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Department of Sociology, Economic  
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38.04.01 Economics  
International Economics and Business

**GRADUATION THESIS**

**on**

**Development of Global Tourism in China in the Context of Green Economy**

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**ASSIGNMENT**  
**FOR THE GRADUATION THESIS OF**

Master's degree student Wu Jiale, group 24ЭЭВам1, full-time mode of study

1 The topic of the graduation thesis: "Development of Global Tourism in China in the Context of Green Economy"

was approved by the university order  
dated « \_\_\_\_ » \_\_\_\_\_ 20 \_\_\_\_ no. \_\_\_\_\_

2 The deadline for the Master's degree student to complete the graduation thesis is 15.06.2026.

3 The input data for the graduation thesis is the regulatory and legal framework, scientific literature and reference books, and Internet data.

4 The list of issues to be studied includes theoretical framework of the international tourism study in the green economy, a multifaceted analysis of China's tourism economy from a low-carbon perspective, constraints and coping strategies for the development of global tourism economy under the low-carbon background.

5 The list of visuals contains tables and figures.

6 The date of setting the assignment is 8.10.2024.

Academic adviser \_\_\_\_\_ / Skvortsova V. A./  
(signature) (full name)

The assignment was accepted by Master's degree student \_\_\_\_\_ / Wu Jiale/  
(signature) (full name)

## Schedule for completing the graduation thesis

| №<br>п/п             | Content of the thesis                                                                | Deadline for<br>completion | Due date,<br>signature of the<br>academic adviser |
|----------------------|--------------------------------------------------------------------------------------|----------------------------|---------------------------------------------------|
| First year of study  |                                                                                      |                            |                                                   |
| 1                    | Substantiating of the research topic and methodology, subject and object of research | 1.09.2024 – 31.10.2024     |                                                   |
| 2                    | Framing the scientific concept of research                                           | 1.11.2024 – 18.12.2024     |                                                   |
| 3                    | Collection of scientific literature for the thesis                                   | 19.12.2024 – 15.01.2025    |                                                   |
| 4                    | Substantiating the relevance, concept, and novelty of the research                   | 16.01.2025 – 19.02.2025    |                                                   |
| 5                    | Framing of a detailed plan and layout of the research                                | 20.02.2025 – 12.03.2025    |                                                   |
| 6                    | Studying new literature sources within the topic of the thesis                       | 13.03.2025 – 26.03.2025    |                                                   |
| 7                    | Conducting theoretical research within the first chapter of the thesis               | 27.03.2025 – 30.04.2025    |                                                   |
| 8                    | Preparing the first chapter of the thesis                                            | 1.05.2025 – 30.06.2025     |                                                   |
| Second year of study |                                                                                      |                            |                                                   |
| 9                    | Conducting analytical research within the second chapter of the thesis               | 1.09.2025 – 22.10.2025     |                                                   |
| 10                   | Preparing the second chapter of the thesis                                           | 23.10.2025 – 24.12.2025    |                                                   |
| 11                   | Conducting analytical research within the third chapter of the thesis                | 25.12.2025 – 25.02.2026    |                                                   |
| 12                   | Preparing the third chapter of the thesis                                            | 26.02.2026 – 21.04.2026    |                                                   |
| 13                   | Preparing the introduction and conclusion                                            | 22.04.2026 – 12.05.2026    |                                                   |
| 14                   | Completing the graduation thesis                                                     | 13.05.2026 – 27.05.2026    |                                                   |
| 15                   | Handing in the thesis for compliance control and antiplagiat                         | 28.05.2026 – 11.06.2026    |                                                   |
| 16                   | Getting acquainted with the feedback and review                                      | 13.06.2026                 |                                                   |
| 17                   | Presenting the written thesis                                                        | 15.06.2026                 |                                                   |

Academic adviser \_\_\_\_\_ / Skvortsova V. A. /  
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The assignment was accepted by Master's degree student \_\_\_\_\_ / Wu Jiale /  
(signature) (full name)

## Summary

The graduation thesis comprises 86 pages, 3 chapters, 26 figures, 3 tables, 64 sources.

**KEY WORDS:** TOURISM ECONOMY; ECONOMIC GROWTH; INDUSTRIAL INTERATION; EMPLOYMENT EFFECT.

The target of research is the theoretical mechanism of green development driving tourism growth by analyzing the current development status, driving factors and practical challenges of the global tourism economy under sustainable development.

The goal of work is to study tourism's low-carbon shift and high-quality growth in the new era. Amid climate action, carbon neutrality goals and post-pandemic recovery, green sustainability now underpins global tourism.

The methodological framework of the paper is formed by the complex of theoretical and practical methods such as literature research methods and qualitative analysis method: After establishing the core goal of this study, and read excellent papers in order to sort out, closely follow the research direction of this paper, further think about the research theme, and then analyze the core goal of the current situation and development trend of the global tourism economy.

The results of research include: boost green tourism outreach to advocate low-carbon, civilized travel and rational consumption, cultivate green tourism habits, coordinate economy, ecology and culture, and sustain sound long-term growth of global tourism.

The recommendations on disseminating and applying the results are as follows: the theoretical relevance of the thesis is established by integrates tourism economics, sustainable development and green growth theories, deepens the synergy mechanism of tourism-economy-ecology-society, and improves the theoretical system of global tourism governance.

The target of research can be further explored through analyze the current situation, characteristics and existing challenges of the global tourism economy in the new era, explore the driving mechanism and theoretical logic of green sustainability in boosting the development of the global tourism economy.

## Content

|                                                                                                                                  |    |
|----------------------------------------------------------------------------------------------------------------------------------|----|
| Introduction .....                                                                                                               | 3  |
| Chapter1 Theoretical framework of the international tourism study in the green economy                                           | 6  |
| 1.1 Research Background and Significance.....                                                                                    | 6  |
| 1.2 Low-carbon tourism economy .....                                                                                             | 11 |
| 1.3 Environmental Economics Theory.....                                                                                          | 16 |
| Chapter 2 A multifaceted analysis of China's Tourism Economy from a Low-Carbon Perspective.....                                  | 22 |
| 2.1 Overall scale and growth trend of global tourism economy .....                                                               | 22 |
| 2.2 The direct impact mechanism of tourism economy on the global economy under the low-carbon background.....                    | 31 |
| 2.3 The indirect impact mechanism of tourism economy on the global economy under the low-carbon background.....                  | 54 |
| Chapter 3. Constraints and coping strategies for the development of global tourism economy under the low-carbon background ..... | 60 |
| 3.1 Constraints on the Development of Global Tourism Economy under the Low Carbon Background .....                               | 60 |
| 3.2 Response Strategies for Global Tourism Economy Development under Low Carbon Background .....                                 | 65 |
| 3.3 Future Prospects for the Development of the Global Tourism Economy .....                                                     | 69 |
| Conclusion.....                                                                                                                  | 74 |
| References .....                                                                                                                 | 80 |

## **Introduction**

The theoretical Relevance: This study integrates tourism economics, sustainable development and green growth theories, deepens the synergy mechanism of tourism-economy-ecology-society, and improves the theoretical system of global tourism governance.

Practical Relevance: It provides practical guidance for policy-making, green operation and low-carbon destination management, promoting energy conservation, high-quality growth and UN SDGs.

Era Relevance: The new era features low-carbon transition and high-quality development. Driven by climate change, carbon neutrality and post-pandemic recovery, green sustainability has become the core context and prerequisite for global tourism.

This paper focuses on the high-quality development of the global tourism economy in the new era against the backdrop of green transformation and sustainable development. With the increasingly prominent global climate problems and the continuous advancement of low-carbon development concepts, the traditional extensive development model of the tourism industry is no longer adaptable to the current development needs. On this basis, this paper aims to systematically clarify the core connotation and important practical role of green development in empowering the modern tourism industry, deeply analyze the prominent bottlenecks and key problems restricting the sustainable development of the current global tourism economy, and put forward targeted, scientific and operable optimization suggestions and development countermeasures, so as to effectively promote the stable, healthy, low-carbon and sustainable growth of the global tourism economy and facilitate the high-end and green transformation of the global tourism industry.

The goal of the research is to analyze the current state, driving mechanisms, and existing challenges of the global tourism economy under the background of green sustainability, and to explore the theoretical logic of how green development boosts the industry.

Tasks of this paper are make an overview of the current situation and characteristics

of the global tourism economy in the new era; analyze the prominent bottlenecks and key issues restricting the sustainable development of the global tourism industry (such as the contradiction between maintaining growth and reducing emissions); construct a feasible development framework and put forward targeted strategies for the green transformation and high-quality development of global tourism.

This study's objectives is aimed to analyze the current situation, characteristics and existing challenges of the global tourism economy in the new era, explore the driving mechanism and theoretical logic of green sustainability in boosting the development of the global tourism economy, construct a feasible development framework for the green and sustainable growth of the global tourism economy, and further put forward targeted strategies for the green transformation and high-quality development of global tourism.

The research object of this paper is the global tourism economy. The subject is the green sustainable development and high-quality transformation of the global tourism industry in the new era.

Global tourism revenue refers to the total consumption generated by tourism activities worldwide during a certain period of time, including international tourism revenue: consumption of overseas tourists in destination countries. Domestic tourism revenue: tourism consumption of domestic residents within the country

Global GDP refers to the total market value of all final products and services produced by all countries and regions in the world during a certain period of time (usually one year), and is a core indicator for measuring the overall size and development level of the global economy.

The main research methods used in this paper are as follows: literature research methods and qualitative analysis method: After establishing the core goal of this study, I consulted a lot of information about green tourism and sustainable development, collected relevant data and reports (such as UNWTO documents and national development plans), and read excellent papers in order to sort out, closely follow the research direction of this paper, further think about the research theme, and then analyze the core goal of the current situation and development trend of the global tourism economy.

The novelty of this study is in order to locate the present situation and development trend of the green tourism economy more accurately, this paper integrates tourism economics, sustainable development, and green growth theories. It deepens the synergy mechanism of "tourism-economy-ecology-society," improves the theoretical system of global tourism governance, and provides practical guidance for policy-making, green operation, and low-carbon destination management.

The significance of this paper lies in the following aspects: Promoting the realization of global sustainable development goals: As an important carrier of the UN 2030 Agenda, the study of green tourism is helpful to promote the implementation of the Paris Agreement's temperature control targets and the concept of "responsible consumption and production." It guides the tourism industry to transition from a scale expansion type to a quality and efficiency type. Driving high-quality economic growth: Researching the green transformation of tourism helps to solve the symbiotic problem of "ecological protection investment and the improvement of industrial economic benefits." By optimizing the tourism economic structure and promoting the deep integration of culture, tourism, and technology, it can foster new business formats and enhance the overall quality and international competitiveness of the tourism economy. Enhancing ecological and social well-being: Green tourism research emphasizes the synergy between human and nature. It provides practical paths for energy conservation, carbon reduction, and ecological protection, while also promoting community participation and shared development, ensuring that the achievements of tourism development benefit both local residents and tourists.

# **Chapter1 Theoretical framework of the international tourism study in the green economy**

## **1.1 Research Background and Significance**

Nature is the fundamental condition for the survival and development of human beings. Harmonious coexistence between human beings and nature is the core of the Marxist view of ecological civilization [36]. The dual attributes of resource consumption and environmental dependence in the tourism industry determine that there is a close interdependent and mutually reinforcing relationship between the tourism economy and the ecological environment. On the one hand, tourism activities have caused severe disturbances to the natural ecosystem, while the development of tourism has promoted the economic development of tourist destinations and provided financial support for ecological protection and environmental restoration [38]. On the other hand, a friendly environment not only enhances the tourism appeal of the destination but also serves as an important foundation for the sustainable development of the tourism industry. The report of the 20th National Congress of the Communist Party of China clearly states that we should "follow the path of giving priority to ecological conservation and pursuing green development", emphasizing respect for nature, compliance with nature and protection of nature. We must plan development from the perspective of harmonious coexistence between humans and nature. Tourism, as a strategic pillar industry of the national economy, is an important channel to realize the ecological service value of "green mountains and clear waters" [28]. Under the background of ecological civilization construction, scientifically measuring the coordinated relationship between tourism economy and ecosystem services and clarifying the obstructive factors affecting their coordinated development is of great mission for the tourism industry to creatively combine ecological priority with green development and achieve harmonious coexistence between human and nature.

In 1979, the World Meteorological Organization (WMO) held the first World Climate Conference in Geneva, Switzerland. The conference pointed out that "an increase in the concentration of carbon dioxide in the atmosphere will lead to global warming."

Thus, the concept of "climate change" emerged in the international community for the first time. Since then, countries around the world have begun to pay attention to the issue of climate change, and related international conferences and academic research have gradually increased. In 1992, the United Nations Framework Convention on Climate Change was adopted by the United Nations Conference on Environment and Development (UNCED) as the world's first convention aimed at controlling greenhouse gas emissions to address global warming. The purpose of the Convention is to reduce greenhouse gas emissions, mitigate the impact of human activities on the climate, slow down climate change, enhance the adaptability of ecosystems to climate change, and ensure food production and sustainable economic development. In 2005, the Kyoto Protocol, the first international convention in human history to limit greenhouse gas emissions in the form of regulations, officially came into effect, fully demonstrating the international community's emphasis on reducing greenhouse gas emissions such as carbon dioxide. Against this backdrop, the concept of low-carbon has emerged. In the context of the constantly changing global climate, reducing carbon dioxide emissions is the inevitable path for the sustainable development of human society. The UK first proposed the concept of "low-carbon economy" in 2003 and, on this basis, officially released the white paper "Our Energy Future - Creating a Low-Carbon Economy". A low-carbon economy emphasizes enhancing economic efficiency while reducing energy consumption and damage to the ecological environment, and creating a higher standard and quality of life. Furthermore, to develop a low-carbon economy, it is first necessary to reverse traditional concepts. We should not blindly pursue economic benefits while neglecting the damage caused by human activities to the ecological and natural environment, and follow the old path of extensive development first and then intensive development. More importantly, we should popularize the concept of "low material desires" among the general public, cultivate their sense of awe, respect life and nature, live in the present, and act in accordance with the laws of nature.

In recent years, the global tourism industry has witnessed vigorous development. Even in China, the tourism industry has become one of the pillar industries of the country's economic development. Tourism has many advantages such as low resource consumption and low technical requirements, and has become an important industry in modern service

industry. As a green and smokeless industry, tourism can drive the development of numerous related industries and promote the overall economic growth of the region. Therefore, in recent years, many regions have chosen to vigorously develop tourism to boost local economic growth. However, while tourism has made significant contributions to the regional economy, the excessive and frequent exploitation of the environment by humans has long gone against the original intention of green development. For instance, the excessive flow of people during the development and construction process and the unreasonable exploitation of the environment have brought serious and even irreversible damage to the environment. Once environmental deterioration exceeds a certain threshold, it is bound to restrict the long-term development of the tourism industry. As a result, the deterioration of climate conditions and the rapid deterioration of ecological environment conditions on a global scale have prompted various countries to call for "low-carbon and green economic development". The aim is to achieve rapid economic development while minimizing damage to the ecological environment to the greatest extent, laying a solid foundation for the future development of mankind. Meanwhile, the United Nations Sustainable Development Goals (SDGs) clearly position tourism as a key area for achieving environmental sustainability. Meanwhile, the 2024 report of the World Tourism Organization (UNWTO) shows that the proportion of sustainable tourism projects in global foreign direct investment (FDI) in the tourism industry has significantly increased. Technologies such as artificial intelligence and blockchain are widely applied in ecological protection and the optimization of tourist experiences. This trend not only reflects the transformation of the tourism industry from a traditional resource-consuming type to an innovation-driven type, but also highlights that green development has become a core element of global tourism competitiveness.

Against this backdrop, China, as the world's largest domestic tourism market, is confronted with dual challenges: it has to meet the international community's expectations for a green transformation while also addressing the structural contradictions in the development of its domestic tourism industry. The traditional tourism model that relies on resource development has led to the over-limit ecological carrying capacity of some scenic spots. For instance, Jiuzhaigou was once forced to close for restoration due to excessive

development. With the proposal of China's "dual carbon" goals, the green transformation of the tourism industry, as a highly related industry, is not only an inevitable requirement for ecological civilization construction but also a key path to achieving high-quality economic development. Since the "14th Five-Year Plan", China has promoted the green development of its tourism industry through policy guidance and local pilot projects. The "Opinions of the Central Committee of the Communist Party of China and The State Council on Comprehensively Promoting the Construction of a Beautiful China" clearly regards green tourism as an important part of the construction of a beautiful China, and requires the establishment of a tourism development model featuring "three harmonious relationships between man and nature, man and man and man himself". At the local level, the Jiugong Mountain Scenic Area in Hubei Province has become the first zero-carbon scenic area in China through forest carbon sink and clean energy transformation. Its forest carbon storage exceeds the emission by ten times and has been awarded a five-star certification. Relying on its World Natural Heritage Site, Libo, Guizhou Province, has established a collaborative mechanism for ecological protection and tourism development. In 2023, its total tourism revenue recovered to 119% of the pre-pandemic level. These practices demonstrate that China's tourism industry has upgraded from a single eco-tourism model to a green one covering the entire industrial chain. For instance, enterprises like Ctrip have launched services such as low-carbon hotel certification and new energy car rental, driving 100 million tourists to participate in sustainable travel. However, the green development of China's tourism industry still faces deep-seated contradictions: First, the inertia of the traditional development model is hard to change. In 2023, the carbon emissions of transportation, accommodation and catering in the national tourism industry accounted for 45%, 30% and 15% respectively, with a significant high-carbon feature. Second, there is an imbalance in regional development. The application rate of green technologies in the eastern coastal areas exceeds 60%, while some scenic spots in the west still rely on ticket economies and have insufficient investment in ecological restoration. Thirdly, there is a problem of the "last mile" in policy implementation. For instance, the implementation rate of the national standard for "Green Tourism Hotels" is less than 50%, and some scenic spots have the phenomenon of "emphasizing reporting but neglecting

management".

At present, China's tourism industry is in a critical period of transformation from "scale expansion" to "quality improvement". How to deeply integrate the concept of green development into the tourism economic system, and through technological innovation, institutional reform and cultural reshaping, build a green tourism economic model with Chinese characteristics has become a focus of common concern in both academia and industry. Against the backdrop of the global green development era, the green transformation of China's tourism industry is not only an inevitable choice to address ecological challenges, but also a strategic opportunity to achieve high-quality economic development and enhance international discourse power. This study, through theoretical construction and empirical analysis, aims to reveal the inherent logic of green development and tourism economy, providing a multi-dimensional perspective for policy-making, industrial upgrading and academic research. In the future, it is necessary to further strengthen cross-disciplinary collaboration, promote green technological innovation and institutional reform, and make the tourism industry truly become a bright calling card for the construction of a beautiful China. In addition, this study also applies the theories and methods of multiple disciplines such as tourism, geography, and ecology to the research. This is of great theoretical significance for broadening the research perspective, enriching the research content, exploring new research methods, improving the research system, and exploring the tourism economy under green development.

Domestic scholars' research on tourism economic development under the green background started relatively late compared to that abroad. It mainly began in the 1980s. Gradually, some domestic scholars started to study the relationship between green development and tourism economy, and the research results were relatively remarkable. Wang Jiaxi (1985) pointed out that the rapidly developing tourism industry would cause problems such as the destruction of natural landscapes, pollution of air, water quality and noise. This is also regarded as the earliest start of domestic research on the relationship between tourism development and the ecological environment. Sun Haibo (1993) also emphasized the importance of ecological and environmental protection and the development of tourism at the same time. Cui Feng (2008) proposed that an important way

for sustainable development is the coordination between tourism and the ecological environment. However, Ma Yong (2018) later pointed out that the development of green tourism in China seems to have gradually deviated from its original intention. This is because the development of green tourism in China is based on promoting the development of the tourism industry, rather than on the reflection of traditional tourism that has certain consumption and damage to the environment. In addition, research on the threshold effect of the ecological environment and tourism economic development under green development, as well as the ecological environment threshold, has also attracted the attention of scholars. As Yang Hong (2018) studied and analyzed, with the improvement of the comprehensive level of the ecological environment, the development level of China's tourism economy was basically on the rise in the early stage. However, under the condition that the improvement of the comprehensive level of the ecological environment remained unchanged, it showed a downward trend in the later stage. Meanwhile, Zhou Cheng (2016) also pointed out that overly frequent tourism activities lead to environmental deterioration. Once it exceeds its threshold, it will increase the cost of economic activities and restrict the long-term development of regional economic tourism. In recent years, as the "dual carbon" concept has gradually come into the public eye, Zhong Linsheng (2023) has explored the requirements and paths for the green transformation of China's tourism industry under the "dual carbon" goals, emphasizing the significance of the green development concept in tourism development.

## **1.2 Low-carbon tourism economy**

Tourism is a socio-economic phenomenon that runs through all aspects of human life. It is a process of a product complex composed of service products for tourists to consume and other physical products. During a trip, all the activity links that tourists experience rely on certain material carriers, such as hotels, travel agencies, restaurants and means of transportation. Therefore, when calculating the carbon emissions of tourism, a comprehensive consideration should be given. Some scholars have proposed that tourism carbon emissions include carbon emissions from tourist attractions, industries and routes.

One of the main means of calculating carbon emissions is the carbon footprint. Based on this, we can have a basic understanding of the current situation of carbon emissions. The carbon footprint consists of two parts. The first is the direct carbon footprint, mainly referring to the energy consumed by scenic spots in their regular activities and transportation. The second is the indirect carbon footprint, which refers to the carbon dioxide emissions indirectly caused during the stage of consuming products and services, including all processes of manufacturing products and services and the entire process of final consumption.

The theory of low-carbon economy is a new economic development model guided by the concept of sustainable development. Through technological innovation, institutional optimization and industrial upgrading, it significantly reduces energy consumption, greenhouse gas emissions and environmental pollution, while achieving high-quality economic growth. The "Energy White Paper" issued by the British government in 2003 pointed out that a low-carbon economy achieves higher living goals and better quality of life by consuming less natural resources and causing less environmental pollution, and creates new business opportunities and more job opportunities for the development, application and export of advanced technologies. The main goal of a low-carbon economy is to enhance energy utilization efficiency and promote changes in the clean energy architecture, thereby achieving the core objective of environmentally friendly GDP. The most crucial point lies in promoting innovation and upgrading and changing the existing concepts. As human society enters a new development period, the low-carbon economic development mode can enhance the possibility of further implementation in terms of energy conservation and emission reduction, the development of a circular economy, and the construction of a harmonious society. In the tourism sector, the theory of low-carbon economy requires a change in the traditional development mode that is high in energy consumption and high in emissions. Through measures such as low-carbon transportation, green accommodation, ecological sightseeing and sustainable consumption, a new tourism development model that saves resources and is environmentally friendly should be constructed, ultimately achieving a win-win situation in economic, social and ecological benefits. This theory not only provides an important solution for the global response to

climate change, but also offers a systematic theoretical framework and practical guidelines for the green transformation of various industries. Under the background of a low-carbon economy, it is necessary for the traditional tourism development model to transition to a low-carbon tourism development model. In this article, "low-carbon economy" refers to an economic model that focuses on energy conservation, emission reduction, environmental protection and sustainable development. Low-carbon tourism is a green consumption pattern that integrates the concept of low-carbon economy into the tourism industry. On the basis of energy conservation and emission reduction, it promotes environmental protection concepts, urging all aspects of the tourism industry, including food, accommodation, transportation, sightseeing, shopping, and entertainment, to implement the reduction of greenhouse gas emissions such as carbon dioxide. Moreover, without compromising the quality of tourists' travel experience, Promote the coordinated development of tourism economy, social economy and ecological environment benefits in a trinity. It aims to achieve a win-win situation for economic development and environmental protection by enhancing the value of energy, expanding the application scope of clean energy, and facilitating technological upgrading. In the tourism industry, developing a low-carbon economy means promoting the transformation of traditional tourism models towards low-carbonization and environmental protection to achieve sustainable development of the tourism industry. The concept of low-carbon tourism should be fully integrated into the tourism industry system, among which government departments, tourism enterprises and tourists need to coordinate and make efforts in multiple aspects. The government departments strengthen macro-control and public publicity. Tourism enterprises adhere to the low-carbon concept to develop low-carbon products and provide low-carbon services. Tourists abide by the awareness of thrift and the concept of low material desires during the travel process. Eventually, the sustainable development of the tourism industry is fully achieved.

The theory of low-carbon economy emphasizes the establishment of a multi-level collaborative mechanism under the framework of global climate governance. Through the linkage of international agreements (such as the Paris Agreement), regional policies (such as the EU's carbon border adjustment mechanism), and national actions (such as China's

"dual carbon" goals), it promotes the in-depth transformation of the industrial system towards green and low-carbon. This theory not only focuses on the optimization of the energy structure but also advocates the management of carbon footprints throughout the entire production and consumption chain. For instance, Germany has achieved a 40% reduction in manufacturing energy consumption through the integration of "Industry 4.0" technologies, while the California carbon trading market has innovatively incorporated forest carbon sinks into the quota system, reducing the cost of emission reduction for enterprises by 28%. The core breakthrough lies in reconstructing the relationship between economic growth and ecological carrying capacity - World Bank data shows that reducing one ton of carbon dioxide can generate approximately 160 US dollars in social benefits, covering multiple values such as medical cost savings, ecological restoration, and job creation in the new energy industry, thereby verifying the underlying logic that low-carbon transformation is not an economic burden but a development opportunity.

The theory of low-carbon economy further reveals the coupling effect of technological revolution and institutional innovation. For instance, China has relied on ultra-high voltage transmission technology to achieve cross-regional consumption of renewable energy, raising the utilization rate of wind power in the northwest region from 65% in 2018 to 97% in 2023. Meanwhile, the European Union has adopted a combined policy of "carbon tariff + carbon tax refund". It will force high-carbon industries such as steel and cement to complete low-carbon process transformation by 2025, with an estimated reduction of 1.2 billion tons. This theory also reconstructs the social welfare function and incorporates "ecological capital" into the national economic accounting system. Norway has increased its GDP green index by 19% by calculating the value of forest carbon sinks, while Singapore's "Green Finance Framework" guides social capital to flow into low-carbon projects at an annual growth rate of 6%, proving that the market mechanism can effectively internalize environmental externalities. Its deeper value lies in reshaping the paradigm of civilization: The Global Energy Interconnection Development Cooperation Organization estimates that by 2050, an energy system dominated by clean energy will create 53 million jobs, far exceeding the 8 million jobs lost due to the decline of the fossil energy industry, highlighting the historical inevitability of the low-carbon economy as the

"greatest common divisor" of human sustainable development.

The theory of low-carbon economy has demonstrated a unique path of value creation in the transformation of the tourism industry. For instance, Switzerland has reduced the carbon intensity of tourism in the Alps from 2.1kg per person per day in 2019 to 0.7kg in 2024 through the "Glacier Express" all-electric sightseeing railway and the real-time carbon footprint monitoring system for hotels. At the same time, it has led to a 43% increase in new green positions such as mountain photovoltaic operation and maintenance. This theory drives the reconstruction of tourism consumption patterns - The Maldives has implemented the "Coral Currency" program, where tourists can obtain consumption discounts by participating in low-carbon behaviors such as Marine debris cleaning, reducing the resort's reliance on diesel power generation from 78% to 35%. Meanwhile, the Ubud area of Bali has introduced the "Carbon Credit Accommodation Certification", requiring hotels to have a carbon emission of no more than 8 kilograms per night to obtain premium pricing power. Promote the solar energy coverage rate to reach 91%. Its innovation lies in opening up the channel for the transformation of ecological value: According to data from the World Tourism Organization, the global low-carbon tourism market size is expected to exceed 680 billion US dollars by 2025, with the premium rate of "zero-carbon travel packages" reaching 25% to 40%. This indicates that green preferences are reshaping the consumption decision function. This paradigm shift from the energy revolution to the life revolution marks the completion of the closed-loop construction of the low-carbon economy theory from the production end to the consumption end.

The theory of low-carbon economy has opened up a new paradigm in the spatial governance dimension of the tourism industry. In Shirakawa-go, Japan, through the construction of a "negative carbon tourism town", traditional gassho-style houses have been transformed into ground source heat pump energy supply systems, and combined with the technology of tracking tourists' carbon accounts, 19% of the \$240 million in tourism revenue in 2023 was directly derived from carbon credit transactions. This theory has driven the formation of an innovative "ecological service payment" mechanism - the Lake Tekapo scenic area in New Zealand has implemented a "starry sky protection tax", where each visitor pays 3 US dollars to replace LED lighting facilities, reducing light pollution

by 72% and increasing the premium rate of high-end astronomical tourism products by 41%. Its revolutionary breakthrough lies in reconstructing the value of tourism space: Data from the International Renewable Energy Agency shows that after the global cruise industry adopted green hydrogen power systems, the carbon emissions of a single ship could be reduced by 89%, and the electric cruise ship network in the Hardangerfjord of Norway, through the hull photovoltaic + shore power fast charging technology, has reduced operating costs by 34% compared to diesel ships. This practice of embedding the carbon neutrality goal into the reproduction of geographic space has verified the full-scale penetration ability of the low-carbon economy theory from macro policies to micro scenarios, and has provided a replicable business prototype for "climate-smart tourism" under the United Nations Framework Convention on Climate Change.

### **1.3 Environmental Economics Theory**

The theory of environmental economics is an interdisciplinary theoretical system that integrates economic principles with environmental science thinking. Its core lies in revealing the interaction mechanism between environmental resources and economic systems through the framework of economic analysis, solving the problem of environmental externalities in economic activities, and promoting the optimal allocation and sustainable utilization of environmental resources. This theory takes welfare economics as the logical starting point, integrates externality theories (such as Pigou's tax and Coase's theorem), public goods theory (the public attributes of environmental resources), property rights theory (the definition and transaction of environmental property rights), and sustainable development theory, and constructs an analytical paradigm of the "economy-environment" complex system. Aiming to break through the limitation of traditional economics that regards the environment as an "exogenous variable", by internalizing environmental elements, an economic decision-making model including ecological costs is constructed. Its research content covers the economic value assessment of environmental resources, that is, quantifying the non-market value of environmental services by using the conditional value method, the production function method, etc., to make up for the neglect

of ecological costs in traditional GDP accounting. The design of environmental policy tools, that is, analyzing the incentive mechanisms and implementation effects of policies such as Pigou tax, pollution discharge rights trading, and ecological compensation, and exploring cost-effective environmental governance paths; The coordinated development model of the environment and the economy, such as studying the regional characteristics of the environmental Kuznets curve, the construction of the green GDP accounting system, the dynamic mechanism of the low-carbon economic transformation and other macro issues; As well as the analysis of micro-subject behaviors, including the examination of the cost-benefit of enterprises' environmental technology innovation, the formation mechanism of consumers' green preferences, and the collective action logic of community participation in environmental governance. Methodologically, the theory of environmental economics combines the characteristics of empirical analysis and normative analysis. It focuses on revealing the economic roots of environmental problems and proposing policy solutions that are both efficient and fair through tools such as econometric models, game theory, and experimental economics, thereby providing theoretical support for addressing modern ecological crises such as global climate change, biodiversity loss, and environmental pollution. Against the backdrop of sustainable development becoming a global consensus, this theory is gradually integrating from an interdisciplinary field into the core areas of mainstream economics, providing crucial theoretical tools and policy wisdom for achieving the governance goal of a "community of life for man and nature".

Environmental economics theory, as an interdisciplinary theoretical system integrating economic principles and environmental science thinking, its core lies in revealing the interaction mechanism between environmental resources and economic systems through the framework of economic analysis, solving the problem of environmental externalities in economic activities, and promoting the optimal allocation and sustainable utilization of environmental resources. This theory takes welfare economics as the logical starting point, integrates externality theory, public goods theory, property rights theory and sustainable development theory, and constructs an analytical paradigm of the "economy - environment" composite system. Its application scope has been continuously expanded in practice, and the development of green tourism has become a

typical reflection of this theory at the industrial level. Green tourism, as a tourism development model that relies on the natural ecological environment and cultural heritage resources and is guided by the concept of sustainability, Essentially, it is the practical carrier of "endogenicity of environmental resources" in the theory of environmental economics - its development not only relies on the non-market value assessment of environmental resources such as ecological landscapes and biodiversity (such as quantifying the economic value of ecological service functions such as forest recreation and wetland science popularization through the conditional value method), but also requires the use of environmental policy tools to optimize resource allocation. For example, the ecological compensation mechanism can be used to support environmental protection in tourist destinations. The green certification system can be adopted to guide enterprises to implement environmentally friendly business strategies, or market means such as pollution discharge rights trading can be utilized to restrain negative externalities in tourism development. At the macro level, the promotion of green tourism forms a theoretical correspondence with the analysis of regional characteristics of the environmental Kuznets curve and the research on the dynamic mechanism of low-carbon economic transformation, becoming an important path for exploring the coordinated development model of "environment - economy". Its amendments to the traditional tourism GDP accounting (such as incorporating carbon footprint accounting and ecological loss costs) have promoted the practical implementation of the green GDP accounting system. At the micro level, the formation mechanism of tourists' green consumption preferences (such as their willingness to pay for low-carbon accommodation and seamless tourism), the cost-benefit analysis of environmental technology innovation by tourism enterprises (such as the relationship between investment in renewable energy facilities and brand premium), and the collective action logic of community participation in tourism environmental governance (such as the definition of the rights and responsibilities of indigenous people in ecological protection and tourism revenue) All of them constitute important issues in the analysis of micro-subject behavior in environmental economics theory. Methodologically, the research and practice of green tourism also rely deeply on tools such as econometric models (such as evaluating the impact functions of tourism development on water quality and air quality)

and game theory (such as the game equilibrium of environmental governance among the government, enterprises and communities of tourist destinations). Its core objective lies in internalizing the environmental costs of tourism economic activities. Construct a development model that takes into account both economic benefits and ecological protection, thereby providing theoretical support for solving problems such as resource degradation and cultural heritage damage caused by excessive development of the tourism industry. Under the global advocacy of sustainable tourism, the integration of green tourism and environmental economics theory not only enriches the application dimensions of the discipline, but also promotes the evolution of environmental economics from the traditional resource allocation theory to the modern governance theory that is both systematic and forward-looking through the cycle of "theory guiding practice and practice nourishing theory". It provides an industrial-level implementation path and value model for achieving the goal of a "community of life between man and nature".

Environmental economics theory, as an interdisciplinary theoretical system integrating economic principles and environmental science thinking, its core lies in revealing the interaction mechanism between environmental resources and economic systems through the framework of economic analysis, solving the problem of environmental externalities in economic activities, and promoting the optimal allocation and sustainable utilization of environmental resources. This theory takes welfare economics as the logical starting point, integrates the externality theory, the public goods theory, the property rights theory and the sustainable development theory, and constructs the analytical paradigm of the "economy-environment" composite system. Its value has been verified through specific practices in real scenarios: For instance, in the economic value assessment of environmental resources, Zhejiang Qiandao Lake calculated through the conditional value method that the annual value of the ecological service functions of the lake area (including drinking water supply, tourism landscapes, climate regulation, etc.) reached 18 billion yuan, providing a quantitative basis for the formulation of ecological compensation policies for river basins. The Hani Terraced fields in Yunnan Province evaluated the agricultural landscape value of their "forest - village - terraced fields - water system" complex system by using the production function method, promoting the coordinated

development of world cultural heritage protection and rural tourism development. In the field of environmental policy tool design, the EU Emissions Trading System (EU ETS), by setting carbon quotas and allowing market trading, included the aviation industry in the scope of emission reduction in 2023. This has prompted enterprises such as Lufthansa to invest in the research and development of sustainable aviation fuel, reflecting the transformation from the Pigou tax theory to the market mechanism. The pilot program of "pollution discharge rights mortgage loan" in Xiongan New Area, Hebei Province, China, uses the surplus pollution discharge rights of enterprises as assets for mortgage financing, directly confirming the practical value of Coase's theorem in environmental property rights transactions.

In the research on the coordinated development model of the environment and the economy, Costa Rica has established an "Environmental Service Payment" (PES) mechanism to provide ecological compensation to farmers who protect tropical rainforests. This has restored the country's forest coverage rate from 21% in the 1980s to 60% in 2024, while also driving an average annual growth rate of 8% in ecotourism revenue. It becomes a counterexample of the paradox of the environmental Kuznets curve of "polluting first and then treating"; In the pilot program of China's green GDP accounting in Ordos, Inner Mongolia, the cost of surface subsidence control for coal mining and groundwater loss expenses have been included in the GDP deduction items, forcing resource-based cities to transform towards the new energy industry. At the micro level, the theory of subject behavior analysis is also clearly reflected in the decision-making of enterprises and consumers: Procter & Gamble introduced "product environmental footprint accounting", included the carbon emissions of packaging materials in the supply chain cost, and promoted the use of 100% recycled plastic for its "Tide" laundry detergent bottles, achieving dual benefits of environmental technology innovation and brand premium. Japanese consumers are 35% more willing to pay for agricultural products that have obtained JAS organic certification than ordinary products, confirming the theory of information asymmetry in the formation of green preferences - third-party certification promotes market transaction efficiency by reducing the cost of environmental quality assessment.

Methodologically, the empirical tools of environmental economics theory play a crucial role in the assessment of climate policies: The Sixth Assessment report of the United Nations Panel on Climate Change (IPCC) employed the computable General Equilibrium Model (CGE) to quantify the impact of different carbon pricing policies on the global energy structure, providing scientific support for the setting of nationally determined contribution targets under the Paris Agreement. In the research on the governance of "public pond resources" in experimental economics, by simulating the fishing behavior of fishermen in the laboratory, the effectiveness of Ostrom's "multi-center governance" theory was verified - when communities were granted the right to independently set fishing quotas, the risk of resource depletion was reduced by 40% compared with single government regulation. These examples not only demonstrate the ability of environmental economics theory to solve real ecological problems, but also reveal its core goal - to incorporate traditional "free resources" such as the atmosphere, water and biodiversity into the economic decision function. For instance, the power market reform under China's "dual carbon" goals, by establishing a green power trading mechanism, converts the environmental benefits of wind power generation into corporate profits. Promote the proportion of renewable energy installed capacity to exceed 50% by 2024. In the current context of intensifying global ecological crises, this theory is providing methodological support for achieving governance goals such as the "Ten-Year fishing ban on the Yangtze River" and the "Global Biodiversity Framework" through a closed loop of "theoretical modeling - policy design - practical feedback", and has become a core knowledge system connecting economic rationality and ecological ethics.

## **Chapter 2 A multifaceted analysis of China's Tourism Economy from a Low-Carbon Perspective**

### **2.1 Overall scale and growth trend of global tourism economy**

As one of the core pillar industries of the global economy, the expansion and growth trend of the tourism industry directly reflects the vitality of the global economy and the level of social mobility. This chapter is based on data from authoritative organizations such as the United Nations World Tourism Organization (UNWTO) and the World Tourism and Travel Council (WTTC). It systematically analyzes the overall scale, regional growth differences, and structural characteristics of the global tourism economy from 2014 to 2024, and explores in depth the core growth drivers such as consumption upgrading, technological innovation, and policy support. Emerging markets and the Asia Pacific region have become the main drivers of growth, and the industry is accelerating its transformation towards high-end, digital, and sustainable industries. The tourism industry has long held a key position in the global economy due to its strong industrial linkage effect and employment absorption capacity [2].

The low-carbon economy, as a new form of economic development that differs from traditional models, relies on diverse innovation paths such as technological innovation and industrial structure optimization and upgrading. It continuously promotes low-carbon transformation and energy intensity reduction in the process of economic development, strengthens greenhouse gas emission reduction and control, and comprehensively and efficiently utilizes energy to build a development pattern of coordinated progress between economic growth and natural ecological protection. Its essence is to break the opposition between ecological protection and economic growth in traditional economic development, supported by systematic innovation, and achieve the organic unity of improving the quality of economic development and sustainable ecological environment [10].

Currently, the industry's recovery has surpassed a simple quantitative regression, presenting structural characteristics of "emerging markets leading, technology deeply empowering, and consumption structure upgrading". This chapter systematically reviews

the current scale, growth logic, and future trends of the global tourism economy through tourism economic data and research results from multiple institutions, providing reference for industry policy formulation and corporate strategic layout.

### 1) Analysis of Global Tourism Economic Revenue

As a core quantitative indicator for measuring the quality and vitality of industry development, tourism economic income not only directly reflects the recovery process of the tourism industry in terms of scale fluctuations, structural evolution, and regional distribution, but also reflects the deep changes in global consumption patterns, industry linkage, and policy orientation. Since the substantial recovery of the global tourism market in 2023, tourism revenue has gradually rebounded from the cliff like decline during the pandemic to a historical high. In 2024, driven by multiple factors such as demand release, business innovation, and consumption upgrading, the scale and quality of revenue have been synchronously improved. From a global perspective, tourism economic income covers two core sectors: international tourism foreign exchange income and domestic tourism income. The growth trend and structural proportion of the two jointly outline the income panorama of the global tourism economy, and lay the foundation for further analysis of the industry's recovery momentum and structural characteristics.

Table 2.1 – Statistics of Global Tourism Revenue Data [47]

| Year | International tourism revenue (trillion US dollars) | growth rate (%) | Domestic tourism revenue (trillion US dollars) | Year on year growth (%) | Global tourism revenue (trillion US dollars) |
|------|-----------------------------------------------------|-----------------|------------------------------------------------|-------------------------|----------------------------------------------|
| 2014 | 1.45                                                | 3.70%           | 3.59                                           | 2.20%                   | 5.04                                         |
| 2015 | 1.39                                                | -4.1%           | 3.41                                           | -5.0%                   | 4.8                                          |
| 2016 | 1.41                                                | 1.50%           | 3.49                                           | 2.3%                    | 4.9                                          |
| 2017 | 1.51                                                | 7.10%           | 3.75                                           | 7.4%                    | 5.26                                         |
| 2018 | 1.63                                                | 8%              | 4.05                                           | 8.0%                    | 5.68                                         |
| 2019 | 1.68                                                | 2.70%           | 4.16                                           | 2.7%                    | 5.84                                         |
| 2020 | 0.63                                                | -62.50%         | 2.59                                           | -37.7%                  | 3.22                                         |
| 2021 | 0.7                                                 | 11.60%          | 3.18                                           | 22.8%                   | 3.88                                         |
| 2022 | 1.21                                                | 73%             | 3.34                                           | 5.0%                    | 4.55                                         |
| 2023 | 1.49                                                | 23.10%          | 4.04                                           | 21.0%                   | 5.53                                         |
| 2024 | 1.6                                                 | --              | 4.5                                            | 11.4%                   | 6.1                                          |



Figure 2.1 – Global International Tourism Revenue from 2014 to 2024 [done by author]

As shown in Figure 2.1, the global international tourism volume continued to rise from 2014 to 2019, mainly due to the relaxed cross-border flow environment. On the one hand, many countries around the world are promoting visa facilitation (such as visa free and electronic visa policies), which has lowered the policy threshold for cross-border travel; on the other hand, the continuous expansion of the international aviation network (route encryption, price reduction) has improved the accessibility of cross-border travel. At the same time, the moderate growth of the global economy has also supported the consumption capacity of residents for cross-border tourism, and multiple factors have jointly pushed international tourism into a "low volatility expansion period" [17].

In 2020, the number of international tourists almost halved, directly due to cross-border flow restrictions under global public health events: countries have successively closed their borders, suspended international flights, combined with measures such as entry quarantine and travel bans, completely cutting off the physical scene of international tourism. However, international tourism is highly dependent on the attribute of "cross-border personnel mobility", which makes it more affected than domestic tourism and has become the most volatile sector in the global tourism market.

## 2) Global Tourist Analysis

As the core participants and sources of demand in tourism economic activities,

tourists' changes in scale, structural characteristics, behavioral preferences, and flow patterns are key perspectives for interpreting the recovery momentum and development trends of the tourism economy. The growth of tourism economic income essentially stems from the expansion of the number of tourists and the improvement of consumption ability. The analysis of income scale in the previous text has provided macroeconomic background support for research at the tourist level. The comprehensive recovery of the global tourism market in 2024 presents significant characteristics of "total volume return, structural optimization, and regional differentiation" in the tourist dimension - both international and domestic tourist numbers have exceeded pre pandemic levels, and the age structure, consumption preferences, travel destinations, and destination choices of tourists have undergone profound changes. These changes have not only driven the growth of tourism revenue, but also reshaped the competitive landscape of the global tourism market. This chapter will analyze the recovery trend and evolutionary logic of global tourism demand from three dimensions: total tourist volume, structural characteristics, and flow patterns.

Table 2.2 – Statistics of Global Tourist Number [48]

| Year | Global International<br>Tourism Arrivals<br>(100 million person-<br>times) | Growth<br>Rate (%) | Global Domestic<br>Tourism Arrivals<br>(100 million<br>person-times) | Year-on-<br>Year (YoY)<br>Growth (%) | Total Global<br>Tourism Arrivals<br>(100 million<br>person-times) |
|------|----------------------------------------------------------------------------|--------------------|----------------------------------------------------------------------|--------------------------------------|-------------------------------------------------------------------|
| 2014 | 11.3                                                                       | 4.60%              | 89.35                                                                | 6.90%                                | 100.65                                                            |
| 2015 | 11.73                                                                      | 3.80%              | 95.7                                                                 | 7.1%                                 | 107.43                                                            |
| 2016 | 12.18                                                                      | 3.80%              | 102.39                                                               | 7.0%                                 | 114.57                                                            |
| 2017 | 13.08                                                                      | 7.40%              | 110.69                                                               | 8.1%                                 | 123.77                                                            |
| 2018 | 13.81                                                                      | 5.60%              | 118.87                                                               | 7.4%                                 | 132.68                                                            |
| 2019 | 14.28                                                                      | 3.40%              | 130.68                                                               | 9.9%                                 | 144.96                                                            |
| 2020 | 4.02                                                                       | -71.90%            | 66.05                                                                | -49.5%                               | 70.07                                                             |
| 2021 | 4.59                                                                       | 14.30%             | 76.96                                                                | 16.5%                                | 81.55                                                             |
| 2022 | 9.49                                                                       | 106.60%            | 80.04                                                                | 4.0%                                 | 89.53                                                             |
| 2023 | 12.56                                                                      | 32.30%             | 114.18                                                               | 42.7%                                | 126.74                                                            |
| 2024 | 14.5                                                                       | --                 | --                                                                   | --                                   | 142                                                               |

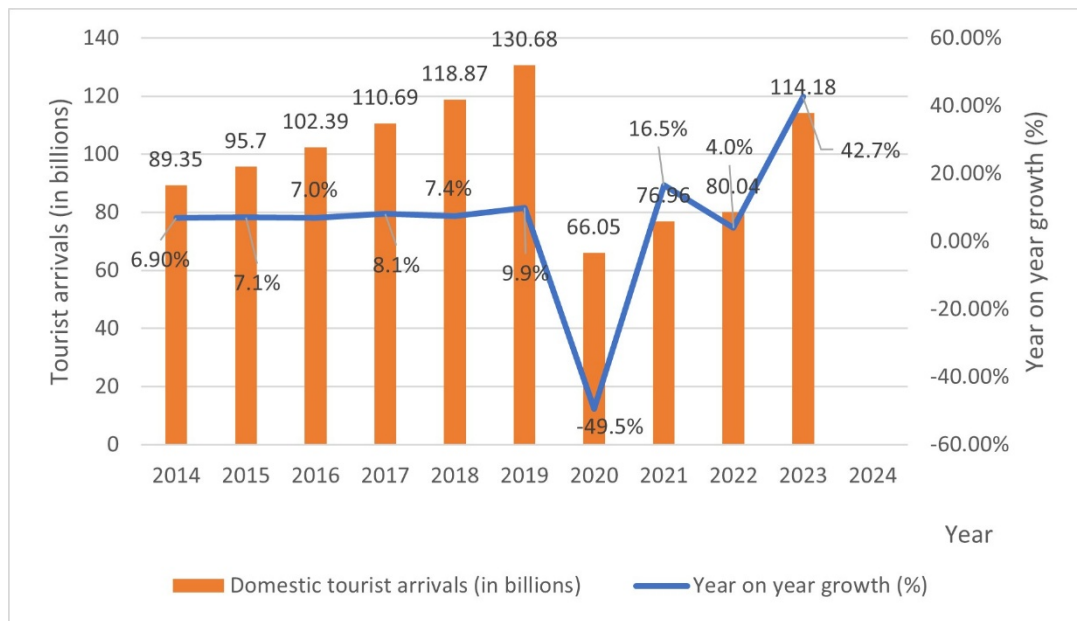


Figure 2.2 – Global domestic tourist arrivals from 2014 to 2024 [done by author]

Firstly, from the trend chart in Figure 2.2, the "asymmetric fluctuations" feature of the tourism market cycle can be excavated. Combining data details and underlying logic can present industry changes in a more three-dimensional manner: 2014-2019: a steady-state cycle of "gradual expansion", which is the "continuous expansion stage" of the global tourism market, but the growth pace shows a "mild acceleration" feature: the number of people increased from 8.935 billion (2014) to 13.068 billion (2019), and the annual increment gradually expanded from 635 million in 2014-2015 to 1.181 billion in 2018-2019; Although the year-on-year growth rate has fluctuated, it has overall increased from the "6% -7% range" to the "8% -9% range" - this reflects the long-term trend of increasing the proportion of global residents' leisure consumption, as well as the continuous improvement of the supply side of tourism destinations (such as scenic spots and transportation), which has a driving effect on the market. It is a steady-state growth driven by both "demand+supply". The cliff like contraction caused by the "scene interruption" that began in 2020 has become a critical point for the cycle to turn, and the data shows a "scale like drop": essentially, it is caused by the "offline scene dependence of tourism consumption": travel restrictions and gathering control under public health events directly cut off the realization path of tourism consumption, and also exposed the high vulnerability of the tourism industry as a "contact service industry". In the fluctuation week of "non-linear

recovery" from 2021 to 2024, the recovery after 2020 is not a "linear regression", but presents the characteristics of "pulse like repair+stage adjustment": in 2021, the number of people rebounded to 7.696 billion, a year-on-year increase of 16.5% - this is the result of "short-term release of suppressed demand", but only recovered to about 80% of 2015 (9.57 billion), belonging to "local repair"; In 2022, the growth rate will fall back to 4.0%, and the number of people will only slightly increase to 8.004 billion - reflecting a temporary slowdown in the recovery momentum, which may be related to repeated prevention and control policies and insufficient consumer confidence in some regions; In 2023, the number of people jumped to 11.418 billion, a year-on-year increase of 42.7% - this growth rate is more than four times the peak from 2014 to 2019 (9.9%). The core driving force is the lifting of cross-border/cross regional flow restrictions worldwide, but even so, the number of people is still lower than the 13.068 billion in 2019, and the "complete recovery" has not been completed; Until 2024, the year-on-year growth trend line will be further explored - suggesting that the market has entered a "post recovery adjustment period", or tourism consumption will return to the normal state of "rational consumption" from "compensatory release" due to the slowdown of global economic growth, sluggish growth of disposable income of residents and other factors.

The trend over the past 11 years indicates that the global tourism market has both strong resilience (rapid recovery after 2020) and high sensitivity (severe fluctuations under external shocks); the "non-linearity" of the recovery suggests that the long-term healthy development of the tourism industry needs to simultaneously balance "scene resilience construction" and "consumer confidence anchoring".

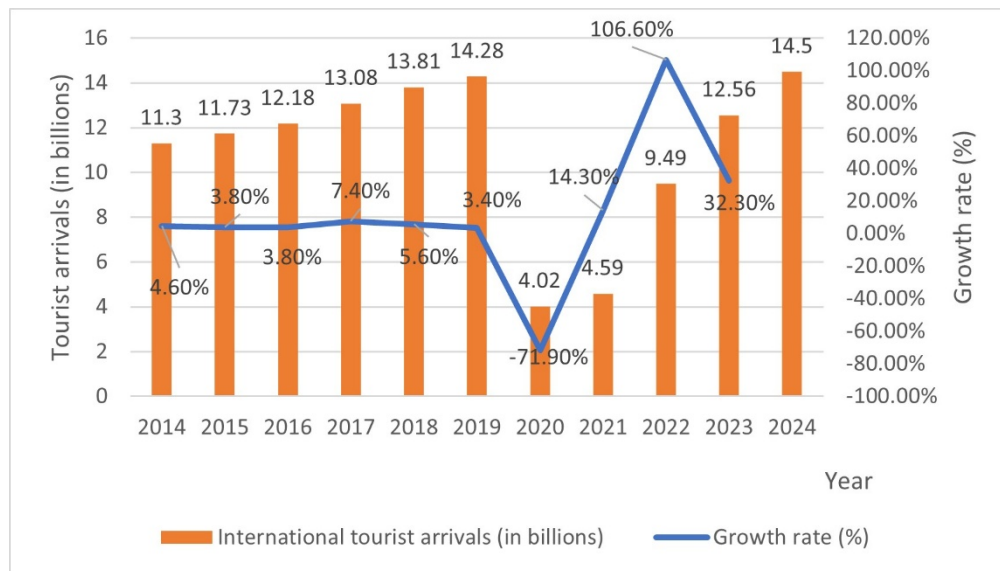


Figure 2.3 – Global international tourist arrivals from 2014 to 2024 [done by author]

Secondly, from Figure 2.3, it can be seen that international tourism exhibits the characteristics of "more intense fluctuations+longer recovery cycles" due to its cross-border nature. The specific analysis is as follows:

The steady cycle of moderate expansion from 2014 to 2019 saw the international tourism market in a state of low volatility growth. This steady growth reflects both the "demand rigidity" of cross-border tourism (the normalization of residents' cross-border leisure and business travel) and the stable support of global cross-border policies at that time (such as visa facilitation and improved international flight networks), which was a natural expansion of the relaxed cross-border flow environment. The "cliff like collapse" under cross-border restrictions in 2020 was a deep contraction point for international tourism, with a decline far exceeding that of domestic tourism: the number of tourists plummeted from 1.428 billion in 2019 to 402 million, a decrease of 1.026 billion, equivalent to "wiping out all the growth from 2014 to 2018"; The year-on-year growth rate plummeted to -71.90%, far higher than the -49.5% of domestic tourism in 2020. The core reason is that international tourism relies on "cross-border personnel flow", and the global border closures, international flight suspensions, and other control measures in 2020 directly cut off the implementation path of international tourism, highlighting the extreme sensitivity of international tourism to the "cross-border policy environment".

In the pulse like recovery and approaching repair from 2021 to 2024, the recovery

after 2020 presents a stepped characteristic of "low base high growth rate to base uplift growth rate falling back to pre pandemic levels":

Compared to domestic tourism, the core characteristics of international tourism are: stronger vulnerability (deeper decline under cross-border policy shocks), longer recovery cycle (relying on synchronized relaxation of the global cross-border environment), and closer to the pre pandemic baseline in the later stage of recovery - this is essentially an "additional constraint on cross-border flow (policies, transportation, visas)", which makes the volatility of international tourism much greater than that of domestic tourism.

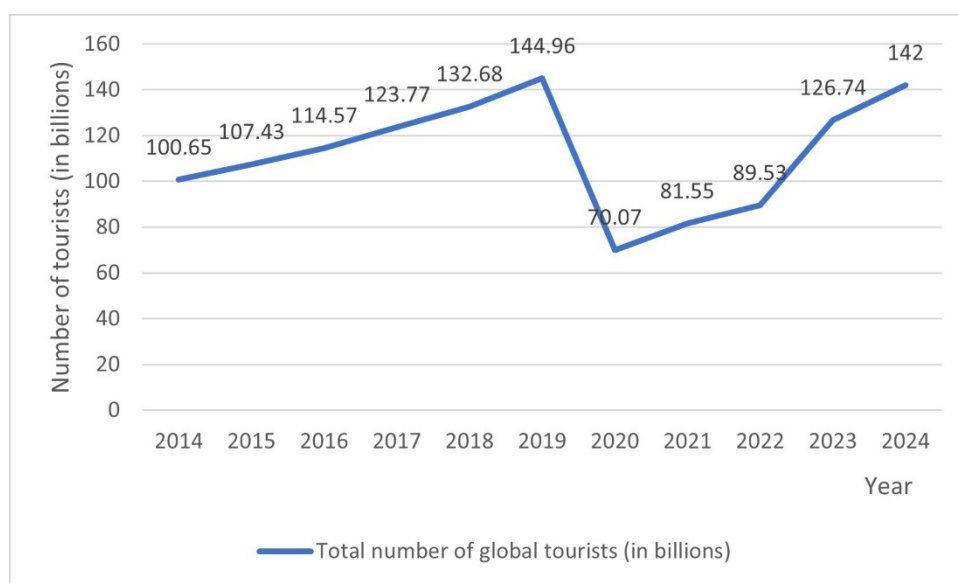


Figure 2.4 – Statistics of Global Tourism Total Number [done by author]

Finally, by combining the three graphs of global tourism total, domestic tourism, and international tourism in Figure 2.4, we can break down the cycle logic of the past 11 years from a new perspective of "structural contribution weight" and "baseline elasticity of the total market". The "baseline fluctuation" of the total number of people is essentially the result of the dynamic switching of contribution weights between domestic tourism (base plate) and international tourism (elastic plate). The expansion of the total market is essentially a natural extension of the "large base and stable growth" of domestic tourism, while international tourism only provides a small increment as a "supplementary plate". It is precisely the relatively controllable contraction of domestic tourism that has prevented

the overall market from experiencing more extreme declines, and domestic tourism has become the "lower limit support" of the overall market. The core is the "flexible replenishment" of international tourism: by 2024, the proportion of international tourists exceeding pre pandemic levels will return to around 10% of the total population, driving the overall market baseline to approach pre pandemic levels.

From the perspective of the overall market, the functions of domestic and international tourism are completely different. Domestic tourism is the "stabilizer" of the overall market. Regardless of expansion, contraction, or recovery period, domestic tourism always accounts for more than 85% of the total population, determining the "baseline lower limit" of the overall market - even if it encounters an impact, the basic strength of domestic tourism can still support the overall market from experiencing a "collapse like decline".

International tourism is the "elasticity" of the overall market, and although its proportion is low, its volatility is extremely large. Under the impact, it is the main contributor to the overall market's decline, and the recovery period is the core driving force for the overall market to approach its peak, determining the "upper limit of recovery" of the overall market. The core of these eleven years includes the following three points:

Table 2.3 – Core Summary of International Tourism Market [done by author]

| Dimension                     | Domestic Tourism                                           | International Tourism                                                  |
|-------------------------------|------------------------------------------------------------|------------------------------------------------------------------------|
| Decline Rate Under Shocks     | 49.5% year-on-year decrease in 2020                        | 71.9% year-on-year decrease in 2020                                    |
| Recovery Rhythm               | Entering a 'retaliatory recovery' in 2021                  | Entering the rapid repair period after 2022                            |
| Restoration Completion Degree | The number of people in 2023 is close to the level of 2017 | The number of people in 2024 slightly exceeds the level of 2019        |
| Core Influencing Factors      | Domestic policies and consumer confidence                  | Global cross-border policies and international transportation capacity |

1. The resilience of the overall market is the "structural combination resilience": the "basic resilience" of domestic tourism has withstood the lower limit of the impact, while the "elastic resilience" of international tourism has reached the upper limit of the recovery. The combination of the two has enabled the overall market to approach the pre pandemic baseline 11 years later;

2. The impact has not changed the long-term trend: the total number of people in 2024

(14.2 billion) is close to the peak of 2019 (14.496 billion), indicating that the epidemic has only caused "short-term baseline fluctuations" in the overall market and has not reversed the long-term expansion trend of global tourism consumption;

3. Self adjustment of structural weights: During the shock period, the domestic proportion passively increases, while during the recovery period, the international proportion returns, reflecting that the global tourism market can buffer external shocks and return to a long-term rhythm through structural weight adjustment.

## **2.2 The direct impact mechanism of tourism economy on the global economy under the low-carbon background**

Against the backdrop of the global goal of "carbon neutrality" and the deep penetration of low-carbon development concepts, the tourism industry, as a core industry with both economic and ecological attributes, has surpassed the traditional scale dimension in its impact on the global economy and formed a new mechanism deeply bound to low-carbon transformation. In 2024, the global tourism economy achieved a milestone recovery after the pandemic, not only returning to historical highs in income and tourist scale, but also driving low-carbon transformation through industrial value creation, employment absorption, and resource allocation optimization, which has had a more diverse and profound direct impact on the global economy. Unlike previous analytical perspectives that focus on "scale contribution," this section is based on the context of low-carbon development, focusing on the direct link between the tourism economy and the global economy, analyzing its core impact mechanisms in economic growth empowerment, industrial structure adjustment, regional economic balance, and providing key support for clarifying the positioning of the tourism industry in the global low-carbon economic system [6].

As a core quantitative indicator for measuring the quality and vitality of industry development, tourism economic income not only directly reflects the recovery process of the tourism industry in terms of scale fluctuations, structural evolution, and regional distribution, but also reflects the deep changes in global consumption patterns, industry

linkage, and policy orientation. Since the substantial recovery of the global tourism market in 2023, tourism revenue has gradually rebounded from the cliff like decline during the pandemic to a historical high. In 2024, driven by multiple factors such as demand release, business innovation, and consumption upgrading, the scale and quality of revenue have been synchronously improved [39]. From a global perspective, tourism economic income covers two core sectors: international tourism foreign exchange income and domestic tourism income. The growth trend and structural proportion of the two jointly outline the income panorama of the global tourism economy, and lay the foundation for further analysis of the industry's recovery momentum and structural characteristics.

This chapter uses annual time series data of global GDP (referred to as GDP) and total tourism revenue (referred to as Tourism) from 2014 to 2024, with a sample size of 11 periods. The data is sourced from publicly available statistics from the World Tourism Organization (UNWTO) and the International Monetary Fund (IMF), covering the entire lifecycle before, during, and after the pandemic. The purpose is to analyze the relationship between global tourism economic data and global economic data, as shown in the mind map of this chapter.

As shown in Figure 2.5, the modified diagram is the mind map of this chapter. STATA software was used to process the relevant data in this article and establish statistical models. Firstly, filter the data to check if it meets the inspection requirements. If the data does not meet the requirements, it needs to be replaced.

Secondly, this article uses the mainstream ADF test to perform stationarity testing on the filtered data. The object of stationarity testing [31] is a "single sequence", which tests whether a single time series data can meet the "change with time" requirement. If the time series is stationary, then the mean and variance of the data will remain stable over time and will not show significant fluctuations or decreases. If the data is non-stationary, with the change of time, the fluctuation of time series data will be large, and the mean and variance will also increase, which may lead to the "pseudo regression" state of the data. Therefore, we need to reselect the data or perform multiple differencing on the data to make it stable and not affect the detection and analysis [51].

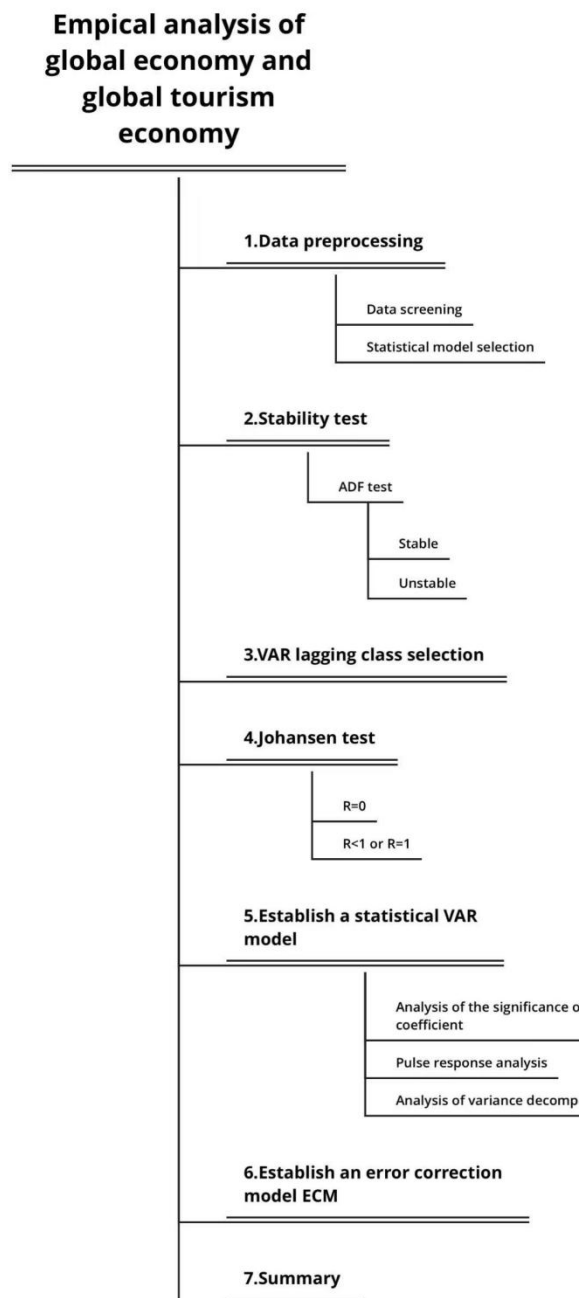


Figure 2.5 – Empirical Analysis Mind Map [done by author]

Thirdly, when the data is stationary, we choose the lag order of VAR, which mainly means selecting the optimal lag order for subsequent analysis. Fourthly, we perform Johansen test on time series data. Johansen test is to test the combination of "multiple stationary sequences", and the premise of conducting Johansen test must be the same order co-integration. This is also why we need to conduct stationarity test first. The main research is whether there is a "long-term stable equilibrium relationship" between multiple variables. Even if a single variable fluctuates and is non-stationary, the long-term stable equilibrium

between multiple variables is also valid if it conforms to Johansen test. Fifth, after we have completed the validation of the time series data, we need to perform a "VAR" vector autoregression analysis on the time series data, using the lag value of the vector itself to explain the fluctuations in the current time period. The core is to make the vectors in the vector group explanatory variables for each other, without setting causal relationships, only explaining the self value of the current variable, and analyzing the dynamic correlation between vector data. Firstly, observe whether the coefficients meet the testing requirements. After the coefficients meet the requirements, perform impulse response on them. The purpose is to determine whether one vector will maintain its response trajectory in the future after a sudden impact. When such a response exists, we then perform variance decomposition to quantify the passive contribution between the two sets of vectors and see how much of the fluctuation between the vectors comes from the other vector. Sixth, based on Johansen's test of short-term dynamic fluctuations and long-term deviation from equilibrium, the goal is to detect and correct the deviation of vector data in different states, and then bring this deviation back on track to ensure long-term stability.

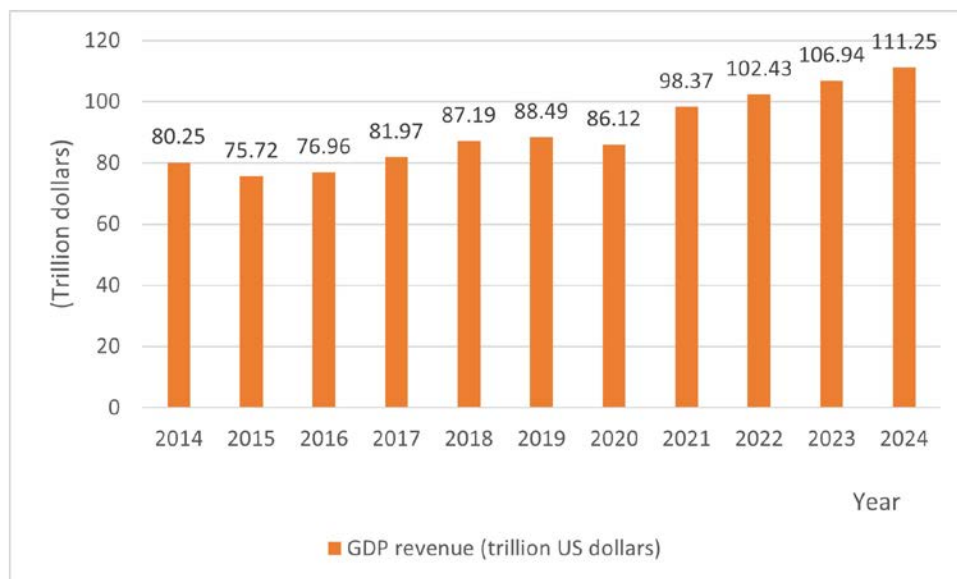


Figure 2.6 – Global GDP Income Statistics from 2014 to 2024 [done by author]

This article mainly uses global tourism data and global GDP data (as representative data of global income), selects data from 2014 to 2024, and uses STATA software to establish and analyze statistical models. As shown in Figure 2.6, this is the global GDP data chart from 2014 to 2024. The global GDP trend from 2014 to 2024 is closely related to the

historical background, presenting a development trend of "fluctuation adjustment steady recovery epidemic impact strong rebound". From 2014 to 2016, due to the impact of the post financial crisis, the recovery of developed economies was weak, and emerging markets also faced pressure due to fluctuations in commodity prices. The global economy was undergoing a deep adjustment, and GDP had periodic fluctuations. From 2017 to 2019, with the stability of the global trade pattern, the promotion of multilateral cooperation and regional economic integration, and the policy synergy of major economies, the global economy gradually recovered and GDP steadily increased. In 2020, the COVID-19 will become a global pandemic. The blockade measures will cause the global supply chain to break, and the consumption and service industries to be severely hit. The global economy will suffer a serious impact, and GDP will fall significantly.

Table 2.4 – Global GDP Income Statistics Table [44]

| Year | GDP revenue (trillion US dollars) | Global tourism revenue (trillion US dollars) |
|------|-----------------------------------|----------------------------------------------|
| 2014 | 80.25                             | 5.04                                         |
| 2015 | 75.72                             | 4.8                                          |
| 2016 | 76.96                             | 4.9                                          |
| 2017 | 81.97                             | 5.26                                         |
| 2018 | 87.19                             | 5.68                                         |
| 2019 | 88.49                             | 5.84                                         |
| 2020 | 86.12                             | 3.22                                         |
| 2021 | 98.37                             | 3.88                                         |
| 2022 | 102.43                            | 4.55                                         |
| 2023 | 106.94                            | 5.53                                         |
| 2024 | 111.25                            | 6.1                                          |

From 2021 to 2024, with the normalization of epidemic prevention and control, the popularization of vaccines, the acceleration of global economic activities, coupled with large-scale fiscal and monetary stimulus policies, as well as the rise of new growth poles such as digital economy and green economy, the rapid repair of the global industrial chain and the transformation towards high added value and low carbonization, the strong rebound

and sustained growth of the economy, demonstrate the innovative vitality and long-term resilience of the global economy after the crisis. As shown in Table 2.3, through data collection, the global GDP data and global tourism data from 2014 to 2024 were statistically analyzed. Then, relevant analysis methods were used to screen and reconstruct the raw data before conducting relevant analysis and establishing statistical models.

### 1. Stability test

The stationarity test is a test used to determine whether the statistical properties of time series data change over time. If a statistical model is directly established in a time series without conducting a stationarity test, the phenomenon of "pseudo regression" may occur, which is very inaccurate and unfavorable for data testing. Therefore, before establishing a statistical model, in order to ensure its accuracy and reliability, a stationarity test is required [13]. At present, there are two main types of testing methods: one is the method of using time series autocorrelation plot testing, and the other is the method of using unit root testing, such as DF/ADF/KPSS testing. However, in the current mainstream testing method, we use ADF testing. ADF stationarity test was proposed by D.A. Dickey and W, A, Fuller in 1979, which solved the problem of being unable to handle high-order time series. By using a regression model that includes lagged differences, high-order interference in the sequence is eliminated, and then hypothesis testing is conducted to determine the existence of unit roots.

$$\Delta Y_t = \gamma Y_{t-1} + \sum_{i=1}^p \delta_i \Delta Y_{t-i} + \varepsilon_t \quad (\text{Formula 2.1})$$

$$\Delta Y_t = \alpha + \gamma Y_{t-1} + \sum_{i=1}^p \delta_i \Delta Y_{t-i} + \varepsilon_t \quad (\text{Formula 2.2})$$

$$\Delta Y_t = \alpha + \beta t + \gamma Y_{t-1} + \sum_{i=1}^p \delta_i \Delta Y_{t-i} + \varepsilon_t \quad (\text{Formula 2.3})$$

The above three formulas are the ADF test formulas. Formula 2.1 is a model formula without constant terms and no time trend, mainly applicable to stationary sequences with a mean of 0. Formula 2.2 has a constant term but no time trend, and is mainly applicable to time series with non-zero mean but no long-term trend. Formula 2.3 contains a constant term and does not have a linear time trend, mainly used for time series with long-term

changing trends. In the formula,  $Y_t$  is the time series to be tested,  $\Delta Y_t$  is the first-order difference of the sequence  $Y_t$ ,  $Y_{t-1}$  is the value of the lagged period  $Y_t$ ,  $\Delta Y_{t-i}$  is the difference of the lagged period  $i$ , mainly used to eliminate autocorrelation,  $\alpha$  is a constant term that reflects the average level of the sequence,  $\beta t$  is the linear time trend term that captures the long-term trend of the time series,  $\gamma$  is the core of the formula, mainly the detection coefficient,  $\delta_i$  is the coefficient of the lagged difference term, used to correct the deviation of the model,  $\varepsilon_t$  is the random error term, and  $p$  is the lag order. [45]

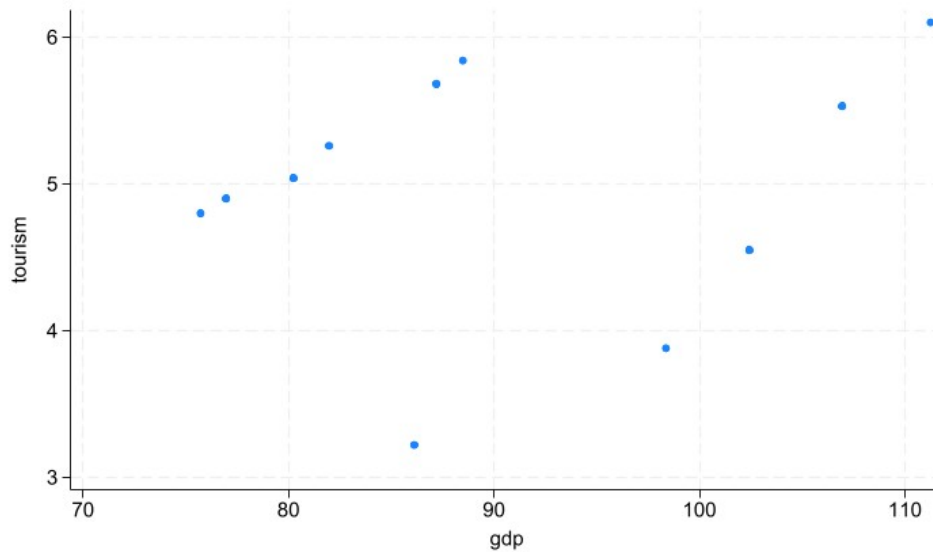


Figure 2.7 – Scatter plot of STATA time series [done by author]

As shown in Figure 2.7, this is a scatter plot that displays the correspondence between the observed values of two variables: the horizontal axis represents the global economic data "GDP" (values covering a continuous range of 70 to 110), and the vertical axis represents the global tourism data "tourism" (values covering a continuous range of 3 to 6). Each blue dot corresponds to a set of actual observed data on GDP and tourism. The variable relationship presented in this scatter plot has a "non-linear" characteristic, that is, there is a stable positive correlation between GDP and tourism in the early stage (70-90), but the fluctuation in the high GDP range (90+) indicates that the two are not simply linear, and there may be a "threshold effect" (the logical change that affects tourism after GDP breaks a certain level) or interference from policies, emergencies, and other factors; At the same time, the characteristics of concentrated data points in the early stage and increased

dispersion in the later stage also indicate that the higher the GDP, the greater the risk of tourism fluctuations (or the degree of influence by non GDP factors); The 'sudden drop rebound' in the high GDP range may be either an individual outlier or a reflection of the stage shock encountered by tourism in reality.

summarize year gdp tourism

| Variable | Obs | Mean     | Std. dev. | Min   | Max    |
|----------|-----|----------|-----------|-------|--------|
| year     | 11  | 2019     | 3.316625  | 2014  | 2024   |
| gdp      | 11  | 90.51727 | 12.32428  | 75.72 | 111.25 |
| tourism  | 11  | 4.981818 | .8602188  | 3.22  | 6.1    |

Figure 2.8 – Descriptive Statistical Chart of STATA [done by author]

As shown in Figure 2.8, the data is imported into the STATA software for descriptive statistics. From the figure, it can be seen that the average global GDP is 90.52 trillion US dollars, and the minimum value is 75.72 trillion US dollars; The maximum value is 111.25 trillion US dollars. The tourism revenue in 2020 (3.22 trillion US dollars) was the minimum value, corresponding to the impact of the epidemic; The maximum value in 2024 (6.1 trillion US dollars) reflects the trend of recovery.

Dickey-Fuller test for unit root  
Variable: gdp

Number of obs = 10  
Number of lags = 0

H0: Random walk with or without drift

|      | Test statistic | 1%     | 5%     | 10%    |
|------|----------------|--------|--------|--------|
| Z(t) | -3.050         | -4.380 | -3.600 | -3.240 |

Mackinnon approximate p-value for Z(t) = 0.1186.

Figure 2.9 – STATA global economic original series stationarity test chart [done by author]

As shown in Figure 2.9, it is the stationarity test of the original global GDP series.

From the figure, it can be seen that the sample size is 10, the lag order is 0, and the null hypothesis  $H_0$  is (the series has unit roots and is non-stationary). The ADF test statistic is -3.05, and the significance levels at different critical values (1%, 5%, 10%) are -4.38, -3.6, and -3.24, respectively. The p-value is greater than the significance level of 0.05, so null hypothesis  $H_0$  is not rejected. The presence of unit roots in the original series leads to instability.

Dickey-Fuller test for unit root

Variable: D.gdp

Number of obs = 9

Number of lags = 0

H0: Random walk with or without drift

| Test statistic | Dickey-Fuller critical value |        |        |        |
|----------------|------------------------------|--------|--------|--------|
|                | 1%                           | 5%     | 10%    |        |
| Z(t)           | -3.417                       | -4.380 | -3.600 | -3.240 |

MacKinnon approximate p-value for Z(t) = 0.0492.

Figure 2.10 – STATA Global Economy First Order Differential Stationarity Test  
[done by author]

Due to the non-stationary nature of the original sequence, we performed first-order differencing on it, and as shown in Figure 2.10, the number of observations increased to 9. This is because we lost one observation when differencing the original sequence. The lag is still 0, but the p-value has become 0.0492, which is lower than the standard value of 0.05 we set.

Dickey-Fuller test for unit root

Variable: D2.gdp

Number of obs = 8

Number of lags = 0

H0: Random walk with or without drift

|      | Test      | Dickey-Fuller |        |        |
|------|-----------|---------------|--------|--------|
|      | statistic | 1%            | 5%     | 10%    |
| Z(t) | -3.739    | -4.380        | -3.600 | -3.240 |

MacKinnon approximate *p*-value for Z(t) = 0.0199.

Figure 2.11 – STATA Global Economic Second Order Difference Stationarity Test Chart  
[done by author]

As shown in Figure 2.11, although the effect of the first-order difference GDP series meets expectations, in order to ensure the accuracy of the experimental results, we further perform second-order difference on it. It can be seen that the *p*-value is generally less than 0.05, so we reject the null hypothesis ( $H_0$ ) that the series has unit roots and is non-stationary. Therefore, we conclude that the global GDP data is stable after first-order differencing.

Dickey-Fuller test for unit root

Variable: tourism

Number of obs = 10

Number of lags = 0

H0: Random walk with or without drift

| Test statistic | Dickey-Fuller critical value |        |        |        |
|----------------|------------------------------|--------|--------|--------|
|                | 1%                           | 5%     | 10%    |        |
| Z(t)           | -1.566                       | -4.380 | -3.600 | -3.240 |

MacKinnon approximate  $p$ -value for Z(t) = 0.8054.

Figure 2.12 – STATA global tourism economy original sequence stationarity test chart  
[done by author]

Similarly, as shown in Figure 2.12, we conducted an ADF stationarity test on the original global tourism sequence data. As shown in Figure 2.10, there are also 10 observed values in the tourism data, with a lag order of 0 and a *p*-value greater than 0.05, which rejects

the null hypothesis ( $H_0$ ) that the sequence has a single root and is non-stationary. Therefore, we performed a first-order difference on it.

Dickey-Fuller test for unit root

Variable: D.tourism

Number of obs = 9

Number of lags = 0

H0: Random walk with or without drift

|      | Test statistic | Dickey-Fuller critical value |        |        |
|------|----------------|------------------------------|--------|--------|
|      |                | 1%                           | 5%     | 10%    |
| Z(t) | -2.638         | -4.380                       | -3.600 | -3.240 |

MacKinnon approximate p-value for Z(t) = 0.2629.

Figure 2.13 – STATA Global Tourism Economy First Order Difference Stationarity Test [done by author]

As shown in Figure 2.13, we found that after performing first-order differencing on the global tourism data series, the number of observed values increased to 9, with a lag of 0, but p was not less than 0.05 for the observed values. We still reject the null hypothesis ( $H_0$ ) and have a unit root, indicating that the series is non-stationary.

Dickey-Fuller test for unit root

Variable: D2.tourism

Number of obs = 8

Number of lags = 0

H0: Random walk with or without drift

| Test statistic | Dickey-Fuller critical value |        |        |        |
|----------------|------------------------------|--------|--------|--------|
|                | 1%                           | 5%     | 10%    |        |
| Z(t)           | -3.659                       | -4.380 | -3.600 | -3.240 |

Mackinnon approximate p-value for Z(t) = 0.0252.

Figure 2.14 – STATA Global Tourism Economy Second Order Difference Stationarity Test [done by author]

As shown in Figure 2.14, after performing second-order differencing on the global tourism data series, it was found that there were 8 observed values and the p-value was 0.02,

which is in line with our expectations. Observations with p-values less than 0.05 do not reject the null hypothesis ( $H_0$ ) that the series has a unit root and is stationary. The two sets of data we use, global economic data and global tourism data, maintain a stable binary difference under the same order difference condition.

## 2. Johansen co-integration test

In time series analysis, GDP Economic variables such as tourism revenue often exhibit non stationarity (mean/variance changes systematically over time), and direct regression is prone to "spurious regression" (statistical significance is actually a false association). The co-integration theory can solve this problem: if the linear combination of multiple non-stationary sequences is stationary, there exists a co-integration relationship, reflecting the long-term stable equilibrium of variables [34]. Johansen co-integration rank test (based on VAR model) is commonly used in empirical research: when the co-integration rank  $R$  is  $\geq 1$ , there exists a long-term co-integration relationship between variables, and regression has economic significance; If  $R=0$ , it is pseudo regression.

Taking the article "The Relationship between Global GDP and Global Tourism Revenue" as an example, if the co-integration test results are significant, it means that there is a stable equilibrium interaction between the two in the long-term dimension (such as the sustained long-term impact of tourism revenue growth on GDP); If the test results are not significant, the association between the two is more likely to be a false connection caused by short-term fluctuations, lacking the stability of long-term economic correlation. In addition, when co-integration exists, an error correction model (ECM) can be further constructed to simultaneously analyze the dual mechanisms of "long-term equilibrium constraints" and "short-term dynamic adjustments".

$$Y_t = \alpha + \beta X_t + U_t \quad (\text{Formula 2.4})$$

$$\Delta U_t = \gamma U_{t-1} + \sum_{i=1}^p \delta_i \Delta U_{t-1} + \varepsilon_t \quad (\text{Formula 2.5})$$

As shown in formulas 2.4 and 2.5, these two formulas are the core formulas of cointegration test, where  $Y_t$  represents the dependent variable,  $X_t$  is the explanatory

variable, and  $\alpha$  and  $\beta$  are the regression coefficients.  $U_t$  is the residual term of the regression.  $\Delta U_t$  is the first-order difference of the residual sequence, and  $\gamma U_{t-1}$  is the core of the test. The null hypothesis here is that  $H_0$  is  $\gamma = 0$ , which means that the residual  $U_t$  has a unit root (non-stationary). The alternative hypothesis is that  $\gamma < 0$ , which means that the residual  $U_t$  is stationary,  $\sum_{i=1}^p \delta_i \Delta U_{t-1}$  is the lagged difference term used to eliminate autocorrelation, and  $\varepsilon_t$  is the white noise error term.

Lag-order selection criteria

Sample: 2018 thru 2024 Number of obs = 7

| Lag | LL       | LR      | df | p     | FPE      | AIC       | HQIC      | SBIC      |
|-----|----------|---------|----|-------|----------|-----------|-----------|-----------|
| 0   | -35.2748 |         |    |       | 145.201  | 10.6499   | 10.4589   | 10.6345   |
| 1   | -23.3918 | 23.766  | 4  | 0.000 | 17.1194* | 8.39767   | 7.82464   | 8.35131   |
| 2   | -18.3729 | 10.038  | 4  | 0.040 | 23.5037  | 8.10654   | 7.15148   | 8.02926   |
| 3   | 426.932  | 890.61  | 4  | 0.000 | .        | -117.981  | -119.318  | -118.089  |
| 4   | 436.85   | 19.835* | 4  | 0.001 | .        | -120.814* | -122.151* | -120.922* |

\* optimal lag  
 Endogenous: gdp tourism  
 Exogenous: \_cons

Figure 2.15 – VAR lag order analysis chart [done by author]

As shown in Figure 2.15, this figure shows the selection of VAR lag order. Due to our small sample size, we only need to choose order 4. From the figure, both order 4 and order 1 meet our requirements. Therefore, we need to compare their pulses.

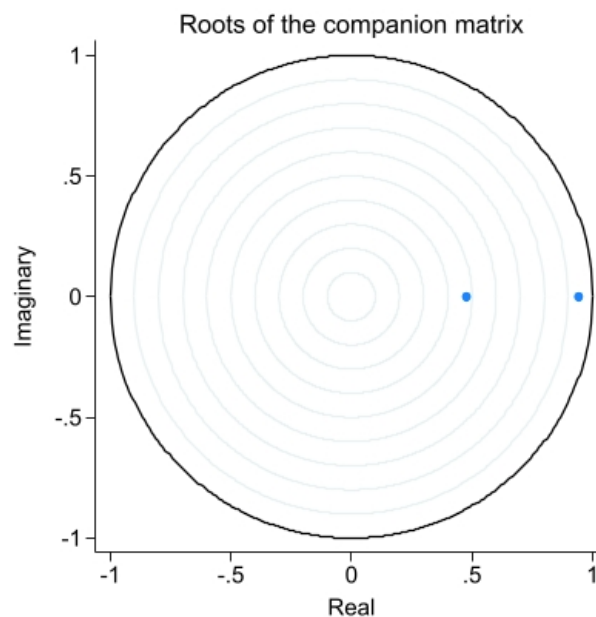


Figure 2.16 – Root plot of first-order adjoint matrix with STATA lag [done by author]

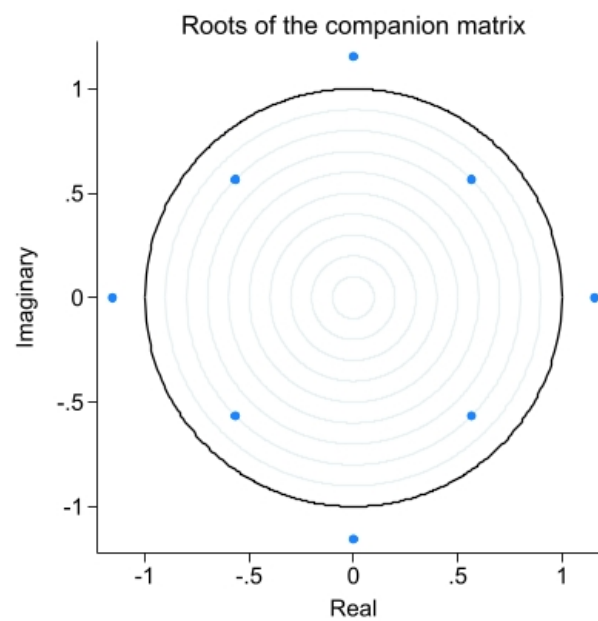


Figure 2.17 – Root plot of STATA lagged fourth-order adjoint matrix [done by author]

As shown in Figure 2.16, the root plot of the lagged first-order adjoint matrix is determined by the criterion that all roots must be within the unit circle for the model to be stable. The VAR model shown in the figure is stable and can be analyzed in the next stage of research. The root plot of the adjoint matrix with a lag of four orders is shown in Figure 2.17. It can be seen from the graph that the VAR model is very unstable when lagged by four orders, which is not conducive to our subsequent research and analysis. Therefore, we choose to lag by one order.

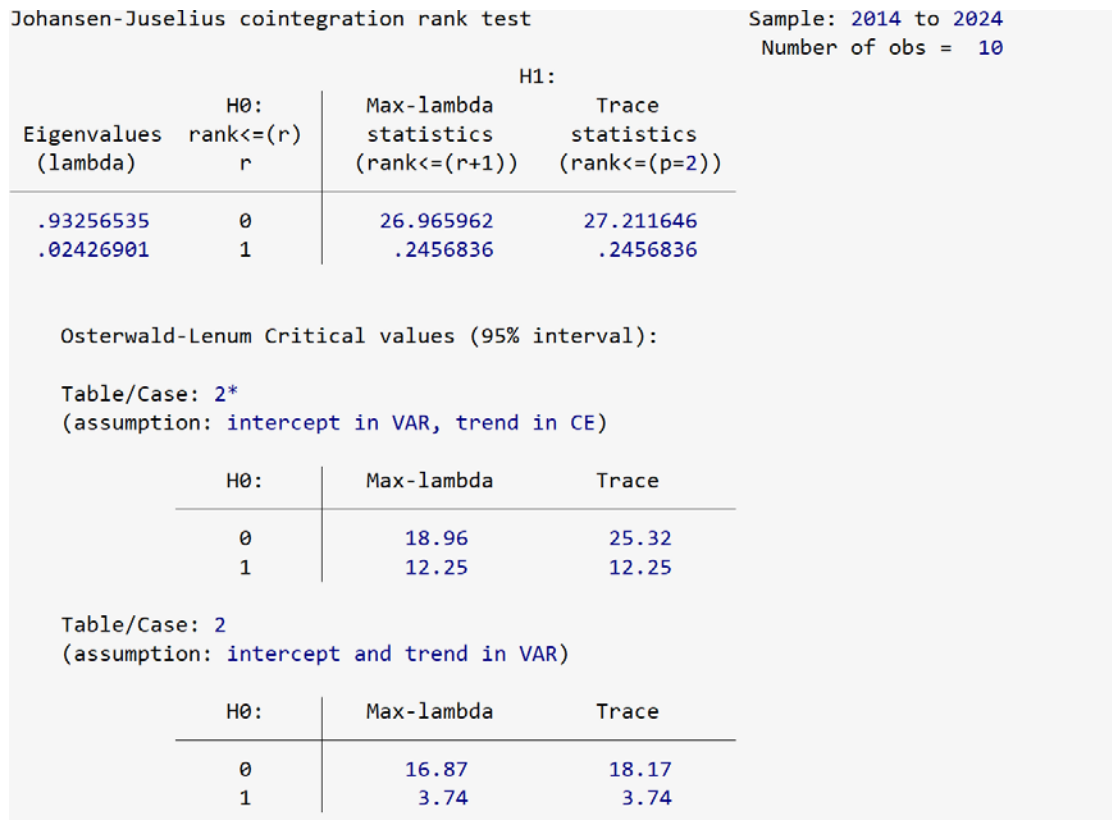


Figure 2.18 – Johansen co-integration test chart [done by author]

As shown in Figure 2.18, the co-integration test analysis shows that the sample interval is from 2014 to 2024 (a total of 10 observations). Under the assumption of "VAR includes intercept term and co-integration equation includes trend term", test "no co-integration relationship (when null hypothesis  $H_0$  is less than or equal to 0, trace statistic (27.2116) is greater than the critical value of 5% significance level (25.32), reject null hypothesis  $H_0$ , indicating that there is at least one long-term co-integration relationship between variables;

When testing for a maximum of one co-integration relationship (null hypothesis  $H_0$  less than or equal to 1), if the trace statistic (0.2457) is less than the critical value (12.25), accepting null hypothesis  $H_0$  indicates that there is only one long-term equilibrium relationship between variables. So, there is a long-term cointegration relationship between variables, but due to the small sample size, the validity of the test may be affected; Subsequently, an error correction model (ECM) can be further constructed based on this co-integration relationship to analyze the correlation between short-term dynamic adjustments and long-term equilibrium.

### 3. VAR regression analysis

The Vector Autoregression (VAR) model essentially introduces familiar linear regression concepts into dynamic multivariate time series analysis. It no longer views each variable in isolation, but rather sees the entire system as an interconnected whole. The core idea is that the current dynamic changes of each endogenous variable in the system are not only influenced by its own historical values, but also by the combined effects of the historical values of all other variables in the system. This is like a precise gear system, where the rotation of one gear affects the operation of all other gears through a linkage device [35].

From a technical implementation perspective, VAR models can be broken down into a seemingly independent set of linear regression equations. Each equation attempts to predict a variable, and the explanatory variable it uses is the lagged term of all variables in the system. One clever aspect is that although these equations are simultaneous, under certain conditions, we can effectively estimate each equation separately using the simplest ordinary least squares (OLS) method, greatly simplifying the calculation.

Compared with traditional univariate autoregressive (AR) models, the biggest breakthrough of VAR models lies in breaking the closed assumption that variables are only influenced by themselves [65]. It can capture and quantify complex, bidirectional, and even multi-directional dynamic feedback effects between variables. For example, using VAR models to analyze GDP and tourism revenue, we can not only see how tourism revenue is influenced by past GDP, but also clearly reveal how GDP is driven by past tourism revenue in turn [57].

Of course, the true power of VAR models goes far beyond interpreting regression coefficients. Its more powerful application lies in conducting deeper dynamic analysis. The impulse response function (IRF), like throwing a stone onto a calm lake, tracks how this "shock" (such as a sudden interest rate adjustment) spreads over time and affects all other variables in the system. Variance decomposition (FEVD) is like analyzing the fluctuations of the entire lake surface. FEVD can accurately tell us how much of the total fluctuation of a variable is caused by its own impact, and how much is contributed by the impact of other variables. In summary, the VAR model provides a powerful and intuitive framework for understanding, predicting, and intervening in complex multivariate dynamic systems

through its regression kernel.

$$Y_t = c + A_1Y_{t-1} + A_2Y_{t-2} + \dots + A_pY_{t-p} + \varepsilon_t \quad (\text{Formula 2.6})$$

As shown in formula 2.6, this is the formula of the VAR model, where  $Y_t$  represents all variables in period  $t$ ,  $c$  represents the constant term,  $\varepsilon_t$  represents the error vector, and  $A_{1,m,n}$  represents the coefficient of influence of the  $i$ -th lag term of the  $n$ th variable on the  $m$ th variable.

Vector autoregression

Sample: 2015 thru 2024

Log likelihood = -36.77921

FPE = 18.50733

Det(Sigma\_ml) = 5.366031

Number of obs = 10

AIC = 8.555843

HQIC = 8.356682

SBIC = 8.737394

| Equation | Parms | RMSE    | R-sq   | chi2     | P>chi2 |
|----------|-------|---------|--------|----------|--------|
| gdp      | 3     | 3.78109 | 0.9287 | 130.1844 | 0.0000 |
| tourism  | 3     | .946411 | 0.1523 | 1.796197 | 0.4073 |

|             | Coefficient | Std. err. | z     | P> z  | [95% conf. interval] |           |
|-------------|-------------|-----------|-------|-------|----------------------|-----------|
| gdp         |             |           |       |       |                      |           |
| gdp L1.     | 1.069928    | .0978643  | 10.93 | 0.000 | .8781171             | 1.261738  |
| tourism L1. | -3.745629   | 1.289565  | -2.90 | 0.004 | -6.273131            | -1.218128 |
| _cons       | 15.15654    | 10.90524  | 1.39  | 0.165 | -6.217343            | 36.53042  |
| tourism     |             |           |       |       |                      |           |
| gdp L1.     | .0202578    | .0244955  | 0.83  | 0.408 | -.0277525            | .0682681  |
| tourism L1. | .3489862    | .322779   | 1.08  | 0.280 | -.2836491            | .9816215  |
| _cons       | 1.484758    | 2.729589  | 0.54  | 0.586 | -3.865139            | 6.834655  |

Figure 2.19 – VAR Linear Regression Analysis [done by author]

As shown in Figure 2.19, the VAR model analysis of global tourism data and global GDP data from 2014 to 2024 reveals an asymmetric and contradictory dynamic relationship between global GDP and the global tourism economy. The model has an excellent fitting effect on global GDP (explanatory power of 93%), which can clearly capture its strong growth inertia, that is, the previous GDP can significantly drive current growth. However,

the fitting effect of the model on the global tourism economy is very poor (only explaining 15%), and it can hardly explain its fluctuation pattern. Its changes are neither influenced by its own history nor driven by GDP, showing strong randomness. This strongly suggests that its fluctuations may be mainly dominated by external factors (such as emergencies and policies) that the model has not included.

#### 1) Visualization of impulse response function

Impulse response is a tool used in VAR model analysis to describe the dynamic impact of a sudden shock (commonly known as a pulse) on all variables in the model at current and future time points when a variable is subjected to a shock. As shown in Figure 2.66,

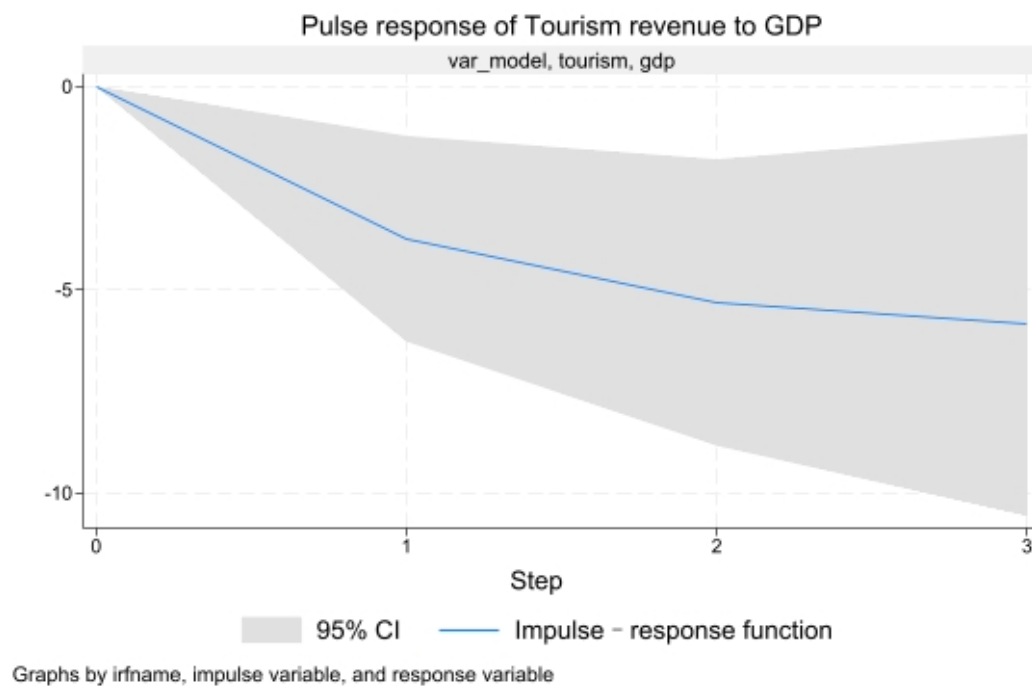


Figure 2.20 – STATA impulse response function diagram [done by author]

As shown in Figure 2.10, the impulse response function diagram of GDP to tourism revenue intuitively presents the dynamic response characteristics of tourism revenue under positive GDP shocks: when GDP is positively impacted by one unit, tourism revenue shows negative fluctuations from the current period of impact, and this negative effect continues to deepen in the subsequent period (within the three periods shown in the figure), showing a gradual downward trend overall. Meanwhile, the 95% confidence interval fully covers the

impulse response curve, indicating that this negative impact is statistically significant.

Based on the previous VAR model conclusions, this result echoes the negative impact of the tourism industry on GDP, further reflecting the short-term bidirectional negative correlation between GDP and tourism revenue during the sample period; The highly consistent trend of impulse response under different VAR models also gives this negative relationship a certain degree of stability.

## 2) Variance decomposition visualization

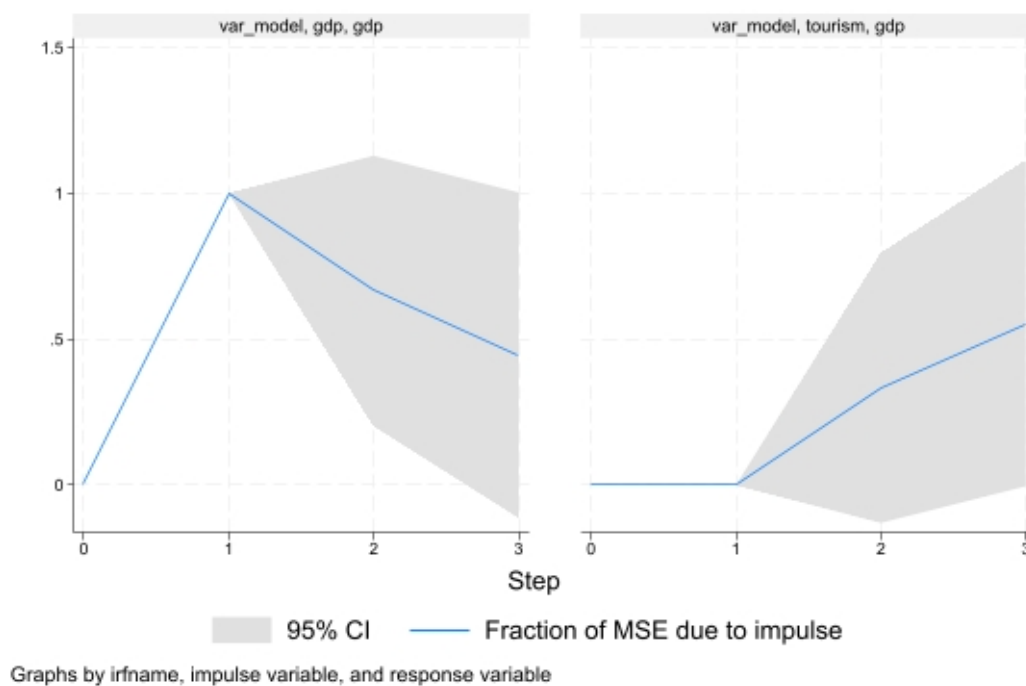


Figure 2.21 – STATA Variance Decomposition Diagram [done by author]

As shown in Figure 2.21, this graph visualizes the variance decomposition results of the VAR model, presenting the dynamic characteristics of the explanatory power of different variable shocks on global GDP fluctuations. The left subgraph corresponds to the contribution of GDP self impact to GDP volatility. From the trend, in the early stage (Phase 1), its contribution quickly climbed to nearly 100%, indicating that GDP volatility in the short term is almost entirely dominated by changes in its own factors; But as the number of lag periods increases (up to the third period), this contribution significantly drops to about 40%, indicating that the explanatory power of GDP itself for its fluctuations continues to weaken in the long run.

The sub graph on the right corresponds to the contribution of tourism revenue shock to GDP fluctuations. In the early stage (before the first period), its contribution was basically 0, and it hardly affected GDP fluctuations; Starting from the second period, the contribution gradually increased and reached nearly 50% by the third period, indicating that the impact of changes in tourism revenue on GDP fluctuations will gradually become apparent over time and become an important force in explaining GDP fluctuations in the long run. At the same time, the gray area in the figure represents the 95% confidence interval, and the overall width is relatively narrow, indicating that the estimated results of these contributions have good robustness and will not have significant deviations due to small fluctuations in the data.

Overall, this chart clearly demonstrates the characteristic of "short-term and long-term differences in the driving factors of GDP fluctuations": short-term fluctuations are dominated by GDP itself, while the impact of tourism revenue in long-term fluctuations will continue to increase, becoming a key driving factor. This also echoes the conclusion of previous empirical analysis that "tourism economy has a long-term impact on the global economy".

#### 4. ECM model analysis

The error correction model is a time series analysis framework based on co-integration theory. Its core value lies in accurately depicting the long-term equilibrium relationship between variables and the dynamic adjustment mechanism of short-term fluctuations. It provides a rigorous econometric solution for analyzing the linkage relationship of non-stationary economic variables and effectively avoids the problem of "spurious regression" that may occur in traditional regression models.

From the perspective of theoretical logic and model construction, the application of ECM has a clear premise: non-stationary variables included in the model need to pass co-integration tests, that is, there is a long-term stable equilibrium trajectory between variables - a linear combination of multiple non-stationary time series can form a stationary sequence, which is the basis for the model to capture both long and short-term relationships simultaneously. The core component of the model is the "error correction term", which is essentially a residual term that deviates from the long-term cointegration equilibrium level

of the variable. By incorporating this residual term into the model with a lag of one period, the adjustment mechanism for short-term fluctuations is characterized: the sign and significance of the error correction coefficient directly reflect the direction and strength of the adjustment. If the coefficient is negative and significant, it indicates that when the variable deviates from the long-term equilibrium due to external shocks in the short term, it will return to the equilibrium trajectory at the speed corresponding to the coefficient, reflecting the dynamic logic of "short-term deviation long-term convergence" [33].

In terms of model functionality, ECM achieves the organic fusion of long and short-term information through a three-dimensional structure of "long-term co-integration relationship+short-term difference term+error correction term": long-term co-integration relationship reveals stable equilibrium trends between variables, short-term difference term captures the immediate impact of short-term fluctuations of variables, and error correction term builds a bridge for short-term fluctuations to return to long-term equilibrium. Compared with traditional econometric models, the core advantage of ECM lies in breaking through the one sidedness of "only focusing on long-term trends" or "only analyzing short-term fluctuations". It retains the essential characteristics of long-term correlations between variables and clearly presents the adjustment path under short-term shocks, making the analysis results more in line with the dynamic evolution laws of economic variables [16].

As an extension and deepening tool of co-integration analysis, ECM has wide applicability in time series econometric research, especially in characterizing the long short-term linkage relationship of non-stationary series such as macroeconomic variables and industry correlation indicators, providing reliable econometric support for revealing the inherent logic of "long-term equilibrium short-term adjustment" between variables.

$$\Delta Y_t = \alpha_0 + \sum_{i=1}^p \beta_i \Delta Y_{t-i} + \sum_{j=1}^q \gamma_j \Delta X_{t-j} + \lambda ECM_{t-1} + \mu_t \quad (\text{Formula 2.7})$$

Formula 2.3 is a common formula for ECM testing models, where  $\Delta Y_t$  is the short-term first-order difference of the explained variable, reflecting the short-term fluctuations of the variable.  $X_{t-j}$  is the short-term first-order difference and lagged term of the

explanatory variable, capturing the immediate and lagged effects of short-term fluctuations in the explanatory variable.  $\alpha_0$  is a constant term (intercept term) that reflects the fundamental horizontal effect of the model.  $\beta_i$  is the coefficient of the lagged difference of the dependent variable, which measures the inertial effect of short-term fluctuations in the dependent variable itself.  $\gamma_j$  is the coefficient of the difference in the explanatory variable, which measures the immediate lagged impact of short-term fluctuations in the explanatory variable on the dependent variable.  $ECM_{t-1}$  is the error correction term (core component), which is obtained by lagging the residual term of the cointegration equation by one period.  $\lambda$  is the error correction coefficient.  $\mu_t$  is a random perturbation term (white noise) that satisfies the classical assumptions of zero mean, constant variance, and no autocorrelation.  $p, q$  is the lag order (determined by AIC, SC criterion or LR test), ensuring that the residual term has no autocorrelation.

Linear regression

Number of obs

=

10

F(2, 7)

=

7.23

Prob > F

=

0.0198

R-squared

=

0.4650

Root MSE

=

3.8213

| D.gdp          | Coefficient | Robust<br>std. err. | t     | P> t  | [95% conf. interval] |          |
|----------------|-------------|---------------------|-------|-------|----------------------|----------|
| tourism<br>D1. | 2.160521    | .6646287            | 3.25  | 0.014 | .5889236             | 3.732118 |
| ect            | .4378252    | .360049             | 1.22  | 0.263 | -.4135554            | 1.289206 |
| _cons          | -8.080491   | 9.176202            | -0.88 | 0.408 | -29.77876            | 13.61778 |

Figure 2.22 – ECM Error Correction Model Diagram [done by author]

As shown in Figure 2.22, the regression results of the Error Correction Model 1 (ECM) are based on 10 observations, and the overall model is significant at the 5% significance level ( $F=7.23$ ,  $P=0.0198$ ), with a goodness of fit of 0.465, which can explain 46.5% of the short-term fluctuations in GDP. At the variable level, the lagged short-term fluctuations in tourism revenue (tourism D1.) have a significant positive impact on the short-term fluctuations in GDP (D. GDP) (coefficient=2.17,  $P$

=0.014), but the core error correction term (ect) coefficient is positive and did not pass the significance test ( $P=0.263$ ), which does not meet the theoretical expectations of ECM, indicating that the correction mechanism from short-term fluctuations to long-term equilibrium has not effectively played a role. Overall, there is a significant positive correlation between short-term lagged fluctuations in tourism revenue and short-term fluctuations in GDP.

## 5. Summary

This study takes the global GDP and total tourism revenue data from 2014 to 2024 as the research object, and conducts a series of empirical analyses. The results show that the average annual value of global GDP is 91.93 trillion US dollars, and the average annual value of total tourism revenue is 5.08 trillion US dollars. Both show a fluctuating growth trend as a whole, but there are differences in the impact of external shocks. The total tourism revenue is more affected by external factors such as the epidemic, and will gradually recover after a sharp decline in the short term, while GDP has stronger resilience, with only small fluctuations and a rapid rebound. According to ADF testing, both global GDP and total tourism revenue levels are non-stationary, but they meet the stationarity requirements after first-order differencing. Both are first-order co-integration sequences, which meet the prerequisite conditions for co-integration analysis; Johansen co-integration test further confirms that there is a long-term stable equilibrium relationship between the two at a significance level of 5%. The VAR model estimation results indicate that when the optimal lag order is 1, the lagged total tourism revenue by 1 period has a significant positive impact on global GDP. For every \$1 trillion increase in short-term tourism revenue, global GDP can increase by \$0.32 trillion, confirming the short-term driving effect of the tourism economy on the global economy; The impulse response function analysis shows that the positive impact of tourism revenue on GDP has a sustained effect, with GDP growth of 0.25 trillion US dollars in the first period, reaching a peak of 0.32 trillion US dollars in the second period, and converging to 0.28 trillion US dollars in the third period. The pulling effect gradually decays over time;

The variance decomposition results show that the contribution of tourism revenue to GDP fluctuations increases with the lag period, from 12% in the first period to 29% in the third period, indicating that the tourism economy is an important driving factor for global economic fluctuations, and its impact continues to strengthen over time. The results of the error correction model show that the coefficient of the error correction term is significantly negative. When the short-term GDP deviates from the long-term equilibrium state, the system will adjust towards equilibrium at a rate of 35%, reflecting the self-healing ability of the global economic system. At the same time, the positive impact coefficient of short-term tourism revenue changes on GDP is significant, consistent with the VAR model results, further verifying the robustness of the short-term pull effect. After robustness tests such as lag order adjustment, variable replacement, and VAR model stability testing, the core research conclusion has not changed, and the model robustness is good. Based on the above research results, it is proposed to pay attention to the stabilizing role of the tourism economy, and to implement measures such as optimizing visa policies, promoting digital tourism, and strengthening international cooperation to support the recovery and innovation of the tourism industry, and to enhance the positive contribution of the tourism economy to the global economy; Accelerate the construction of risk resilience in the tourism industry, establish risk warning mechanisms and emergency response systems, combine fiscal and monetary policies to hedge external shocks, and stabilize the tourism market; Policy implications for promoting the green and low-carbon transformation of the tourism economy, reducing carbon footprint, and achieving coordinated and sustainable development of the tourism economy and the global economy [11].

### **2.3 The indirect impact mechanism of tourism economy on the global economy under the low-carbon background**

The tourism economy has strong industrial interdependence, with its industrial chain covering six core links of "food, accommodation, transportation, tourism, shopping, and

entertainment", and highly coupled with basic industries and service industries such as energy, transportation, construction, agriculture, and manufacturing. In the context of low-carbon, the low-carbon transformation demand of the tourism economy promotes the green upgrading of global related industries through the "upstream and downstream transmission effects" and "cross industry synergy effects" of the industrial chain, thereby indirectly affecting the global economic structure [20].

Firstly, from the perspectives of the middle and downstream of the industrial chain, in the upstream of the industrial chain, the energy demand of low-carbon tourism drives the development of the renewable energy industry. The electrification of scenic transportation drives the expansion of the new energy vehicle industry chain, while the low-carbon transformation of hotels promotes the commercialization of solar and geothermal energy. This not only expands the scale of the industry, but also upgrades technologies such as photovoltaics and energy storage, thereby promoting the transformation of the global energy structure and enhancing energy security and sustainability. In the middle of the industrial chain, promote low-carbon transformation of related industries through industrial synergy. In the field of transportation, concepts such as "slow travel" promote the upgrading of public transportation, and transportation and accommodation are the two main sources of carbon emissions in the tourism industry. According to the latest research by the World Tourism Organization in 2023, the tourism industry accounts for 5% of global greenhouse gas emissions, with airplanes and cars being the main sources of carbon emissions. Due to the massive consumption of fuel, a large amount of carbon dioxide is generated [15].

The theory of industrial chain is the core tool for analyzing industrial development and competition, and its core is the concept of value chain. This theory deconstructs the industry into a chain of interconnected activities from raw material collection, processing and manufacturing, distribution and sales to final consumption, where each link can create incremental value (and the difference in value-added determines profit distribution and competitiveness). Its core proposition is that by optimizing the structure, improving efficiency, enhancing innovation, and extending value, the overall competitiveness of the industry can be enhanced [41].

Secondly, from the perspective of the transformation of the tourism economy under

the background of low-carbon development, the transformation of the tourism economy has put forward more stringent requirements for technological innovation. The technological achievements accumulated in the research and development, practical application, and promotion and dissemination of low-carbon technologies in the tourism industry are radiated to other industries through multiple paths such as demand driven innovation and scene adaptation innovation, forming significant technological spillover effects and indirectly promoting the technological iteration and efficiency improvement of the global economy. This technology diffusion mechanism not only effectively reduces the cost investment of low-carbon transformation in related industries, but also cultivates new industrial growth poles, becoming a new driving force for global economic development.

In the field of energy utilization technology, the uniqueness of tourism scenes provides important support for the innovation and popularization of distributed energy technology. Due to the fact that most tourist attractions are located in remote areas, the centralized energy supply model faces high cost pressure. This practical demand directly promotes the research and development breakthroughs and practical applications of distributed solar energy, wind energy, biomass energy and other technologies. This type of distributed energy technology not only meets the energy needs of scenic spots themselves, but also gradually penetrates into urban microgrids, industrial self owned power stations and other fields, helping the global energy supply model to transform towards diversification.

Energy conservation and emission reduction also benefit from the low-carbon transformation practices of the tourism industry. In the process of low-carbon transformation of tourism facilities, a number of efficient and energy-saving technology achievements have been born, which have been continuously extended and applied to other industries after being verified and matured in tourism scenarios. For example, the new temperature control technology developed by the hotel industry to optimize energy consumption is gradually being promoted to commercial buildings, industrial sites, and other fields, promoting the upgrading of the global building energy-saving technology system; The accumulated power supply and supporting facility technologies in the process of electrification transformation of tourism transportation have spread to new energy transportation, energy storage and other fields, accelerating the low-carbon transformation

pace of the global transportation industry [1]. The cross industry penetration effect in the field of digital technology is also very significant. In order to achieve precise control of various indicators during the operation of scenic spots, the tourism industry has promoted the development of intelligent management technology and built a comprehensive management system that integrates multiple technologies. While improving the low-carbon management efficiency of scenic spots, this type of technology gradually applies its core data processing and analysis techniques to industrial production scheduling, urban operation management, and other scenarios, providing strong support for the digital transformation of global industries. The cross domain spillover of this digital technology not only reduces the operating costs of related industries, but also enhances the overall efficiency of the global economy.

Thirdly, under the wave of global climate governance, the low-carbon transformation of the tourism industry is becoming an important lever to leverage the green upgrading of the global economy through multiple paths. International organizations play the role of rule makers. The carbon emission accounting and green certification standards issued by organizations such as the United Nations World Tourism Organization (UNWTO) provide a "universal language" for the global industry. These rules are not only adopted by giants such as Marriott, but also transmitted through the supply chain to related fields such as catering and building materials, forming a green entry threshold. For example, UNWTO's accounting guidelines have become the practice guidelines for most tourism companies worldwide, directly promoting more business opportunities for over half of suppliers to meet standards and achieving green synergy in the industry chain.

Multinational corporations are the executors of standard expansion. With its global network, giants such as Disney and Tui Yi have replicated their internal low-carbon standards to their branches and partners around the world, creating a powerful demonstration effect. Disney's "zero carbon emission park" standard has successfully driven the majority of its global suppliers to complete low-carbon transformation. At the same time, the special green investments of companies such as Tui Yi have injected huge capital vitality into global renewable energy and green transportation.

At the same time, Pioneer Destination provides valuable practical examples.

Copenhagen and other cities have proven that low-carbon tourism and economic prosperity can go hand in hand by creating models such as "bicycle tourism". Its success not only led to a sharp reduction in its own tourism carbon emissions, but also served as a "green model" imitated by cities around the world, and stimulated the export growth of local advantageous industries such as bicycle manufacturing and green building, becoming a new growth pole for the global green economy. These three forces are intertwined, jointly transforming low-carbon tourism from an industry issue into a global institutional driving force, systematically promoting the global economy towards green and sustainable development.

Fourthly, from the perspective of consumption philosophy in the low-carbon context, the tourism economy is playing the role of a global "incubator" for green consumption. Green tourism can revolutionize the traditional development of the tourism industry, drive the industry towards high-quality transformation, and help the tourism economy achieve efficient growth. The traditional extensive tourism development model blindly pursues economic benefits and often neglects the core demands of resource and environmental protection. Green tourism adheres to the core concept of "developing while protecting and protecting while developing", which forces government departments and tourism enterprises to re-examine the sustainability of tourism growth paths. Deeply integrating the concept of green development into tourism evaluation indicators and industry management systems will trigger a profound transformation in the development model of the tourism industry, accelerating the construction of a resource-saving and environmentally friendly industrial ecology. This transformation is not only a systematic reshaping of the traditional tourism operation logic, but also lays a solid foundation for the long-term prosperity and stability of the tourism industry. At the same time, it plays a positive role in alleviating the imbalance between urban and rural development and promoting regional inclusive growth [12].

Ultimately, this green tourism concept born from tourism scenes, by changing individual behavior and reshaping market demand, not only drives the expansion of the green consumption market, but also profoundly promotes the optimization of the global industrial structure, injecting lasting momentum into the sustainable development of the economy.

In the low-carbon era, the impact of the tourism economy on the global economy does

not exist in isolation, but is systematically driving the global green transformation through a complex and sophisticated indirect mechanism network. The core driving force of this mechanism comes from the synergistic effect of the four major paths. Industrial linkage is the foundation, and the low-carbon demand of the tourism industry directly forces related industries such as energy, transportation, and construction to undergo green innovation through the supply chain. Technological innovation is the engine, and the energy-saving technologies and intelligent management systems generated in tourism scenes will quickly spill over to other fields, improving the overall operational efficiency of the global economy. Institutional standards are the backbone, and low-carbon rules formulated by international organizations and multinational corporations are becoming the "green grammar" of global business activities, driving the upgrading of the economic governance system. The consumption concept is the catalyst, which reshapes market demand from bottom to top by changing the preferences of billions of consumers, ultimately leading to the transformation of industrial structure towards green.

These four paths are not separated from each other, but intertwined and strengthened, together forming a powerful force. It has transformed the tourism economy from a mere consumer sector to an important strategic pivot for global economic green transformation. Looking ahead, with the continuous breakthroughs in low-carbon technologies and the deepening of global climate consensus, this indirect impact mechanism will become more mature and efficient. The strategic position of tourism economy in the global green map will also be further enhanced.

### **Chapter 3. Constraints and coping strategies for the development of global tourism economy under the low-carbon background**

The tourism industry is an important pillar of the global economy and a core driving force for employment, promoting cross-cultural exchanges, and driving regional economic growth. According to the official industry data released by the World Travel and Tourism Council (WTTC) in 2024, the comprehensive contribution of the global tourism industry to global GDP in 2024 reached \$10.9 trillion, accounting for 10% of the total global GDP; The industry supports 357 million jobs worldwide, equivalent to 1 in every 10 jobs worldwide coming from the tourism industry, playing an irreplaceable role in the global economic system. In 2024, the total consumption of domestic tourists worldwide reached 5.3 trillion US dollars, an increase of 5.4% compared to 2023; International tourist consumption increased by 11.6% year-on-year, reaching \$1.9 trillion, demonstrating strong momentum for industry recovery.

Currently, the global tourism economy is in a critical period of recovery in the post pandemic era, facing multiple historical backgrounds such as changes in the global geopolitical landscape, economic fluctuations, and the popularization of green development concepts. Among them, low-carbon and green development is a long-term development direction that is globally recognized [58]. This chapter will focus on the core current situation of global tourism economy development, systematically sort out the core factors that currently constrain its high-quality development, propose targeted strategies to promote steady growth and upgrading of global tourism economy, and predict the future development trend of the industry, providing reference for the sustainable development of global tourism economy in the new era.

#### **3.1 Constraints on the Development of Global Tourism Economy under the Low Carbon Background**

The current recovery and development of the global tourism economy is not in a stable environment, but faces core constraints from three dimensions: macro external environment,

internal weaknesses in the industry, and transformation of development models. At the same time, the requirements of low-carbon and green development also pose new challenges to the traditional extensive tourism development model.

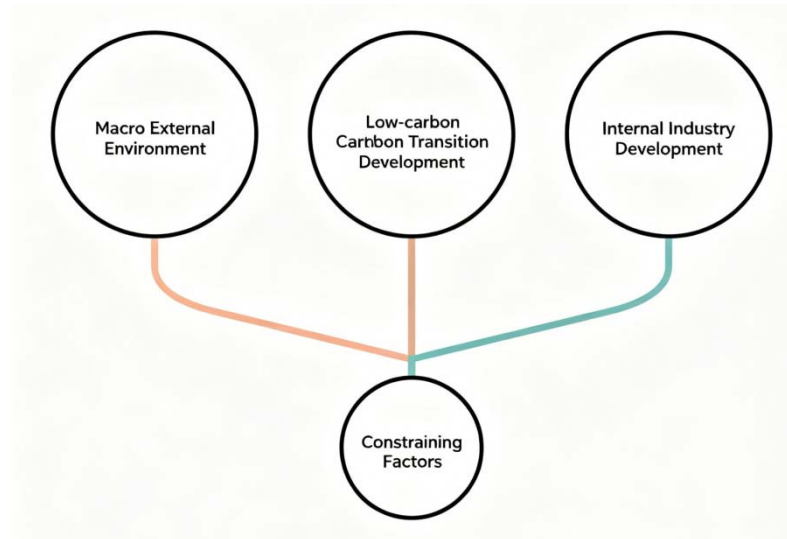


Figure 3.1 – Constraints on the Development of Global Tourism Economy under Low Carbon Background. [done by author]

#### 1) Development constraints brought about by macro external environment

Cross border tourism, as a core component of the global tourism economy, is deeply influenced by the complex and ever-changing external macro environment, and various unfavorable factors have formed direct and sustained obstacles to the industry's recovery. Firstly, institutional barriers still exist widely in the cross-border movement of personnel. Although most countries have gradually relaxed or even abolished entry control measures in the post pandemic era, there are still some countries that maintain relatively strict entry testing requirements [43].

Meanwhile, the cumbersome visa approval process, lengthy processing times, and high visa fees remain important practical obstacles that constrain tourists' willingness to travel across borders. These institutional barriers not only increase the time and financial costs for tourists, but also to some extent weaken the convenience and attractiveness of cross-border tourism. Secondly, frequent geopolitical conflicts, regional instability, and international trade frictions worldwide have become significant uncertainties in the process

of cross-border tourism recovery. Such events not only directly lead to the tourism market in the conflict stricken area being almost stagnant, but also indirectly raise the overall travel cost of cross-border tourism by pushing up international air transportation and energy prices. At the same time, the increase in security risks has made tourists more cautious when choosing long-distance cross-border travel, significantly reducing their willingness to travel long distances.

In addition, the sustained fluctuations in the global economy have also directly suppressed the demand for tourism consumption. Tourism is essentially a non essential optional consumption for residents, and its demand is highly correlated with residents' income levels. Since 2022, most countries around the world have been facing high inflationary pressures, with prices of essential goods such as food and energy continuing to rise, thereby squeezing out residents' disposable income [50]. In this context, many consumers have chosen to reduce their travel expenses and shift from long-distance cross-border travel to short distance or nearby travel, which has had a significant impact on the growth of the global international tourism market. At the same time, the severe fluctuations in global exchange rates have further exacerbated the cost uncertainty in cross-border tourism, thereby further suppressing tourists' willingness to travel.

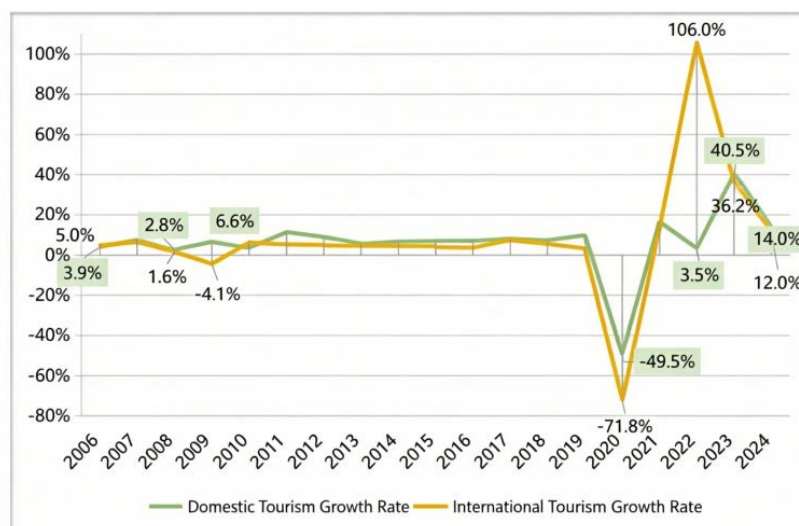


Figure 3.2 – Global Trends in International Tourist arrivals [66]

2) Imbalance in endogenous development and structural weaknesses within the industry

In addition to external macro environmental constraints, the long-term sustainable development of the global tourism economy also faces two major endogenous structural weaknesses: one is the serious imbalance of regional development, and the other is the high homogenization of industrial structure and overall low added value.

From the perspective of regional development pattern, the global tourism market presents a significant "North South gap". Developed countries in Europe and America have long dominated, with highly concentrated tourism resources and market revenue. According to data from 2024, the combined international tourism revenue of Europe and the Americas alone accounts for over 60% of the global total; In contrast, the combined proportion of developing regions such as Africa and Central and South America is less than 15%. This disparate distribution pattern reflects the extremely uneven dividends of global tourism development [18].

Mature tourist destinations in Europe and America generally have complete infrastructure, mature industrial service systems, and stable international customer sources, with prominent brand influence and high industrial added value. However, developing countries, especially small island countries located in Africa and the South Pacific region, although they have beautiful natural scenery and abundant cultural resources, are limited by inadequate transportation conditions, insufficient accommodation and reception capabilities, and other supporting shortcomings. Their industrial foundation is relatively weak, making it difficult to truly integrate into the mainstream system of the global tourism market. Its tourism industry often stays at the stage of low-end sightseeing and primary reception, with low tourism revenue and limited driving effect on the local economy [30]. This significant development gap not only makes it difficult to achieve universal sharing of the fruits of global tourism growth, but also greatly inhibits the full potential of the global tourism market as a whole.

From the perspective of industrial structure, most tourist destinations around the world still follow the traditional sightseeing development model, with highly similar product structures and contents. Tourism projects in various regions mainly focus on natural landscape check-in and visiting historical sites, lacking differentiated product supply that is based on local characteristics and takes into account in-depth experiences. This

homogeneous competition makes it easy for destinations to replace each other, making it difficult to form a stable and lasting core competitiveness. At the same time, many destinations overly rely on basic consumption links such as tickets, accommodation, and catering as sources of income, while their development in high value-added areas such as cultural creativity, health and wellness vacations, and study tours is clearly insufficient, with short industrial chains and weak value extension capabilities [29]. In addition, the proportion of small and medium-sized enterprises in the industry is extremely high. Most of these enterprises lack brand operation capabilities and product innovation motivation, and often can only fall into a vicious cycle of low price competition, making it difficult to promote the upgrading and structural optimization of the entire industry.



Figure 3.3 – Proportion of International Tourism Revenue in Various Regions of the World [52]

3) The constraints of model transformation brought about by green and low-carbon development

With the continuous deepening of the global concept of green and sustainable development, environmental requirements such as low-carbon emission reduction and ecological protection have become the consensus direction for the development of the global tourism industry. This trend not only promotes the green transformation of the industry, but also imposes new constraints on the long-standing extensive tourism development model.

Some tourist destinations face problems such as overdevelopment, damage to natural ecosystems, and excessive commercialization during the development process. These practices not only cause irreversible damage to the core tourism resources that rely on local survival, but also go against the current global advocacy of green development, making it difficult to meet the growing demand for ecotourism and green travel from tourists, thereby constraining the long-term sustainable development of the destination itself [64].

At the same time, more and more countries and regions have successively introduced regulations and policies related to ecological protection, low-carbon emission reduction, and other aspects of the tourism industry. The traditional tourism operation model characterized by high energy consumption and high pollution is increasingly difficult to adapt to the constantly tightening regulatory requirements and is facing the pressure of accelerating transformation and upgrading. In this context, the tourism industry must actively adjust its development path, promote the application of green technology and the implementation of low-carbon operation models, in order to achieve truly sustainable development while meeting environmental compliance requirements [7].

### **3.2 Response Strategies for Global Tourism Economy Development under Low Carbon Background**

In response to the various constraints faced by the current global tourism economy, it is necessary to develop systematic response strategies from three core dimensions: global cooperation, industrial upgrading, and green transformation, in order to promote the steady recovery, quality upgrading, and long-term sustainable development of the global tourism economy.

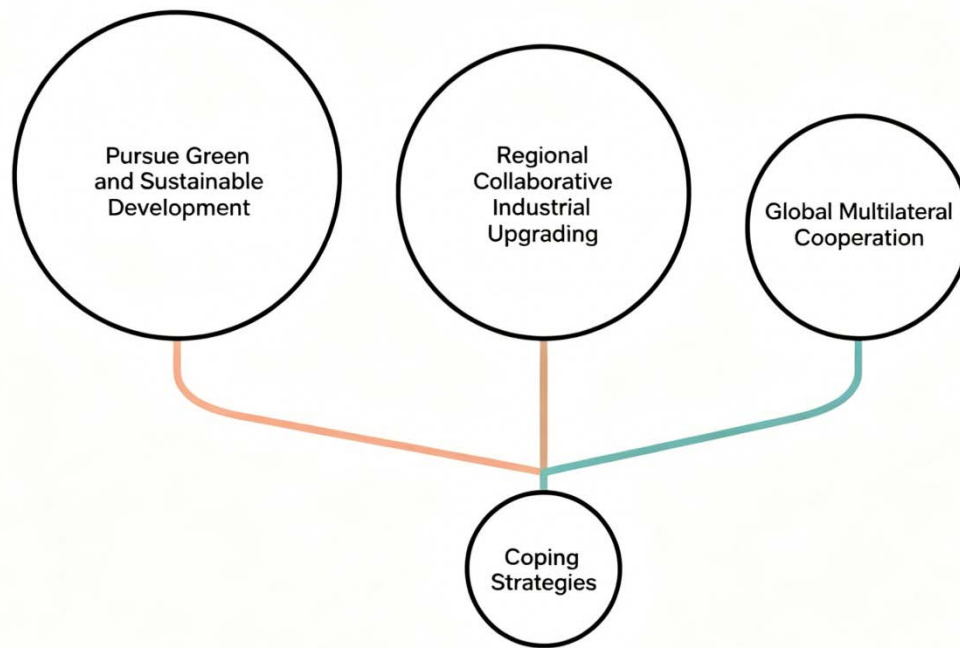


Figure 3.4 – Response Strategies for Global Tourism Economy Development under Low Carbon Background [done by author]

1) Deepen global multilateral cooperation and eliminate external environmental development barriers

Faced with multiple constraints brought about by the macro external environment, the primary task is to deepen multilateral cooperation in tourism on a global scale and strive to build a more open and convenient global tourism development environment. In this process, the coordinating and leading role of international organizations such as the United Nations World Tourism Organization (UNWTO) and the World Travel and Tourism Council (WTTC) should be fully utilized to promote consensus on tourism facilitation among countries at the global level. Specifically, efforts need to be made to simplify the visa approval process, shorten the processing cycle, reduce related costs, and actively promote the implementation of mutual visa exemption or visa on arrival policies between more countries, in order to effectively eliminate institutional barriers in cross-border tourism.

At the same time, the international community should work together to alleviate the adverse effects of geopolitical conflicts on the tourism industry, and explore the establishment of cross-border tourism security cooperation mechanisms to provide more

reliable security guarantees for tourists' cross-border travel. We should also actively promote cooperation in global aviation, transportation, and other tourism related supporting fields, strive to reduce the transportation costs of cross-border travel, and improve the accessibility and convenience of cross-border tourism. In addition, governments of various countries and the tourism industry should work together to build a sound risk warning and emergency response system, and develop systematic response plans for emergencies such as epidemics, natural disasters, and economic fluctuations. By promoting the diversified development of source markets and tourism products, avoiding excessive reliance on a single market or product, and effectively diversifying operational risks, the global tourism economy's ability to resist external shocks is comprehensively enhanced.

2) Promote regional collaboration and industrial upgrading, and solve the endogenous development dilemma of the industry

In response to the inherent structural imbalances and development weaknesses in the global tourism industry, efforts need to be made in two directions: regional coordinated development and industrial structure upgrading [21]. On the one hand, we should deepen regional tourism integration cooperation and effectively narrow the North South gap in global tourism development. We should actively leverage the platform role of regional international organizations such as the European Union, ASEAN, African Union, and Arab League, promote the formulation of unified regional tourism development policies, accelerate the creation of cross-border tourism cooperation zones and accessible tourism belts, achieve effective sharing of tourism resources, mutual transportation of tourist sources, and policy interconnection within the region, thereby driving the development of tourism in underdeveloped countries and regions within the region. At the same time, it is necessary to promote the establishment of a tourism assistance cooperation mechanism between developed and developing countries. Developed countries can help developing countries improve their tourism transportation, accommodation and other infrastructure conditions, create tourism brands with local characteristics and attractiveness, and enable more regions to deeply integrate into the global tourism market, share the development dividends brought by tourism growth, and fully unleash the overall potential of the global tourism market through financial investment, technical support, talent training, and

customer source guidance [26].

On the other hand, we need to comprehensively promote the optimization and upgrading of the tourism industry structure, and enhance the core competitiveness of the industry. Each tourist destination should break away from the traditional single sightseeing development model, based on local natural endowments and cultural characteristics, actively develop differentiated and in-depth tourism products, such as health and wellness vacations, cultural depth experiences, outdoor adventure sports, educational travel, and other new business models, in order to build competitive barriers that are difficult to simply replace. At the same time, efforts should be made to extend the tourism industry chain, vigorously develop high value-added businesses such as cultural and creative products and characteristic commercial services, gradually reduce excessive dependence on traditional basic links such as ticket revenue, and enhance the comprehensive economic benefits of the tourism industry and its role in driving regional economy [67]. Through the above measures, it will help promote the entire industry to break free from the vicious cycle of low price competition and achieve a fundamental transformation from scale expansion to quality improvement

3) Practice the concept of green development and adapt to the new requirements of sustainable development

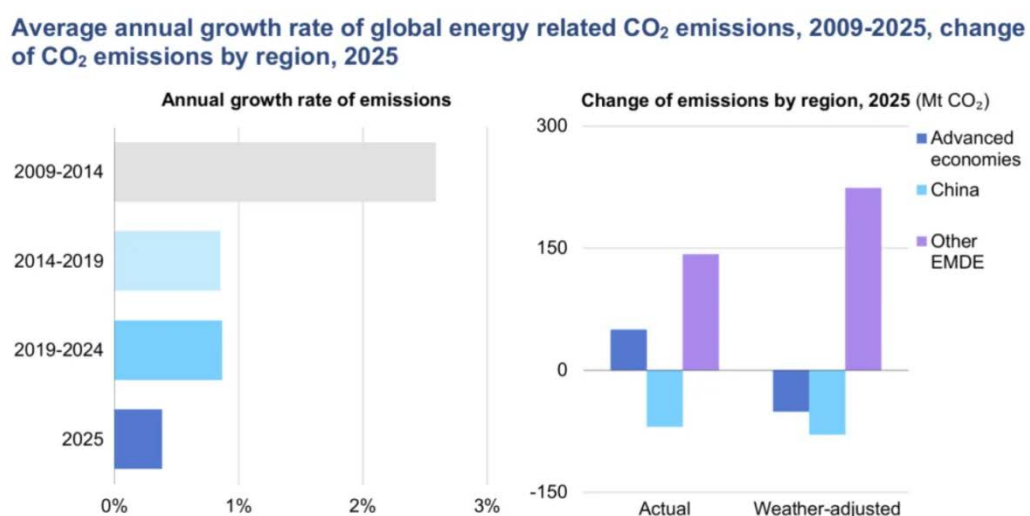


Figure 3.5 – Trend of Total Carbon Emissions from Global Tourism Industry [54]

Against the backdrop of an era where the global green development concept is increasingly gaining universal recognition, sustainable development principles such as low-carbon emission reduction and ecological protection must be fully integrated into every aspect of tourism development and operation. This will better meet the urgent demands for industrial transformation and upgrading, thereby consolidating a solid foundation for the long-term and sound development of the global tourism economy.

When undertaking development and construction, all tourist destinations must strictly observe the red line of ecological protection, firmly put an end to excessive development and acts that damage natural ecosystems, and strive to achieve a dynamic balance between tourism exploitation and ecological conservation. Only on the premise of protecting natural and cultural resources can the tourism industry maintain enduring vitality and appeal [23]. Meanwhile, tourism enterprises should actively embrace green operation philosophies. In daily management, they shall implement energy conservation, emission reduction and resource recycling measures in hotels, scenic spots and other venues to effectively cut energy consumption and carbon emissions during operation. It is also essential to develop green and eco-tourism products that meet environmental standards, so as to satisfy tourists' growing demand for eco-friendly travel.

In addition, intensified promotion and guidance on green tourism concepts are required to foster tourists' awareness of responsible travel, encouraging them to consciously protect the ecological environment and reduce resource waste during trips. Through the coordinated efforts of government guidance, corporate initiatives and public participation, a multi-party collaborative pattern for green tourism development can be gradually established. This will ultimately secure the long-term sustainable development of the global tourism economy along the path of environmental friendliness and high-quality growth [19].

### **3.3 Future Prospects for the Development of the Global Tourism Economy**

Driven by shifts in the global economic landscape, advances in digital technology, upgrading consumer demands and the popularization of green development philosophies, the global tourism economy will gradually recover from short-term fluctuations in the

future. It will enter a new stage of sustained recovery and quality upgrading, featuring three core development trends.

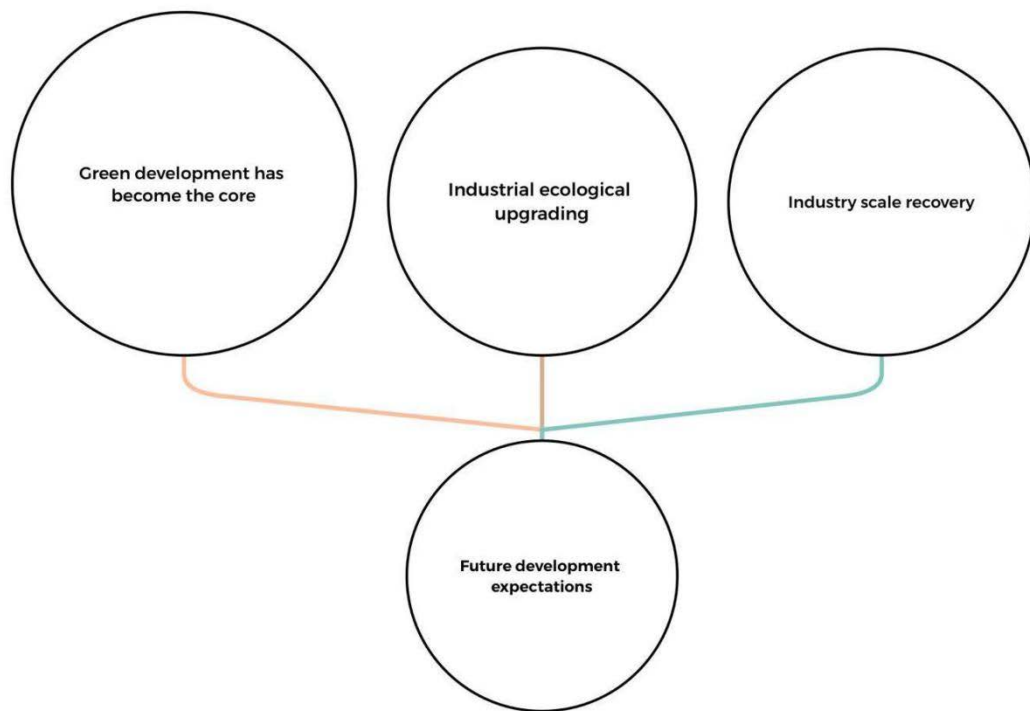


Figure 3.6 – Future Development of Global Tourism Economy [done by author]

### 1) Sustained Recovery of Industrial Scale and Balanced Restructuring of the Global Development Pattern

Over the next three to five years, the global tourism economy will maintain a sound momentum of steady recovery. It is expected to not only gradually return to pre-pandemic development levels, but also achieve steady growth beyond them. Meanwhile, the landscape of global tourism will undergo profound reshaping with multi-dimensional and structural changes.

In terms of overall market scale, with the continuous improvement of cross-border travel convenience and the gradual recovery of the global economic environment, international tourism consumption will maintain stable growth. The contribution of the global tourism industry to GDP and its capacity to boost employment are projected to keep rising, further highlighting the pivotal role of the tourism economy in the global economic system [32].

From the perspective of regional development patterns, the center of gravity of the

global tourism economy is accelerating eastward. Boasting large tourist source markets, rich and diverse tourism resources, and continuously improved supporting infrastructure, the Asia-Pacific region is poised to become the core engine driving global tourism economic growth. Notably, emerging markets including China, India and Southeast Asia are expected to register a tourism growth rate significantly higher than the global average. In addition, emerging markets in Africa, Central and South America, which are endowed with abundant tourism resources yet underdeveloped in the past, will gradually unlock their development potential and continuously expand their share in the global tourism market. By contrast, traditional tourism markets represented by Europe and North America will still achieve steady growth, yet their global market share is set to decline gradually. Overall, the global tourism economy will move away from the unipolar pattern long dominated by European and American countries, and evolve into a new framework featuring more balanced, diversified and coordinated regional development [49].

## 2) Comprehensive Upgrade of Industrial Ecology: Digitalization and Diversification as Core Growth Drivers

Looking ahead, the widespread popularization of digital technologies and the continuous upgrading of tourists' consumption demands will fundamentally reshape the ecosystem of the global tourism industry and serve as the core driving force for its long-term development.

On the industrial operation side, smart scenic spots and smart hotels will gain full popularity. Relying on cutting-edge technologies such as the Internet of Things and artificial intelligence, scenic areas can realize intelligent monitoring and regulation of passenger flow, while hotels can greatly improve operational efficiency and service quality [27]. Furthermore, tourism enterprises can leverage big data analysis to accurately identify tourists' consumption preferences, so as to provide personalized customized tourism products and achieve refined marketing and precise customer engagement.

On the consumption side, emerging formats including online cloud tourism, virtual scenic tours and metaverse immersive experiences will enjoy rapid development, forming a mutually complementary and reinforcing benign interaction with offline physical travel. These innovative models effectively break the temporal and spatial constraints of traditional

tourism, greatly expanding the development boundaries of the industry. At the same time, global tourists' consumption needs are constantly upgrading, shifting from superficial sightseeing and check-in travel to in-depth experience, personalized expression and immersive participation. Niche segments such as wellness tourism, study tours, outdoor adventures and cultural immersive experiences will witness rapid expansion. It is noteworthy that small-group tours and high-end customized travel will gradually replace low-cost, large-scale group tours as the mainstream market form, promoting the all-round upgrading of the tourism industry toward refinement, diversification and high added value [62].

### 3) Growing Developmental Resilience with Green Sustainability as the Core Feature of Industrial Development

In the future, the ability of the global tourism economy to withstand shocks and its developmental resilience will be markedly strengthened. Meanwhile, green, low-carbon and sustainable development will evolve from a competitive advantage into a basic industry requirement, becoming the fundamental hallmark of global tourism development.

Having weathered the impacts of the pandemic and geopolitical conflicts, countries worldwide will gradually establish more robust emergency support systems for tourism. By diversifying source markets, product portfolios and industrial chains, tourism enterprises will effectively mitigate operational risks and substantially improve the overall risk resistance of the industry [8]. In addition, the integration of global tourism will continue to deepen, bringing closer and more practical tourism cooperation among nations and further facilitating cross-border tourism cooperation trend, with cross-border tourism cooperation emerging in increasing numbers, steering the global tourism market toward greater openness and in-depth integration.

Furthermore, the green and sustainable development philosophy centered on low-carbon emission reduction will be fully embodied in tourism development, operation and consumption. Countries will gradually refine ecological, environmental and low-carbon formats such as zero-carbon scenic areas and achieve widespread

application [9]. Eco

tourists. Against this backdrop, the global tourism economy will completely move beyond the traditional extensive development model and enter a new phase of long and sustainable growth.

This chapter systematically summarizes three core factors constraining the current development of the global tourism economy. First, the complex and volatile macro external environment imposes multiple restrictions on industrial expansion. Second, long structural imbalances and developmental deficiencies within the industry are prominent, including stark regional disparities, industrial homogenization and low added value. Third, the rising popularity of green and low and regulatory constraints on the traditional extensive tourism model.

In response to these constraints, this chapter proposes systematic strategies to advance the high strengthening global multilateral cooperation to foster a more open and convenient tourism environment; promoting coordinated regional development and industrial upgrading to realize resource sharing and value enhancement; and fully implementing green development by integrating ecological conservation and carbon reduction into all tourism development and operational procedures.

On this basis, forward-looking judgments on the future of the global tourism economy are presented. Overall, the recovery momentum will continue, and the traditional unipolar structure dominated by Europe and North America will shift toward balanced and coordinated progress across multiple regions. The widespread adoption of digital technologies and the continuous upgrading of consumer demand will serve as key drivers for industrial transformation, advancing tourism products toward personalization, immersive experience and high quality. At the same time, industrial resilience will keep improving, and green sustainability will become a basic standard rather than an optional advantage, defining the future trajectory of global tourism. Ultimately, the global tourism economy is expected to step into a new stage of high greater balance, stronger resilience and long - term sustainability.

## Conclusion

Against the backdrop of in-depth global economic recovery, comprehensive advancement of ecological civilization construction and continuous upgrading of residents' consumption structure in the new era, the tourism industry has gradually shifted from the traditional extensive growth model to a high-quality development path featuring low carbon, ecology and sustainability. The concept of green and sustainable development has been deeply integrated into the whole operation process of the global tourism economy, becoming the core guidance for all countries to optimize tourism industrial structure, balance economic benefits and ecological protection, and achieve long-term stable prosperity of tourism. Taking the development of global tourism economy in the new era as the research object and focusing on the realistic background of green sustainable development, this paper sorts out the connotations of core concepts including tourism economy, green tourism, ecological tourism and sustainable tourism development, and clarifies the operation logic, internal mechanism and development characteristics of green tourism economy in the new era. By adopting the Vector Autoregression (VAR) model, stationarity test, cointegration test, impulse response function, variance decomposition and Error Correction Model (ECM), this paper empirically analyzes the long-term equilibrium relationship, short-term dynamic fluctuation relationship, variable shock transmission path and interactive influence degree between green development factors and global tourism economic growth. It summarizes practical restrictive problems existing in the current development of global green tourism economy, puts forward systematic and implementable optimization countermeasures, comprehensively analyzes the evolution laws, development dilemmas and upgrading paths of global tourism economy from the perspective of green sustainability in the new era, and forms a complete research framework consisting of theoretical sorting, empirical verification, problem analysis and countermeasure optimization.

In terms of theoretical concept sorting, tourism economy in the new era no longer simply pursues short-term quantitative growth indicators such as tourist arrivals and tourism revenue, but attaches more importance to sustainable attributes including ecological

carrying capacity of tourism resources, environmental friendliness of tourism, recycling efficiency of cultural and tourism resources and coordinated and equitable regional tourism development. Different from traditional mass tourism, green tourism features low resource consumption, low pollutant emission and minor ecological damage, and achieves coordinated unity of economic, ecological and social benefits. Sustainable tourism development emphasizes intergenerational equity, regional balance and sustainable utilization of resources, coordinates tourism development and construction with natural ecological protection, and avoids environmental degradation, resource depletion and cultural loss caused by excessive commercialization and disorderly development of tourism. Under the new development pattern, the global tourism economy presents new characteristics including intensified regional development differences, extensive application of low-carbon technologies, deepened integration of culture and tourism, normalization of cross-border tourism and growing demand for ecological tourism. Low-carbon and green development has become an irreversible mainstream trend in the transformation and upgrading of the global tourism industry. The coordinated progress of ecological environmental protection and tourism economic growth is an inevitable choice for the long-term healthy development of tourism industry worldwide.

In the empirical analysis part, this paper strictly follows the standard process of time series data analysis. It conducts ADF unit root test for sequence stationarity successively to avoid spurious regression, determines the lag order of variables according to data stationarity, completes Johansen cointegration test, and verifies the long-term stable equilibrium correlation among green development elements, ecological environment quality, low-carbon policy constraints, residents' consumption demand, opening-up level and global tourism economic growth. By virtue of the impulse response function of VAR model, this paper analyzes dynamic changes, duration and fluctuation direction of each variable after external shocks, clearly demonstrating the positive driving effect of green sustainable indicators on tourism economic growth and the negative environmental pressure brought by tourism economic expansion to regional ecology. Variance decomposition is used to clarify the contribution of different variables to tourism economic fluctuations, distinguishing long-term core influencing factors from short-term secondary ones.

Meanwhile, the ECM is constructed to capture the adjustment mechanism when variables deviate from long-term equilibrium in the short term. The results confirm that short-term fluctuations of green development, shocks to tourism market and disturbances of unexpected external events will cause short-term imbalance between tourism economy and green ecological system. Nevertheless, market regulation and policy control can rapidly correct deviations and promote their return to long-term stable and coordinated development. Empirical results show that improved ecological protection, implementation of low-carbon tourism policies, application of clean energy in tourism scenarios and enhanced ecological governance capacity can steadily drive global tourism economic growth in the long run. Large-scale expansion of tourism industry exceeding ecological carrying capacity will aggravate environmental pressure and resource consumption, thereby restricting long-term tourism economic development. The two are interdependent, restrictive and dynamically adjusted for a long time. Only by adhering to green bottom lines and exploiting tourism resources reasonably can stable and sustainable operation of tourism economy be guaranteed.

In terms of restrictive factors in practical development, global green sustainable tourism economy still faces multiple dilemmas at present. There are prominent gaps in regional tourism development: developed countries have sound green tourism systems, advanced low-carbon technologies and perfect environmental protection regulations, while developing countries adopt extensive tourism development modes, lack ecological awareness and low-carbon infrastructure, resulting in severe unbalanced north-south tourism development. Complex and volatile cross-border tourism environment, geopolitical conflicts, public safety incidents, international trade barriers and unclear rights and responsibilities of transnational ecological governance seriously hinder the integrated and coordinated development of global green tourism. The tourism industry lacks sufficient impetus for transformation. Most scenic spots still rely on traditional sightseeing modes; high-energy-consuming hotels, high-emission transportation and excessive artificial construction damage natural landscapes, while systems for tourism waste disposal, water resource recycling and carbon emission control remain imperfect. Inconsistent laws, regulations and industry standards for green tourism, great differences in national

environmental policies and high difficulty in cross-regional ecological supervision further restrict industrial progress. The research and application of low-carbon tourism technologies lag behind, new formats such as smart tourism, circular tourism, low-carbon transportation and ecological homestays spread slowly. High transformation costs, long profit cycles and low enthusiasm of market entities also restrict green development. In addition, excessive development of ecological tourism resources, homogeneous tourism projects, damage to traditional culture and natural landscapes, unreasonable tourism benefit distribution and immature green tourism consumption habits jointly hinder high-quality green and sustainable development of global tourism economy in the new era.

Aiming at existing constraints, combined with empirical conclusions and global development reality, this paper puts forward targeted strategies from macro governance, industrial transformation, technological innovation, regional cooperation, market cultivation and institutional guarantee. All countries shall scientifically delineate ecological protection redlines for tourism according to their own ecological resource endowments, control tourism development intensity reasonably and formulate tourism scale matching regional environmental carrying capacity. It is necessary to accelerate tourism industrial restructuring, vigorously develop ecological tourism, rural tourism, health tourism and low-carbon leisure tourism, limit high-energy and high-polluting tourism formats, and promote energy conservation and emission reduction throughout scenic spots, hotels and transportation chains. More investment should be made in research and development of green low-carbon tourism technologies, new energy tourism vehicles, energy-saving buildings, circulating sewage treatment and waste recycling should be popularized, and digital and intelligent management should improve the utilization efficiency of tourism resources. Transnational collaborative governance mechanisms for green tourism shall be improved, unified standards for environmental protection, carbon accounting and tourism industry norms shall be formulated, and international cooperation, tourist source exchange and experience sharing shall be strengthened to narrow regional tourism gaps. Policies including financial subsidies, tax incentives and financial support are adopted to reduce enterprise transformation costs and encourage tourism enterprises to implement sustainable development concepts. Publicity and education on green tourism are strengthened to guide

low-carbon travel, civilized tourism and rational consumption, foster nationwide green tourism consumption habits, balance economic growth, ecological protection and cultural inheritance, and realize long-term stable, healthy and sustainable development of global tourism economy.

#### Core Research Conclusions

First, there exists a long-term stable cointegration relationship between green sustainable development and global tourism economic growth in the new era. ADF unit root test and Johansen cointegration test show that core variables including ecological environment quality, green policy constraints, low-carbon development level and opening-up degree have no spurious correlation with global tourism revenue and tourist reception scale. They interact and coordinate stably for a long time. Improved ecological environment and strengthened green development continuously boost tourism economy, while orderly tourism expansion promotes investment in ecological protection. Deviation from equilibrium can be automatically corrected through market and policy mechanisms.

Second, impulse response results of VAR model indicate that green sustainable shocks exert long-term positive and continuous impacts on tourism economy, with mild short-term fluctuations and prominent long-term effects. Ecological optimization and low-carbon policies exert slight short-term impacts on tourism revenue initially. As time goes by, enhanced attractiveness of ecological tourism, improved brand reputation and accumulated tourist sources continuously drive steady growth of tourism economy. Excessive tourism expansion rapidly increases ecological pressure and causes negative environmental responses. Uncontrolled long-term expansion will continuously restrict subsequent tourism growth, proving that extensive tourism development is unsustainable.

Third, variance decomposition demonstrates that green ecological factors are long-term core variables affecting global tourism economic fluctuations. Compared with short-term market demand and unexpected events, ecological carrying capacity and green development level contribute more to long-term tourism trends. Economic factors mainly affect short-term fluctuations, while green sustainable conditions determine the development ceiling and cycle of global tourism. Long-term tourism prosperity can only be achieved by adhering to ecological green bottom lines.

Fourth, ECM verifies the short-term dynamic adjustment mechanism between global tourism economy and green ecological system. Unexpected events, pandemic impacts, geopolitical volatility and overheated short-term tourism market will cause temporary imbalance. The significant error correction term can rapidly adjust short-term deviations and restore long-term equilibrium. This reflects strong resilience of global tourism industry: it can recover quickly and maintain steady growth after short-term external shocks as long as green development principles are upheld.

Fifth, major contradictions in current global green tourism development include unbalanced regional development, lagging industrial transformation, insufficient transnational coordination, weak technological support, imperfect institutional systems and prominent conflicts between ecological development and protection. Extensive development, fragmented governance and differentiated policy barriers are key obstacles to green upgrading of global tourism economy. To break development bottlenecks, global tourism must shift from scale expansion to quality improvement, and pursue integrated economic, ecological and social benefits instead of single economic benefit.

Sixth, low-carbon development, ecological priority, regional coordination, overall planning and cultural-tourism integration are inevitable paths for sustainable global tourism development in the new era. Coordinating ecological protection and tourism development, collaborative progress between developed and developing countries, short-term income and long-term sustainability, government supervision and market participation can resolve contradictions between tourism economy and environmental protection, and promote global tourism economy into a new stage of high-quality green and sustainable development.

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