Can the Digital Economy Enhance Tourism Economic Resilience in the Yellow River Basin? Postprint

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Abstract

The digital economy empowers the smart transformation of the tourism industry, enhancing the sector's overall crisis resistance and innovation transformation capabilities, thereby providing new opportunities for ecological protection and high-quality development in the Yellow River Basin. After systematically elaborating the theoretical foundation of how the digital economy influences tourism economic resilience, this study employs fixed effects models and difference-in-differences models to examine the impact of the digital economy on tourism economic resilience in the Yellow River Basin and its underlying mechanisms, based on panel data from 81 prefecture-level cities in the basin from 2008 to 2020. The findings indicate that: (1) The development of the digital economy can directly promote the enhancement of tourism economic resilience, and this conclusion remains robust after a series of robustness and endogeneity tests, including using the establishment of "Big Data Comprehensive Pilot Zones" as a quasi-natural experiment. (2) The digital economy indirectly enhances tourism economic resilience in the Yellow River Basin by promoting factor mobility and improving innovation levels. (3) Heterogeneity analysis reveals that the effect of the digital economy on tourism economic resilience in the Yellow River Basin is influenced by geographical location and the level of tourism development, manifesting as "middle reaches > upper reaches > lower reaches"; the promoting effect of the digital economy is more pronounced in regions with higher levels of tourism development. The research results provide policy implications for deeply advancing the "digital + tourism" development strategy in the Yellow River Basin and strengthening the tourism industry's capacity for risk prevention and response to external shocks.

Full Text

Can the Digital Economy Promote the Resilience of the Tourism Economy in the Yellow River Basin?

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Abstract

The digital economy empowers the intelligent transformation of the tourism industry, enhancing its overall crisis resistance and innovation capacity, thereby providing new opportunities for ecological protection and high-quality development in the Yellow River Basin. After systematically elaborating the theoretical foundation of how the digital economy influences tourism economic resilience, this study examines the impact of the digital economy on tourism economic resilience in the Yellow River Basin and its underlying mechanisms using panel data from 81 prefecture-level cities in the region from 2008 to 2020. Fixed-effects models and difference-in-differences (DID) models are employed for the empirical analysis. The results reveal that: (1) The development of the digital economy directly promotes tourism economic resilience, and this conclusion remains robust after a series of endogeneity and robustness tests, including using the establishment of "Big Data Comprehensive Experimental Zones" as a quasi-natural experiment. (2) The digital economy indirectly enhances tourism economic resilience in the Yellow River Basin by facilitating factor mobility and improving innovation capacity. (3) Heterogeneity analysis indicates that the positive effect of the digital economy on tourism economic resilience is influenced by geographical location and the level of tourism development, showing a pattern of "midstream > upstream > downstream." The digital economy demonstrates stronger promotional effects in regions with higher levels of tourism development. These findings provide a policy basis for the Yellow River Basin to advance its "digital + tourism" development strategy and strengthen the tourism industry's ability to prevent risks and respond to external shocks.

Keywords: digital economy; tourism economic resilience; factor flow; innovation capacity; Yellow River Basin

1. Introduction

Tourism, as a green industry that supports sustainable development, can help resolve the dilemma between economic growth and ecological protection in the Yellow River Basin, thereby achieving high-quality development within the watershed. At present, due to the lack of systematic development of tourism

resources, the tourism industry in the Yellow River Basin exhibits fragmented and disordered development, with weak resistance to external risks. There is an urgent need to enhance internal capabilities for preventing and responding to shocks to adapt to the constantly changing external environment and tourist demands. Resilience refers to a system's ability to recover after experiencing shocks. Following the emphasis on strengthening the resilience of industrial and supply chains in the 20th Party Congress report, "resilience" has become an important topic in economic research. Tourism economic resilience refers to the ability of the tourism industry to respond to risks, recover and adjust, and restructure and upgrade. Scholars have conducted research on its theoretical connotation, measurement methods, and influencing factors. Among these factors, the digital economy, as a new economic form, plays a significant role in improving tourism factor efficiency and optimizing industrial structure. This raises several key questions: Can the digital economy enhance tourism economic resilience? What are the mechanisms through which it operates? How can the digital economy be effectively leveraged to build a strong and resilient modern tourism system in the Yellow River Basin? While some scholars have explored the role of digital economy in tourism supply chain resilience, few studies have examined its impact on tourism economic resilience from the perspective of the digital economy itself. In light of this gap, this study takes the ecologically vulnerable Yellow River Basin as the research area to examine both the direct impact of the digital economy on tourism economic resilience and its indirect effects through two dimensions—factor flow and innovation capacity. The aim is to provide a theoretical foundation and policy recommendations for promoting digital transformation and enhancing regional tourism economic resilience in the Yellow River Basin.

2. Study Area Overview

The Yellow River is China's second-largest river, spanning four geomorphic units: the Qinghai-Tibet Plateau, the Mongolian Plateau, the Loess Plateau, and the North China Plain. It flows from west to east through nine provinces and autonomous regions, covering a drainage area of 79.2$×10^{4}$ km^2 and boasting rich natural landscapes and cultural heritage. The Outline of the Plan for Ecological Protection and High-Quality Development of the Yellow River Basin emphasizes that protecting and inheriting Yellow River culture requires promoting the integrated development of culture and tourism, making the cultural tourism industry a pillar industry. However, the inherent vulnerability of the tourism economic system has created shortcomings for high-quality cultural and tourism development in the Yellow River Basin. Therefore, research on tourism economic resilience can help overcome the limitations imposed by external shocks on tourism economic development.

In terms of sample selection, since Sichuan Province has been classified as part of the Yangtze River Economic Belt, this study selects 81 prefecture-level cities in the Yellow River Basin as research subjects (Fig. 1). The data for these

cities from 2008 to 2020 are obtained from the *China City Statistical Yearbook*, *China Urban-Rural Construction Statistical Yearbook*, provincial and municipal statistical yearbooks, the EPS database, and national economic and social development statistical bulletins. Missing data for individual years and regions are supplemented using linear interpolation. To mitigate the potential impact of extreme outliers on estimation results, this study performs winsorization on core variables. The descriptive statistics of the main variables are presented in Table 1.

[Figure 1: see original paper]

3. Theoretical Foundation and Research Hypotheses

The new productive forces and supply models spawned by the digital economy have become dual drivers of industrial development, providing solutions to problems such as supply-demand mismatches and slow transformation and upgrading in the Yellow River Basin's tourism industry, and promoting the construction of tourism economic resilience. The theoretical framework of how the digital economy affects tourism economic resilience is illustrated in Fig. 2, with specific mechanisms divided into direct effects and transmission mechanisms.

3.1 Direct Effects of Digital Economy on Tourism Economic Resilience

When the tourism economic system experiences external shocks, the digital economy can enhance resilience through several pathways. First, the digital economy helps promote the agglomeration of digital tourism industries, dispersing the negative impacts of shocks. According to Metcalfe's Law, the network value of the digital economy increases exponentially with the number of internet users, significantly improving the smoothness and breadth of information flow, substantially reducing information search costs, and thereby creating economies of scale and scope on both supply and demand sides. This stimulates diversified demand and services and extends the tourism industry chain vertically. The expansion of the "chain" structure in both horizontal and vertical directions presents more diversified industrial characteristics, which blunts uncertain risks and reduces sunk costs, enabling the tourism economic system to demonstrate stronger resistance.

Second, the digital economy can promote the reorganization of industrial resources, enhancing the recovery capacity of tourism economies. Through technological cross-integration, the digital economy affects all stages of tourism production and consumption, helping to build resource information networks that connect dispersed and closed factor resources within the industry, and boosting the reintegration of internal tourism resources to improve resource allocation efficiency. Particularly after suffering uncertain shocks that break the industrial balance and amplify existing shortcomings and deficiencies in the tourism system, the original combination of industrial resources becomes insufficient to drive the tourism economic system back to its pre-shock development trajec-

tory. The digital economy can rapidly adjust and reorganize factors, improving the industry's recovery capacity from crises and its self-regulation ability in response to external environmental changes, enabling the tourism industry to quickly emerge from downturns.

Finally, the digital economy facilitates the upgrading of tourism industrial structure through digital technology, achieving a transformation of industrial growth paths. Big data visualizes the intangible experiences of tourists during consumption, allowing tourism enterprises to adjust tourism product production through statistical analysis of user demand data. This better satisfies consumers' curiosity-seeking mentality and shifts tourism development value toward a "user-oriented" model, fundamentally changing tourism business operation logic and improving industrial production and operational efficiency. Additionally, artificial intelligence and 5G technology promote the digital and intelligent transformation of the tourism industry, with new tourism forms such as online tourism and digital culture-tourism continuously releasing new vitality. The digital economy promotes industrial structure upgrading by improving tourism industry efficiency and spawning new business forms, enabling the industry to leap into a new development trajectory after stabilizing from shocks.

Hypothesis 1: Digital economic development can directly promote the improvement of tourism economic resilience.

3.2 Transmission Mechanisms of Digital Economy's Impact

The digital economy is a technology-intensive new economic form that plays an important role in improving innovation levels and stimulating innovation vitality. For the supply side, innovation activities require substantial factor inputs in the early stage, and their high-cost, high-risk characteristics reduce enterprises' innovation enthusiasm, with only a few large-scale tourism enterprises conducting independent R&D. However, the internet reduces the cost of searching for and using innovation resources, significantly lowering the threshold for innovation activities, stimulating enterprise innovation vitality, and improving the overall innovation efficiency and service level of the tourism industry. For the demand side, the digital economy transforms the tourism industry from relying on perceptual experience to making scientific decisions based on objective data, with consumers' real needs becoming the fundamental basis for tourism product innovation. Big data platforms break down barriers between production and consumption ends, allowing enterprises to accurately analyze tourists' consumption needs by collecting browsing and consumption traces, reducing innovation risks and similarly enhancing enterprise innovation enthusiasm. From the perspective of supply-demand matching, the digital economy effectively connects innovation subjects and innovation links, spawning new business forms, structures, and products. More diversified industrial structures have stronger positive externalities and risk resistance capabilities, enabling the tourism industry to adjust more promptly after suffering shocks, stimulate new momentum, and obtain long-term and stable tourism economic resilience.

Hypothesis 2: Digital economic development can promote the improvement of tourism economic resilience through factor flow.

Hypothesis 3: Digital economic development can promote the improvement of tourism economic resilience through innovation capacity.

According to the Cobb-Douglas production function, labor and capital are important input factors, and the free flow of factors can not only improve labor productivity in inflow regions but also increase factor returns in outflow regions. The inclusion of digital resources into the production factor system has boosted factor marketization and free factor flow, particularly under the background of highly open and rapidly disseminated data information. The administrative and trade barriers between cities are broken down, reducing the flow costs caused by factor market friction, accelerating the inter-regional circulation speed of production factors, and making factor allocation more rationalized. Specifically, in the labor market, the digital economy alleviates past information asymmetry problems, promotes the deep integration of high-quality human capital and the tourism industry, and enhances risk awareness and forward-thinking in the tourism sector. In the capital market, digital technology incubates inter-regional online economic and trade cooperation platforms, optimizing capital market investment decisions and service models, strengthening external market supervision of capital, making investment decisions more rational, effectively curbing inefficient investment, and significantly improving the scope and efficiency of capital flow. The rapid flow of labor and capital enables tourism industry resource allocation to become more complete, allowing optimal factor combinations to be matched at different stages of responding to shocks, thereby enhancing tourism economic resilience.

4. Data, Variables, and Models

4.1 Data Sources and Processing

The panel data for 81 prefecture-level cities in the Yellow River Basin from 2008 to 2020 are sourced from the *China City Statistical Yearbook*, *China Urban-Rural Construction Statistical Yearbook*, provincial and municipal statistical yearbooks, the EPS database, and national economic and social development statistical bulletins. Missing data for individual years and regions are supplemented using linear interpolation. The 5A-level scenic area data are manually compiled based on lists published by provincial and municipal culture and tourism departments. To mitigate the potential impact of extreme outliers on estimation results, this study performs winsorization on core variables. The descriptive statistics of the main variables are presented in Table 1.

4.2 Variable Definitions

4.2.1 Explained Variable: Tourism Economic Resilience (Res) Based on a review of existing research, this study constructs an evaluation system for

tourism economic resilience from three dimensions: resistance, recovery, and renewal, selecting 15 specific indicators (Table 2). The entropy method is used for weighting. The 5A-level scenic area index is calculated by normalizing regional 5A-level scenic area data, assigning scores of 5, 4, 3, 2, and 1 respectively, and then summing them up. Since prefecture-level cities have not published data on tourism employment and tourism fixed assets, this study follows the approach of Li et al. and calculates these by multiplying the number of employees in the tertiary industry and fixed asset investment by the proportion of tourism revenue to the city's tertiary industry value-added.

4.2.2 Explanatory Variable: Digital Economy (Dec) Following the perspectives of scholars such as Zhao and Huang, and based on the basic connotation of the digital economy and data availability, this study selects four indicators: mobile phone users, internet penetration rate, digital output, and digital industry employees. Using the entropy method to process these four indicators, the digital economy development level of 81 prefecture-level cities in the Yellow River Basin is obtained (Table 3).

4.2.3 Control Variables The control variables include: (1) Economic density (Ecd), measured by GDP per square kilometer; (2) Financial development level (Fin), measured by the ratio of year-end financial institution loans to GDP; (3) Market size (Mar), measured by the proportion of total retail sales of consumer goods to GDP; (4) Government support (Gov), measured by the proportion of local fiscal budget expenditure to GDP; and (5) Population size (Pop), measured by total urban population.

4.2.4 Mechanism Variables The mechanism variables are factor flow (Med) and innovation capacity (Inn). Factor flow is synthesized from regional labor and capital flow levels, with labor flow measured by the ratio of employment to total population and capital flow measured by the increase in fixed assets. Innovation capacity is measured by the number of invention patents per 10,000 people.

4.3 Model Specifications

4.3.1 Benchmark Regression Model To avoid omitted variable bias caused by individual characteristics and temporal changes, this study employs a fixed-effects model to verify the direct impact of the digital economy on tourism economic resilience in the Yellow River Basin. The model is specified as:

$$Res_{it} = \alpha_0 + \alpha_1 Dec_{it} + \alpha_2 X_{it} + \mu_i + \gamma_t + \varepsilon_{it}$$

where Res_{it} represents tourism economic resilience; Dec_{it} represents the digital economy; X_{it} represents a series of control variables including economic density and financial development level; μ_i and γ_t denote individual and time fixed

effects, respectively; ε_{it} is the random disturbance term; i and t represent region and year, respectively; and α_0 is the constant term.

4.3.2 Difference-in-Differences Model To examine the impact of the "Big Data Comprehensive Experimental Zone" policy on tourism economic resilience, the following DID model is specified:

$$Res_{it} = \beta_0 + \beta_1 Treated_{it} + \beta_2 X_{it} + \mu_i + \gamma_t + \varepsilon_{it}$$

where $Treated_{it}$ is a dummy variable reflecting whether the "Big Data Comprehensive Experimental Zone" policy has been implemented. If region i has not implemented the policy in year t, it takes a value of 0; otherwise, it takes a value of 1. β_0 is the constant term, and β_1 and β_2 are the estimated coefficients for the policy dummy variable and control variables, respectively.

4.3.3 Mechanism Testing Model To test the theoretical mechanisms through which the digital economy affects tourism economic resilience in the Yellow River Basin, the following mechanism testing model is constructed:

$$Med_{it} = \delta_0 + \delta_1 Dec_{it} + \delta_2 X_{it} + \mu_i + \gamma_t + \varepsilon_{it}$$

where Med_{it} represents the mechanism variables factor flow and innovation capacity. δ_0 is the constant term, and δ_1 and δ_2 are the estimated coefficients for the digital economy and control variables, respectively.

5. Empirical Results and Analysis

5.1 Benchmark Regression Results

Following a Hausman test, the fixed-effects model is selected, and control variables are added for benchmark regression (Table 4). The regression results show that regardless of whether control variables are included, the estimated coefficients are significant, indicating that digital economic development can promote tourism economic resilience. After adding control variables, the coefficients for economic density, financial development level, and market size are all significantly positive, indicating that regions with higher economic density, better financial development, and larger market size can rapidly adjust their industries and possess stronger crisis resistance capacity. The relationship between government support and tourism economic resilience is not significantly positive, possibly because the government has long been the central force in governance and development in the Yellow River Basin due to its difficult management challenges. However, in practice, opportunistic rent-seeking and insufficient supervision may lead to excessive government intervention, causing factor distortion and resource misallocation, which are not conducive to establishing and improving the tourism economic resilience system in the Yellow River Basin.

Population size also fails the significance test, possibly because cities with larger populations are prone to causing tourism resource depletion and ecological environmental pollution during rapid economic development, hindering sustainable tourism development.

5.2 Robustness Tests

5.2.1 Lagged Explanatory Variable Since the effects of the digital economy may have certain time lags, this study uses a one-period lag of the explanatory variable for robustness testing. As shown in Table 4, after lagging the digital economy variable by one period, the coefficient signs remain unchanged and significance levels show little change, indicating that the regression results are robust.

5.2.2 Exogenous Shock Test To implement the *Outline for Promoting Big Data Development* and address issues such as weak digital industry foundations and insufficient data sharing in China, the National Development and Reform Commission, Ministry of Industry and Information Technology, and Cyberspace Administration of China have successively approved the establishment of National Big Data Comprehensive Experimental Zones in Guizhou, Henan, Inner Mongolia, Liaoning, Shanghai, Chongqing, Beijing, and Tianjin since 2015. This policy implementation aims to enable digital technology and products to benefit different populations, industries, and regions, strengthen the dividend effects of the digital economy, and promote China's overall economy toward intensification and digitalization. This policy provides a new approach for robustness testing in this study. Therefore, the establishment of the "Big Data Comprehensive Experimental Zone" is used as a quasi-natural experiment, and a DID model is employed to assess the policy's actual effect and verify whether digital economy development can improve tourism economic resilience in the Yellow River Basin.

The experimental group consists of 9 cities in Henan Province and Inner Mongolia Autonomous Region within the Yellow River Basin that have been approved to establish Big Data Comprehensive Experimental Zones, while the control group comprises 72 prefecture-level cities in the Yellow River Basin that have not been approved. Before regression, this study follows the approach of Jacobson et al. and uses an event study method to conduct a parallel trend test (Fig. 3) to ensure no significant difference exists between the experimental and control groups before policy implementation. The results show no systematic differences between the groups before policy implementation, satisfying the parallel trend assumption.

Table 4 presents the results after controlling for a series of variables and fixed effects, demonstrating that the "Big Data Comprehensive Experimental Zone" can robustly promote tourism economic resilience in the Yellow River Basin. To exclude the influence of certain unobservable factors on the policy's actual effect, this study conducts a placebo test on the DID model estimation results.

Based on the distribution of Big Data Comprehensive Experimental Zones in the Yellow River Basin, 500 random sampling tests are performed by randomly generating experimental and control groups. The placebo test results (Fig. 4) show that the regression coefficients are normally distributed near zero, indicating that other unobservable factors have not significantly affected the policy effect of the Big Data Comprehensive Experimental Zones.

[Figure 3: see original paper]
[Figure 4: see original paper]

5.3 Mechanism Identification

According to the theoretical analysis, factor flow and innovation capacity are key factors for the tourism industry to adapt to environmental changes and transform growth paths after external shocks. To analyze the relevant mechanisms, Model (3) is empirically tested (Table 5).

5.3.1 Factor Flow Mechanism The regression results in columns (1)-(2) show that regardless of whether control variables are included, the regression coefficients for factor flow are significantly positive, indicating that digital economic development helps reduce trade costs for economic entities and achieve free factor flow. Digital general technology builds high-efficiency, low-cost service platforms, weakens information asymmetry in factor markets, breaks down temporal and spatial trade barriers, and thus reduces the difficulty of inter-regional factor flow. Higher factor flow intensity makes it more likely for tourism enterprises to obtain high-quality production factors and optimize and upgrade their products, helping the tourism industry break away from "low-end lock-in" and achieve quality transformation, thereby supporting the improvement of tourism economic resilience in the Yellow River Basin. This verifies Hypothesis 2.

5.3.2 Innovation Capacity Mechanism The regression results in columns (3)-(4) show that regardless of whether control variables are included, the regression coefficients for innovation capacity are significantly positive. This indicates that data, as a new factor of production, has triggered changes in traditional production models, product forms, and market organizations. For the tourism industry, innovation brought by the digital economy can change original business models, adjust the total and structural imbalances existing on both supply and demand sides. As digitalization of the tourism industry continues to advance, it helps form an industrial pattern with two-way feedback between supply and demand, achieving innovative services across the entire tourism industry chain. This helps the tourism industry reduce its dependence on homogeneous products, integrate internal and external resources, enhance the industry's forward-looking perspective on market development, improve tourism service quality, and enable timely dynamic response and adjustment when unpredictable external shocks occur on either the supply or demand side, thereby enhancing

tourism economic resilience. This verifies Hypothesis 3.

5.4 Heterogeneity Analysis

5.4.1 Basin Heterogeneity Affected by geography, history, and economic development conditions, there are significant differences in digital economy levels and tourism economic resilience across the upstream, midstream, and downstream regions of the Yellow River Basin. Therefore, this study further examines the heterogeneity of the digital economy's impact on tourism economic resilience by dividing the 81 prefecture-level cities into upstream, midstream, and downstream regions for fixed-effects regression testing (Table 6). The results show that the digital economy does not have a consistent promotional effect across different regions of the Yellow River Basin. Specifically, the regression coefficients for upstream, midstream, and downstream regions all pass significance tests, but present a "midstream > upstream > downstream" pattern. The possible reasons are: On the one hand, digital development in downstream regions started earlier than in midstream and upstream regions, leading to diminishing marginal effects of the digital economy, which may even distort the tourism industrial structure due to excessive pursuit of the virtual economy. On the other hand, as China has repeatedly emphasized the construction of digital information infrastructure in recent years, policies and funds for digital economy development have gradually shifted toward midstream and upstream cities, creating a favorable institutional environment and financial reserves for urban digital economy development and enabling these regions to overtake downstream regions in building tourism economic resilience systems.

5.4.2 City Heterogeneity The impact of the digital economy on tourism economic resilience may vary with different levels of tourism development. This study conducts heterogeneity tests based on whether cities are designated as "China Excellent Tourism Cities" (Table 6). Cities designated as excellent tourism cities are considered to have higher tourism development levels, while others have lower levels. The regression results show that the coefficient for excellent tourism cities is significant at the 1% level, while the coefficient for non-excellent tourism cities is significant at the 5% level. This indicates that under different tourism development levels, the digital economy has significantly different effects on tourism economic resilience, with better promotional effects in regions with higher tourism development levels. The underlying logic may be that regions with higher tourism development levels have richer tourism resources and better market environments, providing preconditions for tourism industry development, while the digital economy further optimizes resource allocation and promotes tourism economic resilience.

6. Conclusions and Policy Implications

Overall, the Yellow River Basin urgently needs to enhance the anti-fragility of its tourism system, and the digital economy provides a new perspective for

building a resilient tourism industry. Through theoretical and empirical research, this study finds that the digital economy, with its unique advantages in information transmission and data processing, can break through geographical space limitations and play an important role in reorganizing production factors and reconstructing production links, thereby enhancing tourism economic resilience in the Yellow River Basin. Compared with previous studies, this research innovates by measuring and analyzing tourism economic resilience at the prefecture-level city scale in the Yellow River Basin, moving beyond single descriptions of spatiotemporal evolution characteristics and enriching the resilience research system. However, this study has certain limitations in measuring the digital economy and tourism economic resilience, which should be addressed in future research by overcoming data constraints and constructing more comprehensive and reasonable measurement models to provide more scientific references for modern tourism system construction in the Yellow River Basin. Additionally, further empirical investigation into the effects of the digital economy on resistance, recovery, and renewal capacities is needed to more deeply and systematically reveal how the digital economy promotes tourism economic resilience.

The main conclusions are as follows: (1) The digital economy has a significant positive impact on tourism economic resilience—the higher the level of digital economy development, the greater its promotional effect on tourism economic resilience. (2) As an important policy arrangement to accelerate China's digital economy construction, the establishment of National Big Data Comprehensive Experimental Zones has significantly improved tourism economic resilience, and this result remains robust after parallel trend tests and placebo tests. (3) Factor flow and innovation capacity are important transmission channels through which the digital economy affects tourism economic resilience in the Yellow River Basin. (4) Heterogeneity analysis shows that the positive effect of the digital economy on tourism economic resilience in the Yellow River Basin is influenced by geographical location and tourism development level, specifically showing a "midstream > upstream > downstream" pattern. The digital economy demonstrates better promotional effects in regions with higher tourism development levels.

Based on these findings and China's current uncertain external environment, to enhance tourism economic resilience in the Yellow River Basin, the government should utilize digital technology to monitor environmental pollution and promote the ecological transformation of tourism development. It should strengthen the promotional effects of factor flow and innovation capacity, break the pattern of "nine provinces managing the Yellow River separately," and achieve regional collaborative governance. Simultaneously, tourism development should pay attention to regional differences, with localities formulating differentiated development strategies according to their industrial environment and market demands.

References

[1] Martin R, Sunley P, Tyler P. Local growth evolutions: Recession, resilience and recovery[J]. Cambridge Journal of Regions, Economy and Society, 2015, 8(2): 141-148.

[2] Lu Lin, Li Lei, Hou Ying. Resilience and quality development of tourism sites in the context of the epidemic crisis[J]. Tourism Tribune, 2022, 37(9): 1-3.

[3] Cellini R, Cuccia T. The economic resilience of tourism industry in Italy: What the great recession data show[J]. Tourism Management Perspectives, 2015, 16: 346-356.

[4] Fang Yelin, Wu Yanni, Huang Zhenfang, et al. Evolution of inbound tourism industry and its resilience in Chinese mainland[J]. Economic Geography, 2023, 43(1): 188-196.

[5] Ntounis N, Parker C, Skinner H, et al. Tourism and hospitality industry resilience during the COVID-19 pandemic: Evidence from England[J]. Current Issues in Tourism, 2022, 25(1): 46-59.

[6] Pocinho M, Garcês S, de Jesus S N. Wellbeing and resilience in tourism: A systematic literature review during COVID-19[J]. Frontiers in Psychology, 2022, 12: 748947.

[7] Tian Xiaobo, Hu Jing, Jia Yaoyan, et al. Exploring the causes of spatial differentiation of tourism development level in the high-quality development stage: Empirical evidence of Yellow River Basin based on factor decomposition[J]. Arid Land Geography, 2023, 46(3): 460-470.

[8] Pei Changhong, Ni Jiangfei, Li Yue. Approach digital economy from the perspective of political economics[J]. Finance & Trade Economics, 2018, 39(9): 5-22.

[9] Jing Wenjun, Sun Baowen. Digital economy promotes high-quality economic development: A theoretical analysis framework[J]. Economist, 2019(2): 66-73.

[10] Zhao Tao, Zhang Zhi, Liang Shangkun. Digital economy, entrepreneurship, and high-quality economic development: Empidence from urban China[J]. Management World, 2020, 36(10): 65-76.

[11] Yang Yong, Wu Xue. From the digital economy to the digital divide: New logic and new problems in tourism development[J]. Tourism Tribune, 2022, 37(4): 3-5.

[12] Wang Bida, Su Jing. Can the free flow of factors lead to regional coordinated development: A theoretical hypothesis and empirical test based on coordinated agglomeration[J]. Finance & Trade Economics, 2020, 41(4): 129-143.

[13] Huang Qunhui, Yu Yongze, Zhang Songlin. Internet development and productivity growth in manufacturing industry: Internal mechanism and China experiences[J]. China Industrial Economics, 2019(8): 5-23.

[14] Chen Xiaohong. Trend analysis of technology fusion and application innovation in the digital economy era[J]. Journal of Central South University (Social Sciences Edition), 2018, 24(5): 1-8.

[15] Theilmann C, Hukauf M. Customer integration in mass customisation: A key to corporate success[J]. International Journal of Innovation Management, 2014, 18(3): 1-23.

[16] Wang Kaifeng, Wu Chaolin. The impact of income disparity on environmental total factor productivity in Chinese cities: Evidence from 285 cities at prefecture level and above[J]. Inquiry into Economic Issues, 2018(2): 49-57.

[17] Li Lu, Liu Xuehua. Industrial structure change in China and its determinants[J]. The Journal of Shanghai Administration Institute, 2020, 21(4): 97-111.

[18] Du Chuanzhong, Zhang Yuan. On the mechanism of the impact of digital economic development on the growth of enterprise productivity[J]. Securities Market Herald, 2021(2): 41-51.

[19] Chen Wanling, Hu Yao. The economic effects of the establishment of pilot free trade zones: An analysis based on factor flow and economic growth[J]. International Business Research, 2023, 44(1): 70-86.

[20] Wen Jun, Yan Zhijun, Cheng Yu. Digital economy and upgrading regional innovation capacity[J]. Inquiry into Economic Issues, 2019(11): 112-124.

[21] Han Xianfeng, Song Wenfei, Li Boxin. Can the internet become a new momentum to improve the efficiency of regional innovation in China[J]. China Industrial Economics, 2019(7): 119-136.

[22] Cainelli G, Ganau R, Modica M. Industrial relatedness and regional resilience in the European Union[J]. Papers in Regional Science, 2019, 98(2): 755-778.

[23] Tian Kun, Xing Weibo, Huang Kun. Transportation infrastructure upgrading and high-quality development of tourism economy: An empirical study based on the opening of high-speed railway[J]. China Journal of Economics, 2023, 10(1): 1-25.

[24] Xu Yuan, Zhang Linling. The economic resilience of Chinese cities and its origin: From the perspective of diversification of industrial structure[J]. Finance & Trade Economics, 2019, 40(7): 110-126.

[25] Wang Hongyan, Ma Yaofeng. Research on the tourism resources and inbound tourism in Shaanxi Province based on the theory of spatial mismatch[J]. Journal of Arid Land Resources and Environment, 2016, 30(10): 198-203.

[26] Tan Zhixiong, Luo Jiahui, Han Jingwei. Comparative advantage, factor flow and industrial low-end locked breakthrough: Based on the new perspective of dual circulation[J]. Economist, 2022(4): 45-57.

[27] Boschma R. Towards an evolutionary perspective on regional resilience[J]. Regional Studies, 2015, 49(5): 733-751.

[28] Li Zhilong, Wang Diyun. Temporal and spatial differentiation of tourism economy: Ecological efficiency and its influencing factors in Wuling Mountain area[J]. Economic Geography, 2020, 40(6): 233-240.

[29] Jacobson L S, Lalonde R J, Sullivan D G. Earnings losses of displaced workers[J]. The American Economic Review, 1993, 83(4): 685-709.

[30] Wu Dandan, Feng Xuegang, Ma Renfeng, et al. Nonlinear effects of digital economy development on tourism total factor productivity[J]. Tourism Tribune, 2023, 38(2): 47-65.

[31] Li Su, Liu Haonan. Spatio-temporal pattern evolution of coupling coordination between urbanization and ecological resilience in arid region: A case of Ningxia Hui Autonomous Region[J]. Arid Land Geography, 2022, 45(4): 1281-1290.

Note: Figure translations are in progress. See original paper for figures.