# A comparative analysis of the structural characteristics of the spatial correlative networks of domestic tourism economy and tourism flow in the middle reaches of the Yangtze River∗

Ma Lijun,Liu Cong

*Business School of Xiangtan University，Xiang tan411105，Hunan，China*

**Abstract:** This paper collected relevant data and analyzed the structural characteristics and similarity of the network structure of tourism flow and tourism economy in the middle reaches of the Yangtze River by using Granger causality test, gravitational model and social network analysis. The results show that: ①The density of tourism economy network in the middle reaches of the Yangtze River is low, the tourism economy link between cities is weak, and the tourism economy link needs to be strengthened. The central trend value of the whole network is low, and the development of tourism economy network is more balanced. The communication between the blocks of the tourism economy in the middle reaches of the Yangtze River is frequent, and the spillover effect is obvious. ②The density of the tourism flows network in the middle reaches of the Yangtze River is larger, the correlation is high, but most tourism flows are small. The degree of spatial correlation is high, the central potential value of the whole network is low, and the development of tourism flows network is more balanced. ③There are differences in the structure of the tourism economy and tourism flows network in the middle reaches of the Yangtze River. Compared with the tourism economy, the spatial correlation between the cities in the middle reaches of the Yangtze River tourism flows network is higher, the tourism flows network is more stable, the tourism flows of each city are more closely linked, and the tourism economy network is less centralized and the development is more balanced.

**Keywords**: The middle reaches of the Yangtze River; Domestic tourism economy; Tourism flows; Spatial association; Network structure；

## I.     INTRODUCTION

With the rapid development of the national economy and the rapid increase in disposable income of residents, people have begun to focus on spiritual pursuits other than material life, and tourism is becoming more and more popular as a way of leisure and holiday. The Ministry of Culture and Tourism of the people's Republic of China released data from the Bureau showing that in 2019, domestic tourism accounted for 6.006 billion trips, up 8.4% year-on-year; inbound tourism accounted for 145 million trips, up 2.9% year-on-year; and total tourism revenue for the year was 6.63 trillion yuan, up 11% year-on-year, with growth rates continuing to remain higher than GDP. The rapid growth of the tourism industry has led to an increasingly strong spillover effect of tourism development, and the tourism development links between regions are becoming closer and closer. The spatial linkage of regional tourism development has gradually become a hot spot for academic research, and relevant studies can be broadly divided

into two aspects: the spatial linkage of tourism economic development and the spatial linkage of tourism flow development. In terms of the spatial association of tourism economic development, relevant studies mainly focus on the spatial spillover effect of the tourism economy [1-3], the degree of tourism economic association and network characteristics[4-7], and the spatial and temporal differences and influencing factors of tourism economy[8-13]. In terms of the spatial association of tourism flow development, relevant studies mainly focus on the spatial and temporal distribution of tourism flow[14-17], influence and impact factors [18-24].

On the whole, the results available have made certain achievements and provided some theoretical support and methodological reference for this study, but most of the studies have isolated the tourism economy and tourism flows, only analyzed the spillover effects and network structure characteristics of tourism economic development or the network structure characteristics of tourism flows, lacking a comprehensive and comparative analysis of the two. The middle reaches of the Yangtze River is an inter-regional mega-City Group planned and built by China. The Development Plan for the middle reaches of the Yangtze River approved by the State Council of the People's Republic of China positions it as a new growth pole for China's economic development, a pioneer area for new-type urbanization in central and western China, a demonstration area for inland opening and cooperation, and a leading area for the construction of a "two-type" society, aiming to promote China's economy to develop in a healthy and stable direction. Since 2012, this City Group has been cooperating in the areas of tourism development planning, tourism standards, management and services, tourism products, etc., building barrier-free tourism areas, creating integrated tourism zones, and developing regional tourism more and more closely. On December 26, 2016, the 13th Five-Year Plan for Tourism Development promulgated by the State Council proposed to strengthen cross-regional tourism City Groups such as the middle reaches of the Yangtze River, putting forward new requirements for the development of tourism in the middle reaches of the Yangtze River. This paper collects data on domestic tourism revenue from 2000 to 2019, 2019 domestic tourism flow and flow direction in the middle reaches of Yangtze River, and uses Granger causality test, gravity

model and social network analysis to analyze the structural characteristics of the spatial association network of tourism economy and tourism flow in the middle reaches of Yangtze River, and examine the similarities and differences between the two and analyze the reasons for their formation. It is expected to enrich the research related to tourism economy and tourism flow network structure, and provide a reference for each city to clarify its position in the tourism economy and tourism flow network of the middle reaches of Yangtze River, and take relevant measures to promote the development of source markets, regional tourism cooperation, and thus promote the development of tourism in the middle reaches of Yangtze River.

## II. METHODOLOGY

### 2.1 Granger Causality

Granger causality test is a statistical method used to test the causal relationship between two-time series, often used to test whether the lagged value of one time series can affect the other time series. If the addition of lagged values of time series $X$ significantly improves the prediction of time series $Y$, then time series $X$ can be considered to influence time series $Y$, which means that time series $X$ is the Granger cause of time series $Y$ [28]. This paper focuses on using this method to analyze whether there is a causal relationship between domestic tourism economic development among cities in the middle reaches of Yangtze River, and the extent of the spillover effects of tourism economic development in each city.

In this paper, 10% is chosen as the test, that is, when the $p$-value is less than 10%, it indicates the existence of Granger causality between the two. If the Granger causality test shows that the tourism economic data between two cities are bi-directional causality, it means that both cities have spillover effects on each other's tourism economic development; If the Granger causality test shows that the tourism economic data between two cities are uni-directional causality, it means that the tourism economic development of one city has spillover effects on the tourism economic development of the other city.

### 2.2 Gravitational model

Granger causality test can only test whether there is a spillover effect of tourism economic development between two cities, and cannot measure the size of the spillover effect, in order to further analyze the size of the spillover effect of

tourism economic development in each city, this paper introduces the gravitational model as an analytical method with the following calculation formula [29]:

$$S_{xy} = C_{xy} \times \frac{\sqrt{I_x} \times \sqrt{I_y}}{D_{xy}^2} \qquad （1）$$

$$C_{xy} = \frac{I_x}{I_x + I_y} \qquad （2）$$

In this formula $S_{xy}$ denotes the degree of tourism economic linkage between cities $x$ and $y$, i.e., the spillover intensity of city x to city y; $I_x$ and $I_y$ denote the actual domestic tourism revenue of city $x$ and city $y$, respectively; $D_{xy}$ denotes the spatial distance from city $x$ to city $y$; and $C_{xy}$ denotes the contribution rate of city $x$ to city $y$. If the tourism economic development between two cities is two-way causality, it is necessary to formula (1) and (2) to calculate the spillover effect of the two cities respectively. If the tourism economic development between two cities is one-way causality, that is, the tourism economic development of one city between two cities has a spillover effect on the tourism economic development of the other city, the other city tourism economic development has no spillover effect on it, then we only need to calculate the city with spillover effect The tourism economic development spillover intensity of the city with spillover effect。

*2.3 Social network analysis method*

Social network is a collection used to study the members of a society and the relationships between them. This study uses social network analysis to analyze the structural characteristics of the spatially linked network of tourism economy and tourism flows in the middle reaches of Yangtze River. Each city is a point in the network and the spatially linked domestic tourism economy and tourism flows between the cities are the lines in the network. In this paper, we mainly analyze the individual network structure and the whole network structure at two levels, where the individual network is analyzed through indicators such as network size, centrality and structural hole, and the whole network focuses on the characteristics of network correlation, central potential, core-edge model and blockmodels, where the blockmodels is divided into Two-way spillover , Main beneficiary , Main spillover, and Broker (Table 1) [30].

The social network analysis method mainly studies the relational data, and believes that the society is not simply an ensemble of individuals, it should contain both individuals and social, economic or cultural relationships among individuals. In the analysis process, the original data will be dimensionless delineated, and finally the network structure characteristics will be portrayed by indicators such as network density. Therefore, despite the different nature of the domestic tourism income and tourism flow data of the middle reaches of Yangtze River in this paper, the relevant indicators of the network structure can be analyzed comparatively.

Tab.1 Four position types for blockmodels

| Internal relationship ratio | Proportion of relationships received | |
|---|---|---|
| | ≈0 | >0 |
| » $(g_k\text{-}1)$ /$(g\text{-}1)$ | Two-way spillover | Main beneficiary |
| « $(g_k\text{-}1)$ /$(g\text{-}1)$ | Main spillover | Broker |

Note:gk is the number of members in the plate; g is the number of members in the whole network; (gk-1)/(g-1) is the expected relationship ratio.

### III. DATA

Network Attentions I, the Baidu search index, which refers to the degree of people's online attention to something in China, and a lot of previous studies have shown that there is a close positive correlation between web attention and tourism flow [25-27]. This paper relies on the Baidu index to collect the network attentions between 31 cities in the middle reaches of Yangtze River in 2019 as the flow and flow data of tourism flow, which is used to analyze the network structure of tourism flow in the middle reaches of Yangtze River. The keywords used in the search are divided into two categories: one is the names of all A-class scenic spots in the middle reaches of the Yangtze River, and after repeated tests, the total number of scenic spots that can be used as keywords is 153 after removing the spots that are not included in the Baidu index platform and the spots that are duplicated or have unknown meanings; The second category is "city name + 旅游" and "city name + 景点", such as Changsha, in addition to the keywords of scenic spots names, "长沙旅游" and "长沙景点" are also keywords retrieved to increase the credibility of the data.

In addition, this study needs to collect domestic tourism revenue, CPI index, list of A-class scenic spots, and spatial distance between cities in the middle reaches of the Yangtze River from 2000-2019 for 31 cities in the middle reaches of Yangtze River. The domestic tourism revenue data and CPI index are obtained from provincial statistical yearbooks and statistical bulletins of each city. Since the domestic tourism revenue data are statistical values, which do not eliminate the influence of price factors and cannot effectively reflect the actual development of tourism and economy of each city, the actual domestic tourism revenue data of the cities in the middle reaches of the Yangtze River are obtained by using 2000 as the base period and making a reduction with CPI and GDP index; The list of A-class scenic spots was obtained from the tourism and cultural offices of each province and city; the spatial distance between cities in the middle reaches of Yangtze River was measured with Baidu Maps.

## IV. ANALYSIS AND RESULTS

*4.1 Analysis of the characteristics of the spatial association network of the middle reaches of the Yangtze River tourism economy*

4.1.1 Construction of a Spatially Linked Network of Tourism Economy of the middle reaches of Yangtze River

Eviews10 was used to test whether there was a one-way or two-way spillover between the domestic tourism economies of the two cities with the help of Granger causality. To eliminate heteroskedasticity interference, the actual domestic tourism revenue of each city was digitized. Before conducting the Granger causality test, the ADF test was performed on all time series, and the optimal lag was selected using the same results of multiple tests of AIC and SC in the lag selection.According to the results of ADF test, the original series is stable for 12 cities, the first-order difference of the original series is smooth for 29 cities (including 12 cities with smooth original series), and the second-order difference data are stable for all cities.Granger causality tests were done two by two for the smooth series. The johansen cointegration test

was performed on the first-order smooth original series, and if there was cointegration, it was corrected by the VEC model and tested for Granger causality, and if there was no cointegration, it was measured by the first-order difference data.The original series and the first-order difference series were used in turn with for the johansen cointegration test that performed on the second-order difference smooth data, and if there was cointegration, it was corrected by the VEC model, and if there is no cointegration relationship, the data are measured by second-order difference data. The results showed that there are 380 city pairs with Granger causality and 107 with bidirectional relationship, generating a total of 487 spillovers, accounting for 52.37% of the maximum possible 930 spillovers from 31 cities, thus showing that tourism economic linkages between cities in the middle reaches of the Yangtze River are generally. Tourism economic spillover is common in 31 cities, with no independently developed cities, and all cities have tourism economic spillover and benefit. Using the gravity model to calculate the magnitude of 487 spillover relationships in the middle reaches of the Yangtze River in 2019, establish the tourism economic spillover intensity matrix, and build a network diagram of tourism economic spillover relationships among cities with the help of gephi9, as shown in Fig. 1.

More than one-third of the tourism economic spillover relationships among cities show insignificant and weak spillover relationships.19.92% of the spillover relationship strengths were greater than 0.5%, 41.27% were between 0.1% and 0.5%, and 38.8% were less than 0.1%Among them, Huanggang has the largest tourism economic spillover intensity to Ezhou at 56.81%;,followed by Xiangtan's tourism economic spillover intensity to Zhuzhou at 49.49%. In addition to the spillover intensity of more than 10% there are four groups, respectively, Wuhan to Xiaogan's tourism economic spillover intensity of 18.4%, Wuhan to Huanggang's tourism economic spillover intensity of 16.19%, Yichun to Xinyu's tourism economic spillover intensity of 12.23%, Wuhan to Xianning's tourism economic spillover intensity of 11.8%.

Fig.1 Structure of the networks associated with the domestic tourism economy in the middle reaches of the Yangtze River

4.1.2 Characteristics of the network structure of the Ego networks of the tourism economy of the middle reaches of the Yangtze River

Ucinet6 was used to analyze the Ego networks structure of the middle reaches of the Yangtze River tourism economy, and the results are shown in Tab. 2. As seen in Table 2, Jiujiang has the least number of network members, followed by Zhuzhou, with which less than 20 cities have economic ties. Wuhan, Xiaogan, Xiantao, Xiangyang, Yichang, Jingzhou, Jingmen, Tianmen, Qianjiang, Changsha, Xiangtan, Hengyang, Yueyang, Changde, Loudi and Shangrao have a network size greater than 25, and most cities have tourism economic spillover relationships.

Wuhan, Xiantao, Xiangyang, Yichang, Jingmen, Tianmen, Qianjiang, Hengyang, Yueyang and Changde have a higher In-Degree, i.e. more beneficial relationships. Xiangtan, Xiaogan, Changsha, Xiangyang, Loudi and Ji'an have higher Out-Degree, i.e., more spillover relationships. Wuhan, Huanggang, Xiantao,

Xiangyang, Yichang, Jingzhou, Jingmen, Tianmen, Qianjiang, Hengyang, Yueyang, Changde, Yiyang, Nanchang, Yingtan and Pingxiang have more beneficiary relationships than spillover relationships, Ezhou has the same number of beneficiary relationships as spillover relationships, and the remaining 14 cities have more spillover relationships than beneficiary relationships. Wuhan, Xiaogan, Xiantao, Xiangyang, Jingmen, Xiangtan, Yueyang and Changde are 8 cities with stronger network centrality, indicating that these cities are at the core of the tourism economic network and are most closely connected to other members of the network, and their Point centrality, Betweenness centrality and Closeness centrality are higher than other cities. The Point centrality and Closeness centrality are higher than 90%, and more spillover relationships occur with their respective individual network members, indicating that these cities have a higher degree of control over tourism economic interactions with other cities and a stronger mediating role.

Tab.2 Ego networks structure indicators of domestic tourism economy in the middle reaches of the Yangtze River

| City | Size | Out-Degree | In-Degree | Degree （%） | Closeness （%） | Betwe-enness | Structural Hole | | |
|------|------|-----------|-----------|-------------|-----------------|--------------|--------|------------|-----------|
| | | | | | | | EffSize | Efficienc | Constrain |
| Wuhan | 28 | 17 | 20 | 93.33 | 93.75 | 0.86 | 25.41 | 0.91 | 0.30 |
| Huangshi | 23 | 17 | 11 | 76.67 | 81.08 | 0.63 | 20.02 | 0.87 | 1.01 |
| Huanggang | 23 | 13 | 19 | 76.67 | 81.08 | 0.40 | 20.06 | 0.87 | 0.64 |
| Ezhou | 24 | 14 | 14 | 80.00 | 83.33 | 0.60 | 21.38 | 0.89 | 0.76 |
| Xiaogan | 29 | 21 | 17 | 96.67 | 96.77 | 0.92 | 22.38 | 0.77 | 0.74 |
| Xianning | 24 | 18 | 17 | 80.00 | 83.33 | 0.55 | 17.68 | 0.74 | 0.61 |
| Xiantao | 27 | 18 | 21 | 90.00 | 90.91 | 0.98 | 22.75 | 0.84 | 0.40 |
| Xiangyang | 28 | 20 | 21 | 93.33 | 93.75 | 0.93 | 24.10 | 0.86 | 0.27 |
| Yichang | 26 | 15 | 23 | 86.67 | 88.24 | 0.68 | 22.51 | 0.87 | 0.25 |
| Jingzhou | 25 | 13 | 19 | 83.33 | 85.71 | 0.63 | 22.15 | 0.89 | 0.28 |
| Jingmen | 27 | 14 | 24 | 90.00 | 90.91 | 0.92 | 23.70 | 0.88 | 0.30 |
| Tianmen | 26 | 12 | 22 | 86.67 | 88.24 | 0.60 | 21.81 | 0.84 | 0.37 |
| Qianjiang | 25 | 12 | 22 | 83.33 | 85.71 | 0.60 | 21.93 | 0.88 | 0.24 |
| Changsha | 25 | 21 | 6 | 83.33 | 85.71 | 0.67 | 22.17 | 0.89 | 0.23 |
| Zhuzhou | 19 | 16 | 11 | 63.33 | 73.17 | 0.29 | 14.94 | 0.79 | 0.76 |
| Xiangtan | 27 | 23 | 8 | 90.00 | 90.91 | 0.89 | 24.40 | 0.90 | 0.61 |
| Hengyang | 26 | 13 | 23 | 86.67 | 88.24 | 0.75 | 22.04 | 0.85 | 0.28 |
| Yueyang | 29 | 19 | 24 | 96.67 | 96.77 | 0.92 | 24.46 | 0.84 | 0.24 |
| Changde | 28 | 18 | 21 | 93.33 | 93.75 | 0.84 | 24.47 | 0.87 | 0.25 |
| Yiyang | 22 | 13 | 17 | 73.33 | 78.95 | 0.42 | 18.80 | 0.86 | 0.36 |
| Loudi | 26 | 20 | 10 | 86.67 | 88.24 | 0.82 | 21.84 | 0.84 | 0.40 |
| Nanchang | 23 | 11 | 15 | 76.67 | 81.08 | 0.45 | 19.88 | 0.86 | 0.31 |
| Jiujiang | 17 | 11 | 7 | 56.67 | 69.77 | 0.28 | 14.38 | 0.85 | 0.32 |
| Jingdezhen | 21 | 16 | 13 | 70.00 | 76.92 | 0.37 | 19.24 | 0.92 | 0.27 |
| Shangrao | 25 | 16 | 11 | 83.33 | 85.71 | 0.74 | 21.85 | 0.87 | 0.26 |
| Yingtan | 23 | 9 | 17 | 76.67 | 81.08 | 0.63 | 21.07 | 0.92 | 0.31 |
| Xinyu | 21 | 13 | 12 | 70.00 | 76.92 | 0.37 | 17.80 | 0.85 | 0.54 |
| Yichun | 24 | 14 | 12 | 80.00 | 83.33 | 0.64 | 20.25 | 0.84 | 0.34 |
| Pingxiang | 22 | 15 | 17 | 73.33 | 78.95 | 0.40 | 18.82 | 0.86 | 0.37 |
| Fuzhou | 22 | 15 | 7 | 73.33 | 78.95 | 0.44 | 18.31 | 0.83 | 0.34 |
| Ji'an | 23 | 20 | 6 | 76.67 | 81.08 | 0.57 | 19.27 | 0.84 | 0.45 |

Wuhan, Xiangyang, Yichang, Jingzhou, Jingmen, Qianjiang, Changsha, Hengyang, Yueyang, Changde and Shangrao have larger EffSize and Efficienc and smaller Constrain, indicating that these cities have less redundancy in the tourism economic spatial association network, and they are less restricted by other cities, less dependent on other cities, and are in a relatively favorable position in the network. The EffSize and Efficiency of Huangshi, Huanggang, Xianning, Zhuzhou and Xinyu are smaller and the Constrain is higher, which indicates that these cities have high redundancy in the spatially linked network of the tourism economy, are more restricted by other cities, have a high dependence on other cities

for tourism economy. These cities need to strengthen the connection and cooperation between regions.。

4.1.3 Characteristics of the whole network structure of the tourism economy of the middle reaches of the Yangtze River

As measured by Ucinet6, the spatial correlation of the domestic tourism economy in the middle reaches of the Yangtze River is high, and the whole network correlation is 1. The tourism economic spillover links between cities are common, and the whole network density is 0.52. When the threshold value of tourism economic spillover intensity is taken as 0.1%, the whole network density is 0.32, and when the threshold value is equal to 0.5%, the whole network density is only 0.1, and the network density is very low. It indicates that the small tourism economic spillover in the middle reaches of the Yangtze River is on the high side, and the tourism economic linkages among cities still need to be strengthened. The Point centralization of the overall tourism economy network is 3.78%, and the Betweenness centralization is 2.21%, which is in a low value, indicating that the tourism economy network structure is less centralized, and the development of the tourism economy network in the middle reaches of the Yangtze River is balanced。

According to the local relationship of 31 cities, the tourism economic network of the middle reaches of the Yangtze River is divided into 5 blocks namely Wuhan Metropolitan Area, Xiang-Jing-Yi City Group, Changsha-Zhuzhou-Xiangtan City Group, The Poyang Lake City Group and Xing-Yi-Ping City Group. The first block is Wuhan Metropolitan Area, including Wuhan, Xianning, Huangshi, Xiaogan, Huanggang, Xiantao, Ezhou, Tianmen and Qianjiang; the second block is Xiang-Jing-Yi City Group, including Xiangyang, Yichang, Jingzhou and Jingmen; the third block is Changsha-Zhuzhou-Xiangtan City Group, including Changsha, Zhuzhou, Xiangtan, Hengyang, Yueyang, Changde, Yiyang and Loudi; the fourth block is The Poyang Lake City Group, including Jiujiang, Jingdezhen, Shangrao, Yingtan, Nanchang and Fuzhou; the fifth block is Xing-Yi-Ping City Group, including Ji'an, Xinyu, Yichun and Pingxiang [31]. The characteristics of each block are shown in Table 3.

Tab.3 Characteristics of the whole Network Segments of Domestic Tourism economy in the middle reaches of the Yangtze River

| | Wuhan Metropolitan Area | Xiang-Jing-Yi | Chang-Zhu-Tan City Group | The Poyang Lake City Group | Xing-Yi-Ping | Block membership | Actual internal relationship ratio /% | Expected internal relationship ratio /% | Number of extra-modular relationships accepted | Block Types |
|---|---|---|---|---|---|---|---|---|---|---|
| Wuhan Metropolitan Area | 47 | 26 | 37 | 16 | 16 | 9 | 33.10 | 26.67 | 163 | Main beneficiary |
| Xiang-Jing-Yi | 21 | 9 | 18 | 7 | 7 | 4 | 16.07 | 10.00 | 87 | Main beneficiary |
| Chang-Zhu-Tan City Group | 53 | 28 | 28 | 24 | 10 | 8 | 19.58 | 23.33 | 120 | Broker |
| The Poyang Lake City Group | 26 | 12 | 20 | 10 | 10 | 6 | 12.82 | 16.67 | 70 | Broker |
| Xing-Yi-Ping | 16 | 12 | 17 | 13 | 2 | 4 | 3.33 | 10.00 | 39 | Broker |

Among the 487 correlations in the whole network, there are 135 intra-block relationships and 352 inter-block relationships in the 5 blocks, indicating that the output and introduction roles are more obvious and frequent exchanges between blocks. Wuhan Metropolitan Area block received 163 relations and issued 142 relations, including 47 intra-block relations, received 116 from other blocks and issued 95 relations, with the expected internal relation ratio of 26.67% and the actual internal relation ratio of 33.1%, which is higher than the expected value, this block is the Main beneficiary. Xiang-Jing-Yi City Group block received 87 relationships and issued 62 relationships, of which 9 were internal to the block, 78 were received from other blocks and 53 were issued, with a desired internal relationship ratio of 10% and an actual internal relationship ratio of 16.07%, this block is the Main beneficiary. Changsha-Zhuzhou-Xiangtan City Group block received 120 relations and sent out 143 relations, including 28 internal relations of the block, received 92 relations from other blocks and sent out 115 relations, the proportion of expected internal relations was 23.33% and the proportion of actual internal relations was 19.58% , this block is the Broker. The Poyang Lake City Group block receives 70 relations and sends out 78 relations, among which 10 relations are internal to the block, 60 relations are received from other blocks and 68 relations are sent out, the proportion of expected internal relations is 16.67% and the proportion of actual internal relations is 12.82% , this block is the Broker. The Xing-Yi-Ping City Group block received 39 relationships and issued 60 relationships, including 4 relationships within the block, received 35 relationships from other blocks, and issued 56 relationships, with an expected internal relationship ratio of 7.69% and an actual internal relationship ratio of 3.33%, this block is the Broker. From the proportion of internal relationship, the proportion of internal relationship of each city group is Wuhan Metropolitan Area, Changsha-Zhuzhou-Xiangtan City Group, Xiang-Jing-Yi City

Group, The Poyang Lake City Group and Xing-Yi-Ping City Group in order from largest to smallest, the higher the proportion of internal relationship, the more frequent and close tourism economic exchanges within its block.

Table 4 shows the density matrix for each block. As seen from Table 4, the spillover effect of Wuhan Metropolitan Area block is mainly concentrated in Xiang-Jing-Yi City Group block, followed by intra-block, Changsha-Zhuzhou-Xiangtan City Group and Xing-Yi-Ping City Group blocks, and the spillover effect on The Poyang Lake City Group block is the smallest. The spillover effect of Xiang-Jing-Yi City Group block is mainly concentrated within the block, followed by Wuhan Metropolitan Area, Changsha-Zhuzhou-Xiangtan City Group and Xing-Yi-Ping City Group block in order, and the spillover effect on The Poyang Lake City Group block is the smallest。 The spillover effect of Changsha-Zhuzhou-Xiangtan City Group block is mainly concentrated in Xiang-Jing-Yi City Group block, followed by Wuhan Metropolitan Area block, internal block and The Poyang Lake City Group block in order, and the spillover effect on Xing-Yi-Ping City Group block is the smallest. The spillover effect of The Poyang Lake City Group block is mainly concentrated in Xiang-Jing-Yi City Group block, followed by Wuhan Metropolitan Area, Changsha-Zhuzhou-Xiangtan City Group and Xing-Yi-Ping City Group block, and the spillover effect within the block is the smallest. The spillover effect of Xing-Yi-Ping City Group block is mainly concentrated in Xiang-Jing-Yi City Group block, followed by The Poyang Lake City Group, Changsha-Zhuzhou-Xiangtan City Group and Wuhan Metropolitan Area block, and the spillover effect within the block is the smallest. On the whole, all blocks have tourism economic linkage and spillover relationship with each other, and there is no isolated block, which means that each block is more closely connected with each other。

Tab.4 Density matrix of Domestic Tourism economy in the middle reaches of the Yangtze River

|  | Wuhan Metropolitan Area | Xiang-Jing-Yi | Chang-Zhu-Tan City Group | The Poyang Lake City Group | Xing-Yi-Ping |
|---|---|---|---|---|---|
| Wuhan Metropolitan Area | 0.653 | 0.722 | 0.514 | 0.296 | 0.444 |
| Xiang-Jing-Yi | 0.583 | 0.750 | 0.563 | 0.292 | 0.483 |
| Chang-Zhu-Tan City Group | 0.736 | 0.875 | 0.500 | 0.500 | 0.313 |
| The Poyang Lake City Group | 0.481 | 0.500 | 0.417 | 0.333 | 0.417 |
| Xing-Yi-Ping | 0.444 | 0.750 | 0.531 | 0.542 | 0.222 |

The whole network density of 0.52 as the cut-off value, higher than 0.52 assigned to 1, lower than 0.51 assigned to 0 to draw like matrix, the results are shown in Figure 2. As the lowest total tourism economic income among the five blocks, Xiang-Jing-Yi City Group block has the strongest Money-absorbing ability, and is an important tourism economic beneficiary block, receiving tourism economic overflow from Wuhan Metropolitan Area, Changsha-Zhuzhou-Xiangtan City Group, and the Xing-Yi-Ping City Group block, while also having tourism economic overflow to Wuhan Metropolitan Area, Changsha-Zhuzhou-Xiangtan City Group block. Although the number of cities in the Xiang-Jing-Yi City Group block is small, it is rich in tourism resources and contains 107 A-class scenic spots including five 5A-class scenic spots, such as Qu Yuan's hometown, Qing Jiang Gallery, People scenic Three Gorges, Three Gorges Dam and Jing Zhou Ancient City. Located in the middle of the middle reaches of the Yangtze River, Xing-Yi-Ping City Group block is the main tourism economic spillover block, and the tourism economic spillover is obvious, there is economic spillover to Xiang-Jing-Yi City Group, Changsha-Zhuzhou-Xiangtan City Group and The Poyang Lake City Group. No block has tourism economic spillover to this block, the main reason is that compared with other blocks, Xing-Yi-Ping City Group block is poor in tourism resources, and there is only one 5A grade scenic spot, which is not attractive enough for tourism, but due to the location, the middle of the middle reaches of the Yangtze River, it has

convenient transportation, which makes it convenient for the residents of this block to go out and travel, thus driving the tourism economic spillover from Xing-Yi-Ping City Group block to other blocks. Wuhan Metropolitan Area and Changsha-Zhuzhou-Xiangtan City Group have tourism economic spillover and spillover-receiving effects, where Wuhan Metropolitan Area block sends tourism economic spillover to Changsha-Zhuzhou-Xiangtan City Group block and receives tourism economic spillover from Xiang-Jing-Yi City Group and Changsha-Zhuzhou-Xiangtan City Group at the same time. And Changsha-Zhuzhou-Xiangtan City Group block sends tourism economic spillover to Wuhan Metropolitan Area and Xiang-Jing-Yi City Group block, and receives tourism economic spillover from Xiang-Jing-Yi City Group and Xing-Yi-Ping City Group block at the same time. The Poyang Lake City Group block is the tourism economic benefit block, but it only receives tourism economic spillover from Xing-Yi-Ping City Group block, and has no economic spillover relationship with other blocks. To sum up, the frequent domestic tourism economic linkage area in the middle reaches of the Yangtze River is mainly concentrated among Wuhan Metropolitan Area, Xiang-Jing-Yi City Group, Changsha-Zhuzhou-Xiangtan City Group and Xing-Yi-Ping City Group blocks, Xiang-Jing-Yi City Group block is the main tourism economic beneficiary block, Xing-Yi-Ping City Group block is the main tourism economic overflow block, The Poyang Lake City Group block has insufficient tourism

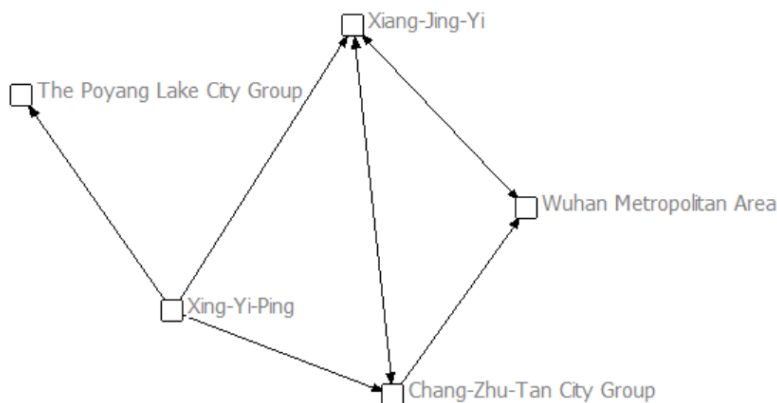economic linkage with other blocks and needs to strengthen the tourism economic exchange with other blocks。



Fig.2 Interrelation of the five blocks of domestic tourism economy in the middle reaches of the Yangtze River

*4.2 Analysis of the structural characteristics of the middle reaches of the Yangtze River tourism flow network*

4.2.1 Construction of the middle reaches of the Yangtze River tourism flows network

Statistical data on the network attention of the tourism among cities in the middle reaches of the Yangtze River reveals that Wuhan is the most active city in the development of tourism flow in the middle reaches of the Yangtze River, with both the inflow and outflow of tourism flow above 4 million, and is in the most central position in the middle reaches of the Yangtze River tourism flow network. Changsha, with both the inflow and outflow above 2 million, is in the second central position in the middle reaches of the Yangtze River tourism flow network. The inflow and outflow of Tianmen, Qianjiang, and Xiantao are in the lower position in the middle reaches of the Yangtze River, especially Tianmen, which is the lowest city in the middle reaches of the Yangtze River in terms of inflow and outflow, residents have the lowest willingness to travel, and residents of other cities have the lowest willingness to travel to Tianmen too. 930 tourism flow direction data should theoretically exist in 31 cities, and 723 data actually exist, that is, a total of 723 tourism flow relationships exist in the middle reaches of the Yangtze River. This accounts for 77.74% of the maximum possible 930 tourism flow directions of the 31 cities, which shows that the tourism flow connections between cities in the middle reaches of the Yangtze River are relatively close. Tourism flows are universally linked in 31 cities, with no independently developed cities, and tourism flows into and out of each city。

The tourism flow inflow and outflow matrices are established and the middle reaches of the Yangtze River tourism flow network in 2019 are analyzed with the help of gephi9. It is found that when the threshold value is 0, there are 723 tourism flow segments and the network density is 0.78, and the tourism flow network is highly correlated. When the threshold value of 0.5 million passengers is selected, the number of tourism flow line segments in the network is 503 and the overall density of the network is 0.54. The number of tourism flow line segments is appropriate at this time, which can avoid overlapping of too many line segments and can highlight the core nodes. Therefore, this paper selects 0.5 million trips as the threshold value and draws the network structure of the middle triangle tourism flow, the results are shown in Figure 3.
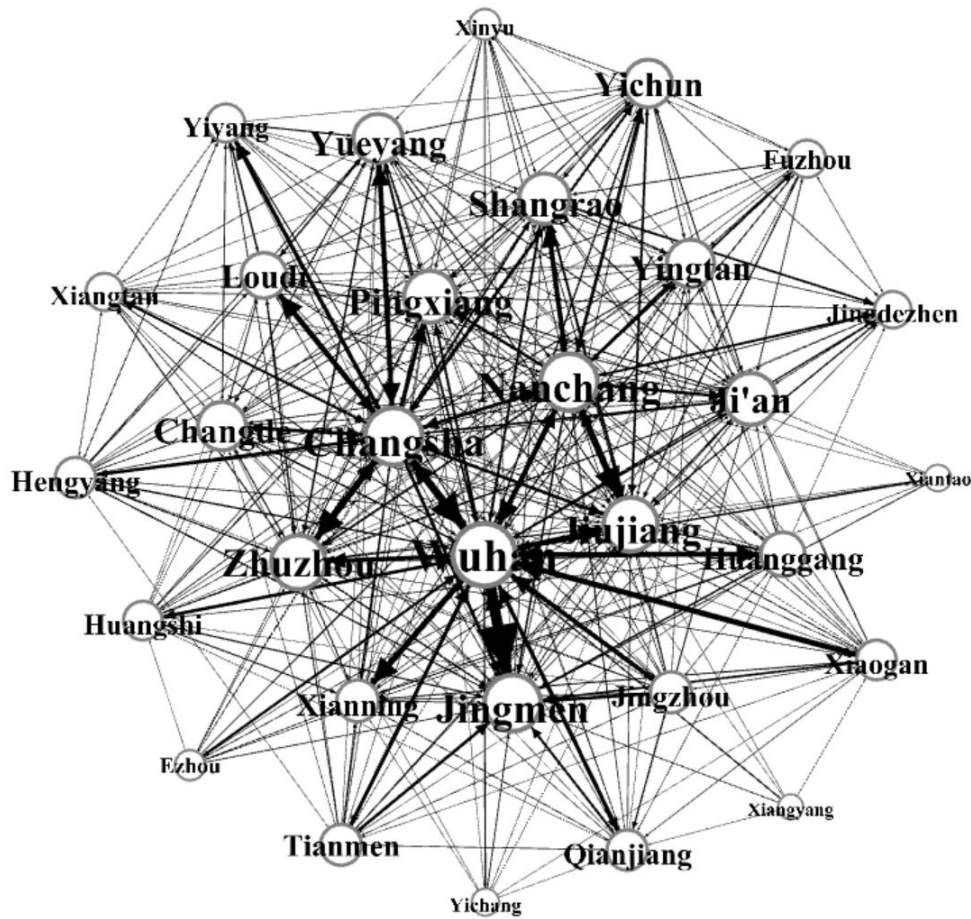
Figure3 Structure of the networks associated with the tourism flows in the middle reaches of the Yangtze River with a threshold of 5000 in 2019

4.2.2 Characteristics of the network structure of individual Network of the middle reaches of the Yangtze River tourism flows

Ucinet6 was used to analyze the individual network structure of domestic tourism flows in the middle reaches of the Yangtze River, and the results are shown in Table 5. As seen in Table 5, Wuhan, Xianning, Yichang, Changsha, Yueyang, Zhuzhou, Hengyang, Nanchang, Jiujiang, Shangrao, Yingtan, Pingxiang and Ji'an have a network size of 30, indicating that the tourism flow connections of these cities are spread throughout the middle reaches of the Yangtze River. The network centered on Xinyu has the fewest members, with less than 20 cities with which tourism flows occur.

Wuhan, Xianning, Yichang, Changsha, Yueyang, Zhuzhou, Hengyang, Nanchang, Jiujiang, Shangrao, Yingtan, Pingxiang and Ji'an have the highest In-degree of 30, i.e., these cities receive tourism flow overflow from all other cities.

Wuhan, Huangshi, Huanggang, Xiaogan, Xiangyang, Yichang, Jingzhou, Jingmen, Changsha, Yueyang, Changde, Zhuzhou, Nanchang and Jiujiang have higher Out-degrees, i.e., these cities have more tourism flow overflow relationships. Wuhan has the highest Out-degree of 30, indicating that Wuhan receives tourism flow overflow to all other cities. Huangshi, Huanggang, Ezhou, Xiaogan, Xiantao, Tianmen, Qianjiang, Xiangyang, Jingzhou, Jingmen, Yiyang, Changde and Xinyu have more spillover relationships than beneficiary relationships, Wuhan has spillover relationships equal to beneficiary relationships, and the remaining 17 cities have more beneficiary relationships than spillover relationships. Wuhan, Xianning, Yichang, Changsha, Yueyang, Zhuzhou, Hengyang, Nanchang, Jiujiang, Shangrao, Yingtan, Pingxiang and Ji'an have stronger network centrality, indicating that these cities are at the core of the tourism flow network and are most closely connected with other members of the network, and their Point

centrality, Betweenness centrality and Closeness centrality are higher than other cities. The Point centrality and Closeness centrality are both 100, while the Betweenness centrality is 0.57, which indicates that these cities have a higher degree of control over the tourism flow interactions between other cities and have a stronger intermediary role.

Tab.5 Individual networks structure indicators of domestic tourism flows in the middle reaches of the Yangtze River

| City | Size | Out-Degree | In-Degree | Degree （%） | Closeness （%） | Betwe-enness | Structural Hole | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | EffSize | Efficienc | Constrain |
| Wuhan | 30 | 30 | 30 | 100.00 | 100.00 | 0.57 | 25.50 | 0.85 | 0.16 |
| Huangshi | 27 | 26 | 21 | 90.00 | 90.91 | 0.18 | 16.68 | 0.62 | 0.41 |
| Huanggang | 28 | 27 | 25 | 93.33 | 93.75 | 0.29 | 16.23 | 0.58 | 0.47 |
| Ezhou | 23 | 23 | 9 | 76.67 | 81.08 | 0.02 | 12.87 | 0.56 | 0.52 |
| Xiaogan | 28 | 27 | 16 | 93.33 | 93.75 | 0.29 | 16.20 | 0.58 | 0.50 |
| Xianning | 30 | 23 | 30 | 100.00 | 100.00 | 0.57 | 19.04 | 0.63 | 0.41 |
| Xiantao | 22 | 21 | 11 | 73.33 | 78.95 | 0.04 | 12.01 | 0.55 | 0.55 |
| Xiangyang | 20 | 20 | 4 | 66.67 | 75.00 | - | 10.51 | 0.53 | 0.59 |
| Yichang | 22 | 20 | 14 | 73.33 | 78.95 | 0.04 | 12.21 | 0.56 | 0.55 |
| Jingzhou | 28 | 27 | 21 | 93.33 | 93.75 | 0.29 | 18.35 | 0.66 | 0.41 |
| Jingmen | 30 | 27 | 30 | 100.00 | 100.00 | 0.57 | 20.62 | 0.69 | 0.35 |
| Tianmen | 29 | 28 | 22 | 96.67 | 96.77 | 0.38 | 18.75 | 0.65 | 0.41 |
| Qianjiang | 28 | 26 | 24 | 93.33 | 93.75 | 0.29 | 17.65 | 0.63 | 0.46 |
| Changsha | 30 | 29 | 30 | 100.00 | 100.00 | 0.57 | 23.91 | 0.80 | 0.20 |
| Zhuzhou | 30 | 27 | 30 | 100.00 | 100.00 | 0.57 | 21.39 | 0.71 | 0.30 |
| Xiangtan | 22 | 22 | 11 | 73.33 | 78.95 | - | 14.26 | 0.65 | 0.42 |
| Hengyang | 25 | 25 | 20 | 83.33 | 85.71 | 0.07 | 17.25 | 0.69 | 0.34 |
| Yueyang | 30 | 25 | 30 | 100.00 | 100.00 | 0.57 | 21.44 | 0.72 | 0.32 |
| Changde | 29 | 23 | 29 | 96.67 | 96.77 | 0.43 | 20.72 | 0.72 | 0.32 |
| Yiyang | 24 | 19 | 22 | 80.00 | 83.33 | 0.02 | 16.29 | 0.68 | 0.41 |
| Loudi | 30 | 23 | 30 | 100.00 | 100.00 | 0.57 | 21.31 | 0.71 | 0.35 |
| Nanchang | 30 | 27 | 30 | 100.00 | 100.00 | 0.57 | 22.87 | 0.76 | 0.23 |
| Jiujiang | 30 | 25 | 30 | 100.00 | 100.00 | 0.57 | 21.85 | 0.73 | 0.27 |
| Jingdezhen | 27 | 19 | 27 | 90.00 | 90.91 | 0.24 | 18.88 | 0.70 | 0.33 |
| Shangrao | 30 | 21 | 30 | 100.00 | 100.00 | 0.57 | 22.25 | 0.74 | 0.28 |
| Yingtan | 30 | 16 | 30 | 100.00 | 100.00 | 0.57 | 22.96 | 0.77 | 30 |
| Xinyu | 17 | 17 | 8 | 56.67 | 69.77 | - | 11.48 | 0.68 | 17 |
| Yichun | 28 | 23 | 28 | 93.33 | 93.75 | 0.33 | 19.94 | 0.71 | 28 |
| Pingxiang | 30 | 20 | 30 | 100.00 | 100.00 | 0.57 | 22.37 | 0.75 | 30 |
| Fuzhou | 23 | 17 | 21 | 76.67 | 81.08 | 0.09 | 15.79 | 0.69 | 23 |
| Ji'an | 30 | 20 | 30 | 100.00 | 100.00 | 0.57 | 23.01 | 0.77 | 30 |

Wuhan, Changsha, Yueyang, Zhuzhou, Xiangtan, Hengyang, Nanchang, Jiujiang, Shangrao, Yingtan, Pingxiang and Ji'an have a larger EffSize and Efficiency and a smaller Constrain, indicating that these cities have less redundancy in

the tourism flow network, and are less restricted by other cities and less dependent on other cities and are in a relatively favorable position in the network. The EffSize and Efficiency of Ezhou, Xiantao, Tianmen, Qianjiang and Yiyang are smaller and the Constrain is higher, indicating that these cities have a large redundancy in the tourism flow network,  are more restricted by other cities and have a high dependence on other cities and need to strengthen the connection and cooperation with other cities.

4.2.3 Characteristics of the whole network structure of the tourism flows of the middle reaches of the Yangtze River

The whole network of domestic tourism flows is analyzed using Ucinet6, and it was found that the whole network density of the middle reaches of the Yangtze River tourism flows is 0.78, 0.54 when the tourism flow threshold is equal to 5000 passengers, and 0.16 when the tourism flow threshold is equal to 50,000 passengers. It indicates that tourism flows between cities are more closely connected and have a higher degree of synergy, but there are more small tourism flows, and cities still need to strengthen the connection of tourism flows between them. The Point centralization of the overall tourism flow network is 21.86% and the Closeness centralization was 2.46%, which is in a low value, indicating that the tourism flow network structure is less centralized and the development of the middle triangle tourism flow network is more balanced.

Based on the local relationship of 31 cities, the middle reaches of the Yangtze River tourism flow network is divided into 5 blocks, namely Wuhan Metropolitan Area, Xiang-Jing-Yi City Group, Changsha-Zhuzhou-Xiangtan City Group, The Poyang Lake City Group and Xing-Yi-Ping City Group, and the characteristics of the blocks are shown in Table 6.

Among the 723 related relationships in the whole network, there are 164 intra-block relationships and 559 inter-block relationships in the five blocks, with obvious overflow effects and close communication between blocks. The Wuhan Metropolitan Area block sent out 160 relationships and received 217 relationships, including 54 intra-block relationships, sent out 106 other blocks and received 163 relationships, with an expected intra-relationship ratio of 26.67% and an actual intra-relationship ratio of 33.75%. Xiang-Jing-Yi City Group sent out 97 relations and received 108 relations, including 12 internal relations of the block, sent out 85 other blocks and received 96 relations, the expected internal relations ratio was 12.37% and the actual internal relations ratio was 11.1%. Changsha-Zhuzhou-Xiangtan City Group sent out 202 relations and received 193 relations, including 56 relations within the block, sent out 146 relations from other blocks and received 137 relations, with the expected internal relation ratio of 23.33% and the actual internal relation ratio of 27.72%. The Poyang Lake City Group sent out 168 relations and received 125 relations, including 30 internal relations of the block, sent out 138 relations of other blocks and received 95 relations, the proportion of expected internal relations is 16.67%, the proportion of actual internal relations is 17.86%. Xing-Yi-Ping City Group sent out 96 relationships and received 80 relationships, including 12 relationships within the block, 84 relationships sent out to other blocks, and 68 relationships received, with an expected internal relationship ratio of 10% and an actual internal relationship ratio of 12.5%. All blocks are Main beneficiaries, among which the actual internal proportional relationship of the Wuhan Metropolitan Area block is the highest, which indicates that there are more tourism flow contact exchanges within the Wuhan Metropolitan Area.

Tab.6 Characteristics of individual network segments of tourism flows in the middle reaches of the Yangtze River

| | Wuhan Metropolitan Area | Xiang-Jing-Yi | Chang-Zhu-Tan City Group | The Poyang Lake City Group | Xing-Yi-Ping | Block membership | Actual internal relationship ratio /% | Expected internal relationship ratio /% | Number of extra-modular relationships accepted | Block Types |
|---|---|---|---|---|---|---|---|---|---|---|
| Wuhan Metropolitan Area | 54 | 33 | 37 | 24 | 12 | 9 | 33.75 | 26.67 | 217 | Main beneficiary |
| Xiang-Jing-Yi | 36 | 12 | 29 | 13 | 7 | 4 | 12.37 | 10.00 | 108 | Main beneficiary |
| Chang-Zhu-Tan City Group | 54 | 30 | 56 | 37 | 25 | 8 | 27.72 | 23.33 | 193 | Main beneficiary |
| The Poyang Lake City Group | 47 | 21 | 46 | 30 | 24 | 6 | 17.86 | 16.67 | 125 | Main beneficiary |
| Xing-Yi-Ping | 26 | 12 | 25 | 21 | 12 | 4 | 12.50 | 10.00 | 80 | Main beneficiary |

Table 7 shows the density matrix of the five blocks. From Table 7, the spillover effect of Wuhan Metropolitan Area is mainly concentrated in Xiang-Jing-Yi City Group, followed by an inner block, Changsha-Zhuzhou-Xiangtan City Group and The Poyang Lake City Group in order, and the smallest spillover effect on Xing-Yi-Ping City Group. The spillover effect of Xiang-Jing-Yi City Group is mainly concentrated in the inner block and Wuhan Metropolitan Area, followed by Changsha-Zhuzhou-Xiangtan City Group and The Poyang Lake City Group in order, and the smallest spillover effect on Xing-Yi-Ping City Group. The spillover effect of Changsha-Zhuzhou-Xiangtan City Group block is mainly concentrated in the inner block, followed by Xiang-Jing-Yi City Group, Xing-Yi-Ping City Group and The Poyang Lake City Group in order, and the smallest spillover effect on Wuhan Metropolitan Area. The spillover effect of The Poyang Lake City Group is mainly concentrated inside the block and the Xing-Yi-Ping City Group , followed by Changsha-Zhuzhou-Xiangtan City Group and Xiang-Jing-Yi City Group, with the smallest spillover effect on the Wuhan Metropolitan Area. The spillover effect of the block around Xing-Yi-Ping City Group is mainly concentrated inside the block, followed by The Poyang Lake City Group, Changsha-Zhuzhou-Xiangtan City Group and Xiang-Jing-Yi City Group, with the smallest spillover effect on the Wuhan Metropolitan Area.

Tab.7 Density matrix of tourism flows in the middle reaches of the Yangtze River

|  | Wuhan Metropolitan Area | Xiang-Jing-Yi | Chang-Zhu-Tan City Group | The Poyang Lake City Group | Xing-Yi-Ping |
|---|---|---|---|---|---|
| Wuhan Metropolitan Area | 0.750 | 0.917 | 0.514 | 0.444 | 0.333 |
| Xiang-Jing-Yi | 1.000 | 1.000 | 0.906 | 0.542 | 0.438 |
| Chang-Zhu-Tan City Group | 0.750 | 0.938 | 1.000 | 0.771 | 0.781 |
| The Poyang Lake City Group | 0.870 | 0.875 | 0.958 | 1.000 | 1.000 |
| Xing-Yi-Ping | 0.722 | 0.750 | 0.781 | 0.875 | 1.000 |

The whole network density of 0.78 as the cut-off value, higher than 0.78 assigned to the value of 1, lower than 0.78 assigned to the value of 0 to draw like matrix, the results are shown in Figure 4 As can be seen from Figure 4, Xiang-Jing-Yi City Group and Changsha-Zhuzhou-Xiangtan City Group are the most important tourist destinations, among which, Xiang-Jing-Yi City Group receives tourist flows from the other three blocks except Xin-Yi-Ping City Group ,and Changsha-Zhuzhou-Xiangtan City Group receives tourist flows from the other three blocks except Wuhan Metropolitan Area, Xiang-Jing-Yi City Group and Changsha-Zhuzhou-Xiangtan City Group are rich in tourist resources and have close interaction with tourist flows from other blocks. The Xiang-Jing-Yi City Group is also the module with the strongest Money-absorbing ability, however, Changsha-Zhuzhou-Xiangtan City Group only receives tourism economic overflow from Xiang-Jing-Yi City Group and Xing-Yi-Ping City Group, so it needs to strengthen its Money-absorbing ability, turn tourism flow into capital flow, and drive tourists from other blocks to Changsha-Zhuzhou-Xiangtan City Group for tourism investment and consumption. The Poyang Lake City Group, which has weaker tourism economy connection with other modules, is the main tourism source block, while there is tourism flow overflow to other four major blocks, and the tourism flow export role is obvious. Xing-Yi-Ping City Group has tourism flow output and inflow to both Changsha-Zhuzhou-Xiangtan City Group and The Poyang Lake City Group. The Wuhan Metropolitan Area block has the least communication with other blocks of tourism flow, only with Xiang-Jing-Yi City Group and The Poyang Lake City Group, and should strengthen the connection with other blocks of tourism flow.。
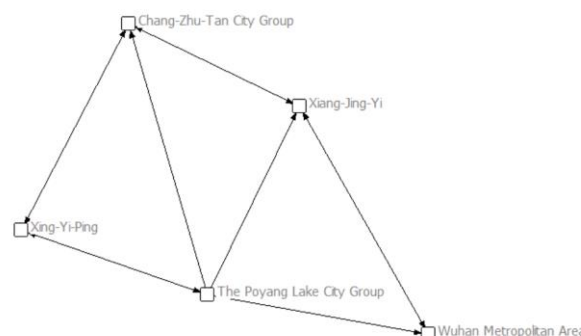


Fig.4 Interrelation of the five major blocks of tourism flows in the middle reaches of the Yangtze River

*4.3 A comparative analysis of the structural characteristics of the tourism economy and tourism flow network in the middle reaches of the Yangtze River*

4.3.1 Comparative analysis of the individual network structural characteristics of the tourism economy and tourism flow in the middle reaches of the Yangtze River

In terms of the size of individual networks, Wuhan, Yichang, Changsha, Hengyang, Yueyang and Shangrao all have larger individual networks with which a lot of cities have tourism economic links and tourism flow links. Jiujiang and Zhuzhou have a small tourism economy individual network size, but the tourism flow individual network size is large, and although there are many cities with which the tourism flow connection occurs, there are few cities with which the tourism economy occurs, and they cannot convert the tourism flow into the capital flow.

In terms of individual network centrality, Xiaogan and Yueyang have the largest Point centrality, Betweenness centrality and Closeness centrality in the middle reaches of the Yangtze River tourism economic network. However, Wuhan, Xianning, Yichang, Changsha, Yueyang, Zhuzhou, Hengyang, Nanchang, Jiujiang, Shangrao, Yingtan, Pingxiang and Ji'an have the strongest centrality in the middle reaches of the Yangtze River tourism flow network. Yueyang has the closest exchange with other city groups in the middle reaches of the Yangtze River, both in terms of tourism economy and tourism flows, due to its geographical location. In contrast, Xinyu and Fuzhou are both weakly centered in the middle reaches of the Yangtze River tourism economy and tourism flow network, and need to strengthen tourism exchanges and cooperation with other cities.

In terms of individual network structure holes, Wuhan, Changsha, Yueyang and Shangrao are all in a relatively favorable position in the middle reaches of the Yangtze River tourism economy and tourism flow network. Huanggang, Ezhou and Xiaogan are more restricted by other cities in the middle reaches of the Yangtze River tourism economy and tourism flow network, and are more dependent on other cities, and need to improve their own tourism attractiveness and strengthen tourism ties and cooperation with other cities in the middle reaches of the Yangtze River. Qianjiang has a relatively obvious advantage in the middle reaches of the Yangtze River tourism economy network, in a favorable position, the

intermediary role is stronger, but instead in a more unfavorable position in the middle reaches of the Yangtze River tourism flow network, subject to the greater restrictions of other cities. Qianjiang has a large deviation in the role and status in the middle reaches of the Yangtze River tourism economy and tourism flow network. By the end of 2019, Qianjiang has no scenic spots above 3A, tourism resources are scarce tourism attraction is not enough, should vigorously tap tourism resources to strengthen the construction of scenic spots to enhance tourism attractiveness. In comparison, the cities in the middle reaches of the Yangtze River tourism flow network are more spatially connected, and each city should strengthen its tourism Money-absorbing ability to convert tourism flows into capital flows.

4.3.2 Comparative analysis of the whole network structural characteristics of the tourism economy and tourism flow in the middle reaches of the Yangtze River

The middle reaches of the Yangtze River tourism economic network contains a total of 487 tourism economic spillover relationships with a network density of 0.52, and the tourism flow network contains a total of 723 tourism flow segments with a network density of 0.78, indicating that the density of the middle reaches of the Yangtze River tourism flow network is greater relative to the tourism economic network, and the cities are more closely linked by tourism flows. Compared to the tourism flow network, the whole network of the middle reaches of the Yangtze River tourism economy has a lower value of centralization, indicating that the structure of the middle reaches of the Yangtze River tourism economy network is less centralized and the development of the tourism economy is more balanced relative then the tourism flow. The distribution of tourism resources in the middle reaches of the Yangtze River is not uniform, there are gaps in tourism attractiveness, resulting in differences in tourism flows between cities, tourism flows will drive capital flows, but tourism flows and capital flows are both linked and distinct, not all cities that benefit more from tourism flows have greater tourism economic benefits, some cities have a strong attractiveness to tourists, but tourism enterprises are highly competitive, the cost of entry is high, lack of investment Attractive.

The middle reaches of the Yangtze River tourism

economy network contains two Main Beneficiary and three Broker, while all five blocks in the flow network are Main Beneficiary, indicating that some cities in the middle reaches of the Yangtze River are in the different roles and positions in the tourism economy and tourism flow network. The number of relationships between the five blocks in the middle reaches of the Yangtze River tourism economic network is relatively small, i.e., the tourism economy between the blocks are not closely enough connected and the whole network is relatively loose. The five blocks in the middle reaches of the Yangtze River tourism flow network are more closely connected, with frequent interactions and a tighter whole network. Xiang-Jing-Yi City Group is the Main Beneficiary in the tourism economy and tourism flow network, and has close communication with other blocks, and its tourism Money-absorbing and Flow-attracting ability is in a favorable position in the middle reaches

of the Yangtze River. Wuhan Metropolitan Area is also the Main Beneficiary in the tourism economy and tourism flow network, but this block has insufficient tourism economy and tourism flow communication with other blocks, and should strengthen tourism communication with other blocks. Other blocks have large differences in the tourism economy and tourism flow network in the middle reaches of the Yangtze River.

The Core/Periphery structure classifies the block on the main diagonal with high density as the Core, and the other block on the main diagonal with low density as the Periphery. In this paper, the core-edge analysis of the middle reaches of the Yangtze River tourism economy and tourism flow network was carried out using Ucinet6, and the results are shown in Table 8.

Tab.8 Core/Periphery of tourism domestic tourism economy and tourism flows network in the middle reaches of the Yangtze River

|  | Core | Periphery |
|---|---|---|
| Tourism economy | Wuhan, Huangshi, Huanggang, Ezhou | Xiaogan, Xianning, Xiantao, Xiangyang, Yichang, Jingzhou, Jingmen, Tianmen, Qianjiang, Changsha, Zhuzhou, Xiangtan, Hengyang, Yueyang, Changde, Yiyang, Loudi, Nanchang, Jiujiang, Jingdezhen, Shangrao, Yingtan, Xinyu, Yichun, Pingxiang, Fuzhou, Ji'an |
| Tourism flow | Wuhan, Huangshi, Huanggang, Xianning, Yichang, Changsha, Yueyang, Nanchang, Jiujiang | Ezhou, Xiaogan, Xiantao, Tianmen, Qianjiang, Xiangyang, Jingzhou, Jingmen, Yiyang, Changde, Zhuzhou, Xiangtan, Loudi, Hengyang, Jingdezhen, Shangrao, Yingtan, Xinyu, Yichun, Pingxiang, Fuzhou, Ji'an |

As seen from Table 8, 4 cities in the tourism economy network are in the Core area and 27 cities are in the Periphery area; 9 cities in the tourism flow network are in the Core area and 22 cities are in the Periphery area. Wuhan, Huangshi and Huanggang are in the Core position in both tourism economy and tourism flow network, indicating that these cities are closely connected with other cities in tourism and have better tourism development. Xianning, Yichang, Changsha, Yueyang, Nanchang and Jiujiang are in the Periphery of the tourism economic network, but in the Core of the tourism flow network, indicating that these cities are rich in tourism resources, however, the tourism Money-absorbing capacity is poor, and corresponding measures should be taken to strengthen their tourism Money-absorbing capacity. Ezhou is in the Core area

in the tourism economic network, but in the Periphery area in the tourism flow network, which means that Ezhou tourism is not attractive enough, and should make more efforts to explore tourism resources, strengthen publicity, create key famous scenic spots and enhance tourism attractiveness. The remaining 21 cities are in the Periphery positions in the tourism economy and tourism flow network, indicating that these cities are loosely connected to other cities in the middle reaches of the Yangtze River in terms of tourism and tourism development needs to be strengthened.

## V.    CONCLUSION

Tourism development spatial linkage contains tourism flow development spatial linkage and tourism economic

development spatial linkage, the two have both links and differences This paper collects relevant data, uses the Granger causality test, gravity model, and social network analysis to analyze the characteristics of the middle reaches of the Yangtze River tourism economy and tourism flow network structure, and then compares them, analyzes their similarities and differences and reasons, and examines the role and position played by each city in the middle reaches of the Yangtze River tourism economy and tourism flow network structure. The conclusions are as follows.

①The tourism economic network density of the middle reaches of the Yangtze River in 2019 was 0.52, which is a low network density, indicating that the strength of tourism economic ties among cities in the middle reaches of the Yangtze River is weak, small tourism economic spillover is high, and tourism economic ties among cities need to be strengthened. Wuhan, Xiaogan, Xiantao, Xiangyang, Jingmen, Xiangtan, Yueyang and Changde have stronger centrality, indicates that these cities are at the core of the tourism flow network and are most closely connected to other members of the network. The EffSize and Efficiency of Wuhan, Xiangyang, Yichang, Jingzhou, Jingmen, Qianjiang, Changsha, Hengyang, Yueyang, Changde and Shangrao are large and the Constrain is small, indicating that these cities are less redundant in the spatially linked network of the tourism economy, less restricted by other cities, less dependent on other cities, and in a relatively favorable position in the network. The whole network has a low value of centralization, indicating the development of the spatially linked tourism economic network of the middle reaches of the Yangtze River is balanced. There are frequent interactions and obvious spillover effects among the blocks of the middle reaches of the Yangtze River tourism economy, Wuhan Metropolitan Area and Xiang-Jing-Yi City Group as the Main Beneficiary and other blocks as the Broker, among which Xiang-Jing-Yi City Group is an important tourism economy beneficiary block and Xing-Yi-Ping City Group block is the main tourism economy spillover block.

② The cities with high tourism flow in the middle reaches of the Yangtze River are Wuhan, Changsha, Yichang and Jiujiang. With the tourism flow network density of 0.78, there is a high degree of correlation of tourism flow in the middle reaches of the Yangtze River, but there are more small tourism

flows, and the cities still need to strengthen tourism flow links with each other. Wuhan, Xianning, Yichang, Changsha, Yueyang, Zhuzhou, Hengyang, Nanchang, Jiujiang, Shangrao, Yingtan, Pingxiang and Ji'an have stronger network centrality, indicating that these cities are at the core of the tourism flow network and are most closely connected to other members of the network. Wuhan, Changsha, Yueyang, Zhuzhou, Xiangtan, Hengyang, Nanchang, Jiujiang, Shangrao, Yingtan, Pingxiang and Ji'an have a large EffSize and Efficiency and a small Constrain, indicating that these cities have less redundancy in the tourism flow network, are less restricted by other cities, are less dependent on other cities and are in a relatively favorable position in the network. The whole network has a low value of centralization, which indicates that the development of the middle reaches of the Yangtze River tourism flow network is balanced. All the five blocks are the Main Beneficiary, among which the Poyang Lake City Group is the most important tourism destination, Xiang-Jing-Yi City Group and Changsha-Zhuzhou-Xiangtan City Group are the main tourism source blocks.

③ From the theoretical analysis, tourism flow and capital flow are both related and different, the flow of tourism flow is bound to drive the flow of capital at the same time, the source of tourism flow is relatively single, but the source of capital is relatively complex, it may come from tourism income and non-tourism income. That is, the spillover path of tourism economy (income) is more complex, it may generate spillover to other regions through direct investment of tourism enterprises, or internalize people's disposable income or government fiscal revenue, generate spillover to other regions through people's tourism activities or government foreign investment, so there are certain differences in the structure of tourism flow network and tourism economic development network. Cities that have obvious advantages and are at the core of the middle reaches of the Yangtze River tourism economic network may not necessarily have advantages and are not necessarily at the core of the tourism flow network. There are differences in tourism resources among cities, some cities are rich in tourism resources, have high internal investment and little spillover to the outside due to development and management, etc., and are in a favorable position in the middle reaches of the Yangtze River tourism economy, however, due to the visibility of

attractions, transportation and other problems, the tourism attractiveness is not enough, resulting in their disadvantageous position in the middle reaches of the Yangtze River tourism flow network. The individual network densities of cities in the middle reaches of the Yangtze River tourism economy and tourism flow networks vary widely. Comparatively, the overall density of individual networks of tourism flows is higher, and the degree of spatial association of cities in the tourism flow network is higher. Compared with the tourism economy, the cities in the whole network of tourism flows in the middle reaches of the Yangtze River have a higher degree of spatial association, a more robust tourism flow network, and more connected tourism flows in each city, while the tourism economy network structure is less centralized and more balanced in development.

This paper analyzes the similarities and differences in the characteristics of the spatially related network structure of tourism economy and tourism flow in the middle reaches of the Yangtze River and the reasons for them, which is new in terms of research perspectives and conclusions, and enriches the research related to tourism economy and tourism flow network structure, and provides a reference to clearing the position of each city in the network of tourism flow and tourism economy in the middle reaches of the Yangtze River, and takes relevant measures to promote the development of source markets and regional tourism cooperation to promote the development of tourism in the middle reaches of the Yangtze River. However, there are certain limitations to the study. Firstly, the Granger causality test has certain requirements for time series data, and the relationship may not pass the causality test when it is just generated or is very weak. Secondly, the network attention is indirect data, which does not fully represent the actual patronage, so the relevant research results may have a certain bias. The above two aspects will be improved in the follow-up study。

## VI. REFERENCES

[1] Paul M. Romer. Increasing Returns and Long-Run Growth[J]. The Journal of Political Economy. 1986,94(5):1002-1037.

[2] Jorge Ridderstaat, Marck Oduber, Robertico Croes, et al. Impacts of seasonal patterns of climate on recurrent fluctuations in tourism demand: Evidence from Aruba[J]. Tourism Management, 2014, 41(2): 245-256.

[3] Konstantinos Eleftheriou, Evangelos Sambracos. Tourism–growth nexus and spatial spillovers: Evidence from Greece[J]. Tourism Economics.2019,25(2):297-302.

[4] Hwangyh, Gretzelu, Fesnmaierdr. Multicity trip patterns Tourists to the United States[J].Annals of Tourism Research,2006,33(4):1057-1078．

[5] Subhalaxmi Mohapatra. Investigating the tourism and economic growth linkage: a panel causality analysis for the SAARC countries[J]. Asia Pacific Journal of Tourism Research, 2018, 23(6) : 573-583.

[6] Cinta Sanz-Ibáñez, Sergi Lozano and Salvador Anton Clavé. Brokers in a destination's knowledge networks[J]. Journal of Destination Marketing & Management, 2019, 11 (2): 120-129.

[7] Wang Kai, Wang Menghan, Gan Chang, et al. Tourism Economic Network Structural Characteristics of National Parks in the Central Region of China[J]. Sustainability, 2021, 13(9) : 4805-4805.

[8]João Romão, Peter Nijkamp. Spatial impacts assessment of tourism and territorial capital: A modelling study on regional development in Europe.[J].International Journal of Tourism Research,2018,20(6):819-829.

[9] Konstantinos Andriotis. Researching the development gap between the hinterland and the coast—evidence from the island of Crete[J].Tourism Management.2005,27(4):629-639.

[10] Yong Yang. Agglomeration density and tourism development in China: An empirical research based on dynamic panel data model[J]. Tourism Management, 2012, 33(6) : 1347-1359.

[11] Jun Ni Wang, Yong Kun Wan, Suo Cheng Dong. Analysis on the Crowding-Out Effect of Tourism and Regional Differences[J]. Applied Mechanics and Materials, 2014, 3013 : 1581-1589.

[12] Hong Shi, Xia Li, Han Zhang, et al. Global difference in the relationships between tourism, economic growth, CO2 emissions, and primary energy consumption[J]. Current Issues in Tourism, 2020, 23(9) : 1122-1137.

[13] Inchausti Sintes Federico, Voltes Dorta Augusto, Suau Sánchez Pere. The income elasticity gap and its implications for economic growth and tourism development: the Balearic vs the Canary Islands[J]. Current Issues in Tourism, 2021, 24(1) :

98-116.

[14]Alvin Chua, Loris Servillo, Ernesto Marcheggiani, et al. Mapping Cilento: Using geotagged social media data to characterize tourist flows in southern Italy [J].Tourism management,2016,57(Dec.):295-310.

[15]Isabelle D. Wolf, Teresa Wohlfart, Greg Brown, et al. The use of public participation GIS (PPGIS) for park visitor management: A case study of mountain biking [J].Tourism management,2015,51(Dec.):112-130.

[16]Faruk Balli and Hatice O. Balli and Rosmy Jean Louis. The impacts of immigrants and institutions on bilateral tourism flows[J]. Tourism Management, 2016, 52 (2): 221-229.

[17]Cao Fangdong, Huang Zhenfang, Huang Rui, et al. Spatial Correlation and Coupling Path between Freeway Flow and Tourism Flow of Scenic Spot in Jiangsu Province [J]. Economic Geography,2021,41(01):232-240.

[18]장호중,홍기석. The Influence of Fun factor of Sports Tourism on Leisure Flow and Psychological Happiness[J]. Korean Journal of Sports Science, 2011, 20(3) : 619-631.

[19]Mohsen Pourkhosravani , Mohammad Reza Iravani. A social work study to measure the impact of socio-economical factors of tourism industry[J]. Management Science Letters, 2012, 2(3) : 939-944.

[20]Yang Yang. Modeling sequential tourist Flows: where is the next destination? [J].Annals of Tourism Research,2013,43(Oct.):297-320.

[21]Kauffmann and Rosenfeld. The impact of local factors on the scope of benefits from public investment: the case of tourism infrastructure in Saxon municipalities[J]. Urban Research & Practice, 2014, 7(3) : 320-336.

[22]Faruk Balli, Hatice O. Balli, Rosmy Jean Louis. The impacts of immigrants and institutions on bilateral tourism flows[J].Tourism management,2016,52(Feb.):221-229.

[23]María Santana-Gallego, Francisco J. Ledesma-Rodríguez, Jorge V. Pérez-Rodríguez. International trade and tourism flows: An extension of the gravity model[J].Economi Modelling.2016,52:1026-1033.

[24] Hongsong Peng, Jinhe Zhang, Zehua Liu, et al. Network analysis of tourist flows: a cross-provincial boundary perspective[J]. Tourism Geographies,2016,18(5):561-586.

[25] James Katz ,Philip Aspden. Motivations for and Barriers to Internet Usage: Results of a National Public Opinion Survey[J]. Internet Research: Electronic Networking Applications and Policy, 1997, 7(3):170-188.

[26] Long Maoxing, Sun Gennian, Ma Lijun et al. An Analysis on the Variation Between the Degree of Consumer Attention of Travel Network and Tourist Flow in Regional Tourism: A Case of Sichuan Province[J]. Areal Research and Development, 2011,30(03):93-97.

[27] MA Lijun, SUN Gennian, HUANG Yunma et al. A correlative analysis on the relationship between domestic tourists and network attention[J]. Economic Geography, 2011,31(04):680-685.

[28] Covey , David Bessler. Testing for Granger' s Full Causality [J]. The review of Economics and Statistics, 1992(Feb.):146 -153.

[29] Crampon L J. A new technique to analyze tourist markets[J]. The Journal of Marketing, 1966, 30(2): 27-31.

[30]Liu Jun. Lectures on Whole Network Approach[M].Shanghai: Ge zhi Publishing House.2009: 253-257.

[31]Zhang Jiafeng. Study on the spatial correlative networks and influencing factors of domestic tourism economy in the middle reaches of the Yangtze River[D].Xiangtan University,2020.