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Dynamics of Tourism Flows in Jiangxi, China: A Spatial-Temporal Analysis of Quantity and Quality Since 2000

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ABSTRACT

While tourism flows have been extensively studied in terms of their scale, the quality of tourism flows remains underexplored. However, studying only the scale and quantity of tourist flows makes it difficult to objectively assess their impact on the economic benefits of tourism. Based on international inbound tourist and foreign exchange income data in Jiangxi Province since 2000, this paper examines the characteristics of both the quantity and quality of tourist flows in terms of their temporal and spatial distribution. Spatial distribution maps and spatial centroid migration routes were created using ArcGIS. Additionally, a Python grey relational analysis was conducted on seven factors from four aspects that influence the quality of inbound tourist flows. The results show that: 1) The spatial development of inbound tourism flows exhibits an asynchrony between quantity and quality. This highlights the necessity for destinations to prioritize enhancing both quality and efficiency while expanding tourism scale; 2) While the regional disparities in the number of inbound tourists have widened, the regional disparities in the quality of tourism flows have diminished, indicating a significant shift in dynamics; 3) Public health crises like COVID-19 exert a decisive influence on the quantity of inbound tourism, whereas their impact on the quality of inbound tourism is relatively modest; 4) Economic development levels, degrees of openness to the global stage, and the quality and allure of tourist attractions play pivotal roles in facilitating the transformation of the economic benefits derived from tourism.

1.0. Introduction

The tourism industry stands as the world's largest and most diverse service sector, serving as a pivotal source of income, employment, private sector growth, and investment for many nations (Gidebo, 2021). In some countries, it even emerges as a primary revenue source (Demir & Gozgor, 2019; Ozcan & Erdogan, 2017). Measuring the level of tourism economic development in a region, inbound tourism becomes a crucial indicator (Yao et al., 2016). Since the 1990s, influenced by economic globalization and market liberalization, international tourism flows have exhibited a consistent upward trajectory (Keum, 2010). Substantial data supports the significant contribution of international tourism flows to the economy (Brida et al., 2016; Boniface et al., 2016). Moreover,

within the tourism sector, inbound tourism's role in driving the growth of the tertiary industry may even surpass that of domestic tourism (Su et al., 2011).

However, while tourism flows have been extensively studied in terms of their scale, the quality of tourism flows remains underexplored (Yan & He, 2013). Thus, the purpose of this quantitative research is to investigate the evolving characteristics of both the quantity and quality of tourism flows in Jiangxi, China, since the year 2000, with a focus on their spatial-temporal distribution. The findings of this study will facilitate a deeper comprehension among local governments and tourism enterprises regarding the dynamic patterns of spatial-temporal distribution in inbound tourism flows. Moreover, it will enable a discerning understanding of the pivotal elements influencing the formation of high-quality inbound tourism flows.

2.0 Literature review

2.1 Tourism flows

Tourism flow, i.e. the flow of tourists, refers to the collective spatial displacement of tourists in a region due to the proximity of tourism demand, specifically, it describes the number of people and the flow pattern of tourists from the source to the destination (Li et al., 2012). Contemporary academic investigations into tourism flows predominantly adopt a spatiotemporal perspective (Lim, 1997; Song et al., 2010; Balli et al., 2013; Culiuc, 2014; Peng et al., 2015). Researchers often focus on modeling the spatial scale of tourism flows, delving into the spatiotemporal characteristics of these flows. For instance, Fourie & Santana-Gallego (2011) employed a standard gravity model of bilateral tourism flows among 200 countries from 1995 to 2006 to analyze the stimulating impact of major sporting events on inbound tourism flow. Santeramo and Morelli (2016) examined the demand for agricultural tourism in Italy from 1998 to 2010, utilizing quantile regression to simulate changes and features of tourism flows via a gravity model. Wang et al. (2021), adopting a perspective grounded in tourism flows, analyzed the spatial cooperation network structure of 470 popular tourist attractions in China's Yangtze River Delta region through web text analysis and Python programming. This analysis aimed to assist government bodies and tourism enterprises in comprehending the influence of visitor spatial behavior on cooperative relationships among tourist attractions. Nister and Nicula (2021), utilizing cross-sectional data, employed Geographic Information Systems (GIS) to analyze flow lines and kernel density of 48 source countries to the UK in 2015, completing the modeling of tourism flows from source to destination.

Nevertheless, these studies often overlook an examination of the quality effects on tourism flows (Li et al., 2012). Few explore whether the development of tourism flow quality aligns with that of quantity. In reality, quantity dominance does not necessarily equate to quality leadership. Solely focusing on the scale of tourism flows proves inadequate in objectively evaluating its potential to drive economic benefits. Shi (2012) exemplified this by studying the impact of inbound tourism promotion on a nation's revenue using Australia as a case study. The results indicated that government-promoted inbound tourism only increases revenue if it attracts tourists with exceptionally high spending, and the national income of the country effectively promoted surpasses that of the destination country. International tourism epitomizes a process in which individuals earn money in one location and expend it in another (Gidebo, 2021). Therefore, tourism flows transcend mere population movements, holding paramount economic significance for the tourism system. Thus, it is imperative to reevaluate the contribution of the tourism industry to the economy and explore factors influencing the formation of high-quality tourism flows.

2.2 Factors influencing tourism flows

Research into the factors influencing tourism flows represents another focal point of tourism flow research. This is a broad and complex topic, currently among the most extensively researched aspects of tourism flows. Scholars have scrutinized various facets of influence on

tourism flows. For instance, some contend that macroeconomic factors constitute the fundamental drivers of tourism demand growth (Shahzad & Ferrer, 2020) and serve as pivotal indicators for assessing destination tourism economic development (Haller et al., 2021). Generally, growth in the per capita GDP worldwide leads to an increase in tourism scale, while currency devaluation in destination countries and relative domestic price reductions enhance consumer purchasing power (Martins et al., 2017). Others argue that the appeal of destination tourism resources and infrastructure, such as transportation, form critical determinants of tourism flow (Vengesayi et al., 2009; Adeola et al., 2018; Ismail et al., 2022). Hui Shi found that tourists tend to visit destinations with unique tourism resources, excellent facilities, and developed transportation networks (2012). Boniface et al. (2016) reached a similar conclusion, asserting that accessibility to the destination region, attractions, and convenience facilities plays a pivotal role in driving international tourism. Researchers have also evaluated the impact of openness to the outside world on tourism scale and economic development levels (Soshiroda, 2005; Balli et al., 2013; Adeola et al., 2018). For example, Adeola et al. (2018) employed a Poisson regression model to study the key drivers of international tourism demand for 44 African countries from 1995 to 2015. Their results indicated that, besides infrastructure, political stability, and per capita income, foreign direct investment (FDI) and trade openness were crucial drivers of international tourism flow into Africa. Furthermore, with frequent outbreaks of global health crises in recent years (e.g., SARS and COVID-19), an increasing number of scholars have started examining the influence of destination risk on tourism flows (Popescu, 2021; Li et al., 2022). They contend that due to international tourists' heightened concern for travel safety (Eilat & Einav, 2004) and their reluctance to travel to high-risk countries or regions (Page, 2009), the occurrence of tourism crises not only directly leads to a reduction in destination tourism flow quantity (Petermann et al., 2005) but also results in alterations in destination choices and spending patterns for inbound tourists (Senbeto & Hon, 2020; Sánchez-Pérez et al., 2021), consequently reshaping the spatiotemporal patterns of inbound tourism flow.

Despite the widely recognized impact of these factors on tourism flow scale, their influence on tourism flow quality has remained inadequately explored. Tourism flow quality represents the driving capacity of individual tourism flows on tourism revenue (Yao et al., 2016) and serves as a crucial indicator for achieving high-quality tourism industry development. Nevertheless, the current research in this area is notably deficient. To address these research gaps, this study focuses on Jiangxi Province, known for its substantial contribution to the tertiary industry by the tourism sector. The objective of this study is to comprehensively examine both the quantity and quality of tourism flows, utilizing dynamic and visual research methods such as quantitative analysis, ArcGIS software, and Python programming. It aims to conduct an in-depth analysis of the spatiotemporal patterns and influencing factors of inbound tourism flows in Jiangxi Province since 2000.This study provides valuable references and guidance for governments and businesses in formulating future inbound tourism development policies, thereby enhancing the quality of tourist flows and optimizing their spatial distribution.

3.0 Methodology

3.1 Study area

Jiangxi Province is located in the southeastern region of China, encompassing 11 prefecture-level cities, with a land area of 166,900 square kilometers and a population of over 45 million. The province boasts abundant tourism resources, with tourism being a cornerstone industry. It is home to five world-class heritage sites and 14 5A-level tourist attractions, ranking seventh among all 31 provincial-level administrative regions in China. Additionally, there are 171 4A-level tourist attractions, accounting for 18% of the national total. In 2019, the total tourism revenue in Jiangxi Province accounted for a remarkable 82.11% of the province's tertiary industry (Jiangxi Statistical Yearbook, 2020), a figure significantly higher than that of most provinces and cities nationwide. Figure 3.1 illustrates the number of inbound tourists and foreign exchange

revenue from tourism in the province since 2000, while Table 3.1 provides details on the number of inbound tourists in various cities within the province since the same year.

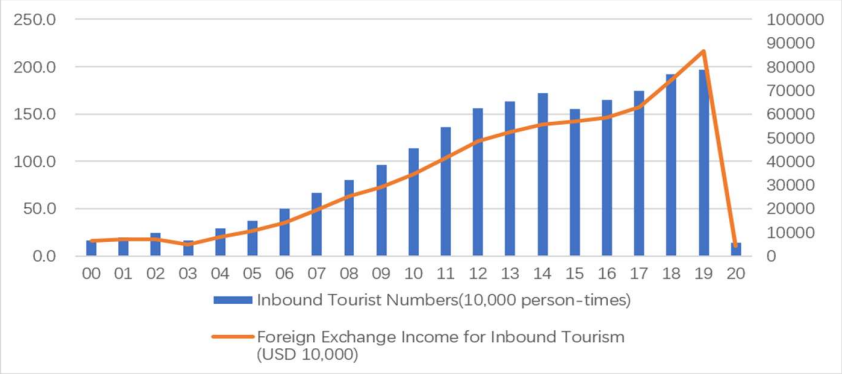

Figure 3.1: Inbound Tourist Numbers and Foreign Exchange for International Tourism in Jiangxi from 2000 to 2020

Table 3.1: Inbound tourist numbers of 11 cities in Jiangxi Province since 2000(10000 person-times).

Year	Nanchang	Jingdezhen	Pingxiang	Jiujiang	Xinyu	Yingtan	Ganzhou	Jian	Yichun	Fuzhou	Shangrao
2000	3.70	1.48	0.12	3.08	0.03	1.49	3.77	1.38	0.33	0.26	0.65
2001	4.14	1.61	0.16	4.19	0.04	1.73	4.52	1.60	0.37	0.48	0.79
2002	4.48	2.75	0.25	5.02	0.13	2.54	4.99	1.81	0.60	0.62	0.88
2003	3.43	2.00	0.32	3.91	0.10	1.58	2.09	1.35	0.29	0.59	0.89
2004	5.43	4.02	0.44	6.04	0.20	3.04	4.49	2.62	0.55	0.74	1.21
2005	6.52	4.81	0.71	8.02	0.22	3.59	5.46	4.23	0.78	1.10	1.82
2006	7.51	5.92	1.67	11.77	0.32	4.31	7.36	5.30	1.01	0.99	3.58
2007	8.91	7.24	2.76	15.46	0.76	5.43	8.53	7.54	2.50	3.03	4.32
2008	9.72	10.76	3.26	18.30	1.03	5.80	9.42	8.85	3.16	3.72	6.18
2009	10.40	15.59	3.82	22.00	1.12	5.89	10.55	10.16	4.72	4.50	7.68
2010	12.05	19.49	4.40	25.05	1.37	5.54	12.00	12.38	5.41	5.17	11.22
2011	14.36	22.25	5.98	27.66	1.53	5.87	13.14	18.06	5.85	5.88	15.25
2012	18.45	25.48	7.48	29.91	1.99	6.85	15.22	19.01	7.15	6.81	17.83
2013	20.18	26.73	7.78	30.72	2.37	7.15	16.1	19.34	7.42	7.08	18.74
2014	20.78	27.76	7.91	31.35	2.63	7.48	16.33	20.05	7.89	7.16	22.34
2015	20.45	22.85	6.59	25.8	2.81	4.24	14.06	19.02	9.09	5.14	25.22
2016	22.77	23.43	6.94	27.62	2.95	4.26	15.89	19.43	10.29	5.36	25.88
2017	26.50	27.43	7.38	30.20	3.27	2.69	17.67	18.29	12.19	5.67	23.38
2018	29.12	22.44	6.92	33.31	3.82	7.86	18.8	20.24	12.95	9.09	27.25
2019	32.69	13.16	7.17	37.65	4.5	8.51	20.81	21.1	13.57	9.73	28.26
2020	2.84	1.3	0.24	2.02	0.31	0.27	2.15	0.73	1.21	0.97	2.24

3.2 Data acquisition and sources

This study is based on the data of inbound tourist arrivals and foreign exchange revenue from tourism in the 11 prefecture-level cities of Jiangxi Province from 2000 to 2020. It calculates the Quality Index (Quality) of tourism flows for each region and assesses the correlation between the quality of tourism flows and economic development level, transportation infrastructure, tourism resource attractiveness, and degree of openness to the outside world. Specifically, the economic development level is measured using indicators such as per capita GDP (pcGDP), the Retail Price Index (RPI), and total retail sales of social consumer goods (TRS). The level of transportation infrastructure is assessed by the presence of civil airports and their accessibility (airport) and the actual year-end mileage of highways (highway). Tourism resource attractiveness is measured by the number of tourist attractions rated 4A and above (TA), and the degree of openness to the outside world is evaluated using actual foreign investment utilization (FI). Data for this study were compiled from various official sources, including the “Jiangxi Statistical Yearbook” (2001-2021), “Annual reports on the national economic and social development statistics” from the prefecture-level cities, local statistical bureaus, and tourism authorities.

3.3 Research methods

3.3.1 Tourism flow quality index

The concept of tourism flow quality was originally introduced by Li Zhenting et al. (2012). They defined tourism flow quality as the ratio between the monetary flow scale and the passenger flow scale generated by a specific volume of tourism flow from an economic perspective. The expression formula for tourism flow quality is as follows:

$$Q = \frac{a_i}{b_i} = \frac{x_i^t}{\sum_{i=1}^{n} x_i^t} / \frac{y_i^t}{\sum_{i=1}^{n} y_i^t} \quad [1]$$

In the formula, Q represents the Tourism Flow Quality Index, where a_i denotes the proportion of tourism income of region i in the overall market, and b_i represents the market share of the number of tourists in region i. Additionally, x_i^t signifies the tourism income of the region i in year t, while y_i^t represents the number of tourists in region i in the same year. A higher Q value indicates that the scale of tourists has a more significant impact on the scale of funds, reflecting higher tourism flow quality. Table 3.2 indicates the inbound tourism flow quality index for each city from 2000 to 2020.

Table 3.2: Inbound tourism flow quality index from 2000-2020.

Year	Nanchang	Jingdezhen	Pingxiang	Jiujiang	Xinyu	Yingtan	Ganzhou	Jian	Yichun	Fuzhou	Shangrao
2000	1.82	1.51	0.76	0.60	0.76	0.42	0.54	0.73	1.38	2.05	1.11
2001	1.96	0.91	0.83	0.61	0.75	0.72	0.60	0.79	1.50	1.33	1.13
2002	1.23	1.08	1.05	0.78	0.63	0.65	1.01	0.90	1.36	1.57	1.40
2003	1.12	0.93	0.86	0.88	0.60	0.71	1.10	0.82	1.68	1.17	1.53
2004	1.14	1.06	1.04	0.99	1.05	0.53	1.07	0.66	1.34	1.53	1.35
2005	0.95	1.03	1.95	1.13	1.10	0.49	1.05	0.80	1.21	0.77	1.48
2006	0.72	1.53	1.08	1.13	1.26	0.39	0.71	0.65	2.42	2.50	1.26
2007	0.98	1.07	1.14	1.22	0.90	0.55	0.98	0.81	1.06	1.02	0.96
2008	0.98	1.11	1.01	1.07	0.82	0.59	0.94	1.06	0.86	1.18	1.02
2009	1.01	1.13	0.91	1.17	0.69	0.55	0.96	0.65	1.00	1.06	1.14
2010	0.84	1.10	0.92	1.19	0.71	0.61	0.84	0.90	0.96	1.09	1.10
2011	0.91	1.06	1.04	1.11	0.87	0.67	0.89	0.91	1.05	1.09	1.07
2012	0.95	0.99	1.02	1.08	0.87	0.73	0.99	0.97	1.04	1.09	1.04
2013	0.99	0.98	1.02	1.07	0.96	0.77	0.96	0.97	1.05	1.08	1.04
2014	1.01	0.98	1.00	1.10	0.92	0.77	0.96	0.97	1.02	1.08	0.99
2015	0.97	1.07	1.07	1.20	0.79	0.80	1.00	0.91	0.88	1.25	0.86
2016	1.07	0.99	0.95	1.17	0.88	0.90	0.91	0.95	0.91	1.11	0.92
2017	1.04	0.98	0.95	1.08	0.91	0.93	0.96	0.94	0.94	1.00	1.02
2018	1.12	1.11	0.97	1.06	0.93	0.92	0.91	0.85	1.02	0.86	0.96
2019	1.05	0.96	0.92	1.01	1.10	0.96	1.03	0.91	1.09	0.91	0.99
2020	1.07	1.00	0.93	0.96	1.12	1.13	0.90	0.82	1.24	0.89	1.00

3.3.2 ArcGIS spatial analysis method

Geographic Information System (GIS) is a computer-assisted system that involves the collection, storage, management, processing, analysis, visualization, and description of geo-referenced data to support decision-making (Ali, 2020). In this study, ArcGIS 10.8 software was used to create spatial distribution maps of both the quantity and quality of inbound tourism flows for 11 cities in the years 2000, 2003 (included due to significant fluctuations), 2005, 2010, 2015, and 2020 (Figure 4.1) (Figure 4.3). The spatial centroids for both quantity and quality were calculated using a centroid coordinate weighting method. Additionally, route maps for the spatial centroids of tourism flows from 2000 to 2020 were generated (Figure 4.2) (Figure 4.4).

The centroid, also known as the center of mass, is a unique point that represents the mean position of all matter that composes it (Gahramanova, 2019). The formula for calculating the centroid coordinates (x_0, y_0) is as follows:

$$x_0 = \frac{M_y}{m} = \frac{\sum_{i=1}^{n} m_i \cdot x_i}{\sum_{i=1}^{n} m_i},\ y_0 = \frac{M_x}{m} = \frac{\sum_{i=1}^{n} m_i \cdot y_i}{\sum_{i=1}^{n} m_i} \quad [2]$$

Where m_i is the mass at the point (x_i, y_i) on the plane. m denotes the sum of the masses of all the masses in the mass system. M_y and M_x are the weighted sum of the mass coordinates of each mass in the mass system on the x and y axes respectively.

In this study, we first calculated the centroid coordinates of each city using ArcGIS. Then, we multiplied the tourism flow quality index for each of the 11 cities for the years 2000 to 2020 by the respective coordinates on the x-axis and y-axis. This allowed us to compute the centroid coordinate weighted values. Finally, we determined the spatial centroid coordinate positions for the quality of tourism flow for each year in the province.

3.3.3 Grey correlation analysis

This study employed grey correlation analysis to assess the impact of economic development level, transportation infrastructure, resource attractiveness, and openness to foreign influence on the quality of tourism flow. Grey correlation analysis is a statistical method used to measure the intensity, size and order of relationships between factors (Wang et al., 2019). Its basic principle is to determine the closeness of these relationships by assessing the similarity in the shapes of sequence curves. The closer the curves are, the stronger the correlation between the sequences, and vice versa. If we designate the reference sequence as x_0 and the comparative sequences as x_i, with a total of m comparative sequences, each containing n samples, the sequence matrix can be represented as follows:

$$\begin{matrix} x_0(1) & x_1(1) & \cdots & x_m(1) \\ x_0(2) & x_1(2) & \cdots & x_m(2) \\ \vdots & \vdots & \cdots & \vdots \\ x_0(n) & x_1(n) & \cdots & x_m(n) \end{matrix}$$

Therefore, the grey correlation degree $y(x_0, x_i)$ of the comparative sequence x_i with respect to the reference sequence x_0 is given by:

$$y(x_0, x_i) = \frac{1}{n}\sum_{k=1}^{n} y(x_0(k), x_i(k)) \quad [3]$$

Where $y\big(x_0(k), x_i(k)\big)$ denotes the correlation coefficient of the comparison sequence x_i to the reference sequence x_0 at point k,

$$y\big(x_0(k), x_i(k)\big) = \frac{a+\rho b}{|x_0(k), x_i(k)|+\rho b} \quad [4]$$

$$a = min_i min_k |x_0(k) - x_i(k)| \quad [5]$$

$$b = max_i max_k |x_0(k) - x_i(k)| \quad [6]$$

a denotes the bipolar minimum difference between the comparison sequence x_i and the reference sequence x_0, b is the bipolar maximum difference, and ρ is the discrimination coefficient, which generally takes the value of 0.5.

This paper used a Python program for correlation analysis. In the first step, the data was dimensionlessly processed, and the absolute differences of the data were calculated. Then, based on the formula, the extrema were determined to calculate the correlation coefficients for various factors, and a visual correlation coefficient heatmap was plotted.

4.0 Results and discussions

Based on Figure 3.1 and Table 3.1, combined with the spatial distribution map of inbound tourism quantity (Figure 4.1), it can be observed that overall, the number of inbound tourists to Jiangxi Province has shown a rapid upward trend since 2000. In 2019, the number of inbound tourists reached 1.9717 million, the highest in history, which was 12 times that of 2000 (163,100 tourists). There were brief declines in the number of inbound tourists in 2003 and 2015, but they quickly rebounded in the following year. However, in 2020, due to the unprecedented global COVID-19 pandemic, the number of inbound tourists plummeted to 143,000, which is lower than the level in 2000.Tourism foreign exchange income followed a similar trend. Additionally, the absolute differences in the number of tourists between different regions have been widening year by year.

In terms of spatial distribution, in 2000, the number of inbound tourists in Jiangxi Province showed a concentration in the “north and south heavy, middle light” pattern, with tourist numbers concentrated in three cities: Ganzhou, Nanchang, and Jiujiang. After 2000, the inbound tourism business rapidly developed in the northern cities of Jiujiang, Shangrao, and Jingdezhen, while Ganzhou gradually lost its dominant position. By 2015, Jiujiang, Shangrao, and Jingdezhen ranked in the top three in terms of inbound tourist numbers, and the spatial distribution center gradually shifted northward, leading to increased regional disparities, resembling a “top-heavy” trend. In 2020, due to the impact of the COVID-19 pandemic, the inbound tourism business was reshuffled, and the provincial capital, Nanchang, became the “center”of inbound tourism. Jiujiang, Jingdezhen, Pingxiang, and Ji’an saw a decline in their inbound tourism status. However, the central regions, which had not previously been major destinations for inbound tourism, such as Yichun, Fuzhou, and Xinyu, saw new development opportunities.

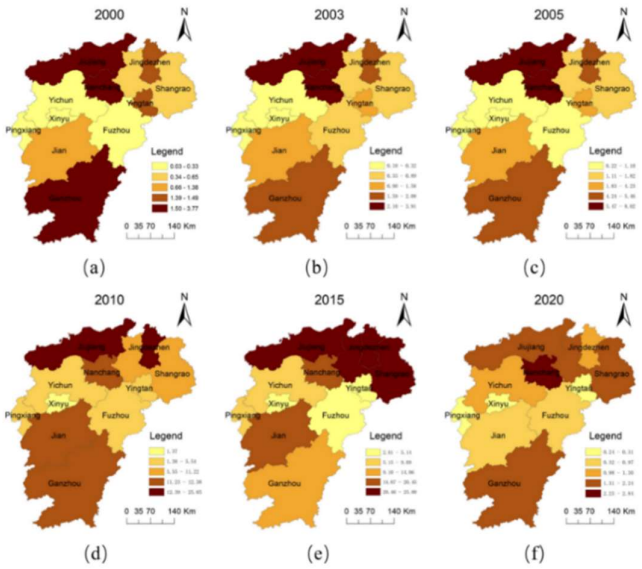

Figure 4.1: Maps of the spatial distribution of the quantity of tourist flows in selected years.

According to the spatial roadmap of the quantity centroid of tourism flows in various cities (Figure 4.2) and the ArcGIS spatial analysis software, the range of the quantity centroid of tourism flows in the entire province is roughly located between 115.8538° to 116.0064° E longitude and 27.9450° to 28.2884° N latitude, mainly in the eastern part of Yichun City near the border with the provincial capital, Nanchang. After 2000, the quantity centroid of inbound tourism flows in the entire province gradually shifted to the northern and eastern parts, with a migration route that went from north to south to west to northeast to southwest to southeast, with the largest migration from 2002 to 2003, setting the tone for the northward shift. After the COVID-19 outbreak in 2019, the tourism center shifted to the eastern region.

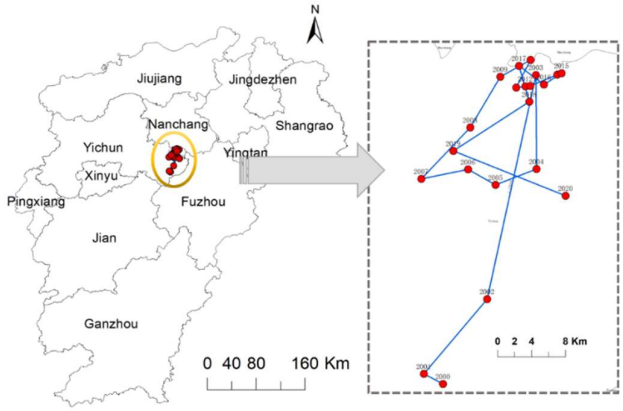

Figure 4.2: Spatial roadmap of the mass center of the tourist flow quantity since 2000.

This article, based on the tourism flow quality index for each region from 2000 to 2020 (Table 3.2), calculated the average quality index for tourism flows in the entire province to be 1.01 and found that the mean between the average and the highest value is 1.15. Therefore, the tourism flow quality spatial levels for various cities were divided into three categories using 1.01 and 1.15 as boundaries. Regions with a quality index $\geq$ 1.15 belong to the first level, representing high-quality tourism flows. In these areas, the number of inbound tourists has a strong impact on foreign exchange income, and the efficiency of benefit conversion is high. Regions with quality indices ranging from 1.01 to 1.14 fall into the second level, indicating good-quality tourism flows. In these regions, the economic driving efficiency is also higher than the provincial average. Regions with a quality index < 1.01 belong to the third level, representing low-quality tourism flows. In these areas, the impact of inbound tourist numbers on foreign exchange income is weak, and their contribution to the tourism economic benefits is lower compared to other regions.

However, when comparing the spatial distribution maps of tourism flow quantity (Figure 4.1) with those of tourism flow quality (Figure 4.3), it is evident that the spatial distribution of tourism flow quality does not synchronize with the trends in quantity distribution. In 2000, high-quality tourism flows were primarily concentrated in the central regions of the province, such as Fuzhou (2.05), Nanchang (1.82), Yichun (1.38), and the northeastern city of Jingdezhen (1.51). Meanwhile, areas with a quantitative advantage like Jiujiang (0.60) and Ganzhou (0.54) did not exhibit a corresponding advantage in terms of quality. In fact, they were categorized as low-quality tourism flow regions. This suggests that these traditional tourist destinations, while pursuing quantity expansion, neglected the improvement of tourism flow quality and economic benefits (Yao et al, 2016).

Subsequently, Nanchang, Fuzhou, Yichun, and Jingdezhen lost their advantageous positions in terms of quality, while the northern regions, such as Shangrao and Jiujiang, saw their advantages become increasingly prominent. It is worth noting that after 2000, the number of high-quality tourist destinations in the entire province gradually decreased, from 4 in 2000 to just 1 in 2020. This once again underscores that, despite the overall increase in the number of inbound tourists, the quality of tourism flow in various regions has not correspondingly improved; in fact, it has declined. However, regional disparities have been gradually narrowing. In 2000, the extreme difference in tourism flow quality among different regions was 1.06, reaching its maximum of 1.24 in 2006. Afterward, this gap continued to decrease, with a difference of 1.00 in 2020, as shown in Table 3.2.

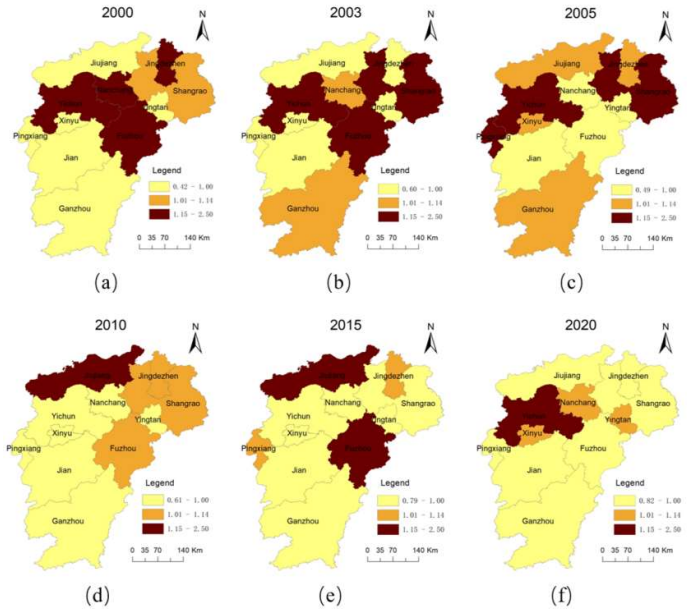

Figure 4.3: Maps of the spatial distribution of the quality of tourist flows in selected years.

The range of the quality center of tourism flow in the entire province is located between 115.6225° and 115.9565° east longitude and between 28.0178° and 28.1584° north latitude. As seen from the quality center spatial route map (Figure 4.4), although the quality center of tourism flow from 2000 to 2020 is also located in the eastern part of Yichun City, it is primarily positioned to the west and north of the quantity center. It does not completely overlap with the quantity center. Additionally, the migration direction of the quality center mainly moves from the northeast to the southwest, which is in contrast to the trajectory of the quantity center's movement. It has undergone migration directions such as south → west → northeast → southwest → southeast → north, further confirming the asynchrony between the spatial development of tourism flow quality and quantity development.

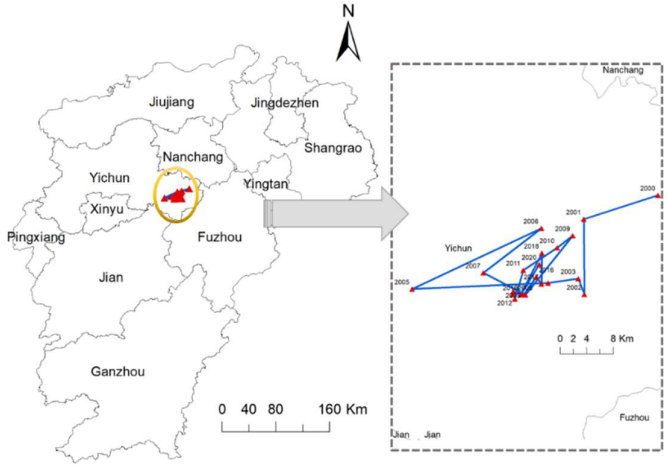

Figure 4.4: Spatial roadmap of the mass center of the tourist flow quality since 2000.

In summary, since 2000, the number of inbound tourists to Jiangxi Province has generally grown rapidly, except for certain years. In 2020, due to the impact of the COVID-19 pandemic, the number of inbound tourists saw a sharp decline. The spatial pattern has also gradually shifted its center from the “heavier at both ends and lighter in the middle” to the northern region, resulting in an increased gap between the north and south. In 2003 and 2020, China and the world experienced major public health crises such as SARS and COVID-19, respectively. These two years

also witnessed the largest migration of the quantity center. This indicates that significant public health crises and other major emergencies not only greatly affect the number of inbound tourists but also significantly alter the spatial distribution pattern of inbound tourists.

Simultaneously, we have observed that contrary to the growth in the number of inbound tourists, the quality of inbound tourism flow in Jiangxi Province has not improved significantly since 2000; instead, it has been declining. The number of high-quality tourism flows has gradually decreased, and the quality of tourism flows in various regions has fluctuated significantly with an uneven spatial distribution. This mismatch between the spatial distribution of quantity and quality of inbound tourism flow is further confirmed by the reverse migration routes of their centroids. This suggests that the growth in the quantity of tourism flow does not necessarily lead to an increase in economic effects. It reminds us that while expanding the scale of inbound tourism, regions should also focus on improving the economic benefits and quality of tourism flow. Only high-quality tourism flow can truly bring economic, social, cultural, and environmental benefits and achieve intensive, efficient, and sustainable development in the tourism industry. As an important driving force and support for the development of the tertiary industry, the tourism industry in Jiangxi Province should put more effort into promoting the quality and efficiency of tourism flow.

In summary, based on the refined literature review presented earlier, this study used the quality index of inbound tourist flows in various regions as the dependent variable. It selected 7 independent variable factors from four aspects: economic development level, transportation development level, attractiveness of tourism resources, and degree of openness to the outside world. These factors included per capita GDP (pcGDP), the Retail Price Index (RPI), total retail sales of social consumer goods (TRS), actual utilization of foreign capital (FI), the number of tourist attractions rated 4A or above (TA), the presence of civil airports and their accessibility (airport), and the actual year-end mileage of highways (highway). Grey relational analysis was then conducted to explore the impact and significance of these factors on the quality of inbound tourist flows. Table 4.1 and Figure 4.5 present the results of the grey relational analysis and the heatmap of correlations.

Based on the results, the following conclusions can be drawn: The 7 selected factors all have a certain impact on the quality of inbound tourist flows, with the highest impacts coming from total retail sales of social consumer goods (0.835), actual utilization of foreign capital (0.821), and the number of tourist attractions rated 4A or above (0.815). This suggests that factors related to market consumer demand, degree of openness, and the attractiveness of tourism resources are the most important influencing factors when it comes to tourists converting their economic benefits. Typically, a high degree of openness and high-quality tourist attractions will enhance a region's visibility and attract tourists. Additionally, robust market consumer demand stimulates tourist spending, thereby increasing tourism revenue. The Retail Price Index (0.801), the actual year-end mileage of highways (0.795), and per capita GDP (0.756) also affect the quality of tourist flows. The Retail Price Index reflects the price level in a region, influencing the level of tourism revenue. However, it is important to note that excessively high prices may suppress tourists' willingness and ability to make purchases. The actual year-end mileage of highways reflects a region's transportation infrastructure, which affects the mobility of tourists in the area. Better transportation connectivity often implies a higher degree of openness and economic outward orientation, which plays a crucial role in stimulating local economic development and market consumer demand.

Surprisingly, the presence of civil airports and their accessibility has the lowest impact on the quality of tourist flows, with a correlation coefficient of only 0.549. This is likely because inbound tourists traveling to central and western regions like Jiangxi are often influenced by factors such as flight availability and transportation. As a result, they may not choose cities within

these regions as their primary entry points. In such cases, provincial capital cities like Nanchang have a competitive advantage and serve as the main hubs for inbound tourists. This is also why Nanchang experienced a dominant position in inbound tourism distribution after the outbreak of the COVID-19 pandemic, as mentioned earlier. Furthermore, inbound tourists in these regions largely rely on road and rail transportation for their domestic travel activities, so the presence of airports in other cities may not significantly impact inbound tourist flows. In conclusion, in the post-pandemic era, Jiangxi Province should aim to enhance the quality of inbound tourist flows. This can be achieved by stimulating market consumer demand, expanding openness to the outside world, improving the quality and attractiveness of tourist attractions, and simultaneously focusing on the enhancement of tourism infrastructure and urban road transportation construction.

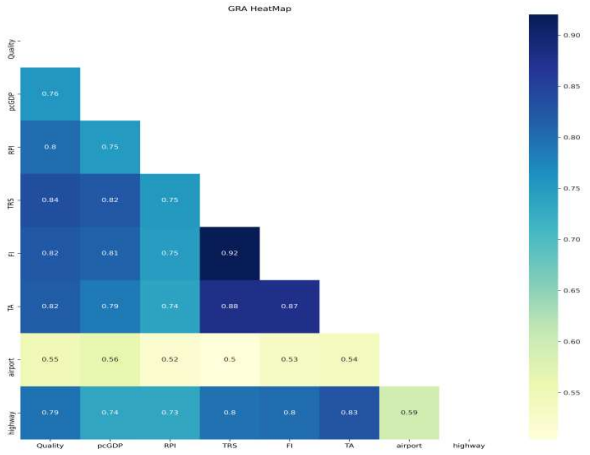

Figure 4.5: Python correlational coefficient heatmap.

Table 4.1: The results of the grey correlational grade.

S.No	Grey Correlational Coefficient	Orders
pcGDP	0.756	6
RPI	0.801	4
TRS	0.835	1
FI	0.821	2
TA	0.815	3
airport	0.549	7
highway	0.795	5

5.0 Conclusions

This article analyzed the spatiotemporal evolution patterns and influencing factors of inbound tourism flows in 11 cities in Jiangxi Province since 2000. Using ArcGIS spatial mapping software, the article generated spatial distribution maps for both the quantity and quality of inbound tourism flows. It also depicted the migration routes of their spatial centroids since 2000. Furthermore, the study conducted grey relational analysis on 7 factors from four aspects that may affect the quality of inbound tourism flows. The results revealed the following key findings: 1) Since 2000, inbound tourism flows in Jiangxi Province have generally seen rapid growth in quantity. In terms of spatial distribution, the centroid of tourism flow quantity has shifted northward, leading to increased regional disparities. Sudden public health crises can have a decisive impact on inbound tourism business and influence the spatial distribution pattern of inbound tourism flows. However, their impact on the quality of tourism flows is not significant. 2) The quality and quantity of inbound tourism flows do not perfectly match in spatial distribution,

indicating that the development of tourism flow quality does not necessarily align with quantity. In recent years, the quality of tourism flows in the entire province has gradually declined, and the number of high-quality tourist destinations has decreased. While the tourism industry pursues quantity, it should also focus on enhancing quality. 3) Economic development level, market consumer demand, degree of openness, and the quality and attractiveness of tourist attractions play crucial roles in converting tourism flow into economic benefits. In the future, Jiangxi Province can enhance the quality of tourism flows by making breakthroughs in these areas. Strategies may include stimulating consumer demand, improving the investment environment, enhancing infrastructure construction, and increasing the attractiveness of tourist destinations.

This study introduces the concept of tourism flow quality and reevaluates the evaluation of inbound tourism flows. It explores tourism flows from a spatial perspective, achieving visual representations of the quantity and quality of inbound tourism flows in spatiotemporal distribution. Additionally, the article conducts a correlation analysis of factors affecting the quality of inbound tourism flows to identify key aspects. The research findings make a significant contribution to understanding the spatiotemporal distribution patterns and dynamic mechanisms of tourism flows and provide valuable insights and guidance for adjusting and optimizing the spatiotemporal patterns of the tourism industry and formulating regional tourism development plans in the future.

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Author Contributions

Lijuan Jin:Conceptualization, Data Collection,Software, Draft-Writing; **Nurwati Badarulzaman:** Supervision,Writing-Reviewing and Editing; **Shida Irwana Omar:** Methodology, Writing-Reviewing.

Conflicts of Interest

The manuscript has not been published elsewhere and is not under consideration by other journals. All authors have approved the review, agree with its Submission and declare no conflict of interest in the manuscript.

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