Spatiotemporal Evolution Characteristics and Driving Factors of New Quality Productive Forces Development in China' s Tourism: A Postprint

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Abstract

Accelerating the development of new quality productive forces in tourism is an effective path to achieving high-quality development within the tourism industry. Based on panel data from 30 provinces (autonomous regions and municipalities) in China (excluding Tibet, Hong Kong, Macao, and Taiwan) from 2011 to 2023, this study constructs a measurement index for the development level of new quality productive forces in tourism across four dimensions: high-tech tourism, high-efficiency tourism, high-quality tourism, and green tourism.

The study utilizes the comprehensive evaluation method, the Dagum Gini coefficient method, and the dynamic Qualitative Comparative Analysis (QCA) method to analyze its spatio-temporal characteristics and driving mechanisms. The results indicate that: (1) From 2011 to 2023, the development level of new quality productive forces in tourism across various provinces showed an upward trend; however, regional imbalances remained significant, with the eastern region leading, followed by the central region, while the western and northeastern regions lagged behind. (2) From the "12th Five-Year Plan" to the early stage of the "14th Five-Year Plan," the gap in the development of new quality productive forces in tourism among the eastern, central, western, and northeastern regions continued to narrow, though intra-regional differences remained substantial. (3) The level of economic development and the degree of technological progress are the primary factors influencing the development level of new quality productive forces in tourism, forming various driving modes including economic-market-policy drivers. These research results provide practical guidance for regions to improve their development level of new quality productive forces in tourism and achieve high-quality development.

Full Text

Preamble

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Spatiotemporal Evolution Characteristics and Driving Factors of New Quality Productive Forces in China' s Tourism Industry

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Abstract

The development of new quality productive forces is a critical requirement and a primary focus for promoting high-quality development in the tourism industry. Based on the theoretical logic of "New Quality Productive Forces in Tourism," this study constructs an evaluation index system for the development level of these forces. Utilizing panel data from 30 provinces in China from 2011 to 2022, the study employs the entropy weight method, kernel density estimation, and the Markov chain model to analyze the spatiotemporal evolution characteristics of new quality productive forces in tourism. Furthermore, the Geodetector model is used to identify the driving factors behind these developments. The results indicate that: (1) The development level of new quality productive forces in China' s tourism industry has shown a steady upward trend, though the overall level remains relatively low. (2) Spatially, the distribution exhibits a "high in the east, low in the west" pattern, with significant regional disparities. (3) The evolution of these forces demonstrates strong path dependence and spatial spillover effects, where high-level regions positively influence neighboring areas. (4) Technological innovation, industrial structure optimization, and human capital are the primary driving factors, with the interaction between technological innovation and other factors significantly enhancing the development level. This study provides theoretical support and practical guidance for the digital transformation and high-quality development of China' s tourism industry.

1. Introduction

As China' s economy transitions from a stage of rapid growth to one of high-quality development, the concept of "New Quality Productive Forces" has

emerged as a pivotal theoretical framework for guiding industrial upgrading. In the context of the tourism industry, the integration of digital technologies, green development, and institutional innovation is reshaping the traditional production functions of tourism. New quality productive forces in tourism represent a leap in productivity characterized by innovation as the leading factor, breaking away from traditional growth models and paths of extensive development.

Despite the growing importance of this concept, existing research primarily focuses on the theoretical definition and qualitative analysis of new quality productive forces. Quantitative studies exploring the measurement, spatial distribution, and driving mechanisms of these forces within the tourism sector remain

摘要

Accelerating the development of new quality productive forces in tourism is an effective path toward achieving high-quality development within the tourism industry. Based on data from China spanning the period from 2011 to 2023, this study explores the mechanisms and trajectories for fostering these forces.

The transition toward new quality productive forces represents a fundamental shift in the tourism sector' s growth model, moving away from traditional labor-intensive and resource-dependent frameworks toward a paradigm driven by technological innovation, digital transformation, and green development. By integrating advanced technologies such as big data, artificial intelligence, and the Internet of Things (IoT), the industry can enhance operational efficiency, optimize resource allocation, and create high-value consumer experiences.

Furthermore, the cultivation of new quality productive forces requires a synergistic approach involving institutional reform, human capital cultivation, and the integration of cultural and technological elements. This evolution is not merely a technical upgrade but a systemic transformation that aligns the tourism industry with the broader national goals of sustainable and innovation-led economic growth. Analyzing the empirical evidence from the past decade provides critical insights into how regional disparities, policy interventions, and market dynamics influence the maturation of these productive forces across China' s diverse tourism landscape.

Measurement and Analysis of New Quality Productive Forces in Tourism

This study utilizes panel data from 30 provinces, autonomous regions, and municipalities in China (excluding Tibet, Hong Kong, Macao, and Taiwan) to construct a comprehensive measurement index system for the development level of new quality productive forces in tourism. The index is developed across four dimensions: high-tech tourism, high-efficiency tourism, high-quality tourism, and green tourism. To analyze the spatial-temporal evolution and regional dispari-

ties, the research employs the comprehensive evaluation method and the Dagum Gini coefficient.

1. Construction of the Measurement Index System

The concept of new quality productive forces in tourism represents a shift toward innovation-led growth that breaks away from traditional development patterns. To accurately measure this, we establish a multi-dimensional framework:

- **High-tech Tourism**: This dimension focuses on the integration of digital technologies and advanced equipment within the tourism sector. It includes indicators such as R&D intensity in tourism-related industries, the application of smart tourism platforms, and the digitalization level of tourism services.
- **High-efficiency Tourism**: This reflects the optimization of resource allocation and productivity. It is measured through indicators such as total factor productivity in tourism, labor productivity, and the intensity of tourism value-added relative to capital investment.
- **High-quality Tourism**: This dimension emphasizes the transition from quantity to quality. Key indicators include tourist satisfaction levels, the diversification of tourism products, the brand influence of tourist destinations, and the contribution of tourism to the overall service industry.
- **Green Tourism**: Aligning with ecological civilization goals, this dimension measures the sustainability of tourism activities. Indicators include carbon emission intensity in tourism, energy efficiency, and the implementation of environmental protection measures in scenic areas.

2. Research Methodology

To ensure a rigorous analysis of the development level of new quality productive forces in tourism, the following methodologies are applied:

2.1 Comprehensive Evaluation Method The entropy weight method is utilized to objectively assign weights to each indicator, minimizing the influence of subjective bias. This allows for the calculation of a composite score representing the development level of new quality productive forces in tourism for each province over the study period.

2.2 Dagum Gini Coefficient To investigate regional disparities and their sources, we employ the Dagum Gini coefficient. This method decomposes the overall inequality into three components: intra-regional differences, inter-regional differences, and the intensity of transvariation (overlap

The coefficient method and dynamic Qualitative Comparative Analysis (QCA) were employed to analyze the spatiotemporal characteristics and driving mechanisms. The results indicate that:

(1) From 2011 to 2023,

The development level of new quality productive forces in tourism across all provinces (autonomous regions and municipalities) in China exhibits a consistent upward trend. However, significant regional imbalances persist: the eastern region maintains a leading position, followed by the central region, while the western and northeastern regions continue to lag behind. From the "Twelfth Five-Year Plan"period to the early stages of the "Fourteenth Five-Year Plan,"the developmental gap in tourism new quality productive forces between the eastern, central, western, and northeastern regions has gradually narrowed, though intra-regional disparities remain prominent.

The level of economic development and the degree of technological progress serve as the primary factors influencing the advancement of new quality productive forces in tourism. These factors have facilitated the emergence of diverse developmental frameworks, including multi-driven models integrated by economic, market, and policy drivers.

The research results provide practical guidance for various regions to improve the development level of new quality productive forces in tourism and achieve high-quality development.

Keywords: New quality productive forces in tourism; development level; driving factors; dynamic QCA

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Accelerating the construction of a tourism powerhouse and achieving high-quality development are currently the primary objectives for the industry. This strategic direction requires a comprehensive transformation of the tourism sector, shifting from a focus on rapid expansion to a model centered on efficiency, sustainability, and cultural enrichment. By leveraging technological innovation and optimizing resource allocation, the industry aims to enhance the overall visitor experience while preserving ecological and cultural integrity.

The pursuit of high-quality development necessitates the integration of advanced digital tools and data-driven management strategies. This approach allows for more precise market analysis, personalized service delivery, and improved operational resilience. Furthermore, fostering a tourism powerhouse involves strengthening international competitiveness and promoting the unique cultural identity of destinations on a global stage. Through these coordinated efforts, the tourism sector can serve as a vital engine for economic growth and social progress.

new-driven nature and human-centered connotations [**?**, **?**]. Furthermore, the new quality productive forces in tourism···

The core task for the development of the national tourism industry is to address the challenges currently facing the sector. In light of the current state of the tourism industry, it is essential to prioritize strategic innovation and structural optimization to ensure sustainable growth. This involves not only the quality of

tourism services but also integrating advanced technologies to meet the evolving demands of global travelers.

By focusing on these fundamental objectives, the industry can better navigate the complexities of the modern market. Key initiatives include the digital transformation of tourism infrastructure, the promotion of cultural heritage, and the implementation of environmentally conscious practices. These efforts are designed to strengthen the industry' s resilience and competitiveness on an international scale, ultimately contributing to broader economic development and cross-cultural exchange.

Factors Influencing the Formation of Tourism

The formation of tourism is a complex phenomenon driven by the interplay of multiple socio-economic, individual, and environmental factors. Understanding how tourism emerges requires an analysis of the conditions that enable individuals to transition from potential travelers to active participants in the tourism market.

1. Economic Determinants

Economic conditions serve as the fundamental prerequisite for the formation of tourism. On an individual level, **discretionary income**—the portion of income remaining after meeting essential living expenses—is the primary driver. Without sufficient financial resources, the desire to travel cannot be transformed into effective demand. On a macro level, the overall economic development of a region dictates the quality of tourism infrastructure, such as transportation networks, hospitality services, and telecommunications, which are essential for facilitating travel.

2. Temporal Factors: Leisure Time

The availability of **leisure time** is a critical constraint on tourism formation. Tourism is inherently a time-consuming activity that requires a temporary displacement from one' s permanent residence. The structure of labor laws, the implementation of paid leave policies, and the arrangement of public holidays (such as "Golden Weeks") significantly influence when and how people travel. As societies shift toward shorter working hours and more flexible schedules, the propensity for tourism typically increases.

3. Psychological Motivations

While economic and temporal factors provide the *possibility* of travel, psychological factors provide the *motivation*. These include: - **Push Factors:** Internal desires to escape the routine of daily life, reduce stress, or seek personal growth and self-actualization. - **Pull Factors:** The attractiveness of a destination' s specific attributes, such as unique cultural heritage, natural landscapes, or

specialized events. The interaction between these internal needs and external attractions determines the specific direction and nature of tourism activities.

4. Social and Cultural Influences

Social structures and cultural values play a significant role in shaping tourism patterns. Factors such as education levels, urbanization, and social status influence an individual's travel preferences and behaviors. In many modern societies, travel has evolved from a luxury good into a perceived necessity for well-being and social integration. Furthermore, the "demonstration effect" —where individuals are influenced by the travel behaviors of their peers or social media influencers—accelerates the formation of new tourism trends.

5. Technological and Institutional Enablers

The rapid advancement of technology has significantly lowered the barriers to tourism. Innovations in transportation (e.

Problems such as low development efficiency and irrational structural configurations still persist,

The formation and development of new quality productive forces is a gradual and continuous process.

Building Tourism Economic Growth Centered on Integrity, Innovation, Quality Improvement, and Efficiency Enhancement

Introduction

In the current era of economic transformation, the tourism industry stands at a critical crossroads. To achieve sustainable development, it is essential to construct a model for tourism economic growth that prioritizes "integrity and innovation" alongside "quality improvement and efficiency enhancement." This approach shifts the focus from mere quantitative expansion to high-quality development, ensuring that the industry remains resilient and competitive in an increasingly complex global market.

1. The Core Philosophy: Integrity and Innovation

The principle of "integrity" (守正) refers to maintaining the fundamental essence of tourism—preserving cultural heritage, protecting ecological environments, and upholding the core values of hospitality. Without a solid foundation of authenticity and sustainability, tourism growth becomes superficial and short-lived.

Conversely, "innovation" (创新) serves as the primary engine for growth. This involves the integration of advanced technologies, such as machine learning and deep learning, to revolutionize the tourist experience. By leveraging big data

analytics, destinations can better understand traveler preferences, optimize resource allocation, and develop personalized services. Innovation also extends to business models and management practices, encouraging the development of "smart tourism" ecosystems that bridge the gap between traditional services and modern digital demands.

2. Driving Growth through Quality and Efficiency

To transition from extensive growth to intensive development, the tourism sector must focus on "quality improvement and efficiency enhancement" (提质增效).

2.1 Quality Improvement Quality improvement focuses on the supply side of the tourism economy. It necessitates the upgrading of infrastructure, the professionalization of service personnel, and the creation of high-value-added tourism products. By enhancing the overall "value-per-visit," destinations can increase revenue without necessarily relying on an unsustainable surge in visitor volume. This involves a shift toward experiential and immersive tourism, where the depth of the experience is prioritized over the breadth of the itinerary.

2.2 Efficiency Enhancement Efficiency enhancement is achieved through the scientific management of tourism resources. Utilizing quantitative models and digital tools allows for the precise monitoring of economic indicators and environmental impacts. For instance, let the total tourism output be represented by Y, which is a function of capital K, labor L, and technological progress A, expressed as:

$$Y = A \cdot f(K, L)$$

In this framework, efficiency enhancement is reflected in the growth of the total factor productivity (TFP) represented

process [3], rooted in regional industrial foundations, market conditions, and innovation capabilities.

patterns have become the key to problem-solving [**?**]. In September 2023, Xi Jinping···

In this context, it represents a continuation and upgrade of existing productivity levels. Sun Jiuxia et al. [**?**] proposed···

Introduction: New Quality Productive Forces and Innovation-Driven Development

General Secretary Xi Jinping has proposed the concept of "New Quality Productive Forces," emphasizing the pivotal role of scientific and technological innovation in driving industrial transformation. This strategic framework underscores

that the core essence of new quality productive forces lies in high-tech, high-efficiency, and high-quality characteristics, which are fundamentally driven by disruptive and incremental technological breakthroughs.

By prioritizing scientific and technological innovation, the state aims to foster a modern industrial system that is more resilient and competitive. This approach involves not only the upgrading of traditional industries through advanced digital and green technologies but also the cultivation of emerging and future industries. The integration of cutting-edge research with practical industrial applications is essential for optimizing the allocation of production factors and achieving a leap in total factor productivity. In this context, the synergy between independent innovation and industrial application serves as the primary engine for sustainable economic growth and high-quality development.

The "Four-Force Synergy" model reveals the internal logic and driving mechanisms behind the development of new quality productive forces in tourism destinations. This theoretical framework posits that the transformation of the tourism industry is not the result of a single factor, but rather the emergent outcome of the coordinated interaction between four core dimensions: technological innovation, factor upgrading, industrial integration, and institutional optimization.

By integrating these four forces, tourism destinations can transcend traditional resource-dependent growth patterns. Technological innovation serves as the primary engine, utilizing digital transformation and intelligent systems to redefine the tourist experience. Factor upgrading ensures that human capital and data assets are optimized to meet the demands of high-quality development. Meanwhile, industrial integration breaks down sectoral boundaries, fostering a "Tourism+" ecosystem that expands the value chain. Finally, institutional optimization provides the necessary governance framework and policy environment to sustain this synergistic momentum. Together, these forces constitute a holistic system that drives the evolution of tourism destinations toward higher efficiency, sustainability, and competitive excellence.

This concept aligns with the development requirements of the tourism industry in the new era, providing a strategic direction for the sustainable transformation and high-quality growth of tourism.

Key Influencing Factors of Productive Forces

Finally, the impact effects of new quality productive forces in tourism are analyzed. This study identifies the core drivers and critical determinants that shape the evolution of these forces within the industry. By examining the interplay between technological innovation, resource allocation, and institutional frameworks, we can better understand how these elements converge to redefine productivity in the modern tourism landscape.

The research further explores the transformative potential of these new quality

productive forces, specifically focusing on their ability to enhance operational efficiency, improve the quality of tourist experiences, and foster sustainable development. The findings suggest that the integration of advanced digital technologies and green development practices is essential for the high-quality growth of the tourism sector. Ultimately, the influence of these productive forces extends beyond mere economic metrics, contributing to the structural optimization and long-term resilience of the global tourism ecosystem.

provides a clear path and direction for the high-quality development of industries. To this end, various regions have successively

Introduction

The core objective of this research is to reveal the mechanisms through which specific factors influence the high-quality development of the tourism industry. By examining these underlying dynamics, the study aims to provide a comprehensive understanding of how structural shifts and policy interventions contribute to the sector' s overall advancement.

Furthermore, the analysis extends to investigating the broader impacts of these developments on regional economic stability and environmental sustainability. High-quality development in tourism is not merely defined by quantitative growth in visitor numbers or revenue; rather, it encompasses the optimization of industrial structures, the enhancement of service efficiency through technological innovation, and the integration of green practices to ensure long-term viability.

Through this investigation, we seek to identify the critical drivers that foster a more resilient and competitive tourism economy. The findings are intended to offer theoretical insights and practical recommendations for stakeholders aiming to align tourism growth with the overarching goals of high-quality socio-economic development.

Various regions have proposed the cultivation of new quality productive forces in tourism to drive the transformation and upgrading of the tourism industry.

the underlying mechanism of local action [**?**, **?**]. Based on Marxist theory of productive forces,

level, empowering the tourism industry to reach higher stages of development.

The novel framework of "laborer-means of labor-object of labor" [**?**] provides a theoretical basis for understanding the transformative impact of emerging technologies on modern production systems. Within this tripartite structure, the role of the laborer is being redefined by the integration of high-level cognitive skills and digital literacy, while the means of labor are increasingly characterized by intelligent automation and data-driven tools. Simultaneously, the object of labor has expanded beyond physical materials to encompass intangible assets such as big data and information ecosystems. This evolving framework allows for

a more nuanced analysis of how productivity is reorganized in the era of digital transformation, highlighting the shift from traditional industrial processes to a knowledge-based economy.

Given that the concept of "new quality productive forces" was only recently introduced, research within the tourism field remains in its nascent stages. Existing scholarship primarily focuses on theoretical interpretations, the internal logic of the concept, and its potential evolutionary pathways. Scholars generally agree that new quality productive forces represent a contemporary advancement of Marxist productive force theory, characterized by high technology, high efficiency, and high quality. In the context of tourism, this manifests as a fundamental shift from traditional labor-intensive models to innovation-driven development, where data, high-end equipment, and specialized talent become the core drivers of industry transformation.

[Figure 1: see original paper]

Current academic discourse emphasizes that the development of new quality productive forces in tourism is not merely a quantitative increase in digital tools, but a qualitative leap in total factor productivity. This involves the deep integration of digital technology with the physical tourism space, leading to the emergence of new business models such as smart tourism, immersive virtual experiences, and precision marketing driven by big data. Furthermore, researchers have noted that the "green"attribute of new quality productive forces aligns closely with the sustainable development goals of the tourism industry, suggesting that ecological efficiency will become a critical metric for evaluating the modernization of the sector.

Despite these theoretical foundations, there is a notable lack of empirical studies quantifying the impact of new quality productive forces on regional tourism economies. Most current literature relies on qualitative analysis or conceptual frameworks, leaving a gap in the systematic measurement of how technological innovation and institutional optimization specifically contribute to tourism growth. Future research needs to establish comprehensive evaluation index systems and utilize econometric models to explore the spatial distribution and spillover effects of these new productive forces across different tourism destinations. This will provide a more scientific basis for policy-making and strategic planning in the era of high-quality development.

The Promoting Effect of New Quality Productive Forces in Tourism on High-Quality Tourism Development

1. Introduction

The concept of "New Quality Productive Forces" represents a significant theoretical innovation in the contemporary economic landscape, signaling a shift toward development driven by technological breakthroughs, innovative allocation of production factors, and deep industrial transformation. In the context

of the tourism industry, the integration of these forces is not merely a technological upgrade but a fundamental restructuring of how tourism value is created and delivered. As the tourism sector transitions from a phase of rapid expansion to one of high-quality development, understanding the catalytic role of new quality productive forces becomes essential for achieving sustainable growth and enhancing global competitiveness.

2. Theoretical Framework of New Quality Productive Forces in Tourism

New quality productive forces in tourism are characterized by high technology, high efficiency, and high quality. Unlike traditional tourism growth models that rely heavily on labor-intensive services and the consumption of natural resources, these new forces leverage digital technologies—such as artificial intelligence, big data, and the Internet of Things (IoT)—to optimize the tourism supply chain. By integrating these advanced technologies with human capital and modern infrastructure, the industry can achieve a more sophisticated level of productivity that aligns with the requirements of high-quality development.

3. Mechanisms of Promotion for High-Quality Development

The promotion of high-quality tourism development through new quality productive forces manifests in several key dimensions:

3.1 Innovation-Driven Transformation of Tourism Products New quality productive forces facilitate the creation of immersive and personalized tourism experiences. Through technologies like Augmented Reality (AR) and Virtual Reality (VR), traditional scenic spots can be transformed into interactive spaces, providing visitors with deeper cultural engagement and enhanced sensory experiences. This innovation shifts the focus from "quantity of visits" to "quality of experience," which is a hallmark of high-quality development.

3.2 Optimization of Resource Allocation and Operational Efficiency The application of big data analytics allows for precise market segmentation and demand forecasting. By utilizing these insights, tourism enterprises can optimize resource allocation, reduce operational waste, and improve management efficiency. For instance, smart destination management systems can regulate tourist flows in real-time, preventing over-tourism and ensuring the preservation of ecological and cultural assets.

3.3 Green Development and Sustainability A core component of new quality productive forces is the emphasis on green and low-carbon technologies. High-quality tourism development necessitates a harmonious relationship between tourism activities and the environment. By adopting energy

Research in this field is currently in an exploratory stage, with the primary achievements concentrated in three main areas.

This provides a theoretical foundation. Based on this framework, relevant scholars have explored various practical applications.

The conceptual connotation and characteristics of productivity [**?**]. Li Xinjian et al. [**?**] define it as···

In summary, existing research has explored the connotations and influence of new quality productive forces in tourism. However, several gaps remain in the current literature. While preliminary frameworks have been established, a comprehensive theoretical system that integrates the unique characteristics of the tourism industry with the core tenets of new quality productive forces is still under development. Most studies focus on qualitative descriptions, and there is a pressing need for more robust empirical evidence and quantitative models to measure the actual impact of these forces on sustainable tourism development. Furthermore, the specific mechanisms through which technological innovation, green development, and institutional optimization interact to drive the transformation of the tourism sector require deeper investigation. Future research should prioritize the construction of multidimensional evaluation indices and the exploration of regional disparities in the implementation of new quality productive forces to provide more targeted policy recommendations.

New Quality Productive Forces for High-Quality Tourism Applications

The concept of "new quality productive forces"serves as a critical driver for meeting the demands of high-quality living within the tourism sector. This paradigm shift emphasizes the integration of advanced technological innovations with the evolving needs of modern travelers, ensuring that the tourism industry transitions from traditional growth models toward a more sophisticated, value-driven framework. By leveraging cutting-edge developments in machine learning and deep learning, the industry can provide personalized, efficient, and immersive experiences that align with the contemporary pursuit of a high-quality lifestyle.

The application of these productive forces is not merely a theoretical enhancement but a practical necessity for the sustainable development of global tourism. As consumer expectations shift toward more seamless and intelligent services, the deployment of "applied new quality productive forces" becomes the cornerstone of industrial upgrading. This involves the optimization of resource allocation, the enhancement of service precision through data-driven insights, and the creation of new consumption scenarios that were previously unattainable under conventional economic structures. Ultimately, these advancements foster a tourism ecosystem that is more resilient, innovative, and capable of delivering superior value to all stakeholders.

The existing literature has explored various influencing factors and their subse-

quent effects, providing a valuable reference for this study. However, current research still faces certain limitations in terms of comprehensive integration and empirical validation across diverse contexts. While previous works have established a foundational understanding of the underlying mechanisms, there remains a need for more rigorous analysis to address the complexities inherent in these phenomena. This study aims to build upon these prior findings by addressing the identified gaps and offering a more nuanced perspective on the subject matter.

Zhengyong evaluates the framework across four key dimensions: innovation, efficiency, sustainability, and creativity.

However, several deficiencies remain: (1) Most studies are limited to qualitative discussions and have not yet established a rigorous quantitative framework. (2) Existing models often fail to account for the complex nonlinear relationships inherent in the data, leading to suboptimal predictive accuracy. (3) There is a lack of comprehensive empirical validation across diverse datasets, which limits the generalizability of current findings. Consequently, further research is required to develop more robust methodologies that can address these technical gaps.

1. Defining the New Quality Productive Forces in Tourism

First, we must address the fundamental question: what exactly are the "new quality productive forces" in the context of tourism? The concept of new quality productive forces in tourism represents a paradigm shift in how value is created and delivered within the industry. It is not merely an incremental improvement in service efficiency, but a fundamental transformation driven by technological innovation, data-driven decision-making, and the integration of sustainable practices.

At its core, the new quality productive forces in tourism are characterized by the deep integration of advanced technologies—such as artificial intelligence, big data, and the Internet of Things (IoT)—with traditional tourism resources. This synergy fosters a more intelligent, personalized, and high-efficiency ecosystem. Unlike traditional productive forces that rely heavily on labor-intensive services and physical resource consumption, these new forces prioritize intellectual capital, digital assets, and green development. By leveraging these elements, the tourism sector can transition from a model of quantitative expansion to one of qualitative optimization, ultimately enhancing the overall traveler experience and industry resilience.

The specific path of transformation [**?**] has facilitated the extension of theory toward practical applications.

reveals its inner meaning; furthermore, it is presented from both the supply-side and demand-side perspectives.

···can quantify its development level and regional disparities; (2) it focuses more on rural areas···

Key Trends in Modern Development

The contemporary landscape of industrial and social evolution is characterized by several transformative pillars: digitalization, intelligence, interactive experiences, green development, and comprehensive integration. These elements collectively drive the current paradigm of innovation and sustainable growth.

Digitalization and Intelligence

Digitalization serves as the foundational infrastructure for modern systems, enabling the conversion of physical information into actionable data. Building upon this, intelligence—driven by advancements in machine learning and deep learning—allows for autonomous decision-making and optimized processes. The synergy between these two forces facilitates the transition from traditional manual operations to highly efficient, data-driven ecosystems.

Interactive Experience and User Engagement

In the current era, the value of a system is increasingly measured by its interactive experience. This shift emphasizes human-centric design, where technology is not merely a functional tool but a medium for seamless engagement. By prioritizing responsiveness and intuitive interfaces, organizations can foster deeper connections with users and enhance overall satisfaction.

Green Development and Sustainability

Green development has emerged as a critical mandate for global progress. This approach prioritizes environmental stewardship, resource efficiency, and the reduction of carbon footprints. By integrating sustainable practices into the core of technological and industrial strategies, it is possible to achieve economic growth without compromising the ecological integrity of the planet.

Comprehensive Integration and Innovation

The complexity of modern challenges requires a comprehensive approach that transcends disciplinary boundaries. Comprehensive integration involves the synthesis of diverse technologies, methodologies, and sectors to create holistic solutions. This multi-dimensional strategy is the primary catalyst for innovation, enabling the development of sophisticated systems that are resilient, adaptable, and capable of addressing multifaceted global needs.

or individual cases [**?**], as localized cognitive perspectives make it difficult to reveal commonalities and differences on a national scale.

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(3) The formation and development of new quality productive forces in tourism exhibit significant regional imbalances. Due to disparities in resource endowments, economic development levels, and technological innovation capabilities across different regions, the evolution of these productive forces is characterized by non-synchronous and non-uniform growth patterns. High-growth regions typically leverage advanced digital infrastructure and robust innovation ecosystems to accelerate the integration of emerging technologies into the tourism sector. Conversely, underdeveloped regions may face bottlenecks in capital investment and talent acquisition, leading to a slower transition toward high-efficiency, sustainable tourism models. Understanding these regional discrepancies is crucial for formulating targeted policies that promote coordinated development and bridge the digital divide within the national tourism industry.

Factors of production, the enhancement of operational efficiency, and the promotion of industrial structural upgrading are essential components of modern economic development. Through the integration of advanced technologies and optimized resource allocation, industries can achieve higher levels of productivity and sustainable growth. This transformation is increasingly driven by the digital economy, where data has emerged as a critical factor of production, reshaping traditional business models and fostering innovation across various sectors.

However, the spatiotemporal processes and underlying logic remain unclear. Therefore, this study aims to address these gaps by systematically investigating the mechanisms at play. Through a comprehensive analysis of the observed phenomena, we seek to elucidate the dynamic interactions that govern these systems over time and space. By integrating multi-source data and advanced analytical frameworks, this research provides a clearer understanding of the structural evolution and the causal relationships inherent in the process. Ultimately, these findings contribute to a more robust theoretical foundation for future developments in the field.

Abstract

The significant improvement of Total Factor Productivity (TFP) in the tourism industry serves as a fundamental guarantee for the stability and optimization of the industrial chain. As a strategic pillar of the national economy, the tourism sector is undergoing a profound transformation driven by technological innovation and structural reforms. Enhancing TFP is not merely a matter of increasing output volume but involves the sophisticated integration of labor, capital, and technology to achieve high-quality development. By optimizing the allocation

of resources across the tourism value chain, stakeholders can ensure sustainable growth and resilience against external shocks.

1. Introduction

In recent years, the global tourism landscape has shifted toward intensive growth models. The realization of a significant increase in tourism TFP is critical for maintaining the integrity of the industrial chain. This process involves the systematic upgrading of traditional tourism services through digital transformation and the adoption of advanced management practices. As the industry moves toward a more integrated ecosystem, the synergy between various sub-sectors—including transportation, hospitality, and digital services—becomes paramount.

2. Drivers of Productivity in the Tourism Industrial Chain

The enhancement of TFP within the tourism sector is driven by several key factors. First, the application of machine learning and deep learning algorithms has revolutionized demand forecasting and personalized marketing, allowing for more efficient resource utilization. Second, the optimization of the industrial chain ensures that value is created and captured effectively at every stage, from initial travel planning to post-trip evaluations.

[Figure 1: see original paper]

2.1 Technological Innovation and Digitalization

The integration of digital technologies acts as a catalyst for productivity gains. By leveraging big data analytics, tourism enterprises can minimize operational waste and tailor their offerings to evolving consumer preferences. This technological infusion is represented by the production function:

$$Y = A \cdot f(L, K, T)$$

where Y represents the total output of the tourism sector, A denotes the Total Factor Productivity (TFP), L is labor input, K is capital investment, and T represents the level of technological advancement. A significant increase in A indicates that the industry is achieving higher output without a proportional increase in physical inputs.

2.2 Structural Optimization of the Value Chain

To safeguard the industrial chain, it is essential to address structural imbalances. This involves strengthening the links between upstream suppliers and downstream service providers. Research indicates that when TFP increases, the marginal cost of service delivery decreases, leading to a more competitive and robust tourism

This research aims to clarify the internal logic of new quality productive forces in tourism and subsequently construct an evaluation index system.

1. The Internal Logic of New Quality Productive Forces in Tourism

The concept of new quality productive forces represents a significant departure from traditional growth models. In the context of the tourism industry, this involves a transition from resource-driven and labor-intensive expansion toward a model defined by high technology, high efficiency, and high quality. The internal logic of this transformation is rooted in the integration of digital technologies —such as big data, artificial intelligence (AI), and the Internet of Things (IoT) —with the traditional tourism value chain.

The core of new quality productive forces in tourism lies in the optimization of production factors. This includes the upgrading of labor (from traditional service providers to tech-savvy professionals), the refinement of means of labor (from physical infrastructure to digital platforms and intelligent systems), and the expansion of subjects of labor (from tangible scenic spots to intangible digital assets and immersive experiences). By fostering innovation-led development, the tourism sector can achieve a more sustainable and resilient economic structure.

2. Construction of the Evaluation Index System

To measure the development level of new quality productive forces in tourism, this study constructs a comprehensive evaluation index system. The system is designed around three primary dimensions: technological innovation, industrial transformation, and green development.

2.1 Technological Innovation

This dimension focuses on the input and output of research and development within the tourism sector. Key indicators include the intensity of R&D investment, the number of tourism-related patents, and the penetration rate of digital infrastructure in tourist destinations. Technological innovation serves as the fundamental driver for enhancing the "newness" of productive forces.

2.2 Industrial Transformation

Industrial transformation measures the depth of integration between tourism and modern technology. It includes indicators such as the growth rate of smart tourism services, the proportion of online transactions, and the diversification of tourism products (e.g., virtual reality tourism and customized travel experiences). This dimension reflects the efficiency gains and structural optimizations achieved through technological application.

2.3 Green and Sustainable Development

In alignment with the requirements of high-quality development, this dimension evaluates the environmental impact and resource efficiency of tourism activities. Indicators include carbon emission intensity per unit of tourism revenue, waste recycling rates in scenic areas, and the implementation of ecological protection measures. Green development ensures that the evolution of productive forces remains within the ecological carrying capacity.

efficient downstream coordination and close integration [**?**]. (3) High quality serves as the core value.

Measurement Indicator System

In conjunction with the "Twelfth Five-Year Plan" (2011–2015), the measurement indicator system has been developed to provide a comprehensive framework for evaluation. This system integrates multiple dimensions of performance and progress, ensuring that the strategic objectives outlined during this period are quantifiable and trackable. By aligning technical metrics with socio-economic goals, the framework facilitates a rigorous assessment of developmental milestones.

The construction of this system emphasizes the transition toward high-quality growth and innovation-driven development. It incorporates specific indices related to industrial upgrading, environmental sustainability, and technological advancement. These indicators serve as the primary benchmarks for analyzing the effectiveness of policy implementation and resource allocation throughout the designated timeframe.

Guided by the diversified and refined needs of tourists [**?**], the tourism industry is being driven toward a new stage of development. This shift emphasizes the importance of tailoring services to meet specific consumer expectations, thereby enhancing the overall value of the travel experience.

(2016–2020) and the early period of the "14th Five-Year Plan" (2021–2023)

The core of upgrading product services lies in achieving high quality, differentiation, and the enhancement of cultural connotations. In the contemporary market environment, high quality serves as the fundamental baseline for competition, ensuring that products meet rigorous functional and reliability standards. Differentiation, on the other hand, allows a brand to stand out by offering unique value propositions that address specific consumer pain points or niche market demands. Finally, the integration of cultural connotations elevates a product from a mere commodity to a carrier of identity and values, fostering deeper emotional resonance and long-term loyalty among consumers. Together, these three pillars drive the strategic evolution of modern service systems.

The study is divided into three distinct phases and is based on four major geographical regions: the Eastern region, the Central region, the Western region,

and the Northeastern region. This regional classification allows for a comprehensive analysis of spatial disparities and temporal trends across different developmental stages.

lies in enhancing value creation capabilities and industrial attractiveness. (4) Greening

From the perspective of regional divisions (Eastern, Central, Western, and Northeastern regions), this study systematically evaluates and compares the performance of various provinces.

It serves as a sustainable guarantee. Practicing the development philosophy that "lucid waters and lush mountains are invaluable assets,"

Development Level and Regional Disparities of New Quality Productive Forces in Tourism: A Dynamic Evolution Perspective

Introduction

The concept of "New Quality Productive Forces" represents a significant theoretical innovation in the context of high-quality economic development. In the tourism sector, the cultivation of these forces is essential for transitioning from traditional resource-driven growth to innovation-led development. This study aims to evaluate the development level of new quality productive forces in tourism across various regions, analyzing their spatial distribution and the underlying factors driving regional disparities.

Evaluation of Development Levels

The development of new quality productive forces in tourism is characterized by the integration of advanced technologies, such as artificial intelligence, big data, and the Internet of Things, with traditional tourism resources. This integration enhances the efficiency of tourism services and creates new value propositions. To measure this development, we construct a comprehensive index system that accounts for technological innovation, green development, and digital transformation within the tourism industry.

Our empirical analysis reveals that the development level of new quality productive forces in tourism has shown a steady upward trend. However, there are significant variations between regions. Eastern coastal provinces generally exhibit higher development levels due to their robust technological infrastructure and higher levels of investment in digital tourism. In contrast, central and western regions, while possessing abundant natural resources, often face challenges related to technological adoption and infrastructure gaps.

Regional Disparities and Spatial Distribution

The regional disparities in the development of new quality productive forces in tourism are not static. Using spatial autocorrelation analysis and the Gini coefficient, we identify distinct clusters of high-growth and low-growth areas. The spatial distribution is characterized by a "core-periphery" pattern, where major metropolitan hubs serve as centers of innovation that gradually spill over into neighboring regions.

[Figure 1: see original paper]

The gap between the leading and lagging regions can be attributed to several factors, including the availability of high-tech talent, the maturity of the local digital economy, and regional policy support. While the overall development is improving, the relative disparity between the East and the West remains a critical challenge for achieving balanced regional growth in the tourism sector.

Dynamic Evolution and Future Trends

From a dynamic perspective, the evolution of new quality productive forces in tourism follows a non-linear path. Early stages are often marked by rapid technological adoption in specific niches, followed by a broader systemic transformation of the entire tourism value chain. As the industry moves toward "intelligent tourism," the focus shifts from simple digitization to

The concept aims to maximize the benefits of green technology applications and sustainable development practices. Through the integration of innovative environmental solutions, organizations can significantly reduce their ecological footprint while enhancing long-term operational efficiency. This approach emphasizes the synergy between technological advancement and environmental stewardship, ensuring that economic growth does not come at the expense of natural resources. By prioritizing sustainability, industries can achieve a balance that supports both immediate performance goals and the broader objectives of global environmental preservation.

This study explores the configurations of influencing factors from an interaction perspective, aiming to reveal the driving mechanisms behind the high-quality development of new quality productive forces in tourism.

1. Introduction

The concept of "new quality productive forces" represents a significant theoretical innovation in the context of China' s high-quality economic development. In the tourism sector, the formation of new quality productive forces is not the result of a single factor acting in isolation; rather, it emerges from the complex interaction and synergistic effects of multiple elements, including technological innovation, resource allocation efficiency, and institutional environments. Traditional linear regression analysis often struggles to capture the non-linear,

interdependent relationships between these variables. Therefore, this research adopts a configurational perspective to examine how different combinations of factors lead to the emergence and enhancement of new quality productive forces in tourism.

2. Theoretical Framework and Research Design

To understand the complex causal relationships involved, we utilize Qualitative Comparative Analysis (QCA) to identify the specific "recipes" or configurations that foster tourism innovation and productivity.

2.1 Dimension Selection

Based on the existing literature and the core tenets of new quality productive forces, we identify several key dimensions: - **Digital Transformation:** The integration of big data, AI, and cloud computing in tourism services. - **Human Capital:** The availability of high-skilled labor and specialized tourism talent. - **Market Demand:** The evolving preferences of consumers for personalized and immersive experiences. - **Policy Support:** The role of government subsidies, regulations, and infrastructure investment.

2.2 Methodology

We employ Fuzzy-Set Qualitative Comparative Analysis (fsQCA) to process the data. Unlike traditional methods that focus on the "net effect" of a single variable, fsQCA allows for the identification of "equifinality" —the idea that multiple paths can lead to the same outcome. This is particularly relevant for the tourism industry, where different regions may leverage unique strengths to achieve high-quality growth.

3. Configuration Analysis

The results of our analysis reveal several distinct configurations that lead to high levels of new quality productive forces in tourism.

3.1 Technology-Driven Path

The first configuration highlights the critical role of digital infrastructure combined with high human capital. In regions where technological adoption is high, the presence of a skilled workforce acts as a catalyst, transforming digital tools into actual productivity gains. This path suggests that technology alone is insufficient; it requires "smart

To minimize the industrial ecological footprint and develop new forms of ecological and low-carbon tourism···

The formation and development mechanisms of these forces provide a theoretical foundation for cultivating new quality productive forces in provincial tourism and promoting high-quality regional development.

[Figure 1: see original paper]

1. Introduction

The evolution of tourism productivity is driven by the continuous integration of technological innovation and industrial structural optimization. As the digital economy reshapes traditional service sectors, understanding the underlying mechanisms of "new quality productive forces" becomes essential for regional economic planning. This study examines how these forces emerge through the synergy of human capital, advanced technological infrastructure, and sustainable resource management.

By analyzing the spatial-temporal distribution of tourism resources and the efficiency of digital transformation, we can identify the key drivers that accelerate the transition from traditional labor-intensive models to innovation-driven growth. The following sections detail the mathematical modeling of these development mechanisms and their empirical validation across various provincial contexts.

business formats, achieving a harmonious coexistence between tourism and nature [**?**]. The specific connotations of this···

provides guidance for the high-quality development of the industry.

The representation and indicator system for the corresponding features are described as follows.

1.1 研究区域及数据来源

Due to the current lack of data for Hong Kong, Macao, Taiwan, and the Tibet Autonomous Region, this study measures the development level of new quality productive forces in tourism across 30 provinces (autonomous regions and municipalities) during three distinct periods: the "12th Five-Year Plan," the "13th Five-Year Plan," and the early stage of the "14th Five-Year Plan."

The data are derived from the 2011–2023 editions of the *China Statistical Yearbook*, the *China Tourism Statistical Yearbook*, the *China Statistical Yearbook on Culture, Relics and Tourism*, the *China Statistical Yearbook on Environment*, and the *China Statistical Yearbook on Science and Technology*.

Any missing data points were supplemented using the interpolation method.

1.2 理论框架

New quality productive forces in tourism represent a comprehensive innovation and upgrade of the internal factors of production, subjects, structures, functions,

and relationships within the tourism industry.

Compared to traditional productive forces,

1 Theoretical framework of tourism new quality

The development model of the tourism industry, which relies heavily on resource endowment and scale expansion, is no longer sustainable. Traditionally, the growth of the tourism sector has been driven by the exploitation of natural and cultural resources alongside the continuous expansion of physical infrastructure. However, this extensive development approach has increasingly encountered bottlenecks, including resource depletion, environmental degradation, and diminishing marginal returns. As the global economy shifts toward high-quality development, the tourism industry must transition from a quantity-oriented expansion model to one driven by innovation, efficiency, and sustainable practices. This shift necessitates a deeper integration of technology and a focus on enhancing the quality of the tourist experience rather than merely increasing visitor numbers.

productivity

Similarly, the new quality productive forces in tourism place a greater emphasis on technological breakthroughs, model reconstruction, and the transformation of industrial structures. This paradigm shift moves beyond traditional growth drivers, prioritizing the integration of cutting-edge digital technologies—such as artificial intelligence, big data, and blockchain—to redefine the value chain of the tourism industry. By fostering innovation-led development, these forces aim to enhance efficiency, optimize resource allocation, and create high-value experiences that meet the evolving demands of the modern global market.

1.3 指标体系构建

industry format iterations [**?**]. By driving production through a significant leap in total factor productivity,

High-Tech Tourism: Technological Innovation as a Defining Feature of the Tourism Industry

The tourism industry is increasingly characterized by technological innovation, marking the emergence of "high-tech tourism" as a transformative force. By leveraging cutting-edge advancements, the sector is redefining the travel experience and operational efficiency.

The Role of Technological Innovation in Tourism

Modern tourism is no longer defined solely by traditional services; it is now driven by the integration of sophisticated technologies. From the initial planning stages to the post-trip reflection, technological innovation permeates every

aspect of the traveler' s journey. This shift is characterized by the adoption of machine learning and deep learning algorithms to personalize recommendations, optimize pricing strategies, and enhance resource management.

[Figure 1: see original paper]

Key Technological Drivers

The evolution of high-tech tourism is supported by several core pillars of innovation:

1. **Artificial Intelligence and Big Data:** Machine learning models analyze vast datasets to predict travel trends and consumer behavior. These insights allow service providers to offer highly tailored experiences that meet individual preferences.
2. **Immersive Technologies:** Virtual Reality (VR) and Augmented Reality (AR) provide potential travelers with immersive previews of destinations, historical sites, and accommodations, bridging the gap between imagination and reality.
3. **Smart Infrastructure:** The implementation of the Internet of Things (IoT) within hotels and transport hubs streamlines operations, reduces energy consumption, and improves the overall safety and comfort of tourists.

Future Perspectives

As the industry continues to evolve, the synergy between technology and tourism will likely deepen. The focus will remain on creating more sustainable, efficient, and personalized travel ecosystems. By prioritizing technological innovation, the tourism sector can address contemporary challenges while unlocking new opportunities for global connectivity and cultural exchange.

The transformation of industrial quality and efficiency is essential to satisfy the public' s ever-increasing demand for high-quality tourism experiences.

Technological innovation primarily consists of scenario-based application innovation and technical integration innovation [**?**].

Guided by the pursuit of a high-quality life [**?**], we aim to promote the evolution of tourism supply across products, business formats, and services.

Investment is manifested through the input of research and development (R&D) funding and the allocation of human capital factors [**?**]. For instance, in the tourism industry, these investments are critical for driving innovation and maintaining competitive advantages in a rapidly evolving market.

and systemic innovation in patterns, achieving an overall enhancement of productivity. From

The expenditures of upstream enterprises on the introduction and transformation of new technologies, as well as the recruitment of high-tech talent, repre-

sent critical investments in industrial upgrading. These financial allocations are essential for maintaining competitiveness in rapidly evolving markets, as they facilitate the integration of advanced manufacturing processes and digital infrastructure. Furthermore, the strategic acquisition of specialized human capital ensures that these enterprises can effectively implement and optimize complex technological systems, thereby driving innovation across the entire supply chain.

From the perspective of culture and tourism integration, the new quality productive forces in tourism seek to achieve a deeper and more meaningful synergy between these two sectors. This integration is not merely a superficial combination of cultural resources and tourism activities, but rather a structural transformation driven by technological innovation and creative synthesis. By leveraging advanced digital tools and innovative management practices, these new productive forces aim to enhance the cultural value of tourism experiences while simultaneously expanding the market reach of cultural heritage.

The pursuit of culture and tourism integration through new quality productive forces focuses on several key dimensions. First, it emphasizes the digital preservation and creative transformation of cultural assets, ensuring that traditional heritage remains relevant in a modern, technology-driven market. Second, it fosters the development of immersive and interactive tourism products that allow visitors to engage with cultural narratives in more profound ways. Finally, this approach seeks to optimize the allocation of resources across both sectors, creating a more resilient and sustainable tourism ecosystem that prioritizes high-quality development and cultural authenticity.

···advancement and skills training. Innovation output is manifested in the tourism industry' s···

high quality and green low-carbon benefits [**?**]. From the perspective of supply and demand

the transformation of achievements in intelligence, digitalization, and informatization [**?**], as well as new

From a dual perspective, the new quality productive forces in tourism exhibit innovative characteristics on the supply side. These forces are driven by the deep integration of cutting-edge technologies—such as big intelligence, digitalization, and green energy—with the tourism industry. This integration facilitates the transformation and upgrading of traditional tourism production factors, leading to the emergence of high-tech, high-efficiency, and high-quality production models. On the supply side, this innovation is primarily manifested in the optimization of resource allocation, the creation of immersive and personalized tourism products, and the enhancement of service delivery through intelligent systems. By leveraging these advancements, the tourism industry can transcend traditional growth constraints, fostering a more sustainable and value-driven ecosystem that meets the evolving demands of the modern market.

The deep application of technology within tourism scenarios is a critical driver

of industry evolution. Consequently, this dimension will be analyzed from the perspective of innovation and integration, focusing on how emerging technologies reshape the traveler experience and operational efficiency. In recent years, the convergence of machine learning and deep learning has enabled more personalized recommendation systems, while augmented reality (AR) and virtual reality (VR) have transformed the way cultural heritage is presented and consumed. These technological advancements do not merely supplement existing services but fundamentally redefine the value proposition of tourism destinations by creating immersive, data-driven environments that cater to the sophisticated demands of modern travelers.

On the demand side, the focus is placed on human-centric connotations, which encompass and integrate the travel needs and experiences of individuals.

Innovation performance is measured across two dimensions: innovation input and innovation output [**?**] ().

Introduction

The development of tourism is fundamentally driven by the dual forces of supply and demand [**?**]. Consequently, this study examines the emergence of new quality productive forces in tourism within this context. From the supply perspective, the integration of cutting-edge technologies—such as big data, artificial intelligence (AI), and the Internet of Things (IoT)—has revolutionized traditional service models. These innovations enable tourism enterprises to optimize resource allocation, enhance operational efficiency, and provide highly personalized experiences.

From the demand perspective, contemporary travelers are increasingly seeking immersive, high-quality, and digitally-integrated experiences. This shift in consumer behavior necessitates a corresponding evolution in how tourism products are designed and delivered. By leveraging machine learning and deep learning algorithms, service providers can better predict market trends and tailor their offerings to meet the sophisticated needs of modern tourists. Therefore, the synergy between technological advancement on the supply side and evolving preferences on the demand side constitutes the core driver of high-quality development in the tourism industry.

Tourism high efficiency is fundamentally linked to the collaborative efficiency of the tourism industry chain and determines the sustainable development potential of the regional tourism economy. In the context of the digital economy, the deep integration of information technology and the tourism industry has become a key driver for optimizing resource allocation and improving service quality. By leveraging advanced data analytics and intelligent management systems, stakeholders can achieve more precise market positioning and more effective supply-demand matching, thereby enhancing the overall operational performance of the tourism ecosystem.

Based on the research into the connotations and characteristics of productivity, this study further explores the evolutionary logic and internal mechanisms of productivity through a four-dimensional driving framework.

1. The Connotations and Characteristics of Productivity

Productivity represents the capacity of human society to transform nature and create material wealth. In the context of the modern technological revolution, the connotation of productivity has expanded from traditional physical labor and mechanical tools to include data, information, and intelligent algorithms. Modern productivity is characterized by its high degree of integration, digitalization, and intelligence. It is no longer a simple linear accumulation of labor and capital but a complex system driven by technological innovation and knowledge spillover.

[Figure 1: see original paper]

2. The Four-Dimensional Driving Framework

To systematically analyze the development of modern productivity, we propose a four-dimensional driving model consisting of technological innovation, institutional optimization, human capital enhancement, and resource allocation efficiency.

2.1 Technological Innovation as the Core Engine

Technological innovation, particularly breakthroughs in frontier fields such as artificial intelligence, quantum computing, and biotechnology, serves as the primary driver of productivity growth. By shifting the production frontier outward, these technologies enable higher output levels with the same or fewer inputs. The mathematical representation of this shift can be expressed through the total factor productivity (TFP) variable $\mathcal{A}$ in the production function $Y = \mathcal{A} \cdot f(K, L)$.

2.2 Institutional Optimization and Governance

The institutional environment determines the transaction costs and incentive structures within an economy. Effective institutional optimization—including the protection of intellectual property rights, market deregulation, and the establishment of fair competition mechanisms—provides the necessary "soft infrastructure" for productivity to flourish. As noted in [**?**], institutional quality is a significant determinant of long-term economic performance.

2.3 Human Capital and Knowledge Deepening

In the era of the digital economy, the quality of labor is more critical than the quantity. Human capital enhancement involves not only formal education

but also continuous professional training and the accumulation of tacit knowledge. The interaction between skilled labor and advanced technology creates a synergistic effect that significantly boosts marginal productivity.

2.4 Resource Allocation and Structural Transformation

Efficiency gains are often realized through the reallocation of resources from low-productivity sectors to high-productivity sectors. This dimensional drive focuses on the fluidity of production factors—capital, labor, and data—across industries. By optimizing the industrial structure and leveraging comparative advantages,

Evaluation of the Development Capacity of New Quality Productive Forces in Tourism within Complex Environments

The development of "new quality productive forces" in the tourism industry represents a critical shift toward high-tech, high-efficiency, and high-quality growth models. In increasingly complex global and domestic environments, evaluating the capacity to develop these forces requires a multidimensional approach that integrates technological innovation, environmental sustainability, and institutional optimization.

1. Theoretical Framework and Core Dimensions

The capacity to develop new quality productive forces in tourism is not merely an extension of traditional productivity but a qualitative leap driven by disruptive technological innovations. This capacity can be assessed through several core dimensions:

- **Technological Innovation and Digital Transformation:** This involves the integration of deep learning, big data, and artificial intelligence into tourism services. The ability to utilize these technologies to enhance personalized experiences and operational efficiency is a primary indicator of development capacity.
- **Green Development and Sustainability:** New quality productive forces are inherently "green." Evaluating this capacity requires measuring the industry' s transition toward low-carbon operations and the preservation of ecological capital as a productive factor.
- **Factor Allocation Efficiency:** This refers to the optimization of traditional labor, land, and capital through the introduction of "data" as a new factor of production. The synergy between high-tech tools and high-quality human capital determines the overall productivity level.

2. Methodological Approach to Evaluation

To accurately measure development capacity in complex environments, a hybrid evaluation model is necessary. This model typically incorporates both quantitative indicators and qualitative assessments of institutional environments.

The evaluation process often utilizes machine learning algorithms to process high-dimensional data, allowing for the identification of non-linear relationships between investment in R&D and actual productivity gains. As shown in (eq:productivity_{model}), the relationship between technological input and output quality can be modeled as:

$$\text{Capacity} = \int_{t_0}^{t_1} \mathcal{F}(I_{tech}, E_{env}, S_{sys}) dt$$

where I_{tech} represents technological investment, E_{env} denotes environmental constraints, and S_{sys} signifies systemic support.

3. Challenges in Complex Environments

The "complexity" of the current environment stems from volatile market demands, geopolitical shifts, and the rapid pace of technological obsolescence. Developing new quality productive forces requires a resilient infrastructure that can withstand these external shocks.

[

Introduction

High technology serves as a primary engine for innovation. Driven by cutting-edge fields such as artificial intelligence and big data, the current technological landscape is undergoing rapid transformation. These advancements are not merely incremental; they represent a fundamental shift in how research is conducted and how complex problems are solved across various scientific disciplines. By leveraging machine learning and deep learning architectures, researchers can now process vast datasets with unprecedented efficiency, uncovering patterns that were previously inaccessible through traditional analytical methods.

coordinated linkage and deep integration with other industries. (2) Digital infrastructure

The deep application of cutting-edge technologies is driving the intelligent and digital transformation of the tourism industry.

Introduction

The development of digital infrastructure, represented by the Internet, plays a critical role in supporting the tourism industry. By leveraging these techno-

logical advancements, destinations can enhance their service delivery, improve operational efficiency, and foster more sustainable growth patterns in an increasingly connected global economy.

···providing the underlying technical support and core driving force for a leap in overall productivity.

The tourism industry breaks traditional industrial boundaries and optimizes regional spatial layouts [**?**], providing a high-level foundation for integrated development. By fostering cross-sector collaboration, it enables the reconfiguration of resources and enhances the overall efficiency of regional economic structures.

innovation momentum. (2) High performance serves as the cornerstone of efficiency. By optimizing tourism

efficiency provides the underlying support. (3) The improvement of production efficiency is manifested as follows:

From a dynamic perspective, we propose a theoretical framework for the new quality productive forces in tourism [Figure 1: see original paper], characterized by the following:

The core driving force is the "three-fold qualitative leap" of productive factors. This involves the transformation of labor into a "high-quality" workforce, the evolution of labor subjects into "high-tech" tools, and the expansion of labor objects into "high-value" domains. These elements serve as the fundamental components of the new quality productive forces.

The core engine is the "dual-wheel drive" of technological innovation and institutional reform. This mechanism facilitates the deep integration of cutting-edge technologies with the tourism industry while optimizing the institutional environment to ensure the efficient allocation of resources.

The core manifestation is the "three-dimensional enhancement" of industrial value. This is achieved through the digitalization of traditional tourism formats, the creation of intelligent new service models, and the greening of the entire industrial chain, ultimately leading to a comprehensive upgrade of industrial quality and efficiency.

[3,6]

(1) Industrial structure optimization refers to the continuous improvement of the coordination and quality of various segments within the tourism industry. This process involves the rational allocation of resources among different sub-sectors—such as transportation, accommodation, catering, sightseeing, shopping, and entertainment—to ensure they function as a cohesive and efficient system. By optimizing the industrial structure, the tourism sector can transition from a traditional, labor-intensive model toward a high-value, service-oriented, and technology-driven framework, ultimately enhancing the overall competitiveness and sustainable development of the regional economy.

Spatiotemporal Evolution Characteristics and Driving Factors of New Quality Productive Forces in China' s Tourism Industry

Abstract

As a core engine for promoting high-quality development in the new era, the "New Quality Productive Forces" (NQPF) represent a critical path for the transformation and upgrading of the tourism industry. This study constructs a comprehensive evaluation index system for the NQPF in tourism across three dimensions: new labor subjects, new labor objects, and new labor tools. Utilizing panel data from 30 provinces in China from 2011 to 2022, we employ the entropy weight method, kernel density estimation, and the spatial Durbin model to analyze the spatiotemporal evolution characteristics and driving mechanisms of tourism NQPF. The results indicate that: (1) The development level of tourism NQPF in China exhibits a steady upward trend, characterized by a spatial distribution pattern of "high in the east and low in the west." (2) Significant spatial correlation exists, with high-value clusters primarily concentrated in the Yangtze River Delta and the Pearl River Delta regions. (3) Economic development level, industrial structure optimization, and government support are significant positive drivers of tourism NQPF, while environmental regulation exhibits a non-linear impact. These findings provide theoretical support and policy references for accelerating the cultivation of NQPF in the tourism sector and achieving balanced regional development.

1. Introduction

In the context of the global digital revolution and the pursuit of high-quality economic growth, the concept of "New Quality Productive Forces" has emerged as a pivotal theoretical framework in China. Unlike traditional productive forces that rely on extensive resource consumption, NQPF are driven by technological innovation, data as a key factor of production, and the green transition. As a strategic pillar of the national economy, the tourism industry is undergoing a profound structural shift. The integration of artificial intelligence, big data, and the Internet of Things (IoT) into tourism services has redefined the traditional boundaries of the industry, necessitating a systematic investigation into how NQPF manifest and evolve within this sector.

Existing research has primarily focused on tourism efficiency, digital tourism, and sustainable development. However, a comprehensive analysis of the NQPF specifically tailored to the tourism industry remains nascent. This paper aims to bridge this gap by quantifying the development level of tourism NQPF and exploring its spatial dynamics and underlying determinants.

2. Theoretical Framework and Methodology

2.1 Conceptual Framework

The N

significant improvement in the total factor productivity of the tourism industry [**?**]. By optimizing the allocation of factors of production, the industry can achieve higher efficiency and sustainable growth.

Chinese-style modernization is a modernization characterized by the harmony between humanity and nature [**?**]. Tou

By optimizing factor configurations and innovative management models, the tourism industry can effectively reduce costs and enhance efficiency, thereby fostering the development of new quality productive forces in tourism.

The development of new quality productive forces should integrate concepts such as green development and sustainability, incorporating ecological civilization into the core framework of modern economic growth. This integration requires a fundamental shift from traditional, resource-intensive production models toward a high-tech, high-efficiency, and high-quality paradigm that respects environmental boundaries. By prioritizing green innovation, industries can achieve a synergistic effect where technological advancement and ecological preservation reinforce one another.

Furthermore, the transition toward sustainable productive forces necessitates the optimization of industrial structures and the promotion of circular economy principles. This involves not only the adoption of clean energy and carbon-neutral technologies but also the cultivation of an institutional environment that incentivizes green entrepreneurship. Ultimately, embedding sustainability into the evolution of productive forces ensures long-term economic resilience and fosters a harmonious relationship between human industrial activity and the natural environment.

productivity provides sustainable kinetic energy. Therefore, this dimension will be analyzed from the perspective of industrial structure.

Environmental protection has been placed at a core strategic position. Against this backdrop, the tourism industry has adopted···

We measure this using three dimensions: organizational structure, digital foundations, and production efficiency.

Green technology aims to reduce pollution and resource consumption while increasing investment and focus throughout the development and operational phases.

[18-19]

High-Quality Tourism Development

New quality productive forces in tourism aim to achieve higher quality development within the industry. By integrating advanced technological innovations with sustainable management practices, these forces drive the transformation of traditional tourism models into more efficient, intelligence-driven, and value-added experiences. This evolution is characterized by a shift from quantity-based growth to a focus on the quality of the visitor experience and the optimization of resource allocation.

The development of quality in this sector finds its core competitiveness rooted in the quality of the tourist experience.

Tourist satisfaction is the fundamental objective of the tourism industry. Currently, there is a significant imbalance between the supply of tourism services and the quality of the visitor experience.

Environmental governance efforts can facilitate a win-win scenario for both the tourism economy and ecological benefits. Consequently, this dimension is measured across three specific aspects: environmental pollution, environmental protection, and environmental governance [**?**].

Imbalance is a critical factor constraining the development of new quality productive forces in tourism. High-quality development requires a strategic shift toward optimizing the structural distribution and efficiency of these emerging productive forces.

1.4 研究方法

Tourism supply and the reserve of professional talent constitute the fundamental pillars of its robust development.

1.4.1 综合评价法复杂信息下的指标客观权重计

Tourist satisfaction is the key to achieving a higher level of development in the tourism industry. In the context of individual tourists, satisfaction serves as a critical indicator of service quality and the overall travel experience. As the industry shifts toward high-quality development, understanding the multifaceted drivers of satisfaction has become essential for destination management and marketing strategies.

The CRITIC (Criteria Importance Through Inter-Criteria Correlation) method is an objective weighting technique that comprehensively considers both the contrast intensity of indicators and the conflict between them. Unlike subjective weighting methods, CRITIC determines weights based on the inherent characteristics of the data, thereby eliminating the influence of human bias and ensuring the scientific rigor and objectivity of the evaluation results.

The core logic of the CRITIC method involves two dimensions: first, the standard deviation is used to represent the contrast intensity of an indicator—a larger standard deviation indicates greater volatility and a higher volume of information provided by that indicator. Second, the correlation coefficient is used to represent the conflict between indicators; a stronger positive correlation implies lower conflict, meaning the indicator provides more redundant information and should therefore be assigned a lower weight. By integrating these two dimensions, the CRITIC method effectively captures the objective importance of each evaluation criterion within a complex multi-dimensional system.

In the context of increasing personalized demands, promoting the high-quality development of all links within the tourism industry chain has become a critical objective. As consumer preferences shift toward more customized and diverse experiences, the traditional standardized tourism model is no longer sufficient to meet market expectations. Consequently, stakeholders across the industry —including travel agencies, transportation providers, accommodation services, and destination management organizations—must leverage technological innovations and data-driven strategies to enhance service efficiency and value creation. This transformation is essential for fostering a more resilient and competitive tourism ecosystem that can adapt to the evolving needs of modern travelers.

···considers the advantages of contrast intensity and conflict between various indicators [**?**]. The entropy weight method···

the collaborative improvement of quality and the professionalization and efficiency of the tourism service system.

further introduces considerations regarding the dispersion of indicators, thereby enhancing the objectivity and scientific rigor of the weight allocation process. By incorporating measures of variability, the model can more accurately reflect the relative importance of different parameters within the evaluation framework. This approach ensures that indicators with higher information entropy or greater variance are appropriately prioritized, leading to more robust and reliable analytical outcomes in the context of the overall assessment.

The quality of supply is a fundamental cornerstone for achieving high-quality development. Consequently, this dimension evaluates the system from the perspective of supply quality, focusing on the efficiency of resource allocation and the technical sophistication of the production process. By analyzing these factors, we can better understand how supply-side structural reforms contribute to long-term economic stability and industrial upgrading.

The objectivity and reliability of the weights are paramount. Therefore, this study adopts the CRITIC (Criteria Importance Through Intercriteria Correlation) method to determine the objective weights of the indicators. This approach accounts for both the contrast intensity of each indicator and the conflict between them, ensuring a comprehensive and unbiased evaluation.

···measured across three dimensions: talent quality and the quality of the visitor

experience.

Determination of the Development Level of New Quality Productive Forces in Tourism Using the Entropy Weight Method and Combined Weighting Method

1. Introduction

The evaluation of the development level of new quality productive forces in tourism requires a rigorous and objective weighting methodology to ensure the accuracy of the assessment. To minimize the subjectivity inherent in qualitative assessments and the potential information loss in purely quantitative methods, this study employs a combined weighting approach centered on the Entropy Weight Method (EWM). This methodology allows for a comprehensive analysis of the indicators that constitute the framework of new quality productive forces in the tourism sector.

2. Methodology

2.1 The Entropy Weight Method (EWM) The Entropy Weight Method is an objective weighting technique that determines the importance of indicators based on the degree of variation in their values. In information theory, entropy is a measure of uncertainty; the smaller the entropy, the greater the information provided by the indicator, and consequently, the higher its weight in the comprehensive evaluation.

The calculation process involves the following steps:

1. **Data Normalization**: To eliminate the influence of different units and scales, the raw data is normalized. For positive indicators, the formula is:

$$x'_{ij} = \frac{x_{ij} - \min(x_j)}{\max(x_j) - \min(x_j)}$$

   For negative indicators, the formula is:

$$x'_{ij} = \frac{\max(x_j) - x_{ij}}{\max(x_j) - \min(x_j)}$$

   where x_{ij} represents the value of the j-th indicator for the i-th observation.

2. **Calculation of Information Entropy**: The entropy e_j for each indicator is calculated as:

$$e_j = -k \sum_{i=1}^{n} p_{ij} \ln(p_{ij})$$

   where $p_{ij} = \frac{x'_{ij}}{\sum_{i=1}^{n} x'_{ij}}$ and $k = \frac{1}{\ln(n)}$.

3. **Determination of Weights**: The weight w_j for each indicator is derived from the redundancy $d_j = 1 - e_j$:

$$w_j = \frac{d_j}{\sum_{j=1}^{m} d_j}$$

Tourism Greening

Green development serves as the foundational color of high-quality development. In the context of the tourism industry, "greening" represents a fundamental shift toward sustainability, emphasizing the harmony between economic growth and environmental preservation. This transition is not merely an environmental imperative but a core component of advancing the industry toward a more resilient and value-driven future.

In light of the weightings assigned to each indicator, we have established a comprehensive evaluation framework. By standardizing these indicators, we ensure that the various metrics are comparable across different scales and units. This methodological approach allows for a rigorous quantitative analysis of the overall performance levels, facilitating a more objective assessment of the subject under study.

1 Measurement indicators for the development level of tourism new quality productivity

High-tech Tourism

Tourism R&D Expenditure

Total social R&D expenditure × (Tourism output / GDP)

Tourism Labor Productivity

Total tourism revenue / Number of direct tourism employees

Number of Tourism R&D Personnel

Tourism High-Efficiency

Total tourism revenue / Fixed asset investment in tourism

Number of Tourism Patent Grants

Total number of patent grants × (Tourism output / GDP)

Tourism Industrial Structure Rationalization Index

Tertiary industry output / Secondary industry output

Length of Optical Fiber Cable Lines

Total length of laid optical fiber cables

Number of Broadband Internet Access Ports

Internet Penetration Rate

Mobile Phone Penetration Rate

Telephone Penetration Rate

Tourism Total Factor Productivity (TFP)

Total Factor Productivity Index

Travel Agency Supply

Number of Travel Agencies

Tourist Attraction Supply

Number of High-Level Tourist Attractions

Number of Four-star and Five-star Hotels

Sum of Four-star and Five-star Hotels

Railway Network Density + Highway Network Density

Talent Cultivation Institutions

Number of Tourism Vocational Schools and Colleges

Tourism Greening (Environmental Sustainability)

Tourism Capital Productivity

Tourism Industrial Structure Upgrading Index

High-Quality Tourism

Number of R&D personnel × (Tourism output / GDP)

Scale of Talent Cultivation

Number of Enrolled Students in Tourism Schools and Colleges

Tourist Satisfaction

Online Attention (Baidu Index)

Tourism Industry Exhaust Gas Emissions

Product of total exhaust gas emissions and the proportion of tourism revenue to GDP

Tourism Industry Wastewater Discharge; Tourism Industry Solid Waste Discharge

Per Capita Area of Park Green Space

Product of wastewater discharge and the proportion of tourism revenue to GDP; Product of solid waste discharge and the proportion of tourism revenue to GDP; Per capita park green space area

Green Coverage Rate of Built-up Areas

Percentage of green coverage area within built-up areas

Decontamination Rate of Municipal Household Waste

Capacity for harmless treatment of household waste

Sewage Treatment Rate

Sewage treatment capacity

Environmental Protection Investment Rate

Proportion of environmental protection investment in regional GDP

The symbols "+" and "-" represent positive and negative indicators, respectively. In this study, tourism resource endowment, the number of travel agencies, the number of guest rooms, and fixed asset investment in tourism are used as input variables. Total tourist arrivals and total tourism revenue are used as output variables. Tourism Total Factor Productivity (TFP) is calculated using MaxDEA software.

The standardized values are multiplied by their respective weights and then summed to obtain the New Quality Productive Forces development index for each province (autonomous region or municipality).

1.4.2 Dagum 基尼系数 Dagum 基尼系数具有良好

Due to its decomposability [**?**], the Dagum Gini coefficient can effectively address the issue of cross-overlap between sample data, offering a distinct advantage over traditional measures such as the coefficient of variation and the Theil index. Consequently, this study employs the Dagum Gini coefficient method to analyze the spatial disparities in the development of new quality productive forces in tourism across China.

Specifically, this analysis focuses on the developmental differences among the eastern, central, western, and northeastern regions of China. The value of the Dagum Gini coefficient ranges from [0, 1], where a smaller value indicates a higher degree of equity and more balanced development.

1.4.3 动态定性比较分析（QCA）与传统 QCA 相

Compared to other approaches, the core advantage of this method lies in its incorporation of the temporal dimension, which allows for the analysis of dynamic correlations between variables and the identification of time-series evolution patterns [**?**].

Given the dynamic and continuous nature of the development of new quality productive forces in tourism, dynamic QCA can effectively···

2 Temporal evolution of tourism new