

## Enhancing Tourism Economic Growth through Provincial Tourism Innovation: An Empirical Study Based on Patent Authorisations Across 30 Chinese Provinces (2010–2022)

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### Abstract

Based on panel data from 30 provinces in China from 2012 to 2022, this study quantifies the level of tourism innovation in each province using the number of patent authorisations. It then empirically analyses the mechanisms by which tourism innovation promotes tourism economic growth and its regional heterogeneity. The study finds that tourism innovation has a significant positive impact on tourism economic growth, and that economic development positively moderates this relationship. The impact of tourism industry structure on economic growth varies across regions: the eastern region has the most significant impact, followed by the central region, and the western region is relatively weak. Furthermore, the tourism industry's efficiency partially mediates the relationship between innovation and economic growth. Based on these findings, this paper proposes policy recommendations, including strengthening investment in tourism innovation, implementing differentiated regional policies, optimising industrial structure, improving tourism infrastructure, and establishing a monitoring mechanism, to promote high-quality development of the regional tourism economy and enhance regional sustainable development resilience.

**Keywords:** Tourism innovation level; tourism patent authorization; tourism economic growth; regional differences; tourism industry structure

## Introduction

Tourism is vital for improving the quality of life for both residents and visitors (Uysal et al., 2016). The quality of its development greatly influences public satisfaction and happiness, often overshadowing other sectors. In the mass tourism era, the industry encounters numerous opportunities alongside unprecedented challenges: dependence on expansionist models has resulted in inefficient resource use, product standardisation, regional disparities, environmental harm, diminished global competitiveness, and supply-demand mismatches. These challenges are prevalent worldwide, and an approach focused solely on "economic profits" has intensified the "overtourism" issue (Oklevik et al., 2019). Recent studies also emphasise the significant role of the digital economy in promoting tourism economic growth, highlighting that digital infrastructure and digital inclusive finance significantly drive regional tourism innovation and economic development (Yanlong et al., 2022).

New growth theory emphasises that specific knowledge and specialised human capital drive economic growth by generating increasing returns on investment and improving overall economic efficiency. In modern society, knowledge and technological advancement have become the main drivers of economic growth, replacing traditional capital accumulation. This study explores the relationship between tourism innovation and tourism economic growth in China by incorporating spatial factors. It uses spatial econometric techniques to analyse spatial autocorrelation in provincial tourism data and develops a spatial panel regression model to assess the spatial patterns of residuals, providing insights for tourism development and policy.

## Objectives

This study aims to achieve four key objectives:

1. Assess the impact of tourism innovation on economic growth. This involves evaluating the positive correlation between innovation in tourism, using patent authorisation data as a measure, and the overall economic growth of a region.
2. Examine how economic development levels moderate this relationship. The research will analyse whether the level of economic development in various provinces changes the connection between tourism innovation and economic growth.
3. Analyse regional differences in the tourism industry's structure. The study will investigate how the varying structures of the tourism industry in China's eastern, central, and western regions influence the innovation-growth relationship.

4. Explore the mediating role of tourism industry efficiency. This objective focuses on determining whether tourism industry efficiency acts as a mediator, helping to explain how Innovation positively affects economic growth by improving resource allocation and infrastructure utilisation.

### Literature Review and Hypotheses

Research into tourism innovation and its impact on economic growth reveals a positive and nuanced relationship. Meng (2023) further explored this by identifying a threshold effect of digital finance, suggesting that tourism innovation's ability to boost regional growth is tied to improvements in efficiency and structure. Additionally, Kai et al. (2023) examined China's provincial data from 2004 to 2018, observing a fluctuating upward trend in both tourism innovation and high-quality development, with significant spatial disparities following a "East > Central > Northeast > West" pattern. These studies collectively inform the basis for Hypothesis H1, which is proposed for empirical testing.

**H1: There is a positive correlation between provincial tourism innovation level and tourism economic growth.**

**H2: The level of economic development plays a moderating role in the relationship between provincial tourism innovation level and tourism economic growth.**

Several studies have examined the factors influencing tourism development and its relationship with national economies. Runze (2012) analysed Chinese provincial data, finding that regional economic development and a tourism economy's imbalance promote growth, while the importance of tourism infrastructure varies regionally—being crucial in western China but less so in eastern and central areas. In a similar vein, Morozova et al. (2016) studied Russian regions, concluding that tailored regional tourism policies are necessary, as the drivers of efficiency differ: high-efficiency regions depend on investment and innovation, medium-efficiency regions on transportation and public finance, and low-efficiency regions on basic infrastructure development. Additionally, Bazhenova et al. (2023) focused on tourism's role during crises, noting a strong link between tourism and national economic levels and highlighting the importance of innovative crisis response mechanisms. These collective findings serve as the foundation for Hypothesis H3, proposed for empirical testing.

**H3: The impact of tourism industry structure on tourism economic growth is significantly different in different provinces.**

Recent empirical research has increasingly focused on green innovation efficiency and the role of technological innovation in the tourism industry as critical drivers of high-quality tourism development. For example, Yujing and Jianxiong (2022) analyse the spatiotemporal differentiation and formation mechanisms of green innovation efficiency in China's coastal areas under carbon emission constraints, highlighting the importance of sustainable innovation. Additionally, Kai et al. (2023) demonstrate that the level of technological innovation is closely interlinked with high-quality tourism development and significantly influences regional tourism economic performance. These findings provide strong support for our hypothesis that technological innovation levels positively affect tourism economic growth.

Several studies have examined the dynamics of China's tourism economy, highlighting key drivers and impacts. Bing (2011) found that tourism growth is primarily capital-driven, with other positive factors including price levels, environmental quality, and technological progress. However, this growth may negatively impact manufacturing by reducing the demand for human capital and education. Yumei and Yanqing. (2011) showed that the tourism economy positively influences urban green development and has significant positive spatial spillover effects, suggesting that strengthening regional tourism connections and fostering innovation are important. Similarly, Hongxiong and Guang (2023) analysed tourism efficiency across provinces, noting that eastern regions are more efficient than western ones and advocating for a coordinated approach to support sustainable growth. Xinye and Ranran (2024) explored the resilience and efficiency of the tourism economy, observing a decreasing spatial distribution of development levels across regions. Finally, Yanlong (2025) used data from 59 key tourist cities from 2006 to 2019 and employed the difference-in-differences method to demonstrate that information infrastructure ("Broadband China") can promote tourism economic development through urban innovation and industrial upgrading, and has spatial spillover effects.

**H4: Tourism industry efficiency plays a mediating role in the relationship between provincial tourism innovation level and tourism economic growth.**

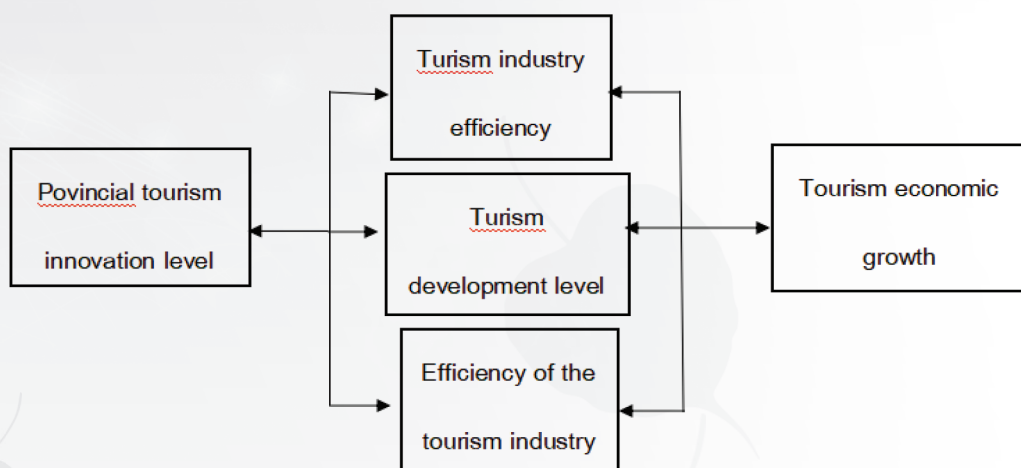


Figure 1 The Impact Mechanism of Provincial Tourism Innovation Level on Tourism Economic Growth

## Research Model Design

### Sample Selection and Explanation

**Sample Selection and Explanation** This study selects panel data from 30 provinces (including autonomous regions and municipalities directly under the central government) in China from 2010 to 2022 to examine the impact of digital technology on tourism economic growth and the mediating effect of tourism industry efficiency in this process. This time period was chosen because it represents a critical stage of rapid development in digital technology in China, as well as because data from this period is more comprehensive and reliable in terms of statistical completeness and disclosure. Relevant data primarily comes from authoritative sources such as the National Bureau of Statistics and various provincial statistical bureaus (Raun et al., 2025).

To better analyse regional differences, the sample provinces are divided into three regions based on their geographical and economic characteristics:

Eastern Provinces: Shanghai, Beijing, Tianjin, Jiangsu, Zhejiang, Fujian, Guangdong, Shandong, Hainan;

Central Provinces: Hebei, Henan, Hubei, Hunan, Jiangxi;

Western Provinces: Inner Mongolia, Guangxi, Gansu, Sichuan, Chongqing, Yunnan, Shaanxi, Ningxia, Xinjiang, Liaoning, Heilongjiang, Qinghai, Guizhou.

This classification helps to explore the distinct characteristics of tourism innovation and economic growth across regions, providing a basis for differentiated policy recommendations.

Method: By collecting tourism patent authorisation (TIP) data, which represents the level of tourism innovation, and combining it with tourism industry efficiency indicators, we use a spatial panel data model to analyse its impact on tourism economic growth.

#### **Variable Selection:**

1. Dependent Variable: Tourism Economic Growth (TGI): Measured by the proportion of tourism industry output to regional GDP, reflecting the contribution and growth level of the tourism industry to the regional economy.

2. Core Explanatory Variable: Provincial Tourism Patent Grants (TIP): As a quantitative indicator of tourism innovation level, data is sourced from the State Intellectual Property Office patent database, determined through keyword search for "tourism" and geographic attribution matching, accurately reflecting regional tourism technology innovation activities and potential.

3. Mediating Variable: Tourism Industry Efficiency (TIE): Measures the efficiency of a unit of tourism service infrastructure, calculated as "tourism revenue/ fixed assets of accommodation and catering industries above a certain limit," reflecting the capital efficiency and service capacity of tourism infrastructure, and mediating the impact of innovation on economic growth.

4. Control variables: Economic development level (PGDP): using GDP per capita as an indicator, reflecting the region's economic strength and residents' consumption capacity; Tourism infrastructure construction (TID): reflecting the degree of perfection of tourism infrastructure, affecting the quality of tourism services and tourist experience; Tourism industry structure (TIS): encompassing the diversity of tourism service facilities, products and services, reflecting the level of tourism market organization and development; Tourism service efficiency (TRF): calculated as the ratio of tourist numbers to fixed assets in the accommodation and catering industries, reflecting the utilization rate of service facilities and capital efficiency.

#### **Design of the Research Model**

Based on the previously stated hypotheses and the selected variables, this study aims to verify Hypothesis 1, Hypothesis 2, Hypothesis 3, and Hypothesis 4. Therefore, the following four models will be constructed: to examine the relationship between provincial tourism innovation level (TIP) and tourism economic growth (TEG), the relationship between tourism economic growth (TGI) and tourism industry efficiency (TIE), the relationship among provincial

tourism innovation level (TIP), tourism industry efficiency (TIE), and tourism economic growth (TEG), as well as the moderating effects of control variables such as economic development level (PGDP), tourism infrastructure development (TID), tourism industry structure (TIS), and tourism service efficiency (TRF) on these relationships.

$$TGI_i = \beta_0 + \beta_1 TIP_i + \beta_2 PGDP_i + \beta_3 TID_i + \beta_4 TIS_i + \beta_5 TRF_i + \epsilon_i TIE$$

$$= \alpha_1 + \gamma_1 \cdot DT + \gamma_2 \cdot TD + \gamma_3 \cdot TIS + \varepsilon$$

$$TGI_i = \beta_0 + \beta_1 TIP_i + \beta_2 PGDP_i + \beta_3 (TIP_i \times PGDP_i) + \beta_4 TID_i + \beta_5 TIS_i + \beta_6 TRF_i + \epsilon_i$$

$$TGI_i = \beta_0 + \beta_1 TIS_i + \beta_2 PGDP_i + \beta_3 TID_i + \beta_4 TRF_i + \epsilon_i$$

$$TGI_i = \gamma_0 + \gamma_1 TIE_i + \gamma_2 PGDP_i + \gamma_3 TID_i + \gamma_4 TIS_i + \gamma_5 TRF_i + \epsilon_i$$

## Empirical Research and Results Analysis

### Descriptive Statistics

The main research variables in this study are shown in the table below. In this study, the descriptive statistics for the variables are presented in the following table. The statistical indicators in the table reflect the number of observations, mean, standard deviation, minimum value, and maximum value of different variables, providing a preliminary understanding of the sample data. Through these statistical results, we can assess the central tendency, dispersion, and range of the variable distributions for further in-depth analysis.

**Table 1 Descriptive Statistics Table**

| Variable | (Obs) | (Mean)   | (Std. dev.) | (Min)   | (Max)    |
|----------|-------|----------|-------------|---------|----------|
| TGI      | 390   | 4.787    | 0.96        | 2.967   | 8.387    |
| TIP      | 390   | 77.569   | 84.942      | 0       | 412      |
| PGDP     | 390   | 58732.94 | 30481.71    | 13119   | 190313   |
| TID      | 390   | 0.088    | 0.083       | 0.00196 | 0.673    |
| TIS      | 390   | 0.212    | 0.127       | 0.00257 | 0.536    |
| TRF      | 390   | 25.205   | 22.651      | 2.186   | 250.353  |
| TPF      | 390   | 248.605  | 229.448     | 19.852  | 2256.776 |

Based on Table 1, key observations from the descriptive statistics are as follows: Tourism economic growth has a mean of 4.787 and a standard deviation of 0.96, indicating a relatively narrow range of tourism industry contributions to GDP across most provinces, with

some variation. Tourism innovation levels show a mean of 77.569 and a standard deviation of 84.942, ranging from 0 to 412, revealing significant disparities among provinces. Per capita GDP has a mean of 58,732.94 and a standard deviation of 30,481.71, reflecting substantial economic development differences. Tourism infrastructure development has a mean of 0.088 and a standard deviation of 0.083, with a wide range from 0.00196 to 0.673. Both tourism industry structure (TIS) and tourism service efficiency (TRF) exhibit considerable variation, while tourism fixed asset efficiency (TPF) highlights significant differences in asset utilisation efficiency. These statistics set the stage for further regression analysis.

### Correlation Analysis and Multicollinearity Test

#### Correlation Analysis

This study employs Pearson correlation analysis to explore the correlations among the variables TGI, TIP, PGDP, TID, TIS, TRF, and TPF. By conducting a correlation analysis of these variables, we can reveal the potential linear relationships among them, providing a theoretical basis for subsequent empirical research. The table below presents the correlation coefficients and their significance levels between the variables, allowing us to observe the interactions among different variables and their potential economic implications.

**Table 2 Variable Correlation Analysis**

|      | TGI      | TIP      | PGDP     | TID      | TIS    | TRF      | TPF |
|------|----------|----------|----------|----------|--------|----------|-----|
| TGI  | 1        |          |          |          |        |          |     |
| TIP  | 0.277*** | 1        |          |          |        |          |     |
| PGDP | 0.685*** | 0.476*** | 1        |          |        |          |     |
| TID  | 0.277*** | 0.616*** | 0.415*** | 1        |        |          |     |
| TIS  | 0.189*** | 0.768*** | 0.350*** | 0.614*** | 1      |          |     |
| TRF  | 0.039    | -0.011   | -0.008   | 0.286*** | 0.019  | 1        |     |
| TPF  | -0.046   | -0.113** | -0.128** | 0.182*** | -0.064 | 0.896*** | 1   |

Standard errors in parentheses \*\*\* p<0.01, \*\* p<0.05, \* p<0.1

The study examines the correlations among key economic variables related to tourism. It finds significant positive links between the total tourism index and tourism investment as well as GDP per capita, emphasising their crucial roles in driving tourism development. The tourism infrastructure development index is strongly tied to both tourism investment and GDP per capita, indicating that economic strength and investment significantly influence infrastructure. The tourism service level correlates positively with tourism investment, GDP per

capita, and infrastructure, especially with investment, highlighting its importance in enhancing service quality. In contrast, tourism revenue shows a weak correlation with other variables but is positively related to infrastructure, suggesting its role in boosting revenue. However, Tourism production capacity correlates negatively with tourism investment, GDP per capita, and infrastructure, with complex variable interactions needing further exploration.

### Multicollinearity Test

In this study, we used the Variance Inflation Factor (VIF) to examine the multicollinearity issue among the independent variables. The VIF value measures the degree of linear relationship between an independent variable and other independent variables. Generally, a high VIF value (commonly greater than 10) indicates that the variable may have strong multicollinearity with other independent variables, which could affect the estimation results of the regression model.

**Table 3 Multicollinearity Test Results**

| Variable | VIF  | 1/VIF |
|----------|------|-------|
| TIP      | 2.95 | 0.339 |
| TIS      | 2.68 | 0.373 |
| TID      | 2.12 | 0.471 |
| PGDP     | 1.35 | 0.739 |
| TRF      | 1.17 | 0.852 |
| Mean VIF | 2.06 |       |

Table 3 displays the VIF values and their reciprocals (1/VIF) for each variable. It can be observed that all VIF values are below 10, indicating that there is no serious multicollinearity issue among these variables. Through the analysis of VIF, we can ensure the robustness and accuracy of the model estimation results.

### Hausman Test

The Hausman statistic is used to determine whether to establish a random effects model or a fixed effects model. The null hypothesis and alternative hypothesis are as follows:

H0: The individual effect is uncorrelated with the regression variables (random effects regression model)

H1: The individual effect is correlated with the regression variables (fixed effects regression model)

$$\text{Hausman statistic: } H = (\hat{\beta}_{FE} - \hat{\beta}_{RE})' [\widehat{\text{Var}}(\hat{\beta}_{FE}) - \widehat{\text{Var}}(\hat{\beta}_{RE})]^{-1} (\hat{\beta}_{FE} - \hat{\beta}_{RE})$$

Where  $\hat{\beta}_{FE}$  represents the estimated coefficients of the fixed effects model,  $\hat{\beta}_{RE}$  represents the coefficients of the random effects model, and  $\widehat{\text{Var}}(\hat{\beta}_{FE}) - \widehat{\text{Var}}(\hat{\beta}_{RE})$  is the covariance matrix of the coefficient vector  $(\hat{\beta}_{FE} - \hat{\beta}_{RE})$ . Under the null hypothesis of the random effects model, the Hausman test follows a chi-square distribution with k degrees of freedom. If the value of the H statistic is less than the critical value, the null hypothesis is accepted; otherwise, the alternative hypothesis is accepted.

**Table 4 Hausman Test Results**

| Test Statistic (chi <sup>2</sup> ) | Degrees of Freedom (df) | P-Value |
|------------------------------------|-------------------------|---------|
| 35.58                              | 4                       | 0.0000  |

Based on the results of the Hausman test, we conclude that the null hypothesis is rejected at a P-value below 0.05; therefore, all models can adopt the fixed effects model.

#### Fixed Effects Model

**Table 5 Fixed Effects Model**

| Variable | Model 1            | Model 2            | Model 3            |
|----------|--------------------|--------------------|--------------------|
| TIP      | 0.008***<br>(0.00) | 0.004***<br>(0.00) | 0.001***<br>(0.00) |
| PGDP     |                    | 0.000**<br>(0.00)  | 0.00<br>(0.00)     |
| PGDP*TIP |                    |                    | 0.213***<br>(0.04) |
| TID      |                    | 2.833***<br>(0.45) | 2.780***<br>(0.44) |
| TIS      |                    | 1.974**<br>(0.79)  | 2.014**<br>(0.77)  |
| TPF      |                    | 0.000***<br>(0.00) | 0.0003**<br>(0.00) |
| _cons    | 4.183***<br>(0.07) | 3.388***<br>(0.15) | 0.70<br>(0.56)     |
| N        | 390.00             | 390.00             | 389.00             |

Standard errors in parentheses \*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.1$

According to the results of the fixed effects model in Table 5, the findings from Model 1 indicate that tourism innovation level has a significant positive impact on tourism economic growth. An increase in tourism innovation level promotes tourism economic growth, which aligns with the expectations of Hypothesis 1.

Model 2 introduces GDP per capita as a control variable to analyse whether the level of economic development moderates the relationship between tourism innovation and tourism economic growth. The results show that the level of economic development has a significant positive impact on tourism economic growth and plays a significant moderating role between GDP per capita and tourism innovation. As the level of economic development increases, the driving effect of tourism innovation on economic growth increases significantly, further verifying Hypothesis 1. This indicates that economic development provides financial support and market demand for tourism innovation, which promotes the overall growth of the tourism industry and strengthens the positive effect of tourism innovation on economic growth.

Model 3 introduces the interaction term between tourism innovation and economic development level to analyse its moderating effect. The results show that the level of economic development significantly moderates the relationship between tourism innovation and tourism economic growth through the interaction term, which supports Hypothesis 2. Specifically, an increase in the level of economic development enhances the positive effect of tourism innovation on economic growth. Summary: Models 1 and 2 validate Hypothesis 1, indicating that tourism innovation has a significant positive impact on tourism economic growth. Model 3 further verifies Hypothesis 2, showing that the moderating effect of the level of economic development is significant.

Overall, tourism innovation, tourism investment and the level of economic development all have a significant impact on tourism economic growth, of which the regulating effect of the level of economic development is particularly critical.

### **Mediating Effect Test**

In this study, we use stepwise regression to examine the mediating effect of tourism industry efficiency between digital technology and tourism economic growth. This method helps reveal how the tourism industry's efficiency influences the impact of digital technology

on tourism growth by progressively assessing the incremental effects of each variable through a series of regression models.

**Table 6 Mediating Effect Test**

| Variable | Model 1            | Model 2               | Model 3            |
|----------|--------------------|-----------------------|--------------------|
| TIP      | 0.004***<br>(0.00) | 0.037***<br>(0.01)    | 0.004***<br>(0.00) |
| TRF      |                    | 0.010***<br>(0.00)    | 0.010***<br>(0.00) |
| PGDP     | 0.000***<br>(0.00) | 0.000*<br>(0.00)      | 0.000***<br>(0.00) |
| TID      | 2.833***<br>(0.45) | 54.189***<br>(8.42)   | 2.312***<br>(0.47) |
| TIS      | 1.974**<br>(0.79)  | -48.674***<br>(14.75) | 2.442**<br>(0.80)  |
| TPF      | 0.000***<br>(0.00) | 0.092***<br>(0.00)    | 0.00<br>(0.00)     |
| _cons    | 3.388***<br>(0.15) | 1.90<br>(2.83)        | 3.370***<br>(0.15) |
| N        | 390.00             | 390.00                | 390.00             |

Standard errors in parentheses \*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.1$

Drawing from the regression analysis findings in Table 6, we can assess the presence of a mediating effect and test Hypothesis 4. This hypothesis suggests that tourism industry efficiency acts as a mediator in the link between digital technology and tourism economic growth. As indicated by the regression results from Models 1, 2, and 3, digital technology (TIP) significantly enhances tourism economic growth (TGI) in Model 1. In Model 2, tourism industry efficiency (TRF) significantly influences the relationship between digital technology and tourism economic growth, showing a positive association. Model 3 further demonstrates that tourism industry efficiency continues to exhibit a significant positive impact, while the effect of digital technology on tourism economic growth persists. These findings thus corroborate the role of tourism industry efficiency as a mediating variable, affirming Hypothesis 4, which posits that tourism industry efficiency indeed mediates the connection between digital

technology and tourism economic growth.

### Heterogeneity Analysis

Table 7 Heterogeneity Test

| Variable | Eastern            |                    | Central            |                    | Western            |                    |
|----------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|
| TIP      | 0.003***<br>(0.00) | 0.001***<br>(0.00) | 0.015***<br>(0.00) | 0.003***<br>(0.00) | 0.015***<br>(0.00) | 0.010***<br>(0.00) |
| PGDP     |                    | 0.000**<br>(0.00)  |                    | 0.000**<br>(0.00)  |                    | 0.00<br>(0.01)     |
| TID      |                    | 3.559***<br>(1.48) |                    | 3.560***<br>(1.72) |                    | 1.664*<br>(0.82)   |
| TIS      |                    | 0.51<br>(1.17)     |                    | 3.51<br>(4.74)     |                    | 2.99<br>(2.01)     |
| TPF      |                    | 0.000***<br>(0.00) |                    | 0.001**<br>(0.00)  |                    | 0.00<br>(0.00)     |
| _cons    | 5.098***<br>(0.09) | 4.244***<br>(0.36) | 3.457***<br>(0.15) | 2.455**<br>(0.93)  | 3.912***<br>(0.93) | 3.337***<br>(0.29) |
| N        | 117.00             | 117.00             | 65.00              | 65.00              | 169.00             | 169.00             |

Table 7 shows that tourism innovation (TIP) positively impacts tourism economic growth in eastern, central, and western provinces, with significant regional differences that confirm Hypothesis 3. The eastern provinces have the highest coefficient (0.003), reflecting the strongest impact due to their robust economic base, infrastructure, and favourable policies that quickly translate innovations into growth. Central provinces have a coefficient of 0.001, indicating room for improvement in innovation capacity and policy support. Western provinces have a coefficient of 0.015, showing strong innovation-driven growth despite a weaker economic base, thanks to recent policy support and market potential. Overall, these differences reflect varying stages of economic development and innovation capacity across regions.

### Robustness Test

#### Removal of Outliers

In the robustness testing process, this study refers to the method used by Qiangyuan et al. (2020) and adopts a two-tailed trimming approach to eliminate the potential impact of

outliers in the data. Specifically, this study conducts a 1% quantile trimming, meaning the lowest 1% and highest 1% of the data are removed to reduce the interference of extreme values on the regression results. This method effectively eliminates unrepresentative outliers, ensuring the robustness of the regression analysis and the reliability of the results. After the 1% quantile trimming process, the data is adjusted to be more stable and accurate, reducing the impact of outliers on model estimation, thereby enhancing the credibility and explanatory power of the research results. The results are shown in Table 8 below:

**Table 8 Robustness Test**

| Variable | Model 1            | Model 2            |
|----------|--------------------|--------------------|
| TIP      | 0.007***<br>0.00   | 0.003***<br>(0.00) |
| PGDP     |                    | 0.000**<br>(0.00)  |
| TID      |                    | 3.66***<br>(0.00)  |
| TIS      |                    | 1.500**<br>(0.00)  |
| TPF      |                    | 0.000***<br>(0.00) |
| _cons    | 4.174***<br>(0.07) | 3.474***<br>(0.15) |
| N        | 390.00             | 390.00             |

The robustness test in Table 8 shows that after 1% quantile trimming, the regression coefficients and significance levels remain consistent. This confirms that outliers were effectively removed, ensuring robust and reliable results. Specifically, tourism innovation still has a significant positive impact on tourism economic growth, even when controlling for factors like economic development level, tourism infrastructure, industry structure, and service efficiency. These findings reinforce the credibility of the research and provide a solid basis for further analysis.

### Endogeneity Test

In the process of testing for endogeneity, this study refers to the research methods of Yumei and Yanqing (2011) to address the endogeneity issue. Specifically, their study used the lagged value of agency costs as an instrumental variable for the current agency costs to handle the endogeneity problem arising from measuring agency costs by the management expense ratio. Drawing on this approach, this study similarly employs the lagged values of tourism innovation level (TIP) for one and two periods as instrumental variables to address the potential endogeneity issues associated with TIP. The results are presented in Table 9 below:

**Table 9 Endogeneity Test**

| Variable | Lagged One Period  | Lagged Two Periods  |
|----------|--------------------|---------------------|
| L1.TIP   | 0.007***<br>(0.00) |                     |
| L2.TIP   |                    | 0.010***<br>(0.00)  |
| PGDP     | 0.000**<br>(0.00)  | 0.000**<br>(0.00)   |
| TID      | 3.66***<br>(0.00)  | 1.91***<br>(0.53)   |
| TIS      | 1.50**<br>(0.00)   | 0.29<br>(0.89)      |
| TPF      | 0.000***<br>(0.00) | 0.0004***<br>(0.00) |
| _cons    | 4.174***<br>(0.07) | 3.475***<br>(0.15)  |
| N        | 390.00             | 390.00              |

The endogeneity test using lagged values of the tourism innovation level (TIP) as instrumental variables shows that tourism innovation significantly positively impacts tourism economic growth. Control variables such as per capita GDP, tourism infrastructure, tourism industry structure, and tourism service efficiency also significantly affect growth. These results confirm the hypothesis of the endogeneity test, demonstrating that lagged instrumental

variables effectively address endogeneity issues while maintaining the positive relationship between tourism innovation and economic growth. These findings enhance the understanding of tourism economic growth across provinces and support policy-making.

In summary, Hypothesis 3 is empirically supported. The impact of regional tourism industry structures on economic growth varies significantly, reflecting differences in regional economic development stages and innovation capabilities. This finding provides empirical evidence for formulating differentiated tourism industry policies and precisely promoting regional tourism economic development.

## Conclusion

This study empirically analyses the impact of tourism innovation level on tourism economic growth based on panel data of 30 provinces in China from 2010 to 2022. The results show that the level of tourism innovation significantly and positively promotes tourism economic growth, and the level of economic development has a positive moderating effect on it. There is regional heterogeneity in the impact of tourism industry structure, with tourism innovation having the strongest role in promoting economic growth in the eastern region, followed by the central region, and a relatively weaker effect in the western region, where tourism industry efficiency serves as a partial mediator. The study recommends strengthening investment in tourism innovation - particularly increasing the number of tourism patent authorisations - optimising the tourism industry structure, and formulating policies that align with regional economic development conditions. In addition, upgrading infrastructure and establishing monitoring mechanisms are essential to promote the high-quality, sustainable development of the tourism industry and thereby fuel regional economic growth.

## Discussion

This study's findings on tourism innovation align with the New Growth Theory that emphasises the role of knowledge and specialised human capital in driving sustainable economic growth. Tourism innovation, measured via patent authorisations, reflects the accumulation of such knowledge capital, which enhances tourism products, services, and overall industry competitiveness. This study confirms the hypothesis that tourism innovation significantly boosts economic growth, reinforcing innovation as a key driver for tourism development. This finding aligns with prior research, such as Huilin and Haiyan (2011) and Kai et al. (2022), who identified positive effects of tourism innovation on regional economies.

Consistent with Bazhenova et al. (2023), regions with stronger economies are more effective at converting innovation into growth, emphasising the importance of region-specific policies. The impact differs across regions: the eastern region leads, the central region lags, and the western region shows growth potential. This variation reflects how regional differences in tourism industry structure regulate the innovation effect, particularly evident in the more economically developed eastern provinces. Additionally, the tourism industry's efficiency serves as a crucial mediating factor, facilitating the translation of innovation into economic gains. These findings support the need for differentiated tourism strategies and provide a foundation for future research.

### Suggestions

To promote the high-quality development of tourism, the following suggestions are proposed from the aspects of innovation investment, regional policies, industrial integration, infrastructure, monitoring and evaluation, and resilience:

1. Increase innovation investment and optimise the industrial structure. Strengthen tourism innovation investment, encourage technological research and development and patent applications, promote innovation in tourism products and services, and enhance industry competitiveness. Promote the integration of tourism with other industries, enrich tourism product supply, optimise the industrial structure, and enhance its contribution to economic growth.

2. Implement differentiated regional policies and upgrade infrastructure. Based on regional economic development levels and innovation foundations, formulate differentiated tourism policies. The eastern region focuses on high-end intelligent development, the central region enhances innovation capabilities and industrial efficiency, and the western region explores market potential and increases innovation investment.

3. Establish a monitoring and evaluation mechanism. Establish a monitoring mechanism for tourism innovation and economic growth, regularly assess the implementation effects of policies, dynamically adjust strategies, and ensure high-quality development of the tourism economy.

4. Enhance tourism industry resilience in response to economic crises. Recent research highlights that tourism plays a critical role in stabilising and revitalising regional economies during crises, necessitating targeted policies to sustain tourism innovation and economic

growth under adverse conditions (Bazhenova et al. 2023). Incorporating resilience-focused strategies into planning will strengthen the sustainability and adaptability of regional tourism economies.

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