services, the cost of energy usage comprises a considerable portion of operating expenses (Banga et al., 2022; Liu et al., 2022). Especially in areas of the country where energy prices are either fluctuating or high, the high cost of energy can have a negative influence on the financial performance and profitability of these

firms (Niu, 2023). Tourism firms can benefit financially, boost their bottom line, and become more competitive by implementing practices and technologies that are energy efficient and assist lower their energy expenses. This study proposes positive relationship between energy use and tourism and its value is 0.86 which is highly significant.

$$TOUR = C_1 + \delta_1 TI + \delta_2 FDI + \delta_3 GLOB + \delta_4 GDP + \delta_5 EU$$

The analysis of study exhibits the positive relationship of globalization with FDI of top 10 tourist visited countries and significant coefficient has been observed in **Table 5**. The reason of direct link may be that the flow of foreign direct investment around the world has seen a significant uptick as a result of globalization. Organizations and agencies have been looking to extend their operations worldwide in order to get access to new markets, resources, and cost benefits as countries have grown more interconnected as a result of technical improvements, trade liberalization, and lower obstacles to investment. Both the inflow and the outflow of foreign direct investment have been significantly enabled as a result of the liberalization of trade and investment laws in a number of nations (Hao et al., 2020; She and Mabrouk, 2023).

Table 5. Results of second equation.

Variables	Coefficients	Std. Err	*t*-ratio	Prob.
Constant	−6.87065	3.335315	−2.05997	0.04
GLOB	0.080286	0.029779	2.696081	0.0073
TI	0.29061	0.165355	1.75749	0.0795
FFE	0.0214	0.01208	1.771523	0.0772
GFCF	0.039091	0.030487	1.282223	0.2005
TOUR	0.413165	0.219582	1.881603	0.0606

It was preliminary supposed that FDI may increase due to technological innovation and there are a number of reasons like advancement of technology has spawned new investment opportunities and industries that are attractive to FDI (Behera and Sethi, 2022; Yasmeen et al., 2022). Emerging technologies like information technology, biotechnology, clean energy, and advanced manufacturing have created a demand for cash and knowledge, which in turn has prompted multi-national firms to invest in nations that have a competitive advantage in these fields (Wang et al., 2023). Countries that encourage technological innovation and provide an atmosphere that is receptive typically attract more foreign direct investment (FDI). The results given in **Table 6** shows that coefficient attached with Technological Innovation is statistically significant and positive with the value of 0.29 (Adikari et al., 2021; Hoang et al., 2021).

In many different types of businesses, such as those dealing with manufacturing, mining, and transportation, fossil fuels, which include coal, oil, and natural gas, are frequently employed as the primary source of energy. Countries that have access to a plentiful supply of fossil fuels at reasonable prices have a better chance of luring foreign direct investment (FDI) in industries that rely heavily on cheap energy (Adebayo, 2022; Umair and Yousuf, 2023). The presence of easily accessible fossil

fuel deposits may have an impact on investments made in businesses such as heavy manufacturing, steel production, and petrochemicals. In line with the above discussion, the study observes the similar positive linkage of Fossil Fuel Energy Consumption on FDI of top 10 most tourist visited countries which is significant at 10 percent.

Table 6. Results of third equation.

Variables	Coefficients	Std. Err	t-ratio	Prob.
Constant	0.902504	10.96054	0.082341	0.9344
GLOB	0.2056	0.055213	3.72366	0.0002
FDI	0.380234	0.202218	1.880321	0.0607
TOUR	0.570752	0.315162	1.810979	0.0681
FFE	0.004072	0.033621	0.121129	0.9036
EU	0.74135	0.95379	0.777267	0.4374

A high level of Gross Fixed Capital Formation (GFCF) suggests that a nation is investing in its physical infrastructure, which can make the nation more appealing to foreign direct investment (FDI) (Kumar and Singhal, 2022; Sijabat, 2022). It is essential for businesses to have adequate infrastructure, which should include transportation networks, communication systems, and power supply, in order for them to function effectively. Countries that make significant contributions to the GFCF demonstrate their dedication to developing their infrastructure and fostering a climate that is conducive to business, which can help them attract foreign direct investment (FDI). In this analysis, the coefficient of GFCF is turned out to be statistically insignificant with positive sign (Kamal et al., 2021).

The core variable of study is Tourist visits in top 10 most tourist visited countries denoting increase in FDI due to increase in tourism and it is statistically significant as well. It may be justified as the tourism industry itself has the potential to be one that brings in foreign direct investment. Countries that have a strong tourism potential, such as well-known destinations, may be able to entice foreign investors who are interested in the prospects presented by the hospitality and tourism industries. These investors may choose to invest in hotels, resorts, travel agencies, entertainment venues, and other tourism-related enterprises (Işik et al., 2017). FDI in the tourism industry can facilitate the transfer of knowledge and best practices from international investors, as well as contribute to the creation of jobs, the development of infrastructures, and overall economic growth.

$$FDI = C_2 + \delta_6 GLOB + \delta_7 TI + \delta_8 FFE + \delta_9 GFCF + \delta_{10} TOUR$$

This study proposes that globalization is turned out to be positive with economic growth with significant coefficient which reveals that economic growth will increase by 0.21 percent due to one index unit increase in globalization in **Table 6**. It does make sense in a way that the lowering of trade barriers, the signing of trade agreements, and the development of improved transportation and communication technology are some of the ways in which globalization has made it easier for countries to engage in increased levels of international trade (Ahmad et al., 2021; Yang and Usman, 2021). The expansion of trade gives countries access to wider

markets, which in turn enables such countries to increase their production capacities as well as their exports of products and services. This expansion of commerce has the potential to generate economic growth by bolstering domestic output, generating employment opportunities, and raising income levels.

Likewise, FDI is supposed to be positively related with GDP growth and our analysis also confirms this phenomenon and its coefficient is 0.38 and significant. Its justification may be that foreign direct investment has the potential to improve a nation's export capacity and raise GDP growth through increasing international trade (Grabara et al., 2021; Iqbal et al., 2023). Establishing production facilities to create items for export or integrating domestic suppliers into global supply chains may be among the options open to foreign businesses looking to invest in the United States. This improves a nation's competitiveness in international markets, increases the volume of exports, and creates earnings in foreign exchange; all of these things have a beneficial impact on the growth of the GDP.

The tourism industry is one that requires a substantial amount of labour and is responsible for the creation of a significant number of direct and indirect jobs. It generates job possibilities in a variety of industries, including hotels, restaurants, transportation, tour operators, souvenir stores, and other services directly or indirectly associated to tourism (Ip et al., 2023; Isik et al., 2018). Enhanced tourism activity results in the creation of additional jobs, which in turn lowers the region's unemployment rate and raises the average level of income there. Moreover, tourism has a multiplier effect on the economy indicating that the initial spending done by tourists causes a ripple effect, which in turn stimulates even more economic activity (Işık et al., 2019; Jabeen et al., 2024). When tourists spend money, that money gets put back into the local economy by being used by companies to pay employees, buy supplies, expand and support other local businesses, and invest in expansion. This results in higher income and consumption, as well as economic growth across a variety of industries. In the study, the positive link of tourist travels variable may be observed and finalized with significant coefficient value (Dogru et al., 2023).

The current analysis analyzes the positive link of Fossil Fuel Energy Consumption with GDP growth but coefficient is not significant. The positive link may be justified as energy, which can come from renewable sources or fossil fuels, is an essential component in both the production and expansion of the economy (Omri and Saadaoui, 2023). When it comes to industrial production, transportation, and the generation of electricity, the primary sources of energy that have historically been utilized are fossil fuels such as coal, oil, and natural gas. It is vital to have a supply of energy that is sufficient and at an affordable price, including fossil fuels, in order to power economic activities and promote GDP growth (Baz et al., 2021; Zhang and Hao, 2023).

Concerning Energy Consumption, it is explored to increase economic growth in top 10 tourist countries but with insignificant probability value. The production process in every industry requires a variety of sources of energy as a vital input. This is true across the whole economy. Along with providing electricity for home, commercial, and public usage, it drives machinery used in manufacturing plants, transportation systems, heating and cooling systems, and other systems. The provision of an adequate and stable energy supply is essential for economic activity

and productivity, both of which are important for the expansion of GDP.

$$GDP = C_3 + \delta_{11}GLOB + \delta_{12}FDI + \delta_{13}TOUR + \delta_{14}FFE + \delta_{15}EU$$

6. Conclusion and policy suggestions

The present study considers the top-10 tourist countries by the tourists in order to examine the influence of Technological Innovation, FDI, and Globalization on Tourism, Economic Growth and FDI. The data on Tourist Visits, FDI, GDP Growth, Gross Fixed Capital Formation, Fossil Fuel Energy Consumption and Energy Consumption has been taken from World Development indicators. The data on Technological Innovation has been gathered by United Nations Conference on Trade and Development (UNCTAD). The source ETH Zurich has been followed for collecting data on Kof Index of Globalization. For that, panel data of France, Spain, the United States, China, Italy, Turkey, Mexico, Thailand, Germany, and the United Kingdom has been taken for the period from 2008 to 2022. Theoretically, it is observed that FDI and Economic growth may be endogenous variables for the Tourism model and Technological Innovation, Globalization, Energy Consumption and Gross Fixed Capital Formation may be exogenous variables so the analysis is based on Three Stage Least Square method (System Equation– Simultaneous equations) after checking identification that confirms the problem of simultaneity in system of 3 equations.

The observed results explore that Technological Innovation, FDI, Globalization Index, GDP Growth and Energy Consumption are the significant variables for improvement in tourism. Concerning to endogenous variable i.e. FDI, this variable is positively affected by Globalization, technological innovation, Fossil Fuel Energy Consumption, Gross Fixed Capital Formation and Tourism but the coefficient of GFCF is only insignificant in the analysis. GDP growth is the 2nd endogenous variable in the study which is significantly increased by Globalization, FDI and Tourism in case of top 10 most visited countries by the tourists. The authors try to suggest some recommendation to the top ten most visited nations improve their tourism industries based on the empirical outcomes of the study, we make the following policy recommendations for sample countries: For France, invest in environmentally responsible tourist practices so that cultural heritage and natural resources can be protected and kept intact. It would be helpful to have better infrastructure and transportation networks in order to make popular tourist locations more accessible. Encourage tourism during the low season in order to reduce the impact of excessive tourist during the high season. In Spain, develop measures to expand tourism offers beyond conventional beach sites, with the goal of showcasing cultural, heritage, and rural assets as potential draws for tourists. Make investments in the infrastructure and services of less well-known places in order to more equitably spread the advantages of tourism. It is important to work together with the local community in order to ensure the growth of sustainable tourism and reduce any negative repercussions.

United States of America should streamline the processes for obtaining visas to make travelling internationally easier and to encourage more people to travel. Encourage domestic travel by bringing attention to less well-known attractions and

focusing on increasing tourism in rural areas. Investing in practices that encourage sustainable tourism and encouraging travelers to behave responsibly will help preserve natural regions and cultural assets. China can boost the effectiveness of foreign marketing initiatives by highlighting a varied selection of locations other than large cities. To better accommodate tourists from other countries, those working in the tourism industry need to improve their English language skills. Develop sustainable tourism practices and guarantee responsible administration of famous tourist destinations. Strategies for crowd control should be implemented in Italy in order to solve the issue of over tourism in prominent towns such as Venice, Rome, and Florence. In order to more equitably divide tourist traffic, it is important to promote cultural heritage sites in areas that are not as well known. It is important to encourage the development of environmentally friendly tourist practices, such as ecofriendly lodging and transportation choices.

The policy making authorities of Turkey feel the need to invest in improving the infrastructure of less well-known locations so that you can draw more visitors to their distinctive cultural and natural assets. Increase traveler trust by strengthening existing safety and security procedures. In order to expand your services, you should consider developing specialized types of tourism, such as those focused on cuisine, cultural experiences, and adventure. In Mexico, efforts can create and promote environmentally responsible tourism should be assisted by public-private partnerships that are strengthened. Enhance the experiences of visitors by working to enhance the underlying infrastructure, safety measures, and tourist services. Rather of focusing just on the well-known beach resorts, Mexico's many other attractions should be highlighted in marketing initiatives.

Germany should encourage environmentally responsible tourism practices such as using public transit, finding eco-friendly hotels, and properly managing garbage. By enhancing linkages across modes of travel, you may make less-visited locations more accessible. Invest in cultural tourism by providing financial assistance to local events, festivals, and tourist sites. Take steps to mitigate the negative effects of tourism on the local environment and society in famous locations such as Phuket and Bangkok in Thailand. Encourage practices that are beneficial to the environment and local communities, and involve those people in tourist planning and development. Expand your tourist options so that you may highlight your cultural history as well as rural locations and lesser-known attractions.

Creation of tourism plans for areas other than London, with the goal of promoting regional destinations and encouraging longer stays and to enhance both the existing infrastructure of transport and the connection between cities and tourist destinations in United Kingdom. Investing in digital tourism efforts can help improve tourist experiences and give travelers with complete information. The purpose of these recommendations is to encourage the growth of tourism in a way that is environmentally responsible, to improve the quality of the experiences that tourists have, to encourage the conservation of cultural and natural resources, and to guarantee that the advantages of tourism are fairly distributed within each nation.

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