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SPATIOTEMPORAL EVOLUTION CHARACTERISTICS AND INFLUENCING FACTORS OF NEW QUALITY PRODUCTIVITY DEVELOPMENT IN CHINA'S ICE AND SNOW ECONOMY

Abstract : *With rapid economic development and the continuous improvement of residents' living standards, ice and snow tourism, winter sports and related industries have gained increasing public attention, driving the rapid expansion of the ice and snow economy. This paper investigates the spatiotemporal development and driving factors of new quality productivity in China's ice and snow economy. The findings show that: (1) The overall development of China's ice and snow economy has maintained a steady growth momentum; (2) Intra-regional difference constitutes the primary source of the overall disparity in the development of new quality productivity within the ice and snow economy; (3) Natural resource endowment, public transport accessibility represented by bus quantity, and the urbanization process are core positive driving factors. Regional heterogeneity exists to a certain extent, while the development trends of most regions are generally consistent with the national pattern.*

Key words: *New Quality Productivity ; Ice and Snow Economy; Influencing Factors.*

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ПРОСТРАНСТВЕННО-ВРЕМЕННЫЕ ЭВОЛЮЦИОННЫЕ ОСОБЕННОСТИ И ФАКТОРЫ ВЛИЯНИЯ РАЗВИТИЯ НОВОЙ КАЧЕСТВЕННОЙ ПРОИЗВОДИТЕЛЬНОЙ СИЛЫ В ЛЕДЯНО-СНЕЖНОЙ ЭКОНОМИКЕ КИТАЯ

Аннотация: *Благодаря стремительному экономическому развитию и повышению качества жизни населения ледяно-снежный туризм, зимние виды спорта и смежные отрасли постепенно привлекают широкое общественное внимание, способствуя динамичному росту ледяно-снежной экономики. В статье анализируются особенности развития новой качественной производительной силы в ледяно-снежной экономике Китая. Полученные результаты показывают, что: (1) развитие ледяно-снежной экономики Китая носит устойчивый поступательный характер; (2) внутрирегиональные различия являются основным источником общей дифференциации уровня развития новой качественной производительной силы в ледяно-снежной экономике; (3) природные ресурсы, количество автобусного транспорта и темпы урбанизации выступают ключевыми положительными факторами влияния на данное развитие. Тенденции развития отдельных регионов в целом соответствуют общенациональным тенденциям, при этом наблюдаются определенные региональные особенности.*

Ключевые слова: *новая качественная производительная сила; ледяно-снежная экономика; факторы влияния*

1 Introduction

Since China successfully won the bid to host the 2022 Winter Olympics in 2015, the government has provided strong policy support for the development of new productivity in the ice and snow economy. Several policies have been

introduced, such as *the Development Plan for Ice and Snow Sports (2016-2025) and the National Plan for Ice and Snow Facilities Construction (2016-2022)*. In the "post-Winter Olympics era," ice and snow tourism, winter sports, and ice and snow manufacturing have achieved rapid growth, driving the development of new productivity in the ice and snow economy. With rising living standards and the popularization of the Winter Olympics, public interest in ice and snow tourism and sports has steadily increased, leading to growing demand for related tourism and sports equipment. However, the development of the ice and snow economy still faces regional imbalances. While the Beijing Winter Olympics has brought a golden opportunity for rapid growth, the development of new productivity in the ice and snow economy also faces numerous challenges in the post-Olympics period. Therefore, studying the factors influencing new productivity in China's ice and snow economy is essential to seizing these historic opportunities in the post-Winter Olympics era.

Academic research on the development of new productivity in the ice and snow economy has yielded substantial results, primarily focusing on three areas:①Construction of an indicator system for new productivity development. Scholars have built a composite indicator system for new productivity in the ice and snow economy, based on three dimensions: new-type laborers, new-type labor resources, and new-type labor objects[1–3]. Methodologically, researchers have employed literature review[4], logical analysis[5], and the entropy-weight TOPSIS method[6] to analyze the current state of new productivity in China's ice and snow economy. The entropy-weight TOPSIS method, in particular, provides an objective measurement of the productivity development level.②Analysis of the spatial-temporal evolution patterns. Researchers are examining regional differences, industrial structures, and development status within the ice and snow economy in China. ③Study of the driving factors influencing new productivity. Current studies predominantly use regression analysis, panel data models, and other econometric methods to investigate how economic development levels, household income, ice

and snow tourism, and other factors impact the development of new productivity in the ice and snow economy.

In summary, while research on the development of new productivity in the ice and snow economy has a theoretical foundation, studies on the factors influencing its development in China remain at an early stage. Building on previous theoretical foundations, this study first constructs an indicator system for assessing new productivity in China's ice and snow economy. It then employs the entropy-weight TOPSIS method to measure productivity development levels, and introduces the Theil index and its decomposition to explore regional disparities. Innovatively, this study applies a panel Tobit regression model to analyze the factors influencing the development of new productivity in China's ice and snow economy.

2 Research methods

2.1 Construction of Evaluation Index System for the Development of New Productivity of China's Ice and Snow Economy

Guided by the concept of new development, this study constructs an evaluation indicator system by referencing previous research on the development of the ice and snow economy and incorporating the connotations of new productivity development. Ultimately, the system is structured around three dimensions: new-type laborers, new-type labor resources, and new-type labor objects, resulting in an evaluation system for the development of new productivity in China's ice and snow economy with 14 secondary indicators.

Tab.1

Evaluation index system for New Quality Productivity development of China's ice and snow economy

Indicator Layer	System Layer	Direction
New Quality Laborers	The number of ski resorts	+
	The number of travel agencies	+

	Ice and snow manufacturing enterprises	+
	Employees in ice and snow tourism industry	+
	The number of star rated hotels	+
New Quality Means of Labor	Science and technology expenditure	+
	The proportion of the tertiary industry to GDP	+
	The actual amount of foreign investment used	+
	The actual urban road area at the end of the year	+
	The number of foreign-invested enterprises in large-scale industrial enterprises	+
New Quality Objects of Labor	Harmless treatment rate of household waste	+
	Industrial sulfur dioxide emissions	-
	Centralized treatment rate of sewage plants	+
	Industrial smoke and dust emissions	-

2.2 Tobit regression model

This study employs the Tobit model and uses panel data from 30 Chinese provinces spanning 2015 to 2021 to analyze the driving factors in the development of new productivity within China's ice and snow economy. A Tobit regression model is established to examine these driving factors, with the final regression results calculated using Stata 17.0 software. The specific formula for the Tobit regression model is as follows:

$$y_i^* = \sum_1^j \beta_j x_{ij} + \beta_0 + \mu_i \quad (1)$$

In the formula, y^*_i represents the dependent variable, which is the entropy-weighted TOPSIS composite score for new productivity development in the ice and snow economy. x_{ij} represents the independent variables, j is the number of influencing factors, β_j denotes the coefficients of the independent variables, β_0 is the constant term, and μ_i represents the random error term.

3 Conclusion and Analysis

3.1Time Series Analysis

It is evident that: From 2015 to 2021, the development of the ice and snow economy across provinces has shown significant differentiation. Some provinces, such as Heilongjiang, Guangdong, and Jiangsu, have consistently maintained high levels of development with higher average scores, indicating strong momentum in the ice and snow economy. In contrast, other provinces, such as Qinghai, Ningxia, and Guizhou, have remained at lower levels, showing relatively slower development. For most provinces, the ice and snow economy index exhibited an upward trend before 2019, likely due to increased public attention to ice and snow tourism and sports. However, from 2019 to 2021, some provinces experienced a decline, possibly due to the impact of the COVID-19 pandemic, particularly on the tourism sector.

3.2 Spatial Sequence Analysis

Heilongjiang in the Northeast region ranks first due to its abundant ice and snow resources and stable development. While Liaoning and Jilin also maintain a certain level of ice and snow economic activity, they significantly lag behind Heilongjiang and show a gradual decline, with Liaoning's score dropping from 0.25723 in 2015 to 0.19859 in 2021, potentially due to resource depletion or changes in industrial priorities. In the East region, Jiangsu ranks second with strong and sustained growth, followed by Shandong, Zhejiang, and Shanghai, which also show active ice and snow economic development, reflecting the region's solid foundation. Guangdong in the South region performs exceptionally well, ranking third, highlighting its strong market demand and consumption capacity. However, Guangdong's ice and snow economic development significantly outpaces that of

Guangxi and Hainan, indicating considerable internal disparities. Hebei in the North region ranks sixth, showcasing its potential for ice and snow economic growth. In contrast, the Southwest and Northwest regions lag behind, with most provinces ranked lower, likely due to differences in resource availability and economic foundations. Overall, significant regional disparities exist in China's ice and snow economic development, with economically advanced and resource-rich provinces performing better, while resource-constrained regions face challenges. Enhancing regional cooperation and optimizing resource allocation will be crucial for achieving balanced and high-quality development of the ice and snow economy.

3.3 Analysis of Driving Factors

3.3.1 Influencing Factors Setting

This study utilizes the entropy-weight TOPSIS method to calculate the comprehensive development level of China's ice and snow economy from 2015 to 2021, with scores ranging between [0,1]. The calculated comprehensive score of new productivity development in the ice and snow economy is used as the dependent variable y. Key explanatory variables include research and development investment, natural resources, transportation conditions, economic level, and urbanization progress. To make these abstract variables measurable, specific indicators are selected: scientific and technological expenditure for research investment, the number of ski resorts for natural resources, the number of buses per capita and traffic density for transportation conditions, per capita income and per capita GDP for economic level, and urbanization rate and urban population size for urbanization progress.

3.3.2 Regression Results Analysis

The number of buses per capita, and urbanization progress have a significant positive impact on the development of new productivity in the ice and snow economy at the national level, while per capita income has a significant negative effect. Regionally, in the Northeast, natural resources and urbanization levels positively influence new productivity development, with regression coefficients of

0.00345 and 0.0795, both significant at the 1% level. The Northeast's abundant ice and snow resources and high urbanization levels substantially contribute to the growth of ice and snow tourism, sports, and manufacturing. However, traffic density and per capita GDP are not significant factors, indicating their limited impact on the region’s productivity development. Negative coefficients for per capita income and urban population size, significant at the 1% and 5% levels, suggest these factors hinder development. Research investment and the number of buses per capita also have negative coefficients but are not significant. In the East region, research investment and per capita GDP significantly drive new productivity development, both significant at the 5% level. This is likely due to the region's advanced research capabilities, high investment in ice and snow industries, and strong economic foundations, which collectively enhance productivity. However, natural resources, the number of buses per capita, and urban population size do not significantly influence productivity in this region. To further promote the development of the ice and snow economy, the East region should focus on increasing investment in ice and snow resources, improving public transportation, and accelerating urbanization.

4 Conclusion

Based on panel data from 30 Chinese provinces between 2015 and 2021, the main conclusions are as follows:

(1) From 2015 to 2021, China’s ice and snow economy showed steady overall growth, though significant disparities remain among provinces. Heilongjiang leads significantly, while provinces such as Qinghai, Gansu, Ningxia, Shanxi, Guizhou, and Guangxi exhibit lower levels of development. (2) During this period, the overall disparities in the development of new productivity in the ice and snow economy have gradually narrowed, but intraregional differences vary. The South region exhibits the largest internal disparities, while the Central region has the smallest. (3) Natural resources, the number of buses per capita, and urbanization progress have significant positive impacts on the development of new productivity in the ice and

snow economy nationwide, whereas per capita income shows a significant negative effect.

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