Spatial Econometric Research on the Impact of Transportation Infrastructure on Regional Tourism

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Abstract: The transportation infrastructure is closely related to the development of tourism. The industrial agglomeration of tourism may be due to the spatial spillover effect of transportation infrastructure. To verify this relationship, a spatial econometric model using compound economic distance was established based on the provincial panel data of China from 2007 to 2016. Specifically, this model was used to study the impact of transportation infrastructure on regional tourism. The results show: (1) There is spatial agglomeration in China's tourism industry. (2) The composite economic space weight matrix is more applicable to the study than the commonly used second-order adjacent spatial weight matrix. (3) In addition to the railway density, all influencing factors have significant impacts on regional tourism. The proportion of high-grade highways has a negative effect, and the rest have positive effects. The spatial spillover effect of highway density and high-grade highway are much smaller than their direct effects.

1. Introduction

With the development of China's national economy, s tourism market has flourished in recent years. Tourism has become an important engine for the development of the national economy and a pillar industry in some regions.Like many industries, tourism has a certain degree of spatial autocorrelation [1]. Therefore, it is necessary to consider spatial influence when studying the impact of transportation infrastructure on regional tourism.

In the existing research, it is more common to analyze the impact of transportation infrastructure on regional economy, and the research on its impact on tourism is not very deep. Most of the literature uses total traffic density or road density to measure the construction of transportation infrastructure [2-4], which does not reflect the impact of various parts of the transportation infrastructure on tourism. In the choice of research methods, existing research often uses Lagrangian test to select in SLM model and SEM model. Some researches use SDM model without considering other spatial measurement models. These may affect the accuracy of the research results.

According to uses China's 2007-2016 provincial panel data, this paper uses the number of tourism practitioners to measure the development of tourism. Based on this, the paper selects the appropriate spatial measurement model to study railways, roads, highways, The impact of civil aviation and government transportation fiscal expenditure on tourism. The results of great significance to guiding the development of tourism in the region and promoting the coordinated development of transportation and tourism between regions.

2. Space Panel Metrology Model

2.1 Tourism Agglomeration Analysis

In order to verify the spatial agglomeration of tourism and provide a basis for the selection of spatial measurement models, the paper uses Morlan's I index to analyze the spatial autocorrelation of inter-provincial tourism.The number of employees was selected as an indicator to measure the development of tourism in various regions. The overall Morlan's I test was conducted on the number of tourism practitioners in 31 provincial-level administrative regions in China from 2007 to 2016.

The overall Morlan's I index of the Chinese tourism industry is positive in the research time range within 5% confidence level.

2.2 Model Solution

Common spatial panel metrology models include spatial Dubin model (SDM), spatial error model (SEM), spatial autoregressive model (SAR) and generalized spatial autoregressive model (SAC). Since the SEM model and the SAR model are special forms of the SDM model, this paper intends to establish the SDM model first, and use the Wald test and the Lratio test to verify whether it can be degraded into the SEM model or the SAR model. If the degradation succeeds, the corresponding model is used; if the degradation fails, then The AIC and BIC information criteria were used to select the better one of the SDM model and the SAC model; the Hausman test was used to determine whether the fixed effect or the random effect was used.

Referring to the previous literature, this paper establishes a spatial Dubin model (SDM) and a generalized spatial autoregressive model (SAC) for the impact of regional transportation infrastructure on tourism as follows:

$$TE_{it} = \rho \sum_{j=1}^{n} w_{ij} TE_{jt} + Trans_{it}\beta_1 + \sum_{j=1}^{n} w_{ij} Trans_{jt}\theta + CV_{it}\beta_2 + \mu_i + \lambda_t + \varepsilon_{it} \qquad (1)$$

$$TE_{it} = \rho \sum_{j=1}^{n} w_{ij} TE_{jt} + Trans_{it}\beta_1 + CV_{it}\beta_2 + \mu_i + \lambda_t + u_{it}, \quad u_{it} = \varepsilon_{it} + \lambda \sum_{j=1}^{n} w_{ij} u_{it} \qquad (2)$$

Where *i* denotes the region, t denotes the year, *TE* is the explanatory variable, *Trans* is an 1×K vector of endogenous latent variables, ρ and θ are the spatial autocorrelation coefficient of the interpreted variables and explanatory variables, *CV* are other control variables, β_1 and β_2 are the coefficients of the explanatory variables and the control variables, w_{ij} is the element of the spatial weight matrix, μ is the regional effects, λ is the time effects, u is the spatial error term, and ε is the error terms, $\varepsilon \sim N\left(0, \sigma_{\varepsilon}^{2} I_n\right)$.

2.3 Variable Selection And Data Source

Referring to the existing model and considering the statistical caliber of indicators, this paper takes 31 province-level administrative regions except Taiwan, Hong Kong and Macao in the decade of 2007-2016 as the research object.

1) Dependent variable (*TE*). Tourism is a labor-intensive industry. The number of tourism industry is a good representation of the development of tourism in various regions.

2) Explanatory variables (*Trans*). This paper selects road density, high-grade highway weight, and railway density to reflect the construction of highway and railway infrastructure; the logarithm of the use of air passenger traffic indicates the construction of aviation infrastructure; the proportion of government financial traffic expenditure measures the government's investment and maintenance of transportation facilities.

3) Control variables (*CV*). This paper adopts three control variables: economic development level (actual per capita GDP), urbanization level (the proportion of non-agricultural population) and labor cost (average salary).

4) Spatial weight matrix (*W*). The commonly used spatial weight matrix can only reflect the geographical or economic distance between the two places. In reality, the inter-regional relationship and interaction level are often related to both. Therefore, this paper uses the composite economic space weight matrix, and the formula is as follows:

$$W = V .* E \tag{3}$$

$$e_{ij} = \begin{cases} 1/\left|\overline{x}_i - \overline{x}_j\right|, i \neq j \\ 0 \qquad\qquad\quad, i = j \end{cases} \tag{4}$$

Where *V* is the ordinary second-order neighbor weight matrix, *E* is the economic weight matrix, x_j is the local actual per capita GDP. And Hainan is defined as adjacent to Guangdong and Guangxi.

The main data sources in this paper are The Yearbook of China Tourism Statistics and China Statistical Yearbook. Individual missing data are supplemented by interpolation.

3. Empirical Results And Analysis

First is to judge whether the SDM model can be degraded into an SEM model or a SAR model. The Wald test and Lratio test results were 29.25 and 30.73, and both were significant within the 1% confidence level, so the assumption of rejection and the SDM model did not degenerate.

Then the Hausman test is performed on the SDM model and the SAC model. The results show that both models should choose fixed effects. The AIC and BIC information criteria are applied to compare the applicability of the two models to the problem. The AIC and BIC of the SDM model are smaller than the SAC model. Based on the test results, a fixed utility SDM model is established and estimation method is quasi-maximum likelihood method.

Table 1 shows the SDM model results using the composite economic space weight matrix W. The results of the common panel regression OLS model are also shown as a comparison.

Table 1 shows that the R^2 of the SDM models is larger than the OLS. This proved that the SDM model is highly applicable to this problem.

From the significance respect, the three explanatory variables (highway density, the proportion of high-grade highways, and the proportion of government fiscal transportation expenditures), and all control variables and spatial spillovers of highway density are both at 1% confidence level in SDM_W models. It shows that the development of transportation infrastructure does have a significant impact on tourism. Control variables have a significant impact on tourism, and the choice of control variables is appropriate.

The spatial spillovers of railway density, air passenger traffic, and the proportion of government fiscal traffic expenditures are not significant in the model. Railway density is not significantly consistent with some findings of existing research which use the operating income of the tourism industry as an explanatory variable. The spatial spillover effect of air passenger traffic is not significant. It may be due to the limited time available for people to travel. The pursuit of rapid and convenient transportation often does not require the transfer of aviation and other modes of transportation in neighboring provinces. The spatial spillover of government fiscal transportation expenditure does not significantly mean that the government's transportation finance expenditure in neighboring regions has no significant impact on the tourism development in this region. This perhaps due to the time-lag of government-funded traffic construction objects.

According to the coefficient of highway density and its spatial overflow term, the direct effect of highway density is three times greater than the indirect effect, which indicates that the provincial highway network promotes the local tourism industry far more than the neighbor provincial highway network. In other words, the tourism industry benefits the most from the development of local road infrastructure, and the neighbor provinces are in the aftermath. The absolute value of the direct effect of the high-grade highway is also greater than the absolute value of its indirect effect, but the difference is relatively small. This indicates that the radiation range of the high-grade highway is wider, which is consistent with its characteristics.

Table 1. Models estimation results

Model	OLS	SDM_W
RoadD	0.0072*** (6.17)	0.0078*** (3.24)
HRoadP	-4.2957*** (-3.59)	-4.1074*** (-4.09)
RailD	-0.0006*** (-2.86)	-0.0001 (-0.64)
lnAirPV	0.0607*** (3.14)	0.0323** (2.00)
GovTO	0.4738** (0.87)	1.6180*** (2.69)
RGDP	0.0764*** (5.57)	0.0739*** (5.94)
PNAP	1.0863*** (2.90)	0.7809** (2.07)
LnAS	0.2268*** (3.73)	0.2675*** (3.99)
WRoadD	-	0.0026*** (4.83)
WHRoadP	-	-3.0310** (-2.08)
WRailD	-	-0.0004 (-1.22)
WlnAirPV	-	0.0158 (0.61)
WGovTO	-	-0.4381 (-0.55)
ρ	-	0.0297** (2.29)
Sigma2_e	-	0.0056*** (6.45)
R^2	0.8874	0.9025

4. Summary

This paper verifies the spatial agglomeration of tourism. Using the spatial Dubin model to analyze the impact of transportation infrastructure and its spatial spillover on tourism, the main conclusions are as follows:

1) In the selection of the spatial weight model, compared with the most commonly used second-order adjacent spatial weight matrix, the model using the composite economic weight matrix gives better statistical test results and is more in line with traditional economic theory. The

conclusion of the model is more representative of the “distance” of tourism and transportation infrastructure between regions.

2) The traffic infrastructure system has a significant positive impact on tourism, such as road density, air passenger traffic, government fiscal traffic expenditure and highway density, and the direct effect of road density on tourism is about space spillover.

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