Technological and Economic Development of Economy
ISSN: 2029-4913 / eISSN: 2029-4921
Article in press
https://doi.org/10.3846/tede.2023.19813

HIGH-SPEED RAIL AND TOURISM EXPANSION IN CHINA: A SPATIAL SPILLOVER EFFECT PERSPECTIVE

Fan ZHANG[1], Feng WANG[2,3*], Shujie YAO[2], Fanjie FU[4]

[1]*School of Economics, Shanxi University of Finance and Economics, Shanxi, China*
[2]*School of Economics and Business Administration, Chongqing University, Chongqing, China*
[3]*Institution of Digital Energy & Technical Economics, Chongqing University, Chongqing, China*
[4]*Sichuan International Studies University, Chongqing, China*

Received 15 January 2023; accepted 31 July 2023; first published online 6 November 2023

Abstract. Tourism exerts a great effect on the modern economy and relies largely on the flow of people facilitated by high-quality transportation infrastructure. Applying a spatial econometric method, this paper investigates the effect of high-speed rail (HSR) on tourism expansion in China from the view of the spatial spillover effect. Based on a 276 Chinese cities' panel dataset over 2005–2019, a positive role of HSR in tourism expansion is observed. Compared with cities unconnected to the HSR network, cities accessible by HSR experienced a 22% increase in tourism revenue and a 38% rise in tourist arrivals. In addition, the connection of a city to the HSR network also exerts a great spatial spillover role in the increase of tourism revenue and arrivals in peripheral cities which are not directly connected by HSR. The research findings offer important insights on the relationship between transportation infrastructure and tourism with significant policy implications regarding tourism development.

Keywords: high-speed rail, tourism, spatial spillover effect, China.

JEL Classification: R11, L83, L92.

Introduction

As one of the world's biggest economic parts, tourism helps to promote social and economic development, creating jobs and garnering indirect benefits via its downstream and upstream connections with other industries (Biagi et al., 2020). In 2019, tourism occuiped 10.3% of the global GDP and 10% of all jobs, growing by 3.5% in revenue which was higher than the global GDP growth for the ninth consecutive year. In China, tourism accounted for 11.3% of GDP and generated 10.3% of total employment in 2019, with the majority (86%) of tourism expenditures arising from domestic travelers and the remainder (14%) from international tourists (see Table 1).

*Corresponding author. E-mail: *wangfeng2008@cqu.edu.cn*

Table 1. Tourism development in the top 10 countries of the world in 2019
(source: World Travel & Tourism Council, n.d.)

	Revenue ($ Bil.)	Share in GDP (%)	Revenue growth (%)	Domestic share (%)	International share (%)	Jobs (10,000)	Jobs Share (%)
America	1839	8.6	2.3	84	16	1683	10.7
China	**1585**	**11.3**	**9.3**	**86**	**14**	**7987**	**10.3**
Japan	359	7.0	1.6	81	19	536	8.0
Germany	347	9.1	1.8	86	14	567	12.5
Italy	260	13.0	2.2	76	24	348	14.9
U.K	254	9.0	1.3	83	17	394	11.0
France	229	8.5	1.9	66	34	268	9.4
Spain	198	14.3	1.8	44	56	288	14.6
Mexico	196	15.5	1.8	85	15	723	13.3
India	194	6.8	4.9	83	17	3982	8.0
World	8900	10.3	3.5	——	——	33000	10

The COVID-19 pandemic brought great difficulties to tourism. In 2020, global tourism suffered losses of nearly 4.5 trillion dollars, with a 49.1% drop in its share of GDP and 62 million job losses compared with 2019. Heavily hit by the pandemic, China's tourism industry experienced negative growth in 2020. With the COVID-19 pandemic effectively contained in China, relieving physical and mental stress will contribute to tourism demand growth. After the pandemic abates, tourism has become one of the major engines of economic recovery in China. During the 2020 National Day holiday, China's tourism accepted 618 million domestic tourists, generating revenue of 454.33 billion RMB[1].

Accessibility is one of the critical determinants of tourism decisions, which is mainly dependent on the development of transport infrastructure (Wang et al., 2012; Yao et al., 2022). Up to 2021, China's HSR has covered all the provincial capital cities, 95% of the cities with a population of more than 500 thousand, and 74% of the national 5A-level scenic spots across the country (see Figure 1). China is the only country that has achieved commercial operation of HSR at a speed of 350 kilometers per hour. It has set a benchmark in the world, showing the "China speed" in the most intuitive way.

To understand the role of HSR on tourism expansion, this paper will study whether the connection of a city with famous tourist cities through HSR can increase its tourism revenue and tourists, as well as the spatial spillover effect to adjacent cities. On basis of a panel dataset including 276 cities in China over 2005–2019, this research uses the difference-in-difference (DID) model and spatial econometric approach and suggests that HSR has had significant economic externalities and spatial spillover roles, boosting tourism expansion.

[1] Data source: Ministry of Culture and Tourism of China (People's Daily Online, 2018).

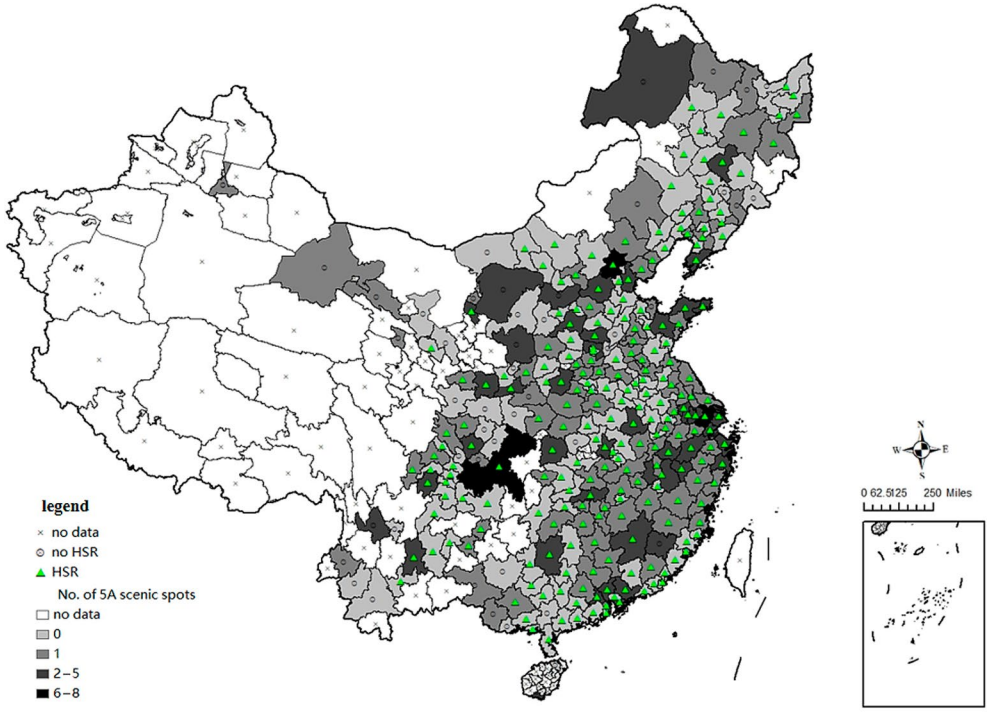


Figure 1. HSR and the number of national 5A-level scenic spots in cities of China in 2021 (source: Ministry of Culture and Tourism of China, n.d.; Transport Bureau of the Ministry of Railways, 2016; China Railway Customer Service Center, n.d.)

The efforts of this research are as follows. (1) It focuses on the asymmetric impact of HSR on local tourism and the tourism of peripheral cities. Even if a city does not open HSR, it may benefit from tourism expansion because of the HSR in the surrounding cities. (2) There are huge differences in tourism resources and economic growth levels between various regions in China. The average effect is obtained by regression analysis of all the cities. This study constructs an econometric model that can distinguish regional heterogeneity, and obtains more detailed observation results on the relationship between HSR and its spatial spillover role in tourism revenue and tourists in different regions. (3) We explored the mechanism of HSR's role in tourism instead of only paying attention to the statistical relationship between them. In this paper, we suggest two mechanisms, the industrial upgrading effect and the tourism economic conversion effect, which have never been paid attention to in the existing literature.

The organization paper is shown below. The literature review is shown in Section 1. Section 2 defines the research methodology and information. Section 3 discusses the empirical outcomes, including a benchmark model and the heterogeneity analysis. Section 4 outlines the mechanism of HSR's role in tourism expansion. Section 5 discusses the economic convergence with HSR and tourism expansion. Section 6 shows the robustness tests. The last Section makes a conclusion.

1. Literature review

1.1. Factors affecting tourism

With far-reaching significance for economic growth and eliminating absolute poverty, tourism can sustain and amplify its economic impact by generating direct income and inducing the multiplier effect (Kahn et al., 1995; Ming, 2013). Factors affecting the development of tourism include many aspects. From a macroeconomic perspective, GDP, CPI (consumer price index), and real effective exchange rate may affect the foreign-exchange earnings of tourism (Chang & Lee, 2017). The financial and economic crisis was found to have harmed both inbound and outbound tourism (Song & Lin, 2010).

Information Communication Technologies (ICTs) offer new patterns for tourism marketing and management (Buhalis & Law, 2008). When word-of-mouth becomes digital, it may influence consumers' choices (Litvin et al., 2008). Blockchain technology is positive on tourism consumers through interactive applications (Florentina, 2022). The innovation and strengthening of infrastructure will lead to an increase in tourism expenditure (Gavurova et al., 2021).

Diseases, climate change, and culture also influence tourism development. The SARS disease outbreak as well as the ongoing Covid-19 pandemic are found to have significantly reduced tourism expenditures (Blake et al., 2003; data shown previously). Climate change can potentially impact tourism from both the supply-side and demand-sides (Moore, 2010). Besides, Pop culture phenomena often attract increased numbers of visitors (Larson et al., 2013). Carbon dioxide emissions affect the increase of tourist index in the long term (Badulescu et al., 2021).

Accessibility is one of the most significant determinants of tourism growth (Page & Connell, 2014). The total transportation capital stock has a positive impact on attracting tourists (Seetanah, 2005). Air and water transport are also found to have accelerated tourism development (Khadaroo & Seetanah, 2008). Among them, highways and HSRs have the most crucial role in tourist destinations (Massidda & Etzo, 2012).

1.2. The attribute and impact of HSR in different sectors

HSR has fundamentally changed the economic and geographical pattern (Yao et al., 2019). It has expanded the scope of the urban financial hinterland, increased investment convenience between cities, expanded the distance between workplaces and residential areas, and reduced traffic congestion in other transportation systems (Zhang et al., 2019).

HSR's role varies in different sectors. For the agricultural sector, it lead to declines in employment (Zhang & Xu, 2023). For the producing industry, HSR shows a positive effect in the short term. However, in the long run, it will suppress the increase in investment scale (Wong et al., 2022). HSR has significantly reduced the ratio of added value of Secondary sector of the economy in GDP, grew the proportion of added value of Tertiary sector of the economy to GDP, and drove industrial agglomeration. In addition, it plays an important role in reducing energy consumption (Chen, 2021).

The tertiary sector benefits the most from HSR. Firstly, HSR focuses on passenger transportation services, providing a broad platform for vigorously developing the catering, retail, culture, and sports entertainment industry (Chen & Wang, 2022). Secondly, HSR exerts a great effect on housing prices, especially residential and office buildings (Liu et al., 2021). Thirdly, HSR improves the medical environment, manifested in improving accessibility and other aspects (Song et al., 2021).

1.3. The effect of HSR on tourism

HSR substantially reduces the temporal and spatial distance among cities, exerting a significant impact on the accessibility of inter-regional transportation (Kurihara & Wu, 2016; Yao et al., 2022).

Numerous studies have focused on the role of HSR on tourism in various countries, such as Spain, Japan (Kurihara & Wu, 2016; Hiramatsu, 2018) and Italy. However, the role of HSR in the tourism industry varies from country to country, even in different regions or cities (see Table 2).

Most of the literature on China's HSR and tourism industry affirms the constructive role of HSR since it may reallocate and transform the tourism market, fostering larger-scale competition, and redistributing urban tourism centers (Zhou et al., 2020; Wang et al., 2012). It also enhances the economic relations between cities based on tourism, and shows the "corridor effect" in the spatial effect on tourism (Wang et al., 2018).

The role of HSR in tourism is heterogeneous. Some suggested HSR's influence was even more noticeable in inland cities, prefecture-level cities, underdeveloped regions, or regions of less geopolitical significance. Some display that the influence of HSR on international tourists is more obvious than that on domestic tourists (Li et al., 2019). Some research only analyzed the influence of a region or an HSR line on tourism in China, among them were northeast China (Jin et al., 2020), or provinces along the Wuhan-Guangzhou HSR line like Guangdong, Hunan, and Hubei (Yan et al., 2014).

Table 2. The influence of HSR in different countries on the tourism industry

Country	Impact of HSR	Related papers
Spain	restricted or negative	Masson and Petiot (2009), Guirao et al. (2016), Albalate et al. (2017)
Italy	a certain positive impact, but usually replaced by aviation	Pagliara et al. (2017), Pagliara and Mauriello (2020)
Europe	positive to the domestic tourism, negative to the foreign tourism	Castillo-Manzano et al. (2018)
Japan	varies with distance and operating time, lead to regional inequality	Kurihara and Wu (2016), Hiramatsu (2018)
China	povitive, especially in the hinterland cities, but heterogeneous in some regions	Chen and Haynes (2012), Zhou and Li (2018), Li et al. (2019), Gao et al. (2019), Zhang et al. (2020), Jin et al. (2020), Yao et al. (2022)

1.4. Our work

The main efforts of this paper are shown below: Firstly, a range of current research has defined the role of HSR in tourism in China. However, they paid little attention to the problem of the asymmetric effect of HSR on local tourism and the tourism of peripheral cities. This paper considered this point, which has important policy implications with the role of traffic accessibility on tourism expansion. Secondly, this research pays attention to the growth of tourism revenue and tourist volume in underdeveloped regions due to the opening of HSR, which drives rapid economic development and narrows the development gap with developed regions. In addition, the industrial upgrading effect is checked to verify the mechanism of HSR's effect on tourism expansion.

2. Research methodology and data

This section constructs an empirical model to quantify HSR's role on tourism expansion incorporating HSR as the key explanatory variable for tourism. On basis of a panel dataset of 276 cities in China over 2005–2019, the time-changing DID model and SDM method are used to effectively capture the spillover role of HSR in tourism expansion.

The general time-varying DID model is as follows:

$$\ln Tour_{it} = \beta_0 + \beta_1 HSR_{it} + \beta_2 X_{it} + \alpha_i + \gamma_t + \varepsilon_{it}, \quad (1)$$

where, *Tour* stands for tourism, which is proxied by tourism revenue (*Touri*) and tourist arrivals (*Toura*). *HSR* is a dummy variable taking value 1 in case of available HSR, 0 otherwise. *X* represents a series of control variables. α_i and γ_t denote the location and time fixed roles, respectively. ε_{it} acts as an error term.

Secondly, HSR may also cause a cross-city spatial spillover effect on tourism development, that is, affecting tourism development in cities with HSR stations and their surrounding cities. Furthermore, the development of tourism may also have spatial spillover effects. Therefore, the SDM method is used to comprehensively consider the spatial lag term of the explanatory variables and the explained variables in the regression (Lesage, 2008), as well as dividing the total effect into direct and indirect impacts to illustrate the existing spatial correlation more concisely. The SDM model is defined in Eq. (2):

$$\ln Tour_{it} = \alpha + \rho W \times \ln Tour_{it} + \beta_1 HSR_{it} + \theta W \times HSR_{it} + \beta_2 X_{it} + \tau W \times X_{it} + \mu_i + \gamma_t + \varepsilon_{it}, \quad (2)$$

where, *W* means an asymmetric geography weight matrix, in which the elements w_{ij} in matrix *W* follow Eq. (3):

$$w_{ij} = \begin{cases} \dfrac{1}{d_{ij}}, i \neq j \\ 0, i = j \end{cases}, \quad (3)$$

where, *d* represents the geographical distance between city *i* and city *j*.

Spatial autoregressive coefficients ρ, θ, and τ investigate the spatial spillover role of HSR in tourism expansion. Because of the spatial lag term, the regression parameters of explana-

tory variables include a large amount of information on interactions among relevant cities. Following Lesage (2008), we define the direct / indirect roles of HSR in tourism expansion. The former stands for the mean impact of explanatory variables on the local region, while the latter means the mean impact of explanatory variables on other areas. Accordingly, Eq. (2) is rewritten as:

$$\begin{aligned}&\ln Tour_{it} = (I_n - \rho W)^{-1}\alpha\iota_n + (I_n - \rho W)^{-1}(\beta_1 HSR_{it} + \theta W \times HSR_{it}) + \\ &(I_n - \rho W)^{-1}(\beta_2 X_{it} + \tau W \times X_{it}) + (I_n - \rho W)^{-1}\varepsilon_{it},\end{aligned} \tag{4}$$

where, I_n is the n-th order unit matrix, ι_n is the n-th order matrix.

$$\text{let } V(W) = (I_n - \rho W)^{-1}; \tag{5}$$

$$S_r(W) = V(W)(I_n\beta_1 + \theta W); \tag{6}$$

$$Z_r(W) = V(W)(I_n\beta_2 + \tau W); \tag{7}$$

$$\begin{bmatrix} y_1 \\ y_2 \\ \vdots \\ y_n \end{bmatrix} = \sum_{r=1}^{k} \begin{bmatrix} S_r(W)_{11} & S_r(W)_{12} & \cdots & S_r(W)_{1n} \\ S_r(W)_{21} & S_r(W)_{22} & \cdots & S_r(W)_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ S_r(W)_{n1} & S_r(W)_{n2} & \cdots & S_r(W)_{nn} \end{bmatrix} \begin{bmatrix} hsr_{1r} \\ hsr_{2r} \\ \vdots \\ hsr_{nr} \end{bmatrix} +$$

$$\sum_{r=1}^{k} \begin{bmatrix} Z_r(W)_{11} & Z_r(W)_{12} & \cdots & Z_r(W)_{1n} \\ Z_r(W)_{21} & Z_r(W)_{22} & \cdots & Z_r(W)_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ Z_r(W)_{n1} & Z_r(W)_{n2} & \cdots & Z_r(W)_{nn} \end{bmatrix} \begin{bmatrix} x_{1r} \\ x_{2r} \\ \vdots \\ x_{nr} \end{bmatrix} +$$

$$V(W)l_n\alpha + V(W)\varepsilon, \tag{8}$$

where, the total effect of *HSR* is denoted as the mean of the sums of matrices $S_r(W)$; the direct role of *HSR* is denoted as the mean of diagonal factors $S_r(W)_{ii}$ in matrix $S_r(W)$; the indirect role of *HSR* is denoted as the average of non-diagonal factors in matrix $S_r(W)$. The total role means the sum of the direct and indirect roles.

The control variables are shown below: (1) $pGDP_{it}$, per capita GDP (in 2004 price); (2) $5A_{it}$, the number of National 5A-level Tourist Spots; (3) $shotel_{it}$, the number of starred hotels; (4) $Dair_{it}$, the dummy variable taking value 1 if civilian airport is available, 0 otherwise; (5) $pm2.5_{it}$, the annual average PM2.5 concentration.

Touri, *Toura*, and *shotel* are collected from the "China Tourism Statistical Yearbook", CEIC database (https://www.ceicdata.com/) and provincial statistical yearbooks. *HSR* is gathered from "National Railway Passenger Train Timetable" and China Railway Customer Service Center www.12306.cn. *5A* is collected from the official website. *airport* is gathered from the Civil Aviation Administration of China, http://www.caac.gov.cn. PM2.5 concentration collected from the Energy Policy Institute. The variable definition and summary statistics of the main variables are presented in Table 3.

Table 3. Variable definition and summary statistics

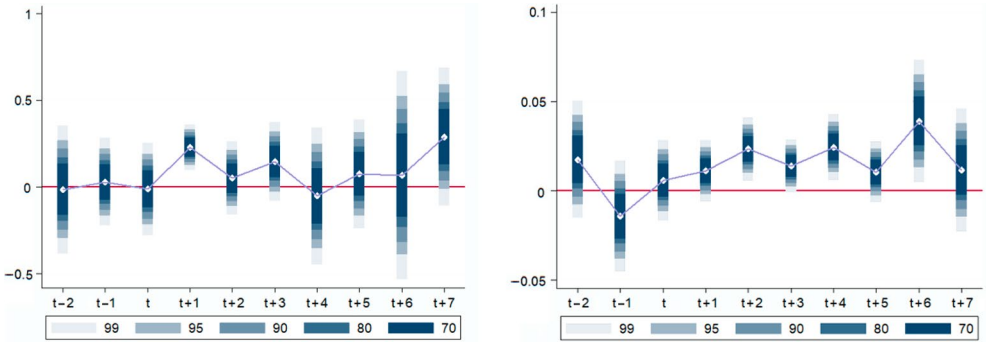
Variables	Definition	Obs.	Mean	S.D.	Min	Max
ln*Touri*	tourism revenue (million yuan)	3941	9.02	1.83	0.03	13.34
ln*Toura*	tourist arrivals (10,000 persons)	3955	7.01	1.56	0.02	10.52
HSR	dummy variable equals 1 if the city is HSR available, otherwise 0	4140	0.26	0.44	0	1
pGDP	per capita GDP (yuan, in 2004 price)	4140	10.35	0.79	4.50	15.86
ln*shotel*	number of starred hotels	3546	3.36	0.86	0	6.73
Dair	dummy variable equals 1 if the city has a civilian airport, otherwise 0	4135	0.45	0.50	0	1
ln*pm*	the annual average PM2.5 concentration (Mg/m^3)	4140	3.72	0.47	1.48	4.72
5A	number of 5A scenic spots	4007	0.43	0.84	0	8

3. Empirical results

3.1. Causality from HSR to tourism expansion

The time-varying DID model is employed for testifying the causality from HSR to tourism expansion. The parallel trend hypothesis is met since the coefficient of HSR in the years before policy implementation was insignificantly different from 0 (see Figure 2)

Table 4 shows the estimation outcomes of the time-changing DID model in Eq. (1). Whether the control variables are added or not, the parameters of HSR_{it} are statistically great at the 1% level, confirming the positive role of HSR in tourism revenue and tourists. As the results in columns 3 and 5, by comparing with cities unconnected by HSR, cities that are connected by HSR experience an 13.7% grow in tourism revenue and 39.2% increase in tourist arrivals. These differences are remarkable.



DV = ln*Touri* DV = ln*Toura*

Figure 2. Result of the parallel trend Test

Table 4. HSR and tourism expansion: time-varying DID model

Variables	DV = ln*Touri*			DV = ln*Toura*		
HSR_{it}	0.895*** (0.054)	0.167*** (0.047)	0.137*** (0.050)	0.930*** (0.047)	0.490*** (0.046)	0.392*** (0.057)
ln*gdp*	——	1.305*** (0.027)	1.303*** (0.027)	——	0.745*** (0.026)	0.745*** (0.026)
ln*shotel*	——	0.201*** (0.027)	0.167*** (0.057)	——	0.372*** (0.056)	0.270*** (0.057)
Dair	——	0.189* (0.117)	0.193* (0.116)	——	0.341*** (0.113)	0.281** (0.114)
ln*pm*	——	–0.208** (0.085)	–0.151 (0.092)	——	–0.467*** (0.082)	–0.434 (0.091)
5A	——	——	0.082*** (0.032)	——	——	0.065** (0.031)
constant	6.767*** (0.022)	–4.446*** (0.438)	–4.652*** (0.444)	6.775*** (0.025)	–0.121 (0.422)	–0.100 (0.438)
City fixed effect	YES	YES	YES	YES	YES	YES
Time fixed effect	YES	YES	YES	YES	YES	YES
No. observations	3955	3465	3301	3941	3476	3312
R^2	0.253	0.486	0.511	0.134	0.329	0.326

Notes: Standard errors are in parentheses. ***, **, * the significance degrees at the 1%, 5% and 10%. DV = dependent variable.

3.2. Spatial spillover effect: the SDM method

HSR not only stimulates the tourism growth of cities connected by HSR, but also drives that of their surrounding cities. Meanwhile, the booming tourism industry of a city will also have spillover effects on the surrounding areas irrespective of whether it is connected by HSR or not. The Moran's I of tourism revenue and the tourists are reported in Figure 3, indicating the stability of the spatial autocorrelation throughout the sample period.

Table 5 reports the econometric test for SDM regression. Most of the Lagrange multiplier (LM) tests results satisfy the 1% degree of significance, which suggests that SDM is the most suitable tool for our analysis, compared with the Spatial Autoregressive Model and the Spatial Error Model. The Hausman test suggests that fixed effects are superior to random effects. All LR tests refuse the null assumption at the 1% significance degree, implying that the SDM will not degenerate into the SAR model or SEM. Moreover, the LR test outcomes also satisfy the 1% level of significance, indicating that the space-time double fixed-effect SDM should be utilized for empirical analysis.

Table 6 shows the estimation outcomes from the SDM method in Eq. (2). The spatial correlation coefficient ρ is significant, indicating the spatial spillover role in tourism. The regression coefficients for *HSR* are positive and significant, meaning that cities accessible by HSR experienced a 22% increase in tourism revenue and a 38% rise in tourist arrivals, compared with cities unconnected by HSR. In the spatial lag term *W*, the parameter is positive and great at the 1% level for the regression regarding the effect of HSR on tourism revenue, indicating that HSR drives the tourism growth of the surrounding cities.

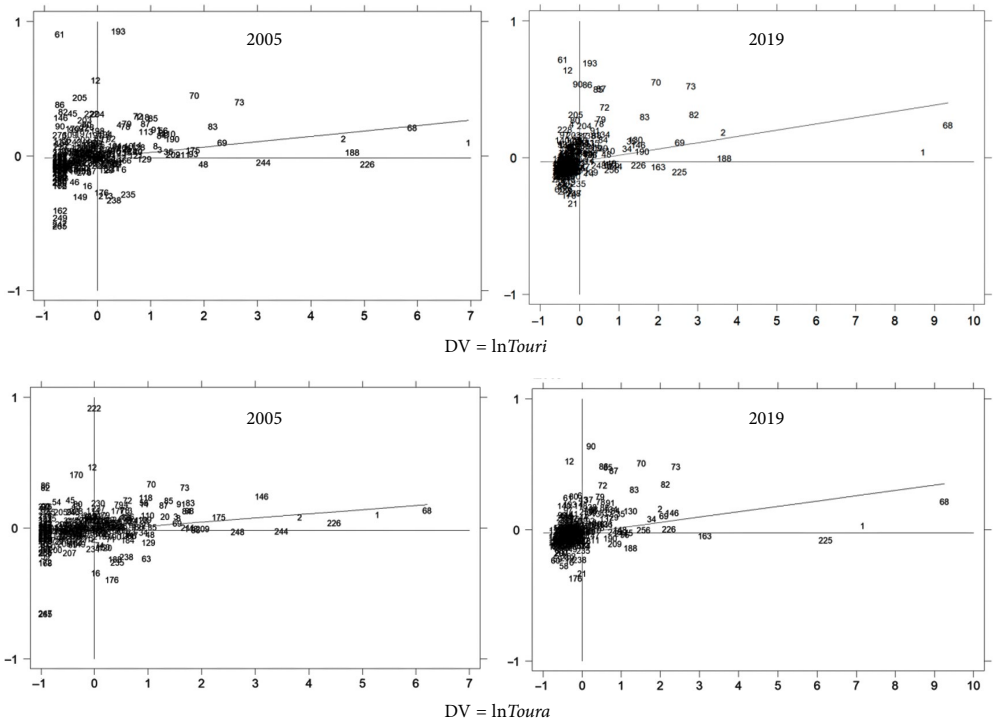


Figure 3. Moran's *I* scatter plot of ln*Touri* and ln*Toura*

Table 5. Tests for SDM method

	ln*Touri*	ln*Toura*
LM test no spatial error	43.42***	19.17***
Robust LM test no spatial error	33.72***	17.28***
LM test no spatial lag	9.71***	1.91*
Robust LM test no spatial lag	0.01	0.02
Hausman	645.85***	608.96***
LR spatial error	60.47***	46.8***
LR spatial lag	80.09***	51.48***
LR ind nested in both	31.06***	14.39
LR time nested in both:	426.94***	939.57***

Notes: Standard errors are in parentheses. ***, **, * the significance degrees at the 1%, 5% and 10%.

The direct and indirect roles of HSR in tourism expansion are also displayed in Table 6. The HSR lines exerts significantly positive direct influence on tourism in the local city, and the linkage between a city and the HSR network can create a significant spatial spillover effect on tourism revenue and tourist arrivals for its surrounding cities. With the operation of HSR, the spatial distribution of tourist destinations evolves from a structure of isolated spots to a network structure with spot-connecting axes, which is amicable for the regional tourism resources integration and the balanced tourism growth across the entire country.

Table 6. Spatial spillover role of HSR in tourism expansion: SDM method

	DV = ln*Touri*	DV = ln*Toura*	DV = ln*Touri*	DV = ln*Toura*
HSR	0.220** (0.096)	0.380*** (0.085)	0.299** (0.147)	0.325** (0.162)
W	3.207*** (0.699)	2.110*** (0.642)	2.978*** (0.579)	2.268* (1.229)
ρ	0.931*** (0.017)	0.889*** (0.027)	0.742*** (0.057)	0.826*** (0.041)
Direct effect	0.430*** (0.115)	0.487*** (0.090)	0.301** (0.147)	0.493*** (0.170)
Indirect effect	5.235*** (1.865)	2.262** (0.857)	7.336** (2.918)	2.410* (1.452)
Total effect	5.665*** (1.871)	2.749*** (0.859)	7.637*** (2.905)	2.903* (1.759)
Control variables	ln*pgdp*, ln*shotel*, *Dair*, ln*pm*, *5A*		ln*pgdp*, ln*shotel*, *Dair*, ln*pm*	
City fixed effect	YES	YES	YES	YES
Time fixed effect	YES	YES	YES	YES
No. observations	4140	4140	4140	4140

Notes: tandard errors are in parentheses. ***, **, * the significance degrees at the 1%, 5% and 10%. DV = dependent variable.

The parameters of the explanatory variables HSR in the first line are different from the coefficients of the direct effect. That is because the linkage between a city and the HSR network affects tourism in other cities by way of spillover effects before returning to the city via inter-city interactions. As a result, a feedback effect is generated. For example, the coefficient of *HSR* is 0.22 for the regression of tourism revenue, and the direct effect of *HSR* is 0.43, which means the value of the feedback effect is 0.21. Although the indirect effect (5.235) of HSR on tourism revenue is stronger than the direct role in terms of value, the indirect effect (0.019 = 5.235/276) is much weaker than the direct effect for a single city.

3.3. Heterogeneity

3.3.1. Heterogeneity of domestic and international tourism

Having examined the spatial spillover role of HSR in tourism expansion, we further explore the heterogeneity of this effect when distinguishing between domestic and international tourism. The total tourism revenue has been divided into tourism revenue incurred from domestic tourists and foreign exchange earnings, and tourist arrivals have been categorized into domestic tourist arrivals and international tourist arrivals. The estimated coefficients for *HSR* in Table 7 display that the operation of HSR lines greatly leads to an increase in tourism revenue incurred from domestic tourists, foreign exchange earnings, domestic tourist arrivals, and international tourist arrivals, with a more significant impact on tourism revenue incurred from domestic tourists than on international tourists.

For the direct and indirect roles of HSR in tourism expansion, the linkage between a city and the HSR network has a positive direct and indirect effects on domestic tourists. It indi-

cates that domestic tourists are more easily attracted (spillover) to the peripheral cities as a result of HSR operation. However, there is no spatial spillover effect for international tourists, as the indirect effect of HSR on foreign exchange earnings and international tourist arrivals is insignificant. Since the primary mode of transportation for foreign tourists is air travel and their visiting destinations are normally in the counties' most attractive metropolis such as Beijing, Shanghai, Xi'an, and the like, the spillover effect on the peripheral cities without world-class tourist attractions is minimal.

Table 7. Heterogeneity of domestic and international tourism

	DV = ln*Touri*		DV = ln*Toura*	
	domestic revenue	foreign exchange earnings	domestic tourists	international tourists
HSR	0.115* (0.610)	0.018 (0.052)	0.382*** (0.103)	0.045 (0.044)
W	1.203** (0.602)	1.305*** (0.392)	2.290*** (0.749)	0.593* (0.325)
ρ	2.313*** (0.030)	0.849*** (0.036)	0.876*** (0.031)	0.841*** (0.040)
Direct effect	0.149** (0.065)	0.057 (0.051)	0.477*** (0.106)	0.064 (0.045)
Indirect effect	1.149* (0.665)	0.900 (1.370)	2.209*** (0.868)	0.413* (0.238)
Total effect	1.298** (0.594)	0.957 (0.908)	2.686*** (0.860)	0.477 (0.315)
Control variables	YES	YES	YES	YES
City fixed role	YES	YES	YES	YES
Time fixed role	YES	YES	YES	YES
No. observations	4140	4140	4140	4140

Notes: standard errors are in parentheses. ***, **, * the significance degrees at the 1%, 5% and 10%. DV = dependent variable.

3.3.2. Regional heterogeneity

We also investigate whether the spatial spillover effect has regional heterogeneity when cities share similar location characteristics. We divide 276 cities into eastern cities, central cities and western cities based on their geographical locations. Table 8 shows the direct, indirect, and total roles of HSR in tourism expansion in different regions.

In the eastern and central areas, the linkage between a city and the HSR network has a notable positive direct role in the tourism revenue and tourists to the local city. Meanwhile, the spatial spillover effect on tourist arrivals in peripheral regions is positive and significant, represented by the indirect effect and the total effect, but there is no indirect effect on tourism revenue. In the Western region, HSR plays a significantly positive role in the local tourism revenue of peripheral cities. The estimated coefficient of ln*Toura* is the largest in the three regions. Compared with cities unconnected to the HSR network, cities accessible by HSR

Table 8. Spatial spillover role of HSR in the tourism expansion in regions

	Eastern		Central		Western	
	ln*Touri*	ln*Toura*	ln*Touri*	ln*Toura*	ln*Touri*	ln*Toura*
*HSR*group dummy*	0.453** (0.208)	0.405*** (0.150)	0.435* (0.263)	0.376*** (0.008)	0.360* (0.179)	0.429*** (0.151)
W	0.483 (1.315)	0.776*** (0.056)	3.746*** (1.386)	1.333*** (0.059)	1.903* (1.056)	3.167*** (1.334)
ρ	0.739*** (0.057)	0.819*** (0.043)	0.730*** (0.059)	2.287*** (0.030)	2.322*** (0.030)	1.885*** (0.028)
Direct effect	0.462** (0.218)	0.548*** (0.164)	0.388* (0.262)	0.379*** (0.008)	0.412* (0.228)	0.904*** (0.243)
Indirect effect	0.400 (4.920)	0.079** (0.039)	1.336 (0.910)	0.369*** (0.042)	2.067*** (0.786)	2.066* (1.148)
Total effect	0.862 (4.809)	0.627*** (0.275)	0.948 (0.886)	0.739*** (0.043)	2.479** (1.265)	2.970* (1.669)
Control variables	YES	YES	YES	YES	YES	YES
City fixed role	YES	YES	YES	YES	YES	YES
Time fixed role	YES	YES	YES	YES	YES	YES

Notes: standard errors are in parentheses. ***, **, * the significance degrees at the 1%, 5% and 10%. DV = dependent variable.

experience a 36% increase in tourism revenue and a 42.9% increase in tourist arrivals in the western region. Meanwhile, the spatial spillover role in tourism revenue in peripheral regions and tourist arrivals are positive and significant.

The empirical results of this study show that the influence of China's HSR on the tourism industry is varied from some European countries. Apart from generating increased tourism development locally, the linkage between a city and the HSR network also has a significant spatial spillover role in the increase of tourism revenue and tourists in peripheral cities. Besides the direct economic interests, the Chinese government has fully considered the huge economic and social externality that HSR construction can bring, including the balanced development of the regional economy, comprehensive development of agriculture, tourism and investment in backward regions. Compared with other countries, especially European countries, China's HSR construction has the characteristics of faster, shorter periods, and lower costs. Moreover, China has a population of nearly 1.4 billion, and the number of middle-class people who can afford HSR has rapidly increased in the past decade.

4. Mechanism of HSR's effect on tourism expansion

As a corridor connecting tourist origins and destinations, HSR can effectively promote interregional passenger travel and production factor flow, shaping and optimizing regional tourism spatial structures. Tourism as an essential national economic segment heavily depends on regional traffic accessibility. HSR mainly brings about the industrial upgrading effect on tourism expansion.

HSR has brought about the upgrading of the tourism industry and the upgrading of the structure of tourism products. With the integration of HSR and tourism, several new products that integrate "arriving fast and traveling slowly" have emerged. Such as tourism projects of HSR+tourist attractions, HSR+car rental tourism, and HSR+hotel. The combination of these elements, which take HSR as the carrier and meet the various needs of tourists, has pushed forward the upgrading and adjustment of the tourism industry. With the continuous improvement of the HSR network, most of the group tours in the past will be replaced by self-guided tours and in-depth tours, turning the traditional sightseeing tourism trend into a multi-integrated tourism economy. This will be of great benefit to the scenic cities along the HSR lines.

Tourism expansion also promotes the growth of related industries, including retail, catering services, and accommodation, which leads to an economic multiplier effect. Due to the labor-intensive nature of tourism, its development can help create a large number of service sector jobs. On December 26, 2014, the Guiyang-Guangzhou HSR was operated, and the travel time from Guiyang to Guangzhou was reduced from 22 hours to less than 5 hours. It can not only promote the development of transportation, excursion, accommodation, catering, entertainment and shopping, but also promote the development of the commerce and service industries. Figure 4 shows that the revenue of Guizhou accommodation and catering industry has increased significantly after the HSR operation.

On basis of the above, we have made the following empirical regression based on model (4). The related industries of tourism like retail, catering services, and accommodation are tertiary industries. First, we consider the impact of the tertiary industry, which is calculated by the output of the tertiary industry as a percentage share of GDP. Outcomes of Table 9 display that the tertiary industry is conducive to the effect of HSR on the growth of local tourism and the spillover role in the tourism economy of other cities.

Table 9. Mechanism of HSR's effect on Tourism Expansion

	ln*Touri*	ln*Toura*
*HSR*the tertiary industry*	0.773* (0.429)	0.337** (0.158)
W	6.928** (3.410)	1.424** (0.649)
ρ	0.930*** (0.052)	0.896*** (0.026)
Direct effect	1.282*** (0.477)	0.381* (0.058)
Indirect effect	12.556* (6.809)	4.027* (2.177)
Total effect	13.838* (7.440)	4.408* (2.463)
Control variables	YES	YES
City fixed role	YES	YES
Time fixed role	YES	YES

Notes: standard errors are in parentheses. ***, **, * the significance degrees at the 1%, 5% and 10%. DV = dependent variable.

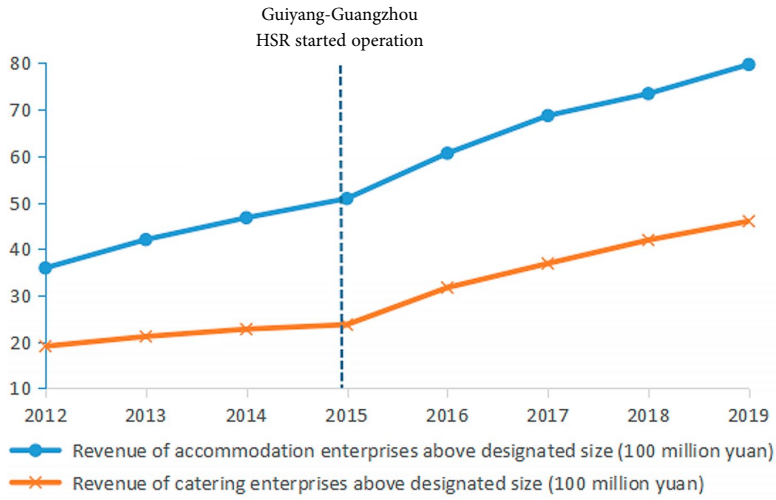


Figure 4. Development of Guizhou accommodation and catering industry (source: Guizhou Provincial Bureau of Culture and Tourism, n.d.)

5. Balanced development with HSR and tourism expansion

HSR has profound significance for further narrowing the development gap between different Chinese regions. Guiyang-Guangzhou HSR (via Guiyang, Longli, Changming, Duyun, Guilin, Hezhou, Zhaoqing, Foshan, Guangzhou), Baoji-Lanzhou HSR (via Lanzhou, Dingxi, Tianshui, Baoji), Xining-Yinchuan HSR (via Xi'an, Xianyang, QingYang, Wuzhong, Yinchuan) and other HSR lines passing through the typical mountain tourist cities in western China such as Guizhou, Gansu, Shaanxi, Ningxia, etc., have exerted a core effect on tourism and inclusive regional growth.

Metropolis like Beijing, Shanghai, and Guangzhou, as well as cities endowed with many famous Tourist Spots or world heritage sites, including Chengdu, Suzhou, and Changchun, are at the top of the tourism development ranking of Chinese cities. Notably, since the running of the Guiyang-Guangzhou HSR line in 2015, Guizhou province's (in the western region of China) tourist arrivals and tourism revenue have experienced explosive growth. In the first month after the HSR operation, the tourist arrivals served by large travel agencies in Guizhou province saw an average year-on-year growth of over 300%, while the number of visitors (42.3% arriving by HSR) to the Huangguoshu tourist Spot increased by 154% year-on-year. After the HSR operation, tourist arrivals to Guizhou province rose by 22% annually and tourism revenue increased by 24.4% annually to 289.6 billion RMB[2] from 2014–19. With the HSR connecting South China, Guiyang rose in national rankings by tourism revenue year by year. By 2019, Guiyang had already surpassed some of the most visited cities, including Suzhou and Nanjing, ranking number 6 instead of 18 in 2014 among all the popular tourist destination cities in China (see Table 10).

[2] Data source: Official website of Guizhou Provincial Bureau of Culture and Tourism n.d.

Table 10. Tourism development ranking of Chinese cities in 2019 (source: CEIC database)

	City	Domestic income (million yuan)	City	Foreign exchange income (million dollars)
1	Beijing	586,620	Shanghai	8,376
2	Shanghai	478,930	Guangzhou	6,530
3	Chengdu	455,134	Beijing	5,190
4	Tianjin	423,522	Shenzhen	5,003
5	Guangzhou	400,336	Xiamen	4,238
6	Guiyang	307,431	Chongqing	2,525
7	Suzhou	255,929	Suzhou	2,513
8	Nanjing	241,224	Fuzhou	2,206
9	Ningbo	230,310	Guilin	2,062
10	Changchun	217,224	Chengdu	1,946
	City	Number of domestic tourists (thousands)	City	Number of inbound tourists (thousands)
1	Shanghai	361,405	Shenzhen	12,170
2	Beijing	318,330	Guangzhou	8,994
3	Chengdu	276,431	Shanghai	8,972
4	Tianjin	244,974	Chongqing	4,113
5	Guiyang	228,302	Chengdu	3,814
6	Zhengzhou	209,280	Beijing	3,769
7	Kunming	184,946	Xiamen	3,765
8	Changsha	166,996	Zhuhai	3,411
9	Nanning	152,097	Guilin	3,146
10	Hefei	146,062	Huizhou	2,614

Longli County and Duyun of Qiannan Buyi and Miao Autonomous Prefecture are the stations of Guizhou-Guangzhou HSR. They were originally relatively backward, but have vigorously developed tourism due to the opening of the Guizhou-Guangzhou HSR (see Figure 5). Within five years after the HSR operation, the total tourism revenue of Longli County has rapidly grown from 1.1 billion yuan to 7.4 billion yuan, an average annual development of 46.1%. The number of tourists grew from 1.4 million to 8.1 million, an average annual increase of 41.8%. The number of employees in travel agencies increased from 3,068 to 5,253, an average annual increase of 11.4%. The Longli County Government has proposed a new development method of global tourism, which has raised the tourism industry to an unprecedented strategic level and facilitated poverty alleviation. The total tourism revenue of Duyun grew from 9.2 billion yuan to 29.5 billion yuan, with an average annual increase rate of 26.2%. The number of tourists grew from 10.1 million to 32.7 million, an average annual increase rate of 26.5%.

Results of Table 6 show that the spillover role of HSR in the peripheral cities' foreign exchange earnings and international tourists is minimal. We collected the number of world cultural heritage sites located in city *i* in year *t* from the official website and examined whether

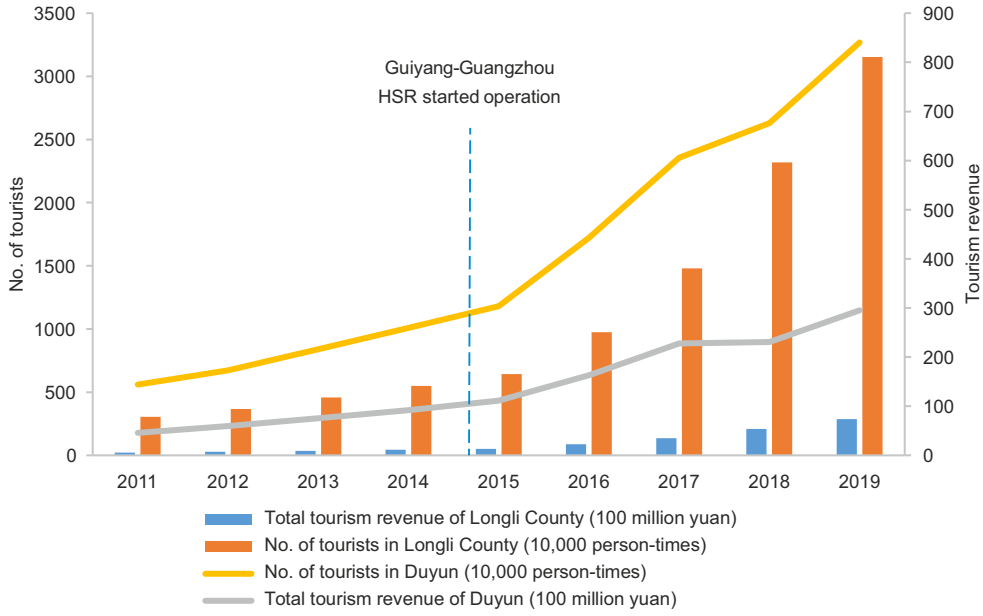


Figure 5. Tourism development in Longli County and Duyun, Guizhou Province (source: Guizhou Provincial Bureau of Culture and Tourism n. d.)

the city will attract international tourists to visit by HSR if there is world cultural heritage. By the end of 2019, China had 37 world cultural heritages, some of which were located in different cities, such as the Great Wall and the Silk Road. We have regressed by region and found that only for the western region (21 world cultural heritages in 15 of the 52 cities), cities with world cultural heritage are indeed conducive to the attraction of HSR to foreign exchange earnings and international tourists (the second and third columns of Table 11).

Finally, we conducted a regression test on sub-samples of Guizhou Province. Results of the forth and fifth columns of Table 11 indicate that HSR exerts a grat effect on driving tourism development and space spillover among cities in Guizhou Province. It can be seen that HSR can bring more far-reaching tourism resources into the residents' tourism consumption demand, especially to better stimulate the tourism economic development of backward regions, improve the regional development structure, and narrow the development gap between regions.

6. Robustness checks

Robustness checks are reported in Table 12. First, we replace the nested weight matrix W measuring the geographic distances with the 0–1 spatial matrix W_1, representing adjacency between cities. The constituent element w_1 of W_1 is defined as:

$$w_{1ij} = \begin{cases} 1, \text{City } i \text{ is adjacent to city } j \\ 0, \text{ City } i \text{ is not adjacent to city } j, \text{ or } i = j \end{cases}. \quad (9)$$

Table 11. Economic convergence with HSR and tourism expansion

	world cultural heritage sites in the western region		Guizhou Province	
	foreign exchange earnings	international tourists	ln*Touri*	ln*Toura*
*HSR*world cultural heritage sites*west*	0.167* (0.263)	0.376*** (0.008)	——	——
*HSR*cities in Guizhou Province*	——	——	0.515* (0.299)	0.704* (0.426)
W	3.508*** (1.377)	1.333*** (0.059)	7.476** (3.335)	4.187*** (1.495)
ρ	0.773*** (0.051)	1.287*** (0.030)	0.932*** (0.017)	0.895*** (0.026)
Direct effect	0.084* (0.262)	0.379*** (0.008)	1.302*** (0.466)	1.194** (0.533)
Indirect effect	1.336 (0.910)	2.078** (1.035)	13.383* (6.920)	14.948** (7.118)
Total effect	0.948 (0.886)	0.739** (1.293)	14.685* (7.531)	16.142** (7.650)
Control variables	YES	YES	YES	YES
City fixed effect	YES	YES	YES	YES
Time fixed effect	YES	YES	YES	YES

Notes: standard errors are in parentheses. ***, **, * the significance degrees at the 1%, 5% and 10%. DV = dependent variable.

The direct, indirect, and total roles of HSR in tourism revenue and tourists in adjacent cities are still significantly positive. It means that an alternative spatial weight matrix does not vary the summary of the previous regression outcomes.

Second, we introduce the HSR accessibility measure into our empirical model. Point degree is one of the most widely used urban transportation network complexity indicators in the social network theory (Li et al., 2016). The point level of city *i* denotes the number of cities directly linked to city *i* in the whole HSR network. The formula of point degree is defined below:

$$HSR\_D_i = \sum_{j=1}^{n} Z_{ij}, \tag{10}$$

where, Z_{ij} represents the number of linkage between city *i* and city *j*, and *n* represents the total number of cities. The regression results in Table 8 with HSR_D_i are still robust. With regard to tourism revenue, HSR_D_i exerts a great and positive direct role, indirect effect, and total role in tourism revenue. In terms of tourist arrivals, HSR_D_i has a marked facilitative effect on tourists in the local city, but the effect is not significant in peripheral cities.

In addition, we also employ the data of HSR train frequency and HSR stations[3] instead of the HSR dummy variable in Eq. (2). Lastly, a subsample with 185 top tourist destinations published by National Tourism Administration has been used to recheck our conclusion. Consistent with the previous findings, HSR exerts a marked direct role and a significant spatial spillover role in tourism revenue.

[3] Data source: "National Railway Passenger Train Timetable" and China Railway Customer Service Center www.12306.cn.

Table 12. Robustness checks

Variables	DV = ln*Touri*			DV = ln*Toura*		
	Direct effect	Indirect effect	Total effect	Direct effect	Indirect effect	Total effect
The 0-1 spatial adjacency matrix W_1						
HSR	0.155* (0.094)	1.290*** (0.243)	1.444*** (0.264)	0.339*** (0.086)	0.708*** (0.204)	1.119*** (0.219)
ρ	0.490*** (0.016)			0.447*** (0.017)		
HSR accessibility measure						
HSR_D$_i$	0.103** (0.043)	1.438** (0.630)	1.541** (0.640)	0.139*** (0.038)	0.196 (0.399)	0.335 (0.405)
ρ	0.668*** (0.040)			0.559*** (0.047)		
No. of HSR train frequency						
HSR_fre	0.002*** (0.0002)	0.043*** (0.016)	0.045*** (0.016)	0.0007*** (0.0002)	0.003 (0.009)	0.004 (0.009)
ρ	0.895*** (0.026)			0.853*** (0.036)		
No. of HSR stations						
HSR_sta	0.107*** (0.010)	4.560*** (1.512)	4.667*** (1.518)	0.034*** (0.010)	1.455** (0.687)	1.489** (0.690)
ρ		0.887*** (0.028)			0.848*** (0.037)	
Subsample with 185 top tourist destinations						
HSR	0.129* (0.075)	3.207** (1.596)	3.336** (1.604)	0.463*** (0.092)	2.615 (1.854)	3.078* (1.867)
ρ	0.654*** (0.054)			0.743*** (0.047)		
Control variables	YES	YES	YES	YES	YES	YES

Notes: standard errors are in parentheses. ***, **, * the significance degrees at the 1%, 5% and 10%. DV = dependent variable.

Conclusions

This research investigates the spatial spillover role of HSR in tourism expansion with the latest data on multiple indicators, including the construction of HSR lines between Chinese cities, tourism revenue, tourists, and popular tourist attractions. The empirical results indicate the significant spatial autocorrelation of tourism in China and a great positive role of HSR in tourism expansion. Compared with cities unconnected to the HSR network, cities accessible by HSR experienced a 22% increase in tourism revenue and a 38% rise in tourist arrivals. Apart from generating increased tourism development locally, the linkage between a city and the HSR network also exerts a great spatial spillover role in the increase of tourism revenue and tourists in peripheral cities.

Outcomes of heterogeneity discussion demonstrate that the influence of HSR on tourism revenue incurred from domestic tourists and domestic tourist arrivals is greater than its impact on foreign exchange earnings and international tourist arrivals. In the western region, the linkage between a city and the HSR network plays a notable positive role in the number of visitors to the local city, and its spatial spillover role in tourism revenue and tourists in peripheral regions is positive and significant. HSR's positive effect on local tourism revenue is most pronounced in the east.

In Europe, HSR is often used for cross-border travel. Conversely, China shows a large population and vast territory with even economic growth, which requires consideration of regional differences and spillover effects for the growth of HSR and tourism. The empirical outcomes of this research suggest that even cities inaccessible by HSR can benefit from neighboring cities linked to the HSR network via the spatial spillover effects. As long as the extensive HSR network covers a lot of cities, all cities, whether linked to the HSR network or not, can be benefited by HSR's time-space compression role.

The study outcomes of this article have policy meanings For countries that rely on land transportation, they need to attach great importance to the inclusive benefits brought about by HSR through promoting tourism expansion, so that more people can feel a sense of abundance, fairness, and happiness. It is necessary to improve tourism transportation facilities, continuously improve the level of tourism services and reception capabilities, and vigorously develop smart tourism. It is necessary to expand regional cooperation, promote resource sharing and complementary advantages among cities along the HSR line, and maximize the barrier-free tourism between regions driven by HSR. Meanwhile, it is necessary to enhance the cooperation between the governments of the cities along the HSR lines, strengthen the business communication and docking between tourism firms, and promote cooperation between tourist attractions to maximize the spillover network effect.

Funding

This research is financially supported by the National Natural Science Foundation of China (72203027, 71973019), the National Social Science Foundation of China (18ZDA005), Key Projects of Philosophy and Social Sciences Research, Ministry of Education (No. 21JZD029), Chongqing Social Science Planning Project (2022YC039), and Fundamental Research Funds for the Central Universities of China (2020CDJSK02ZH02, 2021CDSKXYJG007).

References

Albalate, D., Campos, J., & Jiménez, J. L. (2017). Tourism and high speed rail in Spain: Does the AVE increase local visitors? *Annals of Tourism Research*, *65*, 71–82. https://doi.org/10.1016/j.annals.2017.05.004

Badulescu, D., Simut, R., Mester, I., Dzitac S., Sehleanu, M., Bac, D. P., & Badulescu, A. (2021). Do economic growth and environment quality contribute to tourism development in EU countries? A panel data analysis. *Technological and Economic Development of Economy*, *27*(6), 1509–4921. https://doi.org/10.3846/tede.2021.15781

Biagi, B., Brandano, M. G., & Ortega-Argiles, R. (2020). Smart specialisation and tourism: Understanding the priority choices in EU regions. *Socio-Economic Planning Sciences*, *74*(8), 100883. https://doi.org/10.1016/j.seps.2020.100883

Blake, A., Sinclair, M. T., & Sugiyarto, G. (2003). Quantifying the impact of foot and mouth disease on tourism and the UK economy. *Tourism Economics*, *9*(4), 449–465. https://doi.org/10.5367/000000003322663221

Buhalis, D., & Law, R. (2008). Progress in information technology and tourism management: 20 years on and 10 years after the internet – The state of tourism research. *Tourism Management*, *29*(4), 609–623. https://doi.org/10.1016/j.tourman.2008.01.005

Campa, J. L., López-Lambas, M. E., & Guirao, B. (2016). High speed rail effects on tourism: Spanish empirical evidence derived from China's modelling experience. *Journal of Transport Geography*, *57*, 44–54. https://doi.org/10.1016/j.jtrangeo.2016.09.012

Castillo-Manzano, J. I., Castro-Nuño, M., López-Valpuesta, L., Pedregal-Tercero, D. J., & Garrido-Michó, J. M. (2018). High speed rail: Fast tracking tourism in the EU? *Annals of Tourism Research*, *71*, 64–66. https://doi.org/10.1016/j.annals.2018.02.005

Chang, W. S., & Lee, Y. H. (2017). The macroeconomic contribution to foreign-exchange earnings from tourism in Taiwan. *Current Issues in Tourism*, *20*(11), 1110–1115. https://doi.org/10.1080/13683500.2016.1206062

Chen, Z., & Haynes, E. (2012). *Tourism industry and high speed rail – is there a linkage: Evidence from China's high speed rail development* (George Mason University School of Policy, Government, & International Affairs Faculty Research Paper Series No. 2012-14) SSRN. https://doi.org/10.2139/ssrn.2130830

Chen, J. (2021). High-speed rail and energy consumption in China: The intermediary roles of industry and technology. *Energy*, *230*, 120816. https://doi.org/10.1016/j.energy.2021.120816

Chen, Q., & Wang, M. (2022). Opening of high-speed rail and the consumer service industry: Evidence from China. *Economic Analysis and Policy*, *76*, 31–45. https://doi.org/10.1016/j.eap.2022.07.010

China Railway Customer Service Center (n.d.). https://www.12306.cn/index/

Florentina, T. R. (2022). The utility of blockchain technology in the electronic commerce of tourism services: An exploratory study on Romanian consumers. *Sustainability*, *14*(2), 943. https://doi.org/10.3390/su14020943

Gao, Y. Y., Su, W., & Wang, K. N. (2019). Does high-speed rail boost tourism growth? New evidence from China. *Tourism Management*, *72*, 220–231. https://doi.org/10.1016/j.tourman.2018.12.003

Gavurova, B., Belas, J., Valaskova, K., Rigelsky, M., & Ivankova, V. (2021). Relations between infrastructure innovations and tourism spending in developed countries: A macroeconomic perspective. *Technological and Economic Development of Economy*, *27*(5), 1072–1094. https://doi.org/10.3846/tede.2021.15361

Guirao, B., Campa, L., & López-Lambas, E. (2016). The assessment of the HSR impacts on Spanish tourism: An approach based on multivariate panel data analysis. *Transportation Research Procedia*, *18*, 197–204. https://doi.org/10.1016/j.trpro.2016.12.027

Guizhou Provincial Bureau of Culture and Tourism. (n.d.). https://whhly.guizhou.gov.cn

Hiramatsu, T. (2018). Unequal regional iimpacts of high speed rail on the tourism industry: A simulation analysis of the effects of Kyushu Shinkansen. *Transportation*, *45*, 677–701. https://doi.org/10.1007/s11116-016-9746-y

Jin, S. H., Yang, J., Wang, E. X., & Cui, C. (2020). The Influence of high-speed rail on ice-snow tourism in northeast China. *Tourism Management*, *78*, 104070. https://doi.org/10.1016/j.tourman.2019.104070

Kahn, H., Phang, S., & Toh, R. (1995). The multiplier effect: Singapore's hospitality industry. *The Cornell Hotel and Restaurant Administration Quarterly*, *36*(1), 64–69. https://doi.org/10.1177/001088049503600121

Khadaroo, J., & Seetanah, B. (2008). The role of transport infrastructure in international tourism development: A gravity model approach. *Tourism Management*, *29*(5), 831–840. https://doi.org/10.1016/j.tourman.2007.09.005

Kurihara, T., & Wu, L. (2016). The impact of high speed rail on tourism development: A case study of Japan. *The Open Transportation Journal*, *10*, 35–44. https://doi.org/10.2174/1874447801610010035

Larson, M., Lundberg, C., & Lexhagen, M. (2013). Thirsting for vampire tourism: Developing pop culture destinations. *Journal of Destination Marketing & Management*, *2*(2), 74–84. https://doi.org/10.1016/j.jdmm.2013.03.004

Lesage, J. P. (2008). An introduction to spatial econometrics. *Revue D'Économie Industrielle*, *123*, 19–44. https://doi.org/10.4000/rei.3887

Li, L. S., Yang, F. X., & Cui, C. (2019). High-speed rail and tourism in China: An urban agglomeration perspective. *International Journal of Tourism Research*, *21*, 45–60. https://doi.org/10.1002/jtr.2240

Li, X., Huang, B., Li, R., & Zhang, Y. (2016). Exploring the impact of high seed railways on the spatial redistribution of economic activities – Yangtze River Delta urban agglomeration as a case study. *Journal of Transport Geography*, *57*, 194–206. https://doi.org/10.1016/j.jtrangeo.2016.10.011

Litvin, S. W., Goldsmith, R. E., & Pan, B. (2008). Electronic word-of-mouth in hospitality and tourism management. *Tourism Management*, *29*(3), 459–468. https://doi.org/10.1016/j.tourman.2007.05.011

Liu, X., Jiang, C., Wang, F., & Yao, S. (2021). The impact of high-speed railway on urban housing prices in China: A network accessibility perspective. *Transportation Research Part A: Policy and Practice*, *152*, 84–99. https://doi.org/10.1016/j.tra.2021.08.006

Massidda, C., & Etzo, I. (2012). The determinants of italian domestic tourism: A panel data analysis. *Tourism Management*, *33*(3), 603–610. https://doi.org/10.1016/j.tourman.2011.06.017

Masson, S., & Petiot, R. (2009). Can the high speed rail reinforce tourism attractiveness? The case of the high speed rail between Perpignan (France) and Barcelona (Spain). *Technovation*, *29*(9), 610–617. https://doi.org/10.1016/j.technovation.2009.05.013

Ministry of Culture and Tourism of China (n.d.). https://www.mct.gov.cn/mctso/s?qt=5A%E6%99%AF%E5%8C%BA

Ming, C. C. (2013). Does tourism development promote economic growth in transition countries? A panel data analysis. *Economic Modelling*, *33*, 226–232. https://doi.org/10.1016/j.econmod.2013.04.024

Moore, W. R. (2010). The impact of climate change on Caribbean tourism demand. *Current Issues in Tourism*, *13*(5), 495–505. https://doi.org/10.1080/13683500903576045

Page, S., & Connell, J. (2014). Transport and tourism. In A. L. Alan, H. C. Michael, & M. W. Allan (Eds.), *The Wiley Blackwell companion to tourism*, (pp. 155–167). John Wiley & Sons, Ltd. https://doi.org/10.1002/9781118474648.ch12

Pagliara, F., & Mauriello, F. (2020). Modelling the impact of high speed rail on tourists with geographically weighted poisson regression. *Transportation Research Part A: Policy and Practice*, *132*, 780–790. https://doi.org/10.1016/j.tra.2019.12.025

Pagliara, F., Mauriello, F., & Garofalo, A. (2017). Exploring the interdependences between high speed rail systems and tourism: Some evidence from Italy. *Transportation Research Part A: Policy & Practice*, *106*, 300–308. https://doi.org/10.1016/j.tra.2017.09.022

People's Daily Online. (2018). *New economic observation: The holiday economy releases consumption vitality and new business formats and new models develop strongly*. http://finance.people.com.cn/n1/2020/1030/c1004-31912715.html

Seetanah, B. (2005). Transport capital as a determinant of tourism development: A time series approach. *Tourismos: An International Multidisciplinary Journal of Tourism*, *1*(1), 55–73. https://mpra.ub.uni-muenchen.de/25402/

Song, R., & Lin, V. S. (2010). Impacts of the financial and economic crisis on tourism in Asia. *Journal of Travel Research*, *49*(1), 16–30. https://doi.org/10.1177/0047287509353190

Song, X., Qiao, C., & Luo, J. (2021). Does high-speed rail opening affect the health care environment?-evidence from China. *Frontiers in Public Health*, *9*, 708527. https://doi.org/10.3389/fpubh.2021.708527

Transport Bureau of the Ministry of Railways. (2016). *National railway passenger train timetable*. China Railway Publishing House. (in Chinese)

Wang, D., Niu, Y., & Qian, J. (2018). Evolution and optimization of China's urban tourism spatial structure: A high-speed rail perspective. *Tourism Management*, *64*, 218–232. https://doi.org/10.1016/j.tourman.2017.08.010

Wang, X., Huang, S., Zou, T., & Yan, H. (2012). Effects of the high speed rail network on China's regional tourism development. *Tourism Management Perspectives*, *1*, 34–38. https://doi.org/10.1016/j.tmp.2011.10.001

Wong, Z., Chen, A., Shen, C. R., & Wu, D. L. (2022). Fiscal policy and the development of green transportation infrastructure: the case of China's high-speed railways. *Economic Change and Restructuring*, *55*(4), 2179–2213. https://doi.org/10.1007/s10644-021-09381-1

World Travel & Tourism Council. (n.d.). https://wttc.org/Research/Economic-Impact

Yan, Y. Q., Zhang, H. Q., & Ye, B. H. (2014). Assessing the impacts of the high-speed train on tourism demand in China. *Tourism Economics*, *20*(1), 157–169. https://doi.org/10.5367/te.2013.0260

Yao, S., Yan, X., Lei, C. K., & Wang, F. (2022). High-speed railway and tourism development in China. *Tourism Economics*, *28*(6), 1520–1544. https://doi.org/10.1177/1354816621998520

Yao, S., Zhang, F., Wang, F., & Ou, J. (2019). High-speed rail and urban economic growth in China after the world financial crisis. *China and World Economy*, *27*(2), 44–65. https://doi.org/10.1111/cwe.12274

Zhang, A., Liu, L., & Liu, G. (2020). High-speed rail, tourist mobility, and firm value. *Economic Modelling*, *90*, 208–116. https://doi.org/10.1016/j.econmod.2020.05.004

Zhang, F., Wang, F., Ou, J., & Yao, S. (2019). Role of high-speed rail on social fixed assets investments in China. *Journal of Chinese Economic and Business Studies*, *17*(3), 221–244. https://doi.org/10.1080/14765284.2019.1663697

Zhang, Y., & Xu, D. (2013). Service on the rise, agriculture and manufacturing in decline: The labor market effects of high-speed rail services in Spain. *Transportation Research Part A: Policy and Practice*, *171*, 103617. https://doi.org/10.1016/j.tra.2023.103617

Zhou, B., & Li, N. Q. (2018). The impact of high-speed trains on regional tourism economies: Empirical Evidence from China. *Tourism Economics*, *24*(2), 187–203. https://doi.org/10.1177/1354816617749346

Zhou, B., Wen, Z., Ian, S., & Lee, S. (2020). The spatial heterogeneity and dynamics of tourism-flow spillover effect: The role of high-speed train in China. *Tourism Economics*, *28*(2), 1–25. https://doi.org/10.1177/1354816620958309