



# The Impact of Fossil Fuel Energy, Technological innovation and Globalization on Tourism Inflows of Top Ten Most Visited Countries

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## ABSTRACT

Increased uses of fossil fuel consumption, globalization, and tourism activities have significant adverse effects on the sustainability of our ecosystem. The present study takes into account the top 10 most visited nations by tourists to examine the impact of fossil fuel energy consumption, technological innovation, foreign direct investment (FDI), economic growth, and globalization on tourism inflows from 2008 to 2022. Choice of appropriate technique for empirical testing is based on the PP-Fisher, ADF Fisher, IPS, and LLC unit root tests. Due to mixed order of integration of variables, the Panel ARDL is more reliable for econometric investigation. The findings of Panel ARDL reveal that the most significant contributing factors towards growth in tourism are technological innovation, the globalization index, growth in gross domestic product, and use of fossil fuels as an energy source. These results imply that advancements in technology, increased globalization trends, and economic growth are facilitating the growth in tourism activities. Likewise, non-renewable energy consumption is significantly linked to tourism growth in these countries which exhibits that these governments are relying upon fossil fuel consumption to meet the energy demand for tourism activities and to fuel economic growth. Though, FDI is having a detrimental effect on tourism inflows in the top 10 most frequently visited nations. This outcome entails that expanded industrialization and economic footprint negatively influence the ecological environment which adversely affects tourism inflows. The policy implications of this research assert that the development of clean and renewable energy technologies is essential for the promotion of sustainable economic growth, promote eco-tourism in these countries. Similarly, smart manufacturing and environment friendly production can alleviate the negative effects of ecological footprint on tourism inflows.

**Keywords:** Fossil Fuel Energy, Technological Innovation, Globalization, Tourism Inflows, Ecological Footprint, Clean Energy, Sustainable Development

**JEL Classifications:** O00, P18 and Q01

## 1. INTRODUCTION

Tourism is the practice of individuals going to and staying in locations that are not typical to them for the aim of engaging in activities such as vacationing, conducting business, or engaging in other activities (Buckley, 2011; Ramkissoon, 2023). It entails

travelling to a variety of locations in order to discover and take pleasure in a wide range of activities and experiences, all of which contribute to the economic, social, and cultural growth of the host nation or region as well as the tourists themselves. Domestic tourism refers to travel within one's own country, whereas international tourism involves travelling to a different

country entirely (Kuok et al., 2023; Makoni et al., 2023). Tourism can take on a variety of different forms. It comprises a wide variety of activities, including sight-seeing, cultural experiences, adventure tourism, ecotourism, beach holidays, business travel, and a great deal more. The tourism sector has grown to become a large worldwide business, which provides chances for employment and brings in revenue for locations. It does this by causing tourists to spend money on things like lodging, transportation, food and drinks, shopping, and numerous services geared towards tourists. This, in turn, fosters economic growth (Kayani et al., 2023). In addition to this, it supports investment in infrastructure, hotels, resorts, and other amenities relevant to tourism-related businesses.

### 1.1. Tourism, Fossil Fuel and Foreign Direct Investment

In point of fact, there is a school of thought that suggests tourism ought to play a significant role as a location-specific factor in foreign direct investment (FDI) with a fact that FDI takes the income back in the host country and may affect tourism negatively somewhere (Nasim et al., 2023). An increase in the number of tourists would lead to an increase in the demand for hotels, which would then necessitate an increase in the amount of investment. Alongside the process of internationalization, the hospitality business is evolving into a more global one (Sou and Vinnicombe, 2023). Because of this, worldwide hotel giants' chains have pushed hotel brands into all competitive corners throughout the world, which has an effect on foreign direct investment (Perić et al., 2022). This is done to accommodate the expanding demand in travel, particularly international tourism of selected panel of the study. Additionally, international tourism enables prospective investors to gain first-hand knowledge of the culture and environment of the country being visited, as well as information regarding the various opportunities for investment that are now accessible (Ni et al., 2022). According to Rafiq et al. (2022), one can identify potential areas for investment in a country through first hand experiencing the country's goods and services. It is possible that a rise in tourism-related activities would be brought about as a consequence of increased investment in the tourism industry. This would be brought about as a result of an improvement in tourist infrastructure, such as good hotels and transit facilities, as well as the creation of new tourist attractions, such as theme parks, etc. Even though it is common knowledge that FDI and tourism together play a significant part in the process of economic growth in a nation, there have been very few empirical studies that have been published that analyze the connection between inward FDI and tourism in a host country.

FDI is money invested by a company in a location other than its home nation; nonetheless, the investor maintains complete control over how the money is spent (Selvanathan et al., 2012; Craigwell and Moore, 2008; Kaur and Sarin, 2016). Foreign investors are confronted with a variety of obstacles, including the need to become familiar with new cultural norms and economic and political frameworks. The industrial process, which is primarily reliant on fossil fuels to promote economic expansion and development, has been the primary contributor to the accumulation of pollution throughout the course of time. After initially causing an increase in the amount of pollution, higher wages have the

potential to 1 day have a beneficial impact on the condition of the environment. After affluence, one of the elements that has the greatest impact on the environment is energy use. Consumption of energy is an integral part of the manufacturing process, which makes it an important contributor to economic expansion (Akbar et al., 2024). On the other hand, although it is projected that the use of energy derived from fossil fuels would raise CO<sub>2</sub> emissions, the use of energy derived from renewable sources is expected to lower those emissions.

### 1.2. Tourism, Technological Innovation and Globalization

Travel and tourism, technological advancement, and the consumption of energy are all intertwined in a variety of ways. Both in terms of enriching the experience that tourist have and in terms of solving sustainability problems, such as energy consumption, technological innovation is an extremely important part of the tourism sector (Banga et al., 2022; Hysa et al., 2023).

Innovative Technologies have enabled the development of Smart Tourism Infrastructure Innovative technologies that helped to allow the development of smart tourism destinations and infrastructure. Smart cities, for instance, make use of networked sensors, data analytics, and Internet of Things (IoT) devices to maximize the efficiency with which energy is used, increase the functioning of transportation networks, and provide an overall better experience for tourists (Raihan et al., 2023; Niu, 2023). Hotels, resorts, and other facilities associated to tourism can benefit from using smart grids and energy management systems, which can assist cut down on energy use (Nam et al., 2021; Buhalis and Amaranggana, 2013).

The idea of globalization is murky, and its application without boundaries is making it much more so every day. In what follows, we shall give a definition that adheres closely to economic standards. Within the context of this economic system, some people define globalization as a drive towards enhancing the economic integration of the world by lowering barriers to trade, both those that are natural and those that are the result of human activity, and by boosting the flow of capital and labor across international borders (Appadurai and Appiah, 2011; Kayani et al., 2023). This trend towards integration will never be finished, in the sense that it will never arrive at a point where the costs of transactions are reduced to zero. However, globalization is gradually dismantling those barriers, turning individuals and nations into interconnected entities, and undermining attempts at growth through one nation acting alone. Tourism has evolved into an essential part of the economy of the entire world, playing a role in the expansion of the economy, the creation of new jobs, and the acquisition of foreign currency. The movement of cash, investments, and visitors across international boundaries has been made easier by globalization, which has fostered the growth of international tourism and prompted investments in tourism infrastructure. The travel and tourism business is dependent on a worldwide network of supply chains, travel agencies, tour operators, hospitality services, and transportation, all of which contribute to the integration and interdependence of the global economy.

## 2. LITERATURE REVIEW

These studies concentrated their attention solely on the global hotel business when conducting their research; however, they did not address the connection between overall FDI and tourism. Research conducted by Tisdell and Wen (1991) and Razzaq et al. (2023) focused primarily on investments made in the Chinese tourism industry and top ten GDP countries respectively on time series data. The various other studies analyzed FDI inflows into the tourism industry primarily from the perspective of policy issues (Martins et al., 2023). These also highlighted that one of the driving causes behind foreign investment in tourism business is the rapid growth rate of tourism in most visited countries. This argument hinted the authors of this study to use a simultaneous equation model to estimate the empirical relationship among FDI, tourism and economic growth. Research that has been conducted in relation to China’s tourism appears to concentrate almost exclusively on the tourism industry by itself (Jiang et al., 2021; Wu et al., 2022; Jiang et al., 2022; Hailiang et al., 2023; Shang et al., 2023), with the exception of a recent study that investigated the correlation between tourism and trade in China (Shan and Wilson, 2001). However, it would appear that there is a dearth of research that investigates the impact of FDI as a factor in determining the demand for tourism.

For FDI decisions regarding entry mode, location siting in host countries, issues of material supplies, transportation, production, management, and other related topics. The MNCs need to ensure that they are profitable. Because of this, there is an increase in the number of people travelling internationally for business (Falzoni, 2000; Harms and Wacker, 2019; Wacker, 2016; Sethi et al., 2024). After that, members of the staff’s families and possibly some other staff members will travel to personally gather first-hand knowledge for themselves. This is generating the cyclical effect of investigative business and holiday travel, which in turn results in increased tourism (Bezuidenhout and Grater, 2016; Ozturk et al., 2022). Nonetheless, foreign direct investment is undeniably an essential instrument for boosting the tourism industry in developing countries, particularly in nations that are only recently beginning to participate in the sector (Endo, 2006; Faisal et al., 2021).

Innovations in technology have altered the process by which travelers plan, book, and experience their vacations. This has resulted in an improved tourist experience. Travel planning has become easier and more comfortable because to the proliferation of online travel platforms, mobile applications, and virtual reality technology (Shin and Baek, 2023). In addition, technological innovations such as augmented reality and location-based services enrich the experiences that visitors have when they are physically present at a destination by giving interactive information, aid with navigation, and personalized suggestions (Guzman et al., 2023).

## 3. DATA AND METHODOLOGY

Keeping in view the aim of the study that is to estimate the linkage of Technological Innovation, Globalization, FDI, Economic Growth and Fossil Fuel Energy Consumption with Tourism of top 10 most visited countries of the world. For this panel data is being

utilized and data of France, Spain, the United States, China, Italy, Turkey, Mexico, Thailand, Germany, and the United Kingdom have been taken ranging from 2008 to 2022. 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. Top 10 most visited countries have been selected on the basis of tourist arrivals as given by World Population Review (2022) report and other sources as mentioned below the Figure 1. For analysis purpose, the study has made use of descriptive analysis, correlation, Panel Unit root tests (Im, Pesaran and Shin W test, Levin, Lin and Chu test, ADF Fisher test, and PP Fisher test) and Panel ARDL (PMG) technique (Ullah et al., 2022).

In order to examine the objectives of the study, the following model is specified as follows;

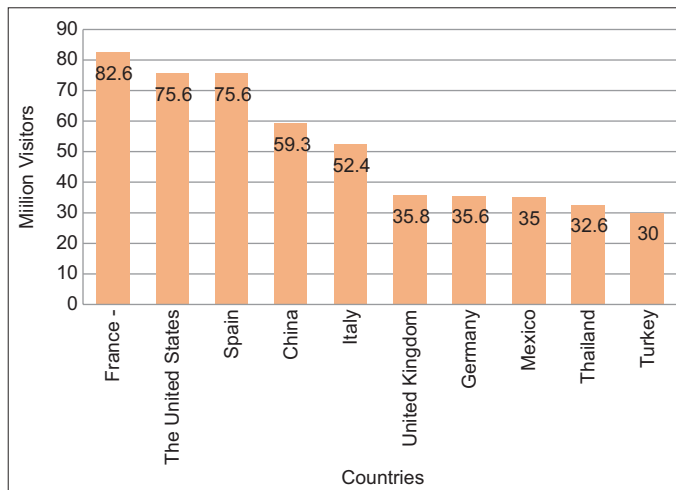
$$TOUR=f(TII,GDP,FDI,FFE,GLOB)$$

The above functional form of the model shows that TOUR is the dependent variable and TII, GDP, FDI, FEE and GLOB are the independent variables. The above model may also be written in the form of following equation;

$$TOUR=\delta_1TII+\delta_2FDI+\delta_3FFE+\delta_4GDP+\delta_5GLOB+u_i$$

In the equation give above, TOUR represents natural log of International tourism (number of arrivals), TII shows Technological Innovation Index, FDI is foreign direct investment, FFE indicates Fossil fuel energy consumption, GDP denotes GDP Growth rate and GLOB represents K of Index of Globalization.  $\delta_s$  are the coefficients and  $u_i$  is stochastic random term. The sources of data along with its measurements are reported in Table 1.

Figure 1: Top ten most visited countries 2022



Sources: UNWTO Tourism Data Dashboard-United Nations World Tourism Organization, World Tourism Barometer-United Nations World Tourism Organization, Trending in Travel - World Travel and Tourism Council and Economic Impact Reports - World Travel and Tourism Council) The Top 10 Ranking of Most Visited Countries in the World is based on the most recent available numbers of visitors a country has gotten during a whole calendar year

## 4. RESEARCH RESULTS

### 4.1. Description Analysis

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. 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.

### 4.2. Correlation Matrix

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. The findings presented in Table 3 indicate that there is no association between the variables, and the severity of the Multicollinearity problem is insufficient for it to have an effect on the empirical findings. The orientations of the calculated relationships will not be switched around for any of the variables.

### 4.3. Panel Unit Root

Table 4 represents the results of Panel Unit root tests by using Levin, Lin and Chu test, Im, Pesaran and Shin W test, ADF Fisher test and PP Fisher test. It expresses that TOUR is stationary at 1<sup>st</sup> difference while FEE, FDI, GDPGH, GLOB and TII are

stationary at level so we can decide about Panel ARDL technique which may be suitable in this situation.

### 4.4. Panel ARDL Results

The long-run Panel ARDL results are provided in Table 5 showing the coefficient values concerning each variable in column 2, and their respective standard errors, t-statistics and probability values are shown in column 3, 4 and 5 accordingly. The first variable given in this table is Fossil Fuels Energy Consumption. The use of fossil fuels is often required for transportation modes such as flying, driving, and travelling by sea and land, all of which are essential to the tourist business. To a far greater extent than other modes of transportation, air travel is a major source of greenhouse gas emissions. Travelers who fly to their destinations and use vehicles powered by fossil fuels while they are there can have a negative impact on the environment and contribute to the production of carbon emissions (Choudhury et al., 2023). Because of this, the need for fossil fuels in the tourist industry has repercussions for both the carbon footprint and the efforts made towards sustainability (Becken and Simmons, 2005; Shang et al., 2023). The estimated results indicate positive association between Fossil Fuel Energy Consumption and Tourism in Top 10 visited countries and its probability value is statistically significant proposing 0.24% increase in tourism due to one percent increase in Fossil Fuel Energy Consumption as percent of total energy use.

FDI may be cause of lower tourism in the top 10 most visited countries and its reason may be that a disproportionate number of enterprises that are foreign-owned might emerge in the tourist industry when there is an excessive dependence on foreign direct investment (FDI). This can lead to a reduction in the amount of local control that is exercised over the development of tourism and the making of decisions on tourism, which may result in a loss of cultural authenticity as well as control over tourist resources (Pata et al., 2023). There is a possibility that the gains brought about by tourism and FDI are not always dispersed fairly among

**Table 1: Description of variable of study**

Variable names	Acronyms	Measurements	Data sources	Expected relationships
Tourism	TOUR	International tourism, number of arrivals	World Development Indicators (World Bank Organization)	Dependent variable
Fossil fuel consumption	FFE	Fossil fuel energy consumption (% of total)	World Development Indicators (World Bank Organization)	Positive
Foreign direct investment	FDI	Foreign direct investment, net inflows (% of GDP)	World Development Indicators (World Bank Organization)	Negative
Economic growth	GDPGH	GDP growth (annual %)	World Development Indicators (World Bank Organization)	Positive
Globalization	GLOB	KOF index of globalization index (KOFGI)	The source ETH Zurich	Positive
Technological innovation	TII	Index is comprised of indices of ICT deployment, skills, R&D activity, Industry activity and access to finance.	United Nations Conference on Trade and Development (UNCTAD)	Positive

**Table 2: Descriptive analysis**

	FFE	FDI	GLOB	GDPGH	TII	TOUR
Mean	78.5773	2.0316	78.5828	1.9513	0.7730	84259236
Median	80.5980	1.8308	82.0000	1.9447	0.7952	75799000
Maximum	91.0570	12.0316	90.3025	11.3535	1.0055	218000000
Minimum	41.6647	-1.1647	61.8271	-11.3254	0.4214	11101000
SD	12.4770	1.4746	8.8908	4.0080	0.1868	58028466
Skewness	-1.6382	2.6390	-0.4018	-0.4781	-0.3900	0.700
Kurtosis	4.9468	1.0773	1.7144	4.2893	1.7060	2.288
Probability (Jarque Bera)	0.3286	0.1734	0.4801	0.81730	0.1371	0.7283

the inhabitants of the area. It's possible for there to be income inequalities, with the bulk of benefits being concentrated in some locations or industries, while local populations, especially those in rural or marginalized areas, could not reap the same advantages. This has the potential to make socioeconomic disparities worse and to intensify social tensions (Zhuang et al., 2022). When it comes to tourism, direct investment can lead to a considerable amount of the produced income and profits being returned to the home nations of the foreign investors. As expected, FDI is having negative effect on Tourism and it is statistically significant as well.

Globalization has a vital and beneficial role in the development of the tourist sector, which is one of the many reasons why tourism and Globalization are inextricably linked. A considerable rise in the number of people travelling abroad can be attributed to the fact that Globalization has made travel less difficult and more economical. People are now able to traverse international borders and visit a wider variety of locations with greater ease as a result of advancements in the infrastructure of various modes of transportation, including air travel, cruise ships, and high-speed railways (Appadurai and Appiah, 2011). As a result of Globalization, governments now have the opportunity to advertise and promote their tourist attractions to a worldwide

audience, which in turn attracts tourists and generates cash for those countries. In the present analysis, the similar positive linkage of Globalization has been observed with Tourism in the long run with highly significant coefficient value.

Economic growth is the important value for enhancing tourism in the nations. In view of the importance of this variable, GDP Growth is taken in this study which expresses positive relationship between Economic growth and Tourism in top 10 most visited countries of the world in the long-run. Individuals often see an increase in their income levels, total discretionary expenditure, and amount of free time as a direct result of economic expansion. As a consequence of this, a greater number of individuals have both the resources and the desire to travel, which has led to an increase in the demand for services related to tourism (Ozkan et al., 2023). It encourages investment in tourism-related infrastructure, such as hotels, resorts, transit networks, and attractions, among other things. An increase in investment may result in the creation of new tourist destinations, the upgrade of existing facilities, and the improvement of existing tourist activities.

The advancement of technology has had a significant influence on the travel and tourism sector, revolutionizing a number of facets of a trip taken by a tourist and redefining the way tourism firms conduct their daily operations (Raihan et al., 2023; Niu, 2023). The accessibility, convenience, and individualization of trip planning have all been improved because to technological advancements. Users get access to a broad assortment of information, reviews, and booking alternatives when they utilize the services of online travel agents, booking platforms, and travel websites. Travelers may easily plan their itineraries,

**Table 3: Correlation matrix**

Variables	FFE	FDI	GLOB	GDPGH	TII	TOUR
FFE	1.00	---	---	---	---	---
FDI	0.10	1.00	---	---	---	---
GLOB	-0.57	-0.03	1.00	---	---	---
GDPGH	0.23	0.14	-0.43	1.00	---	---
TII	-0.40	-0.01	0.77	-0.21	1.00	---
TOUR	-0.32	-0.09	-0.05	0.15	0.22	1.00

**Table 4: Results of LLC, IPS, ADF-fisher, PP-fisher**

Variable	Levin, Lin and Chu t*	Im, Pesaran and Shin W-stat	ADF-Fisher Chi-square	PP-Fisher Chi-square	Conclusion
TOUR	-3.7393*	-3.7003*	49.7789*	173.5*	1 <sup>st</sup> Difference
FFE	-5.002*	-5.1142*	62.7714*	142.875*	Level
FDI	-2.0035*	-2.6238*	38.586*	96.855*	Level
GDPGH	-6.8916*	-4.8682*	61.804*	117.175*	Level
GLOB	-3.6813*	-1.2649	30.1108*	21.4227	Level
TII	-3.9291*	-2.1620*	35.8998*	43.1416*	Level

\*indicating the rejection of null hypothesis that unit root exists

**Table 5: ARDL results**

Variables	Coefficients	Standard errors	t-statistic	Probability
ARDL long-run results				
Fossil fuel energy consumption	0.242	0.083	2.921	0.005
Foreign direct investment	-0.308	0.173	-1.776	0.080
Kof Index of globalization	0.435	0.153	2.846	0.006
Economic growth	1.219	0.387	3.153	0.002
Technological innovation index	10.195	5.665	1.800	0.077
ARDL short-run results				
Speed of adjustment	-0.0663	0.0214	-3.1035	0.0028
D(TOUR(-1))	0.1524	0.1439	1.0587	0.2936
D(FFE)	-0.1113	0.0705	-1.5785	0.1193
D(FDI)	-0.0005	0.0182	-0.0250	0.9801
D(GLOB)	-0.1091	0.0572	-1.9065	0.0610
D(GDPGH)	0.0266	0.0198	1.3473	0.1826
D(TII)	0.8222	1.9253	0.4270	0.6708
Constant	-3.0986	0.9826	-3.1534	0.0024

research places; compare costs, and book lodgings all from the comfort of their own homes. Tourism firms are now able to reach a worldwide audience and connect with them because of the proliferation of social media platforms, search engine optimization, and targeted digital advertising. The study also concludes the positive correlation between Technological Innovation index and Tourism in the long run in these countries but it is significant at 10 percent level.

The term “Speed of Adjustment” comes from the field of economics and refers to the rate at which a variable or system returns to equilibrium following a disruption. A variable’s response time is measured as the amount of time it takes for the variable to return to its original state after being disturbed. Table 5 indicates the value of Speed of Adjustment as -0.0663 expressing the convergence towards long-run equilibrium with statistically highly significant probability value.

## 5. CONCLUSION AND POLICY SUGGESTIONS

The present study considers the top 10 most visited countries by the tourists in order to examine the influence of Fossil Fuel Energy Consumption, Technological Innovation, FDI, Economic Growth and Globalization on Tourism. For taking data on these variables, the sources are World Development indicators, United Nations Conference on Trade and Development (UNCTAD) and ETH Zurich and data have been taken for the period from 2008 to 2022.

The result of Descriptive statistics offers the average values of FEE, FDI, GLOB, GDPGH, TII and TOUR while correlation presents that there is no problem of Multicollinearity among the explanatory variables of the study. Choice of appropriate technique is based on the unit root tests so PP-Fisher, ADF Fisher, IPS and LLC unit root tests have been applied which conclude that except TOUR (stationary at 1<sup>st</sup> difference) all variables (FEE, FDI, GDPGH, GLOB, TII) are stationary at level so the results of Panel ARDL may be the most reliable. The result of Panel ARDL expresses that Technological Innovation, Globalization Index, GDP Growth and Fossil Fuel Energy Consumption are the significant variables for improvement in tourism. Concerning to FDI, this variable is negatively affecting the Tourism in case of top 10 most visited countries by the tourists. On the basis of results, it may be suggested that

- It is essential for nations that play host to properly manage the interaction between tourism and foreign direct investment (FDI) in order to limit the possibility of adverse effects. This may be accomplished by the implementation of efficient rules, environmentally responsible tourist planning, active participation from the community, responsible investment practices, and programs that guarantee the benefits are fairly distributed.
- It is essential to emphasize that despite the fact that Globalization has presented the tourist sector with a great deal of advantages, it also poses a number of difficulties. It is essential, for the development of tourism that is both responsible and sustainable in the context of Globalization,

to find a happy medium between economic expansion, the maintenance of cultural traditions, the maintenance of a healthy environment, and the maintenance of a healthy community.

- The development of new technologies is essential to the promotion of economic growth, the enhancement of productivity, the development of competitiveness, and the resolution of problems facing society. Investments made in research and development, the cultivation of an atmosphere that encourages creativity and cooperation, and the acceptance of new technology and ideas are all ways in which governments, corporations, research institutions, and people all contribute to technological innovation.

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