

The Impact of Digital Economy on Tourism Industry Development in China

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Abstract— The rapid development of digital economy brings opportunities and challenges to various industries, and digital drive has become a general trend. It is of great significance for a large country with a large population and a large tourism country like China to use the digital economy to improve the quality of the tourism industry, to explore the impact of the digital economy on the development of China's tourism industry, and to explore the moderating role of tourism industry agglomeration and tourism industry innovation on the development of the tourism industry under the influence of the digital economy. This paper constructs an indicator system for the development level of digital economy and tourism industry, adopts a panel data regression model, uses a fixed effect model to estimate the impact of the digital economy on the development of tourism industry, and divides China into four regions to explore regional heterogeneity. Finally, tourism industry agglomeration and tourism industry innovation are included in the moderating effect model for regression analysis.

Keywords: Digital economy, Tourism industry development, Panel data regression model, Moderating effect.

I. INTRODUCTION

As the world's second largest economy and the largest developing country, China's rapid development in the field of digital economy is particularly remarkable. According to the China Academy of Information and Communications Technology, China's digital economy will reach 56.7 trillion yuan by 2023, ranking second in the world in terms of total volume, with a nominal year-on-year growth of 10.3 per cent and a share of 43.5 per cent of GDP. This indicates that the importance of the digital economy in China's economic development is becoming more and more obvious. As the world's most populous country, China is rich in tourism resources and the tourism industry is developing rapidly. By 2023, the country's resident population will be about 1.41 billion, total GDP will reach 126 trillion yuan, and total tourism consumption will exceed 4.9 trillion yuan, occupying an important position in the global tourism market. China's tourism industry has become one of the pillar industries of the national economy, and undoubtedly, the digital economy has become a new engine driving the development of the tourism industry. However, with the rapid development of China's tourism industry and the digital economy, some deep-rooted problems have gradually appeared: the serious homogenisation of tourism products, uneven quality of services, imbalanced regional development, and the risk of personal privacy and security. All the drawbacks about technology will still pose a threat to the tourism market. Therefore, the question of how the digital economy affects the development of the tourism industry and what is the underlying mechanism is still worth exploring in depth. Therefore, the objective of this research is based on the degree of importance of digital economy in the development of tourism industry, empirically study the mechanism of digital economy's impact on the development of tourism industry, and reveal the specific mechanism of digital economy's impact on the development of tourism industry, which is of great significance for the better development of the digital economy and ultimately realising the long-term sustainable development of the tourism industry.

II. LITERATURE REVIEW

Since 2000, scholars have conducted research around the impact of digital technology on the tourism industry, and through the comparative combing and analysis of a large amount of literature, it is found that most of the research affirms the positive impact of digital technology on the tourism industry and significantly improves the development level of the tourism industry, but there are also many studies that question this conclusion.

Gössling, S. (2020) concludes after an empirical study that technology and ICTs advance sustainable tourism development in small ways, but that their potential can be harnessed to achieve more desirable outcomes; Van Nuenen (2021) explores the use of artificial intelligence in tourism and the methodological potential of digital technologies in tourism research, where the sharing economy relies on digital infrastructure platforms that have greatly impacted the tourism industry, driving innovation and transformation in the development model of the tourism industry; Karimov, N. (2021) compares the trends of penetration of digital economy in tourism industry in European countries and Uzbekistan. The comparison reveals that nowadays digital technologies are rapidly penetrating into all spheres of human life, and that in the future the digitalisation of the tourism sector will expel traditional offline offices from the tourism market and design tour itineraries according to the parameters set by each particular customer; L P Voronkova (2018) encourages the transformation of the tourism industry towards a people-centred

digital economy. She points out the importance of the digital transformation of tourism for the development of the digital economy, as well as the negative consequences of the introduction of virtual reality technologies into the tourism sector. The use of virtual tours can attract potential customers, visualisation helps to enhance the positive image of the destination, increase the number of tourists and thus lead to the development of the economy. However, virtual tourism could also lead to a decrease in the flow of tourists because of certain security issues or the need to protect the natural heritage; D Hryhorchuk (2022), by analysing the specifics of the use of digital technologies as a condition for the development of the tourism sector of the Ukrainian economy, has concluded that the use of interactive technologies can be a new driving force for the Ukrainian tourism industry, thus creating a new competitive advantage in the region and differentiation based on a personalised approach and customer orientation; V Roblek (2016), by reviewing the existing literature on the importance and impact of the sharing economy, digital platforms and internet connectivity technologies on the creation of business performance in tourism and hospitality, found that innovative technologies, social media and digital platforms can provide customer-orientated services and represent an important framework for low-cost marketing campaigns that can attract a large number of potential guests; Ogechi Adeola et al. with the help of a dynamic panel gravity model explored the impact of the development of ICT on tourism development in Africa in the period 1996-2016, and the results of the research showed that the development of ICT and infrastructure has an impact on tourism development. technology and infrastructure development have a positive and significant relationship on tourism development. Rui Tang (2023) used data from 2011-2019 in the UK as an example to measure the level of tourism industry development by tourism consumption, and the empirical study found that there is a marginal growth trend in the role of the digital economy as a driver of tourism in the UK in each country, and that the digital economy positively affects the tourism business and the holiday market, and can promote the development of the tourism industry by strengthening the ability to regulate the market as well as enhancing trade freedom; HA Yuan (2023) and others, based on the theory of tourism supply and demand, found that the digital economy has a significant positive effect on promoting the high-quality development of the tourism industry by using the panel data of 2013-2019; X Li (2022) investigated the impact of the digital economy on the integration of China's cultural tourism industry in the context of COVID-19 by measuring the degree of integration of the cultural tourism industry as a proxy variable for the integration of culture and tourism, using the Digital Inclusion Index (DII) in place of the digital economy, and found that the development of the digital economy during the COVID-19 pandemic did promote the integration of China's cultural tourism industry; Q Zhou (2024) explored the specific impact of the digital economy on rural tourism consumption based on Chinese Family Tracking Study (CFPS) data for 2016, 2018 and 2020, and found that the digital economy can promote rural tourism consumption by increasing wage income; ML Belonozhko (2019), after a study showed that digital tourism has completely changed the overall structure of the tourism industry and it can attract a large number of viewers at a relatively low cost.

Next is about the selection basis of the variables in this paper: for the independent variable digital economy development level, according to the index system of digital economy development level constructed by J Wang (2021), a total of 19 indicators in 4 dimensions, digital infrastructure, digital industrialisation, industrial digitisation, digital innovation capacity, are measured. For the dependent variable tourism industry development level, according to the tourism economy and ecological environment coordinated development degree model constructed by XS Qu (2022), it is described by 11 indicators in 3 dimensions, namely market scale, industry level, and economic efficiency. Secondly, regarding the selection of the two regulating variables, XY Wang (2020) studied the degree of coupling and the mechanism of synergistic development of tourism economy and ecological environment based on the perspective of diversified agglomeration, which confirmed that diversified clustering of the tourism industry can promote the tourism economisation, so that the clustering of the tourism industry can be selected as a regulating variable. The calculation formula is as follows:

$$S_{i,t} = \frac{\text{rev}_{i,t}/\text{gdp}_{i,t}}{\sum \text{rev}_{i,t}/\sum \text{gdp}_{i,t}} \quad (1)$$

Where $S_{i,t}$ denotes the tourism industry clustering index of province i in year t ; $\text{rev}_{i,t}$ denotes the total tourism revenue of province i in year t ; $\text{gdp}_{i,t}$ denotes the gdp of province i in year t ; $\sum \text{rev}_{i,t}$ denotes the total tourism revenue of China in year t ; and $\sum \text{gdp}_{i,t}$ denotes the gdp of China in year t . The data are obtained from the China Tourism Statistical Yearbook and the previous years of China's statistical yearbooks.

JB Jiang (2018) studied nine cities in the Pearl River Delta and found that Guangzhou, Zhongshan, and Shenzhen have stronger tourism innovation capabilities, so tourism industry innovation can also be used as one of the moderating variables, which can be measured by using the number of China's tourism patent applications and the number of tourism academic papers published.

Finally, regarding the selection of control variables, LJ Ma (2023) found that the factors influencing the tourism development gap include the level of economic development, tourism transport infrastructure, tourism resources, industrial structure, degree of openness to the outside world, and source market; according to GM Weng (2021), it was found that the level of urbanisation also influences the development of the tourism industry; and YC Sheng (2022) found that government promotion will have an

impact on tourism economic efficiency. Therefore, there are eight control variables, using GDP per capita to represent the level of economic development, the proportion of urban population to total population to represent the level of urbanisation, the proportion of total import and export trade to GDP to represent the level of opening up to the outside world, the proportion of tertiary industry value added to GDP to represent the industrial structure, the proportion of general fiscal expenditure to GDP to represent government intervention, the total amount of passenger transport to represent the transportation conditions, the number of accommodation and catering enterprises to represent the resource endowment, the Total regional population represents market size.

III.METHODOLOGY & DATA

This research uses the entropy method to measure the level of digital economy development and tourism industry development in 30 provinces in China from 2012 to 2022. After that, it uses panel data to construct an econometric model, applies panel data regression method to analyse the impact of digital economy on the development of tourism industry, and divides China into four regions, namely, eastern, central, western and northeastern, to explore regional heterogeneity. Finally, tourism industry agglomeration and tourism industry innovation are selected as moderating variables to further explore the moderating mechanism of the impact of digital economy on tourism industry development.

After F-test and Hausman test, it is judged that this paper chooses the fixed effect model to empirically analyse the impact of digital economy on tourism industry development, and the basic model is set as follows:

$$TID_{i,t} = \alpha_0 + \alpha_1 DE_{i,t} + \alpha_2 (DE_{i,t})^2 + \alpha_3 Z_{i,t} + \rho_i + \omega_i + \varepsilon_{i,t} \tag{2}$$

Where: $TID_{i,t}$ is the level of tourism industry development in year t of the i city; $DE_{i,t}$ is the level of digital economy development in year t of the i city; $Z_{i,t}$ is a control variable; α_0 is a constant term; α_1 denotes the level of influence of digital economy on tourism industry development; α_2 denotes the level of influence of the digital economy secondary term on tourism industry development; α_3 denotes the level of influence of the control variable on tourism industry development; ρ_i is the city individual fixed effect ; ω_i is the year fixed effect; $\varepsilon_{i,t}$ is the random perturbation term.

This paper studies the correlation between the impact of digital economy on the development of tourism industry, the benchmark regression is built on the basis of two core variables, with the addition of more variables, some simple correlation can no longer meet the more in-depth study, so this paper through the introduction of moderating effects model to explore more information between the digital economy and the development of the tourism industry, the basic formula is as follows:

$$Y_{i,t} = \alpha_0 + \alpha_1 X_{i,t} + \beta(xz)_{i,t} + \varepsilon_{i,t} \tag{3}$$

Where $Y_{i,t}$ is the explanatory variable, $X_{i,t}$ is the explanatory variable, Z is the moderating variable, α_0 is the intercept term, α_1 is the slope term, β is the coefficient as a function of the moderating effect, $\varepsilon_{i,t}$ is the error term, i denotes the cross-sectional dimension, and t denotes the time dimension. The variables used in this paper are shown in Table 1:

Table 1: Variables and Measures

Variables		Variable Measurement Methods
Dependent Variable	Tourism Industry Development Level (TID)	Entropy method of measuring weights
Independent Variable	Level of development of the digital economy (DE)	Entropy method of measuring weights
	Tourism Industry Clustering (TIC)	Locational entropy
Moderator Variable	Tourism Industry Innovation (TII)	Number of tourism academic papers and tourism patent applications
	Economic Development Level (LED)	GDP per capita
	Urbanisation Level (LU)	Urban population as a proportion of total population
	Level of Openness to the outside world (LEO)	Total import and export trade as a proportion of GDP

Control Variable	Industrial Structure (IS)	Value added of tertiary industry as % of GDP
	Government Intervention (GI)	General Financial Expenditure as % of GDP
	Traffic Conditions (TC)	Total passenger traffic
	Resource Endowment (RE)	Number of accommodation and catering enterprises
	Market Scale (MS)	Total population of the region

IV. EMPIRICAL ANALYSIS

4.1 Analysis of Non-linear Effects

The first is the total sample regression of 30 provinces in China from 2012-2022 for the impact of digital economy on the development of tourism industry, after that, it explores whether there is a non-linear impact between digital economy and tourism industry development, that is, the quadratic term of digital economy is added into the regression equation, and the results of regression are shown in Table 2. where model (1) is a separate regression of digital economy on the development of tourism industry in China, model (2) introduces control variables based on model (1), model (2) introduces control variables on the basis of model (1), model (3) only considers the impact of the digital economy and the quadratic term of the digital economy on the development of tourism industry, and model (4) introduces other control variables on the basis of model (3). All regressions use the fixed effects model.

Table 2: Total Sample Regression Results

Variables	TID(1)	TID(2)	TID(3)	TID(4)
DE	0.256** (2.054)	0.598*** (3.492)	5.793*** (5.970)	2.182** (2.363)
DE ²			-0.933*** (-6.280)	-0.437*** (-3.062)
LED		-0.028 (-1.256)		-0.000 (-0.019)
LU		7.562*** (6.419)		5.792*** (4.464)
LEO		-0.315 (-1.144)		-0.343 (-1.264)
IS		2.982*** (3.797)		3.022*** (3.902)
GI		0.862 (1.155)		1.367* (1.813)
TC		0.688*** (13.446)		0.656*** (12.727)
RE		0.183** (1.971)		0.201** (2.190)
MS		-1.324** (-2.004)		-0.772 (-1.142)
_cons	3.554*** (9.489)	0.464 (0.090)	-6.035*** (-3.851)	-7.461 (-1.314)
N	330	330	330	330
R ²	0.014	0.582	0.129	0.595
F	4.218	45.023	22.103	42.624

***p<0.01, **p<0.05, *p<0.10

Note: t-values in parentheses; * p < 0.1, ** p < 0.05, *** p < 0.01, same below.

Based on the regression results in Table 1, comparing models (1) and (3), it is found that the coefficients of the primary term of the digital economy increase significantly after adding the secondary term of the digital economy, and the coefficients of the primary and secondary terms of the digital economy change after adding the control variables on the basis of model (3), which indicates that the addition of control variables is very necessary. The fit R^2 of model (2) is 0.582, and R^2 of model (4) is 0.595, which indicates that the model with the addition of the coefficients of the secondary term of the digital economy has a better fit, so the following analysis is based on model (4).

According to the regression analysis, the coefficient of the primary term of the digital economy is significantly positive, and the coefficient of the secondary term is significantly negative, which indicates that the impact of the digital economy on the development of China's tourism industry is non-linear, and shows an 'inverted U'-type influence process, i.e., as the level of the development of the digital economy improves, the impact of the digital economy on the development of the tourism industry 'changes from promotion to suppression'. 'from promotion to suppression'. The reason for this phenomenon is that the rapid development of digital economy tends to create a competitive market environment to force the tourism industry to transform and upgrade. The fierce competition environment makes the tourism enterprises with advantages to move in, and the traditional enterprises to survive to grasp the tourism consumption hotspot to innovate, in order to enhance their own competitiveness and promote the development of the tourism industry. However, long-term fierce competition will lead to enterprise bankruptcy, excessive enterprise competition will disturb the price order of the tourism market, which is not conducive to the optimal allocation of market resources. In addition, the blind pursuit of digitalisation in tourism destinations, and technological inputs that are detached from the actual needs will lead to a mismatch between the two integrations, resulting in a waste of resources and undermining the long-term sustainability of tourism resources, thus inhibiting the development of the tourism industry.

Upgrading of industrial structure makes the proportion of tertiary industry increase, and industrial integration creates new tourism products and expands the tourism market; the government can effectively mobilize capital, labour and other resources in the market, and create a good market environment for the development of tourism on a macro level; diversified modes of transport make the proportion of free travel rise, expanding the radius of the tourism source market, and enhancing the tourism experience; the endowment of tourism resources can be enhanced by expanding the consumers' market share, and its spatial connectivity can efficiently link the food, accommodation, travel, shopping and entertainment involved in tourism, comprehensively enhancing the efficiency of tourism industry development. The coefficients of economic development level, openness level and market size on tourism industry development are not significant and need to be further tested.

4.2 Analysis of Regional Heterogeneity

Table 3: Regression Results by Region

Variables	Eastern Region-TID	Central Region-TID	Western Region-TID	Northeast Region-TID
DE	4.685*** (3.051)	10.057** (2.278)	9.152** (2.450)	3.544 (0.208)
DE ²	-0.808*** (-3.861)	-1.634** (-2.221)	-1.657** (-2.615)	0.118 (0.038)
Control variable	Yes	Yes	Yes	Yes
_cons	-16.780 (-1.428)	-23.909 (-0.579)	18.462 (1.406)	-36.229 (-0.645)
N	110	66	121	33
R ²	0.694	0.800	0.658	0.739
F	20.414	19.985	19.213	5.670

***p<0.01, **p<0.05, *p<0.10

To further explore the regional differences in the degree of influence of the digital economy on the development of China's tourism industry, the regression results are shown in Table 3. The influence of the digital economy on the level of development of China's tourism industry has significant regional variability, in which the coefficients of the primary term and the coefficients of the secondary term of the digital economy in the eastern, central and western regions are all significant, which is in line with the results of the total regression, among which the influence of the digital economy on the development of tourism in the eastern region is the strongest, and the nonlinear effect is stronger compared to the total sample regression. The regression results of the Northeast region are not significant because the Northeast region is dominated by heavy industry and the service industry accounts for a relatively low proportion, which cannot effectively use the dividends of the development of the digital economy and restricts the development of the tourism industry. Therefore, the later development should focus on narrowing the gap between the digital economy and tourism development in the east and west regions, and improving the tourism development level in the northeast region.

4.3 Analysis of Moderating Effects

Table 4: Moderating Effects of Tourism Clustering

Variables	Original Regression-TID1	Original Regression-TID2
DE	2.182** (2.363)	-0.531*** (-3.363)
DE ²	-0.437*** (-3.062)	-1.104** (-2.150)
DE × TIC		0.162*** (8.747)
Control variable	Yes	Yes
_cons	-7.461 (-1.314)	-1.146 (-0.246)
N	330	330
R ²	0.595	0.680
F	42.624	55.796

***p<0.01, **p<0.05, *p<0.10

Table 4 reports the results of the cross product term of tourism industry clustering and digital economy, from the model (2), it can be seen that the coefficient of the influence of the interaction term of digital economy and tourism industry agglomeration is 0.162, and it is significant at the 1% level, and the coefficient of the secondary term of the digital economy is smaller, which indicates that the moderating effect of tourism industry agglomeration in the digital economy affecting the development of the tourism industry is positive, and the higher the tourism industry agglomeration in the area of the The higher the level of tourism industry development is affected by the digital economy, the greater the impact of the digital economy. The reason is that the impact of the digital economy on the tourism industry runs through the entire development process, tourism industry development involves the effective allocation of tourism resources and the rapid flow of factors, and the specialisation and diversification of the tourism industry agglomeration uses the division of labour and co-operation and the connectivity effect to reduce the cost of output and transmission, which enhances the positive impact of the digital economy on the development of the tourism industry.

Table 5: Moderating effects of innovation in the tourism industry

Variables	Original Regression-TID1	Original Regression-TID2
DE	2.182** (2.363)	-0.622*** (-3.411)
DE ²	-0.437*** (-3.062)	-1.853*** (-3.301)
DE × TII		0.048*** (3.350)
Control variable	Yes	Yes
_cons	-7.461 (-1.314)	-1.812 (-0.351)
N	330	330
R ²	0.595	0.610
F	42.624	41.136

***p<0.01, **p<0.05, *p<0.10

As can be seen from the model (2) in Table 5, the coefficient of the interaction term influence of digital economy and tourism industry innovation is 0.048 and is significant in the 1% confidence interval, and the coefficient of the quadratic term of digital economy is significantly reduced, which indicates that the moderating effect of tourism industry innovation in the digital economy affecting the development of the tourism industry is positive, i.e., the higher the level of innovation in the tourism industry, the higher the level of the development of the tourism industry by the impact of the digital economy. This is because the government and enterprises actively innovate tourism-related activities to create new tourism scenarios and attract consumers, which strengthens the promotion effect of the digital economy on the development of the tourism industry.

V. CONCLUSION

According to the regression results, the impact of the digital economy on the development of China's tourism industry is non-linear, inverted 'U' shape, with the improvement of the level of development of the digital economy, the impact of the digital economy on the development of the tourism industry 'from promotion to suppression'. Among the control variables, the level of urbanisation, industrial structure, government intervention, traffic conditions and resource endowment can all promote the development of China's tourism industry. In addition, the impact of the digital economy on the development of China's tourism industry has significant regional differences, in which the eastern, central and western regions show significant non-linear characteristics, and the non-linear impact is stronger than the total sample, the impact of the digital economy on the development of the tourism industry in the northeast region is not significant.

The moderating effect of tourism industry agglomeration and tourism industry innovation in the influence of digital economy on the development of tourism industry is positive, that is, the higher the level of tourism industry agglomeration and tourism industry innovation, the higher the level of tourism industry development is affected by the digital economy, and it plays a positive reinforcing role in the process of the digital economy influencing the development of China's tourism industry.

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