Impact of the Digital Economy on Cultural -Tourism Integration

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Abstract. In recent years, the digital economy has become a key force driving the in-depth integration of culture and tourism, but existing studies still lack sufficient empirical discussion on its impact mechanism. Using panel data from 31 Chinese provinces from 2012 to 2023 as samples, this study measured the level of cultural-tourism integration using a coupling coordination degree model and empirically tested the impact of the digital economy on cultural-tourism integration with multiple econometric models.The results show that: (1) The digital economy has a significant positive effect on cultural-tourism integration, which remains reliable, and digital infrastructure plays the strongest driving role; (2) The digital economy exerts an indirect influence through industrial structure optimization and technological innovation; (3) Its impact has a single threshold effect, and the promoting effect significantly enhances after crossing the threshold values; (4) The digital economy has a spatial spillover effect on cultural-tourism integration.

Keywords: Digital Economy; Cultural-Tourism Integration; Influence Mechanism; Spatial Spillover Effect.

1. Introduction

In 2009, China explicitly put forward the policy orientation of strengthening the mutual integration of culture and tourism for the first time. In recent years, based on the people's growing demand for high-level cultural tourism, China has formulated a series of policies and leverages digital technology to empower and enhance the level of integration of culture and tourism, striving to achieve the high-quality development of the integration of culture and tourism. In 2021, the Ministry of Culture and Tourism issued the “14th Five-Year Plan for the Development of Culture and Tourism”, which emphasizes adhering to the principle of "shaping tourism with culture and highlighting culture through tourism", regards promoting the in-depth integration and innovative development of culture and tourism as one of the key tasks, and proposes to advance the digital, networked, and intelligent development of culture and tourism, as well as build a number of national demonstration zones for the integrated development of cultural and tourism industries. Against the backdrop of the digital economy, scholars at home and abroad have conducted in-depth studies on how the integration of culture and tourism can leverage the digital economy to inject new impetus into its future development. This lead to the central research questions: How can we measure the integration of culture and tourism,and what are the logical mechanisms and transmission channels through which the digital economy empowers the high-quality development of the integration of culture and tourism? In response to the above questions, this paper attempts to conduct a more in-depth study on these aspects.

2. Literature Review

Studies on the digital economy driving the development of the integration of culture and tourism mainly fall into the following three categories: The first category is research on the connotation and measurement of the integration of culture and tourism. Early studies argued that the development and utilization of cultural resources have promoted the formation of cultural tourism, which is reflected in religious or folk tourism and other forms [1]. Some scholars have revealed that the integration of culture and tourism covers multiple dimensions, including product-industry integration, factor integration, and market integration [2]. Most of the literature elaborates on the connotation of the integration of culture and tourism by treating culture and tourism as two separate industries. Zhang

Jian [3] expounded on the integration of the cultural and creative industry and the tourism industry from the perspective of the industrial value chain. Some scholars hold that the cultural and creative industry, with "creativity" as its core, provides impetus for the development of the tourism industry, gives rise to new products and services [4], and ultimately achieves the interactive, integrated, and coordinated development of culture and tourism [5]. Gao Erdong et al. [6] further pointed out that the essence of the coupled development of the cultural and tourism industries lies in the process of mutual penetration between the two systems to realize industrial added value.

The clarification of the connotation of the integration of culture and tourism has prompted scholars to explore and evaluate the integration level of culture and tourism. However, the measurement and analysis of the integration of culture and tourism are still in their infancy, and the current methods for measuring the integration of culture and tourism mainly include the following types. The first is the coupling coordination degree model and its modified versions, which are favored by most scholars; scholars have used this model to explore the coordination status between culture and tourism [7]. For example, Hou Bing et al. [8] measured the development level of the integration of culture and tourism in the Yangtze River Delta Region using the coupling degree model, and concluded that the development level of the cultural industry and tourism industry in this region has increased year by year, but the coupling coordination degree remains relatively low. The second type of classic research is the CTI convergence mechanism model proposed by..., which elaborates on the development trends of the cultural and tourism industries from multiple aspects [9]. Foreign scholar Joshua R. Aaron [10] also used this method to measure the level of the integration of culture and tourism. The third type is that a small number of scholars have constructed high-quality development indicators for the integration of culture and tourism from different perspectives to explore the current development status of the integration of culture and tourism [11, 12]. In addition, in recent years, a small number of scholars have proposed the text mining method and the weighted TOPSIS model to evaluate the integration level of culture and tourism [13]. Furthermore, scholars such as Qian Minghui [14] classified the measurement methods of the integration of culture and tourism into types such as industrial correlation degree, industrial integration degree, and industrial coupling degree, which also deserve our consideration and learning.

To sum up, the academic community's understanding of the connotation of the integration of culture and tourism has shifted from a relatively superficial understanding of simple combination to a more in-depth reflection. Although scholars have different perspectives and expressions in specific elaborations, most of them reflect the core idea of "creativity". In the process of continuous penetration, superposition, and coupling between the cultural industry and the tourism industry, scholars have proposed methods such as the coupling coordination degree, the CTI model, and high-quality development indicators, forming a relatively systematic and comprehensive measurement method. Therefore, the cultural and tourism industries, relying on innovative thinking, give rise to new products, new services, and new business formats, drive their own high-quality development, and further promote the in-depth integration of the cultural and tourism industries.

The second category is research on the influencing factors of the integration of culture and tourism. Some literatures have discussed the influencing factors of the integration of culture and tourism from the perspective of demand and supply; some scholars have pointed out that the improvement of educational level and income will lead to more cultural tourism activities [15]. Azmi et al. [16] studied the tourism market and tourism consumers as key factors influencing the integration of culture and tourism. Some literatures have also studied the impact of technological innovation and the level of innovative development on the integration of culture and tourism; for example, Hacklin, F emphasized the importance of factors such as technological integration and innovation management in the process of the integration of culture and tourism [17]. In addition, some scholars have explored the factors influencing the integration of culture and tourism from the perspectives of economic development [11, 18] and economic benefits [19], while a small number of scholars have discussed the role of humanistic and social factors in the integration of culture and tourism [20].

The third category is research on the socioeconomic effects of the digital economy. In recent years, the digital economy has shown characteristics such as high growth potential and strong diffusion in terms of development scale [21]. The White Paper on China's Digital Economy Development released by the China Academy of Information and Communications Technology (CAICT) points out that the growth rate of China's digital economy scale has exceeded three times that of GDP. The digital economy is no longer limited to commerce and services; instead, it has penetrated into all aspects of life and affected social operation and economic development [22]. Scholars believe that the digital economy is conducive to technological innovation and market expansion [23], can promote industrial integration and upgrading [23, 24], improve social productivity [25, 26], and enhance social welfare [27], and has become an important engine driving the high-quality development of the economy. In terms of cultural tourism, the importance of digital technology in the development of the tourism industry is self-evident. Foreign scholars such as Stelnik, E. V [28] emphasized that the development of technical equipment and information technology can promote the advancement of the tourism industry. Voronkova, L. P [29] explained the importance of the digital transformation of tourism from the perspective of the application of the digital economy, especially the application of virtual technology in the tourism industry. Some scholars have further concluded through empirical analysis that the driving effect of the digital economy on the UK's tourism industry shows a marginal growth trend [30].

In terms of the in-depth integration or synergy between the two (the digital economy and the integration of culture and tourism), existing studies mostly focus on the logic of the digital economy empowering the integration of culture and tourism. However, studies on the transmission mechanisms and effects of the digital economy driving the integration of culture and tourism are relatively scarce, and there is a lack of corresponding empirical analysis. The limited existing studies include that domestic scholars such as Liu Yingji [12] conducted a transmission effect test by constructing a panel regression model and a regression model with interaction terms of transmission variables, and verified that the digital economy promotes the integration of culture and tourism through organizational, technological, and product transmission effects, respectively. Based on the mediation effect model and the threshold effect model, scholars such as Yang Li [31] concluded that there are mediating effects of industrial structure optimization and technological innovation, as well as a dual threshold effect in the empowerment process. Zhang Jiabei et al. [32] incorporated ecological protection, the digital economy, and the integration of culture and tourism into a unified research framework to explore the spatial correlation among the three.

It can be seen from the above literatures that the digital economy has achieved rapid growth and entered the public perspective. The academic community has conducted in-depth research and discussion on its socioeconomic effects, and has obtained corresponding achievements in aspects such as how the digital economy affects industrial structure, social welfare, technology, and markets. However, there are relatively few literatures related to the digital economy driving the integration of culture and tourism at present. Moreover, a comprehensive review of the existing literatures reveals two main shortcomings: First, in terms of research perspective, there is still a lack of studies on the impact mechanisms and effects of the digital economy on the integration of culture and tourism; most existing studies focus on the logic and theoretical elaboration of the digital economy driving the integration of culture and tourism, and there is a lack of corresponding empirical analysis on the transmission mechanisms and effects of the digital economy driving the integration of culture and tourism. In addition, there is also a lack of research on the differences in the role of the digital economy in the integration of culture and tourism in terms of its own characteristics and spatial laws.. Second, in terms of research depth, issues such as how strong the spatial effect of the digital economy on the integration of culture and tourism is, what its scope is, and what the regularity of its spatiotemporal process is, all need in-depth research urgently.Therefore, this paper focuses on the mechanism of action and transmission paths of the digital economy promoting the in-depth integration of culture and tourism, aiming to enrich the research scale, perspective, and depth in this field.

3. Theoretical Analysis and Research Hypotheses

3.1. The Direct Effect of the Digital Economy on the Integration of Culture and Tourism

The digital economy realizes direct empowerment by intervening in the entire chain of cultural-tourism integration: On the supply side, digital technologies (e.g., 3D modeling, blockchain) enable the digital protection and visual display of cultural resources (e.g., cultural relics, intangible cultural heritage), addressing the pain point of "difficult transmission of cultural connotations" in cultural-tourism products ; on the demand side, big data can accurately capture tourist preferences, promoting the transformation of cultural-tourism services from "standardization" to "personalization" (e.g., customized travel routes); on the transaction side, digital inclusive finance simplifies the financing process of cultural-tourism enterprises, and online platforms improve resource allocation efficiency, reducing the transaction costs of cultural-tourism integration . In addition, smart cultural-tourism facilities driven by the digital economy (e.g., intelligent guides, unmanned hotels) further improve the cultural-tourism service system, directly enhancing the integration level. Thus, the following hypothesis is proposed:

H1: The digital economy has a significant positive promoting effect on the development of cultural-tourism integration

3.2. The intermediary effect of digital economy in promoting the integration of culture and tourism

The enabling effect of the digital economy on cultural-tourism integration follows a dual transmission mechanism of "Digital Economy → Industrial Structure Optimization/Technological Innovation → Cultural-Tourism Integration":

Mediating Role of Industrial Structure Optimization: The digital economy increases the proportion of added value in the tertiary industry, promoting in-depth cross-integration of culture, tourism, and the digital industry. For example, digital technologies have spawned a "digital cultural-tourism ecosystem" (e.g., digital exhibitions, online performances), expanding the industrial boundary of cultural-tourism integration; meanwhile, digital platforms break geographical limitations, realizing cross-regional coordination of cultural-tourism resources (e.g., "One Phone Tours Yunnan"), and promoting the spatial optimization of industrial structure .

Mediating Role of Technological Innovation: R&D investment driven by the digital economy (e.g., AI, VR technologies) can empower the innovation of cultural-tourism products. For instance, the "Smart Opening" project of the Palace Museum breaks temporal and spatial limitations through AR technology, enhancing tourists' immersive experience; at the same time, the growth in the number of patents promotes the intellectualization of cultural-tourism equipment (e.g., intelligent ticketing systems), improving integration efficiency. Thus, the following hypothesis is proposed:

H2: The digital economy indirectly promotes cultural-tourism integration through the mediating role of industrial structure optimization and technological innovation

3.3. The threshold effect of digital economy promoting the integration of culture and tourism

The enabling effect of the digital economy on cultural-tourism integration is not linear but has a critical threshold:

When the development level of the digital economy is below the threshold value, digital infrastructure is incomplete and data factor agglomeration is insufficient, making it difficult for digital technology to effectively penetrate the cultural-tourism industry chain, resulting in a limited promoting effect on integration.

After the digital economy crosses the threshold value, the characteristic of increasing marginal returns of data factors becomes prominent: On one hand, the scale effect of digital infrastructure (e.g., big data centers) is formed, reducing the technology application costs of cultural-tourism enterprises; on the other hand, the synergistic effect of digital industrialization and industrial digitalization is enhanced, spawning new "culture-tourism + technology" business formats (e.g., virtual tourism,

digital cultural and creative products), and significantly improving the integration level. For example, due to the digital economy level crossing the threshold, the promoting coefficient of eastern China on cultural-tourism integration is significantly higher than that of central and western China. The following hypothesis is proposed:

H3: The promoting effect of the digital economy on cultural-tourism integration has a single threshold effect.

3.4. The Spatial Spillover Effect of Digital Economy Promoting the Integration of Culture and Tourism

The cross-regional mobility of the digital economy and the non-rivalry of data factors determine that its impact on cultural-tourism integration is not limited to the local area, but generates spatial spillover effects through the dual channels of "geographical proximity" and "economic connection" . From a theoretical perspective, this spillover effect is mainly realized through three paths:

Knowledge and technology diffusion: Regions with a high level of digital economy development (e.g., Jiangsu and Zhejiang in eastern China) can transfer their smart cultural-tourism technologies (e.g., AR navigation, digital ticketing systems) and operation models (e.g., global tourism platforms) to adjacent regions through cross-regional cooperation (such as the "Eastern Data and Western Computing" project). This helps surrounding provinces reduce technology R&D costs and improve the efficiency of cultural-tourism integration;

Coordinated allocation of cultural-tourism resources: Digital platforms break geographical barriers and promote the integration of cross-regional cultural-tourism resources. For example, adjacent provinces can share digital cultural-tourism databases to jointly develop inter-provincial tourism routes (e.g., the "Yangtze River Delta Smart Cultural-Tourism Corridor"), realizing mutual tourist flow and co-branding, which indirectly improves the level of cultural-tourism integration in surrounding areas;

Factor agglomeration and radiation: After factors such as talents and capital driven by the digital economy agglomerate in core cities, they will spread to the surrounding areas through the "siphon-radiation" effect. For instance, digital cultural-tourism enterprises in eastern China set up branches in central and western China, driving the upgrading of local digital infrastructure and the innovation of cultural-tourism formats.Thus, the following hypothesis is proposed:

H4: The promoting effect of the digital economy on cultural-tourism integration has a spatial spillover effect.

4. Variables and Data

4.1. Variable Selection

The dependent variable is cultural-tourism integration (CTI). Indicators were selected using the input-output method to evaluate the cultural and tourism industries comprehensively. The integration level was measured through the coupling coordination index of the two systems. The constructed evaluation indicator system for cultural-tourism integration development is shown in Table 1.

Table 1 Evaluation System for Cultural-Tourism Integration Development

Dimension	First-level indicator	Code	Secondary Indicator	Directionality	Weight
Cultural Industry	Cultural Input	C1	Number of Museums (unit)	Positive	0.111
		C2	Number of Public Libraries (unit)	Positive	0.040
		C3	Number of Art Performance Venues (unit)	Positive	0.139
		C4	Number of Cultural Market Entities (unit)	Positive	0.097
		C5	Number of Employees in Cultural Market Entities (person)	Positive	0.118
	Cultural Output	C6	Per Capita Collection of Public Libraries (volume)	Positive	0.140
		C7	Per Capita Cultural Expenditure (CNY)	Positive	0.118
		C8	Total Profit of Cultural Wholesale and Retail Enterprises above Designated Size	Positive	0.219
		C9	Per Capita Consumption Expenditure on Education, Culture, and Entertainment of Urban Households (CNY)	Positive	0.198
Tourism Industry	Tourism Input	T1	Number of Scenic Spots (unit)	Positive	0.119
		T2	Number of Star-rated Hotels (unit)	Positive	0.104
		T3	Number of Travel Agencies (unit)	Positive	0.119
		T4	Number of Catering Enterprises above Designated Size (unit)	Positive	0.176
	Tourism Output	T5	Total Tourism Revenue (billion CNY)	Positive	0.141
		T6	Number of Tourist Arrivals (ten thousand person-times)	Positive	0.118
		T7	Per Diem Expenditure of Inbound Overnight Tourists (USD/(person·day))	Positive	0.033
		T8	Operating Revenue of Star-rated Hotels (billion CNY)	Positive	0.190

The core explanatory variable is the digital economy (DE). Relevant indicators are selected from three dimensions: digital infrastructure development (DE-DID), digital industrialization (DE-DI), and industrial digitalization (DE-ID). This enables a comprehensive evaluation of regional digital economic development. The specific indicator system is shown in Table 2. Other variables selected are listed in Table 3.

Table 2 Digital Economy Evaluation System

Dimension	First-level Indicator	Code	Secondary Indicator	Directionality	Weight
Digital Economy(DE)	Digital Infrastructure Development(DE-DID)	X1	Optical Cable Length per Square Kilometer	Positive	0.130
		X2	Mobile Phone Penetration Rate (%)	Positive	0.031
		X3	Internet Broadband Access Ports per 100 Persons (unit)	Positive	0.045
		X4	Internet Broadband Subscribers per 100 Persons (subscriber)	Positive	0.025
		X5	Mobile Internet Users per 100 Persons (user)	Positive	0.023
	Digital Industrialization(DE-DI)	X6	Per Capita Telecom Business Volume (CNY)	Positive	0.110
		X7	Per Capita Software Business Revenue (CNY)	Positive	0.276
		X8	Employment in Information Transmission, Software, and IT Services (ten thousand persons)	Positive	0.099
		X9	Digital Financial Inclusion Index	Positive	0.034
	Industrial Digitalization(DE-ID)	X10	E-commerce Sales as a Percentage of GDP	Positive	0.006
		X11	Number of Enterprises with E-commerce Transactions (unit)	Positive	0.043
		X12	Number of Websites per 100 Enterprises (unit)	Positive	0.011
		X13	Number of Computers Used per 100 Persons (unit)	Positive	0.037
		X14	Full-Time Equivalent of R&D Personnel (person-year)	Positive	0.130

Table 3 Variable Descriptions

Variable Type	Variable Name & Code		Variable Description
Explained Variable	Cultural-Tourism Integration (CTI)		Coupling Coordination Degree between the Cultural Industry and Tourism Industry
Core Explanatory	Digital Economy (DE)	Digital Infrastructure Development(DE-DID)	Indicators measuring the status of digital infrastructure (broadband, mobile networks, optical cable)
		Digital Industrialization (DE-DI)	Indicators measuring the business volume, revenue, and employment in core digital industries
		Industrial Digitalization (DE-ID)	Indicators related to digital transactions, foundational digital investment, and digital human capital in enterprises
Mediating Variable	Industrial Structure Optimization (ISO)		Share of Tertiary Sector Value-added in GDP
	Technological Innovation (TI)		Number of Patent Applications Granted
Control Variable	Economic Development Level (EDL)		GDP per Capita
	Government Support Level (GSL)		Government Public Service Expenditure as a Percentage of GDP
	Material Capital Investment (MCI)		Total Fixed-asset Investment
	Human Capital Investment (HCI)		Proportion of Employment in the Tertiary Sector
	Market Size (MS)		Total Retail Sales of Consumer Goods
	Infrastructure Construction (IC)		Highway Density

An intermediary effect model is employed to explore the pathways through which the digital economy empowers the deep integration of cultural and tourism industries. The mediating variables selected are industrial structure optimization (ISO) and technological innovation (TI), represented respectively by the share of tertiary sector value-added in GDP and the number of patent applications granted. Other factors influencing cultural-tourism integration are treated as control variables: Government support level (GSL) promotes cultural and tourism integration, represented by public service expenditure as a percentage of GDP; Material capital investment (MCI) and human capital investment (HCI) constitute foundational investments and key drivers of output for cultural and tourism integration. They are measured by total fixed-asset investment and the proportion of employment in the tertiary sector, respectively; Market Size (MS) indicates consumer spending power in the cultural and tourism industries to some extent. An expanded market size further promotes the integration of cultural and tourism development, measured by total retail sales of consumer goods. Infrastructure Construction (IC) has spillover effects, extending the scope of cultural and tourism integration and driving broader development. It is specifically measured by highway density.

4.2. Data Sources and Processing

Data spanning twelve years, from 2012 to 2023, were selected, covering 31 provinces in China (excluding Hong Kong, Macao, and Taiwan). Digital economy-related data were sourced from the China Statistical Yearbook, China Science and Technology Statistical Yearbook, China Tertiary Industry Statistical Yearbook, and provincial statistical yearbooks; cultural and tourism integration

indicators were sourced from China Statistical Yearbook, China Cultural Heritage Statistical Yearbook, China Culture and Related Industries Statistical Yearbook, China Tourism Statistical Yearbook, and China Culture and Tourism Statistical Yearbook; all other variables were obtained from China Statistical Yearbook. To unify data dimensions, data related to the digital economy and cultural-tourism integration indicator systems underwent range standardization. To reduce standard errors and enhance model testing accuracy, variables involving monetary amounts or large numerical values in control and mediating variables were log-transformed. Ratio variables retained their original values, and missing values were imputed using linear interpolation.

4.3. Model Setup

4.3.1 Coupling Coordination Model

$$C = \left[\frac{c \times t}{\left(\frac{c \times t}{2}\right)^2}\right]^{\frac{1}{2}} \tag{1}$$

$$T = \frac{1}{2}(c + t) \tag{2}$$

$$D = \sqrt{C \times T} \tag{3}$$

Among them, c and t represent the comprehensive development scores of the cultural industry and tourism industry, respectively; C denotes the coupling degree of the two systems; T stands for the comprehensive development index; and D refers to the coupling coordination degree between the cultural industry and tourism industry, which represents the cultural-tourism integration development index in this paper.

4.3.2 Benchmark Regression Model

To empirically study the direct effect of the digital economy empowering cultural-tourism integration, a benchmark regression model is constructed as follows:

$$CT_{it} = \alpha_0 + \alpha_1 DE_{it} + \alpha_2 Z_{it} + \mu_i + y_i + \xi_{it} \tag{4}$$

In the model, CT_{it} denotes the cultural-tourism integration development index of region i in year t; DE_{it} represents the digital economy development index of region i in year t; Z_{it} are relevant control variables; α_0, α_1, and α_2 are to-be-estimated coefficients; μ_i and y_i are the regional and time fixed effects, respectively; and ξ_{it} is the random error term.

4.3.3 Mediating Effect Model

To further examine the impact mechanism of the digital economy empowering cultural-tourism integration, mediating variables are selected to construct a mediating effect model:

$$M_{it} = \beta_0 + \beta_1 DE_{it} + \beta_2 Z_{it} + \mu_i + y_i + \xi_{it} \tag{5}$$

$$CT_{it} = \theta_0 + \theta_1 IE_{it} + \theta_2 M_{it} + \theta_3 Z_{it} + \mu_i + y_i + \xi_{it} \tag{6}$$

Among them, Mitdenotes the mediating variable, which represents industrial structure optimization and technological innovation in this paper; β and θ are to-be-estimated coefficients. Equation (5) is used to examine the impact of the digital economy on industrial structure optimization and technological innovation, while Equation (6) is used to analyze the joint impact of the digital economy and mediating variables on cultural-tourism integration.

4.3.4 Threshold Effect Model

Based on the aforementioned analysis, due to the heterogeneity and imbalance in the development of the digital economy, it is hypothesized that there exists a non-linear relationship in the process of the digital economy empowering cultural-tourism integration. Therefore, a panel threshold regression

model with the digital economy as the threshold variable is constructed to test the threshold effect of the digital economy on cultural-tourism integration. The model is as follows:

$$CT_{it} = \lambda_0 + \lambda_1 DE_{it} \times I(DE \le \gamma_1) + \lambda_2 DE_{it} \times I(\gamma_1 < DE \le \gamma_2) + \ldots + \lambda_n DE_{it} \times I(\gamma_{n-1} < DE \le \gamma_n) + \lambda_{n+1} DE_{it} \times I(DE > \gamma_n) + \lambda Z_{it} + \mu_i + y_i + \xi_{it} \quad (7)$$

Among them, IE is the threshold variable, and the core explanatory variable is used as the threshold variable in this paper; λ is the to-be-estimated coefficient; γ is the to-be-estimated threshold value; I(·) is the indicator function—when the threshold interval in the parentheses holds, I takes the value of 1, otherwise 0.

4.3.5 Spatial Econometric Model

The general form of a spatial panel model is as follows:

$$\begin{cases} y_{it} = \rho \sum w_{it} y_{it} + x'_{it}\beta + \sum w_{it} x'_{it}\delta + u_i + \varphi_{it} + \varepsilon_{it} \\ \varepsilon_{it} = \lambda \sum w_{it} \varepsilon_{it} + \nu_{it} \end{cases} \quad (8)$$

Where:y_{it} denotes the dependent variable for region i in period t,ρ ,β ,δ , and λ represent the spatial autoregressive coefficient, regression coefficients of explanatory variables, spatial regression coefficients of explanatory variables, and spatial error regression coefficient, respectively.w_{it} is the spatial weight matrix,x_{it} are the explanatory variables,u_i is the individual fixed effect,φ_{it} is the time fixed effect,ε_{it} is the random error term, and ν_{it} is the independently distributed error term.

Depending on different conditions, equation (8) can be categorized into the following three scenarios: when λ = 0, it represents the "Spatial Durbin Model" (SDM); when λ = 0 and δ = 0, it represents the "Spatial Autoregressive Model" (SAR); when ρ =δ = 0, it represents the "Spatial Error Model" (SEM).

Based on the spatial panel model form, this paper specifies the following three spatial econometric models:

$$SAR: Y_{it} = \rho W Y_{it} + \beta X_{it} + \varepsilon_{it}, \varepsilon_{it} \sim N(0, \sigma^2 I) \quad (9)$$

$$SEM: Y_{it} = \beta X_{it} + \varepsilon_{it}, \varepsilon_{it} = v_{it} + \lambda W_{ij} \varepsilon_{it}, v_{it} \sim N(0, \sigma^2 I) \quad (10)$$

$$SDM: Y_{it} = \rho W Y_{it} + \beta X_{it} + \theta W X_{it} + \varepsilon_{it}, \varepsilon_{it} \sim N(0, \sigma^2 I) \quad (11)$$

Where Y_{it} is the dependent variable,X_{it} is the explanatory variable for region i in period t,ρ ,β ,θ , and λ are the parameters to be estimated,ε_{it} and v_{it} are the error terms, and W is the spatial weight matrix.

5. Empirical Analysis and Testing

5.1. Benchmark Regression Analysis

In the benchmark regression analysis, this paper primarily establishes four models. Model (1) examines the impact of the three main dimensions of the digital economy—digital infrastructure development, digital industrialization, and industrial digitalization—on the deep integration of culture and tourism, focusing on the direct effects of the digital economy on this integration. Model (2) adds six control variables to Model (1): economic development level, government support level, physical capital investment, human capital investment, market size, and infrastructure development. Model (3) examines endogeneity by using the lagged digital economy variable (one period back) as an instrumental variable, without introducing control variables. Model (4) also tests endogeneity but incorporates control variables compared to Model (3).

The results of the four models correspond to columns (1) to (4) in Table 4. Table 4 reveals that in columns (1) and (2), the regression coefficient of the core explanatory variable—digital economy—is significantly positive at the 5% level, indicating that the digital economy directly promotes the deep integration of culture and tourism. Furthermore, the results in column (2) show the presence and

direction of influence from the six control variables on cultural-tourism integration. Specifically, the regression coefficients for economic development level and market size are both positive and significant at the 1% level, indicating that these two factors positively empower the deep integration of culture and tourism. The regression coefficients for physical capital investment and infrastructure construction are significantly positive at the 5% level, suggesting that although their impact is not as strong as that of economic development level and market size, they still exert a positive promotional effect on the deep integration of culture and tourism. In contrast, the impact of government support level and human capital investment is not significant based on the results.

The endogeneity test results in columns (3) and (4) are consistent with the benchmark regression results, indicating that even when considering endogeneity issues, the digital economy still has a significant positive impact on the deep integration of culture and tourism, thereby validating the validity of the benchmark regression results.

Table 4: Benchmark Regression and Endogeneity Tests

	Baseline Regression		Endogeneity Test	
	(1)	(2)	(3)	(4)
Digital Economy (DE)	0.457** (2.37)	0.141** (2.03)	0.374*** (3.21)	0.099** (2.34)
Economic Development Level (EDL)		0.038*** (5.55)		0.052*** (2.74)
Government Support Level (GSL)		0.003 (0.70)		0.001 (0.51)
Material Capital Input (MCI)		0.016** (2.29)		0.011* (1.67)
Human Capital Investment (HCI)		0.019 (1.54)		0.017* (1.67)
Market Size (MS)		0.031*** (2.79)		0.032** (2.40)
Infrastructure Construction (IC)		0.039** (2.06)		0.035** (2.22)
Constant term (con)	0.379*** (3.06)	0.260*** (3.73)	0.374*** (2.86)	0.263*** (2.72)
Regional Effect	Control	Control	Control	Control
Time Effect	Control	Control	Control	Control
Sample Size (N)	372	372	372	372
Coefficient of Determination (R^2)	0.517	0.603	0.542	0.68

Note: *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively; values in parentheses indicate t-values; the same applies below.

5.2. Regional Heterogeneity and Robustness

To further analyze regional variations in how the digital economy promotes the deep integration of culture and tourism, we divide China's economic regions into Eastern, Central, and Western areas. Separate regression analyses were conducted for each region, with results presented in Columns (1) to (3) of Table 5. These results clearly show that the coefficients for the digital economy's impact on deep integration are significantly positive across all regions, consistent with the benchmark regression findings. Second, comparing the three regions reveals that the positive effect of the digital economy on cultural-tourism integration is significant at the 1% level in the eastern region. By contrast, it is significant only at the 5% level in the central and western regions, indicating a relatively weaker impact compared to the east. Considering the economic development levels of these three regions, the disparity in effect is likely due to the eastern region's more advanced digital infrastructure

development and higher levels of digital industrialization and industrial digitalization, resulting in a higher level of digital economic development than the other two regions.

Furthermore, this study further validated the robustness of the benchmark regression results by replacing explanatory variables, primarily introducing three dimensions of the digital economy: digital infrastructure development, digital industrialization, and industrial digitalization. As shown in columns (4) to (6) of Table 5, all three new explanatory variables significantly promote the deep integration of culture and tourism at the 5% significance level, further confirming the inference that the digital economy drives the deep integration of culture and tourism. Notably, the regression coefficient for digital infrastructure development is 0.149, significantly higher than the coefficients of 0.092 and 0.105 for the other two variables. This suggests digital infrastructure development plays a more critical role in driving deep integration of culture and tourism among the three dimensions of the digital economy.

Table 5: Regional Heterogeneity and Robustness Tests

	Regional			Replacement of Explanatory Variables		
	Eastern	Central	Western			
	(1)	(2)	(3)	(4)	(5)	(6)
Digital Economy (DE)	0.318*** (3.70)	0.265** (2.19)	0.047** (2.44)			
digital infrastructure development				0.149** (2.01)		
Digital Industrialization					0.092** (2.31)	
Industrial Digitalization						0.105** (2.25)
Constant	0.407*** (2.71)	0.523*** (3.15)	0.441*** (3.56)	0.579*** (2.86)	0.486*** (3.23)	0.460*** (2.77)
Regional Effect	Control	Control	Control	Control	Control	Control
Time Effect	Control	Control	Control	Control	Control	Control
Sample size (N)	372	372	372	372	372	372
Coefficient of Determination (R^2)	0.634	0.597	0.515	0.642	0.551	0.619

5.3. Mediating Effects

To explore the impact mechanism of the digital economy on deepening the integration of culture and tourism, this study introduces industrial structure optimization and technological innovation as mediating variables for mediation analysis. Columns (1) and (2) in Table 6 show that the regression coefficients of the digital economy on both mediating variables are significantly positive at the 1% level, indicating that it promotes industrial structure optimization and technological innovation. Building on this, the study examines the direct effect of the digital economy on cultural-tourism integration, and compares its transmission effects when introducing industrial structure optimization and technological innovation separately. The results are presented in Columns (3), (4), and (5) of Table 6 for intuitive comparison. The positive and statistically significant regression results at the 5% level for both indicate that the digital economy has a significant positive effect on cultural-tourism integration, whether through its direct influence or its combined effects with industrial structure optimization and technological innovation. Thus, the digital economy not only directly promotes deep cultural-tourism integration but also positively influences it indirectly through industrial structure optimization and technological innovation.

Table 6: Mediating Effects

	Industrial Structure Optimization	Technological Innovation	Cultural-Tourism Integration 1		
	(1)	(2)	(3)	(4)	(5)
Digital Economy (DE)	1.119*** (3.86)	3.391*** (3.23)	0.141** (2.03)	0.117** (2.28)	0.092** (1.99)
Optimization of Industrial Structure				0.035* (1.67)	
Technological Innovation					0.018** (2.42)
Constant Term	3.538*** (3.562)	1.627 (0.88)	0.261*** (3.73)		
Regional Effect	Control	Control	Control	Control	Control
Time Effect	Control	Control	Control	Control	Control
Sample size (N)	372	372	372	372	372
Coefficient of Determination (R^2)	0.603	0.548	0.583	0.612	0.626

5.4. Threshold Effect

To investigate whether the impact of the digital economy on cultural and tourism integration remains constant throughout its development, this study conducts a threshold effect analysis. First, threshold characteristic value tests were performed using repeated sampling via the bootstrap method. The results, shown in Table 7, indicate that the digital economy threshold variable passed the single threshold test at the 10% level. However, the double and triple thresholds failed to pass the significance test. This demonstrates that the digital economy exhibits a relatively pronounced single threshold effect on the deep integration of culture and tourism.

Based on the threshold characteristic value analysis of the digital economy, a threshold effect regression analysis was conducted, yielding threshold values of 0.204 and 0.433, as shown in Table 8. When the digital economy is below 0.204, a one-unit increase in the digital economy drives cultural and tourism integration by 0.166 units. Conversely, when the digital economy exceeds 0.433, a one-unit increase in the digital economy drives cultural and tourism integration by 0.248 units. Although the regression coefficients for cultural and tourism integration are both statistically significant at the 5% level in both scenarios, their values differ. This indicates that as the level of development increases, the digital economy enhances its promotional effect on the deep integration of culture and tourism.

Table 7: Threshold Feature Results

Variable	Nature	F	P	1%	5%	10%
Digital Economy	Single	31.11	0.067	39.627	32.895	29.429
	Dual	7.59	0.801	33.418	29.827	25.735
	Triple	4.82	0.876	59.791	23.921	18.243

Table 8: Threshold Effect Regression Results

		Cultural Tourism Integration
Digital Economy and Indicator Function Interaction Term	DE × I (DE ≤ 0.204)	0.166** (2.19)
	DE × I (DE > 0.204)	0.248** (2.54)
Economic Development Level (EDL)		0.047*** (3.01)
Government Support Level (GSL)		0.01 (0.50)
Material Capital Input (MCI)		0.013** (2.11)
Human Capital Input (HCI)		0.010 (1.48)
Market Size (MS)		0.027 (1.07)
Infrastructure Construction (IC)		0.041*** (2.92)
Constant term (con)		0.305*** (3.50)
Sample size (N)		372
Coefficient of determination (R^2)		0.644

5.5. Spatial Spillover

Spatial correlation is typically assessed using the global Moran's I index, which ranges from -1 to 1. A higher absolute value of Moran's I indicates stronger spatial correlation. Its calculation formula is as follows:

$$Moran's\ I = \frac{\sum_i \sum_j w_{ij}\,(CT_i - \overline{CT})(CT_j - \overline{CT})}{S^2 \sum_i \sum_j w_{ij}}$$

$$S^2 = \frac{1}{n}\sum (CT_i - \overline{CT})^2, \overline{CT} = \frac{1}{n}\sum_i CT_i$$

Where CT_i represents the sample value of cultural-tourism integration and digital economic development level for region i, and $w_{(ij)}$ denotes the (i, j) element of the spatial weight matrix W.

The global Moran's I indices for cultural-tourism integration and digital economic development across China's 31 provinces from 2012 to 2023 are presented in the table below. All global Moran's I values are positive and statistically significant at the 1% level, confirming a strong spatial correlation between the digital economy and cultural-tourism integration.

The global Moran's I index for cultural-tourism integration consistently exhibits significant positive spatial autocorrelation from 2012 to 2023, with all annual p-values below 0.01. This confirms pronounced spatial clustering in cultural-tourism integration, where high-value regions tend to cluster with other high-value regions, and low-value regions with other low-value ones. From a temporal perspective, the index value generally fluctuated upward, increasing from 0.0734 in 2012 to 0.0780 in 2023, with a peak of 0.0884 reached in 2021. This suggests that the spatial linkage effect of cultural and tourism integration is strengthening. This trend demonstrates that China's cultural and tourism industries, driven by regional coordination and policy support, show significant spatial spillover and cluster development, with increasingly tight development linkages between provinces.

In contrast, while the global Moran's index for the digital economy remained significantly positive across all years, its values were generally lower than those for cultural-tourism integration and

exhibited more pronounced fluctuations. The Moran's I index showed an overall downward trend in 2014 and 2018, indicating relatively weak spatial correlation and poor stability in the digital economy. However, starting from 2020, the index began to rebound, reaching 0.0549 in 2023. This suggests that the spatial agglomeration effect of the digital economy has strengthened in recent years, potentially benefiting from cross-regional co-construction and sharing of digital infrastructure, collaborative cultivation of the digital industrial ecosystem, and regional integration in digital governance.

Table 9: Global Moran's I Index for Cultural Tourism Integration and Digital Economic Development Levels in China's 31 Provincial-Level Administrative Regions, 2012–2023

	Cultural Tourism Integration		Digital Economy Development	
	Moran's I	P-value	Moran's I	P-value
2,012	0.0734	0.0021	0.0492	0.0067
2013	0.0670	0.0038	0.0394	0.0218
2014	0.0675	0.0037	0.0273	0.0536
2015	0.0688	0.0033	0.0304	0.0433
2016	0.0740	0.0020	0.0340	0.0336
2017	0.0753	0.0018	0.0319	0.0378
2018	0.0756	0.0017	0.0284	0.0505
2019	0.0743	0.0019	0.0413	0.0187
2,020	0.0656	0.0045	0.0464	0.0112
2,021	0.0884	0.0005	0.0443	0.0137
2,022	0.0758	0.0018	0.0454	0.0129
2,023	0.0780	0.0014	0.0549	0.0058

By plotting partial Moran's, I scatter plots for cultural-tourism integration and the digital economy, this study further analyzes the spatial correlation between China's digital economy and cultural-tourism integration. During the study period, both cultural-tourism integration and the digital economy exhibited significantly positive Moran's I value. Moreover, the Moran's I indices for both variables gradually decreased from 2012 to 2023, indicating that cultural-tourism integration has become increasingly pronounced against the backdrop of the nation's vigorous development of the digital economy.

The Moran's I scatter plots for cultural tourism integration reveal that in 2012, 2020, and 2023, the vast majority of provinces were clustered in the first quadrant (high-high clustering) and third quadrant (low-low clustering), indicating predominantly positive autocorrelation in their local spatial structure. High-value regions such as coastal provinces Jiangsu, Zhejiang, and Guangdong consistently exhibit stable spatial spillover effects, forming contiguous development patterns. Conversely, low-value regions like the western provinces Qinghai, Ningxia, and Tibet exhibit long-term clustering, reflecting regional imbalances in cultural tourism resources and development. Notably, in 2020, affected by the pandemic, some central provinces such as Hunan and Henan experienced slight fluctuations. However, by 2023, the overall spatial pattern had strengthened again, with the driving effect of high-high agglomeration zones and the weak locking-in of low-low regions becoming more pronounced. This indicates that cultural and tourism integration exhibits strong spatial stability and path dependence.

The Moran's dot plot for the digital economy reveals more complex local correlation patterns. Between 2012 and 2023, most provinces remained concentrated in the first and third quadrants. However, some, such as Anhui and Henan, shifted quadrants in different years, indicating dynamic spatial correlations within the digital economy. High-high clusters are predominantly located in economically developed regions such as Beijing-Tianjin-Hebei, Jiangsu-Zhejiang-Shanghai, and Guangdong, with their zones of influence continuously expanding. Conversely, low-low regions are predominantly distributed in the western and northeastern parts of the country.

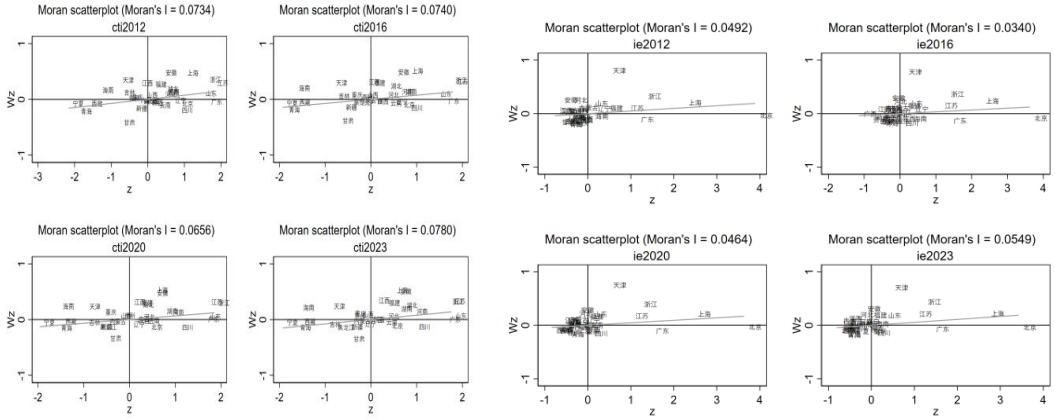

Figure 1: Moran's Dot Plots of China's Cultural Tourism Integration and Digital Economy Development Levels in 2012, 2016, 2020, and 2023

Based on the above analysis, a significant spatial correlation exists between the levels of cultural tourism integration and digital economic development. Therefore, incorporating spatial factors into empirical analysis is necessary.

The LM test results in Table 10 confirm the existence of spatial correlation between the digital economy and cultural-tourism integration. The LR test results for model selection (shown in Table 11) reject the null hypothesis, indicating that the SDM model (Spatial Durbin Model) cannot be simplified to either the SAR or SEM model. This implies that the digital economy's impact on cultural tourism integration involves not only local effects but also cross-regional spillover effects through spatial lag terms, making the SDM model the optimal choice. Furthermore, the Hausman test statistic of 76.26 with P=0.000 strongly rejects the null hypothesis of random effects, further supporting the fixed-effects model. In summary, the final applicable model is the two-way fixed-effects Spatial Durbin Model (SDM). This model simultaneously captures the local direct effects of the digital economy on cultural tourism integration, cross-regional indirect effects, and unobservable factors across both temporal and spatial dimensions.

Table 10: LM Test

Spatial Effects LM Test	Value	Degrees of Freedom	P-value
LM-Error Statistic	302.102	1	0.000
Robust LM-Error statistic	293.109	1	0.000
LM-Lag statistic	10.163	1	0.001
Robust LM-Lag statistic	1.170	1	0.279
Hausman test	76.26	-	0.000

Table 11: Model Selection and Fixed Effects Type Selection: LR Test

Model and Effect Selection	LR Test	Test Value	P-value
Model Selection	Null Hypothesis: The SDM model can be reduced to the SAR model	40.62	0.0000
	Null hypothesis: The SDM model can be reduced to the SEM model	35.30	0.0001
Fixed effects selection	Null hypothesis: Regional fixed effects outperform two-way fixed effects	69.50	0.0000
	Null hypothesis: Time fixed effects outperform two-way fixed effects	591.01	0.0000

Regarding direct effects, under all three matrices, the regression coefficients for the digital economy were significantly positive at the 5% or 1% level, indicating that local digital economic development can drive local cultural and tourism integration. Among these, the direct effect coefficient under the economic matrix was the largest at 0.1842, suggesting that the local promotional

effect of the digital economy is more pronounced in regions with close economic ties. More importantly, the estimated spatial lag term captures spillover effects from neighboring regions' digital economies. Under the distance and adjacency matrices, WX coefficients were 0.1641 and 0.0752, respectively—both positive and significant. This suggests that digital economic development in geographically adjacent areas can enhance local cultural-tourism integration through knowledge diffusion, visitor flow guidance, or technological imitation. Under the economic matrix, the spatial lag coefficient reached 0.5657 and was significant at the 1% level—far exceeding the other two matrices. This indicates that digital economy linkage effects are especially pronounced among regions of similar economic levels, revealing the amplifying role of interregional economic synergy in digital cultural-tourism integration.

Simultaneously, the spatial autoregressive coefficient was significantly positive across all three matrices, further confirming the spatial dependency inherent in cultural-tourism integration,where the development level of surrounding regions significantly impacts local performance. The overall model fit (R^2) reached 0.671 under the economic matrix, significantly higher than the distance and adjacency matrices, indicating that the economic linkage spatial matrix better represents the complex interactive relationship between the digital economy and cultural-tourism integration. In summary, the digital economy not only directly promotes local cultural-tourism integration but also generates cross-regional spillovers through both geographic and economic channels, with the economic dimension playing a more critical role in spatial spillover effects.

Table 12 Spatial Durbin Model (SDM) Regression Results

	(1)		(2)		(3)	
	Distance Matrix		Adjacency Matrix		Economic Matrix	
	X	W*X	X	W*X	X	W*X
DE	0.1513**	0.1641**	0.1921***	0.0752*	0.1842***	0.5657**
	(2.1580)	(2.2597)	(2.8729)	(1.7977)	(2.7083)	(2.3198)
Spatial rho	0.4479** (1.9985)		0.0462*** (2.6704)		0.3708** (2.2061)	
Variance sigma2_e	0.0002*** (13.5580)		0.0002*** (13.6334)		0.0002*** (13.5751)	
Control variables	Control		Control		Control	
N	372		372		372	
R^2	0.277		0.301		0.671	

6. Conclusions and Recommendations

6.1. Conclusions

This study systematically examines the effects and mechanisms of the digital economy on the deep integration of culture and tourism across China's 31 provinces from 2012 to 2023, utilizing panel data. By constructing a coupling coordination degree model, a benchmark regression model, a mediation effect model, a threshold effect model, and a spatial Durbin model (SDM), we empirically investigate the driving role of the digital economy in cultural-tourism integration and its transmission pathways from multiple dimensions. Key findings are as follows:

First, the digital economy exerts a positive and reliable promotional effect on the deep integration of cultural tourism. Benchmark regression results indicate that, after controlling for region and time effects, the regression coefficient of the core explanatory variable—the digital economy—is significantly positive at the 5% level, demonstrating that the digital economy directly provides impetus for deep cultural tourism integration. Furthermore, after endogeneity treatment and explanatory variable substitution, the conclusion that the digital economy significantly promotes cultural tourism integration remains consistent, confirming the robustness of this finding. Notably, after replacing the core explanatory variable, the coefficient for digital infrastructure development—one of the three dimensions of the digital economy—was the largest, indicating its pivotal role in

enabling cultural and tourism integration. Regarding control variables, economic development level and market size form the crucial economic foundation for integration. Physical capital investment and infrastructure development also positively boost integration, while government support level and human capital investment show no significant impact. This may be related to policy transmission efficiency and the mismatch between human capital structure and the needs of the cultural and tourism industry.

Second, the promotional effect of the digital economy on cultural-tourism integration exhibits regional heterogeneity. Eastern regions, characterized by higher digital infrastructure coverage, stronger digital industrialization, and faster industrial digital transformation, are more conducive to the integration and innovative utilization of cultural-tourism resources. In contrast, while central and western regions also show positive effects, their significance levels and magnitude of impact are lower than those in the eastern part of the country. This finding reveals how regional imbalances in digital economic development constrain the effectiveness of cultural-tourism integration.

Third, the digital economy not only directly promotes cultural-tourism integration but also indirectly empowers it through industrial structure optimization and technological innovation. Mediating effect tests indicate a dual transmission mechanism: "Digital Economy → Industrial Structure Optimization / Technological Innovation → Cultural-Tourism Integration." On one hand, the digital economy significantly promotes industrial structure optimization, which in turn positively stimulates cultural-tourism integration. This suggests that the digital economy can facilitate cross-sector integration of cultural services, tourism services, and other business models by increasing the share of the tertiary sector. On the other hand, the digital economy also significantly promotes technological innovation, which effectively enhances cultural-tourism integration. Furthermore, after introducing an intermediary variable, the direct coefficient of the digital economy on cultural-tourism integration remains significantly positive, indicating that the digital economy exerts both a "direct driving" and an "indirect transmission" effect on cultural-tourism integration.

Fourth, the impact of the digital economy on cultural-tourism integration exhibits a single threshold effect. Comparing regression results for digital economy development levels below 0.204 and above 0.433, the marginal promotional effect of cultural-tourism integration significantly intensifies when the threshold is exceeded. This conclusion suggests that driving the digital economy beyond critical thresholds is crucial for achieving deep cultural-tourism integration.

Fifth, the digital economy exhibits pronounced spatial spillover effects on deep cultural-tourism integration. The global Moran's I index reveals significant spatial clustering characteristics for both variables between 2012 and 2023. The Spatial Dobin Model (SDM) further demonstrates that the digital economy not only directly promotes local cultural-tourism integration but also produces positive spatial spillover effects through geographic proximity and economic linkages. This effect is particularly pronounced between regions with strong economic ties. Additionally, the spatial autoregressive coefficient (ρ) is significantly positive, indicating that cultural-tourism integration itself is spatially dependent, and the development level of surrounding areas positively influences local growth.

6.2. Recommendations

Based on the empirical findings, this paper proposes the following targeted recommendations to unlock the potential of the digital economy in driving deep integration of culture and tourism:

First, strengthen digital infrastructure development. Compared to eastern regions, central and western areas require increased investment in resources to enhance new infrastructure such as 5G networks, big data centers, and cloud computing platforms. This will further enhance digital access capabilities and usage levels, narrow the digital infrastructure gap between eastern, central, and western regions and provide robust digital support for cultural-tourism integration.

Second, optimize industrial structures and advance technological innovation. Governments should implement policies encouraging traditional cultural and tourism enterprises to transition toward digitalization, networking, and intelligent operations. Foster new business models and formats

through measures like tax incentives and financial support for technological and operational innovation. Simultaneously, strengthen collaboration with universities and research institutions to facilitate the transfer and application of scientific achievements within the cultural and tourism sectors, thereby enhancing the industry's added value and core competitiveness.

Third, enhance the level of digital economic development in a tiered approach. Governments can employ multiple measures—including policy support, capital guidance, and talent cultivation—to help the digital economy overcome development bottlenecks and achieve a leap from quantitative to qualitative growth, thereby maximizing its catalytic effect on cultural-tourism integration. For provinces with lower digital economic development levels, the focus should be on strengthening the digital economic foundation. Attract digital enterprises through policy subsidies and tax incentives, drive the digital transformation of traditional cultural and tourism businesses, and gradually overcome the first threshold. For provinces positioned between the first and second thresholds, concentrate on the coordinated development of digital industrialization and industrial digitalization. Cultivate local leading digital cultural and tourism enterprises, build digital cultural and tourism industry clusters, elevate the overall level of the digital economy, and advance toward the second threshold. For provinces with advanced digital economies, encourage exploration of cutting-edge models such as metaverse tourism and digital twin attractions to serve as exemplary leaders, driving cultural-tourism integration to higher levels.

Fourth, leverage spatial spillover effects to strengthen regional coordination. Establish cross-regional digital cultural tourism collaboration mechanisms to promote platform interoperability, resource sharing, mutual visitor attraction, and co-branding. For instance, implement an "East-Central/West" digital cultural tourism assistance pairing mechanism where eastern regions export digital technologies and operational expertise to enhance cooperation in the digital economy, accelerate the digital transformation of central and western cultural tourism industries, and jointly advance deep integration.

References

[1] Esteban Ruiz Ballesteros, Macarena Hernández Ramírez. Identity and community—Reflections on the development of mining heritage tourism in Southern Spain. Tourism Management, 2007, 28: 677-687.

[2] Sun J F, Li S T, Ji X M, et al. Coupling Analysis and Optimization Measures of Cultural Resources Endowment and Tourism Industry in Shandong. Economic Geography, 2019, 39: 207-215.

[3] Zhang J. Study on the Integration Situation and Measures of Creative Industry and Tourism Industry in Metropolis. Tourism Forum, 2009, 2: 76-81.

[4] Zou Y. Fusion Development of Tourism and Cultural Creative Industry Mechanism—Taking Sichuan Chengdu as Example. Reformation & Strategy, 2017, 33: 126-132.

[5] Li C F, Ju P. Coupling Coordinative Degree Analysis of Cultural and Creative Industry and Tourism Industry under the Background of Cultural and Tourism Integration. Journal of Service Science and Management, 2020, 13: 97-117.

[6] Gao E D, Xie H Z. Research on Regional Culture Creative Industry and Tourism and Related Industry Integration Development—A Case Study of Xishan District of Kunming. Tourism Research, 2016, 8: 74-79.

[7] Zhang Y F, Zhu H Y. Empirical Research on Coupling Coordination of Cultural Industry and Tourism Industry in Southwest China. Areal Research and Development, 2013, 32: 16-21.

[8] Hou Bing, Zhou Xiaoqian. Measurement and Evaluation of Integration Situation between Cultural Industry and Tourism Industry in Yangtze River Delta Region. Economic Geography, 2015, 35(11): 211-217.

[9] Zhang H Y, Wang Z Y. Research on Industrial Convergence Development of Tourism Industry and Cultural Industry. Resource Development & Market, 2010, 26: 322-326.

[10] Su Z, Aaron J R, McDowell W C, et al. Sustainable synergies between the cultural and tourism industries: An efficiency evaluation perspective. Sustainability, 2019, 11(23): 6607.

[11] Shi Yan, Zhan Guohui. Index Construction, Influencing Factors and Promotion Strategies for High-Quality Development of Culture-Tourism Integration—A Case Study of Jiangsu. Nanjing Journal of Social Sciences, 2021, (7): 165-172.

[12] Liu Yingji, Zou Bingkun, Han Yuanjun, et al. Digital Economy Empowers High-Quality Development of Culture-Tourism Integration—Mechanism, Channels and Empirical Evidence. Tourism Tribune, 2023, 38(5): 28-41.

[13] Tang C, Liu Y, Wan Z, et al. Evaluation system and influencing paths for the integration of culture and tourism in traditional villages. Journal of Geographical Sciences, 2023, 78: 980-996.

[14] Qian Minghui, Li Huruong, Meng Tingting. Analysis and Evaluation of Culture-Tourism Integration Modes for Chinese-Style Modernization. Library Development, 1-21.

[15] Richards G (Ed.). Cultural tourism: Global and local perspectives. Psychology Press, 2007.

[16] Azmi E, Ismail M Z. Cultural Heritage Tourism: Kapitan Keling mosque as a focal point & symbolic identity for Indian muslim in Penang. Procedia-Social and Behavioral Sciences, 2016, 222: 528-538.

[17] Hacklin F, Marxt C, Fahrni F. An evolutionary perspective on convergence: inducing a stage model of inter-industry innovation. International Journal of Technology Management, 2010, 49(1-3): 220-249.

[18] Zhang Y. Research on the Integrated Development of Digital Economy and Cultural-Tourism Industry in Guangdong Province—An Empirical Study from 2013-2021. Proceedings of the 2023 14th International Conference on E-business, Management and Economics, 2023: 152-158.

[19] Zimmerhackel J S, Kragt M E, Rogers A A, et al. Evidence of increased economic benefits from shark-diving tourism in the Maldives. Marine Policy, 2019, 100: 21-26.

[20] Ma Xinyi. Research on the Dissemination of Urban Brand Image under the Background of Culture-Tourism Integration. Contemporary Tourism, 2020, (36): 69-70.

[21] Song Y. Digital economy and high-quality development from the perspective of economic development quality theory. Guizhou Social Sciences, 2019, 11: 102-108.

[22] Hojeghan S B, Esfangareh A N. Digital economy and tourism impacts, influences and challenges. Procedia-Social and Behavioral Sciences, 2011, 19: 308-316.

[23] Gong X Y, Wang H F. Research on the Development and Effects of Contemporary Digital Economy. E-Government, 2019, 8: 51-62.

[24] Wang J. Digital economy drives high-quality economic development: Factor allocation and strategic choice. Social Sciences in Ningxia, 2019, 5: 88-94.

[25] Wang K K, Wu G B, Zhang G. Has the development of the digital economy improved production efficiency. Economist, 2020, 10: 24-34.

[26] Nakatani R. Total factor productivity enablers in the ICT industry: A cross-country firm-level analysis. Telecommunications Policy, 2021, 45(9): 102188.

[27] Huang Xianfeng, Fu Chenglin, Gao Xin. Social Welfare Effect of Digital Economy and Its Mechanism—Spatial and Threshold Evidence from Chinese Cities. Review of Economy and Management, 2023, (5): 124-137.

[28] Stelnik E V, Kiyashko Y A, Lysikov P I. Information technology in the digital document management in the tourism industry as a perspective tool in increasing effectiveness of a tourist enterprise. IOP Conference Series: Materials Science and Engineering, 2019, 483(1): 012062.

[29] Voronkova L P. Virtual tourism: on the way to the digital economy. IOP Conference Series: Materials Science and Engineering, 2018, 463: 042096.

[30] Tang R. Digital economy drives tourism development—Empirical evidence based on the UK. Economic research-Ekonomska istraživanja, 2023, 36(1): 2003-2020.

[31] Yang Li, Li Menghan, Zhang Mingjie, et al. Research on the Influence Mechanism and Threshold Effect of Digital Economy Empowering Culture-Tourism Integration. Statistics and Decision, 2023, 39(12): 29-340.

[32] Zhang Jiabei, Wang Keke, Shi Tianle, Liu Runge. Research on Coupling and Coordinated Development of Ecological Protection, Digital Economy and Culture-Tourism Integration in the Yellow River Basin. Resource Development & Market, 2023, (12): 1684-1692.