

Spatiotemporal Distribution Patterns and Influencing Factors of A-Level Tourist Attractions in Northwest China: Postprint

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Abstract

Rational layout of regional tourist attractions is an intrinsic requirement and fundamental guarantee for achieving high-quality development of the tourism industry, and investigating the evolution of their spatial patterns and influencing factors is of great significance for promoting regional tourism cooperation, economic sharing, and cultural integration. Based on data from A-level tourist attractions in Northwest China from 2010 to 2020, GIS spatial technology is employed to analyze the spatiotemporal distribution characteristics of the attractions, an indicator system of influencing factors is constructed from three aspects: social, economic, and environmental, and the Geodetector method is used to clarify the internal mechanism between the evolution of the spatial pattern of attractions and the influencing factors. The results show that: (1) The change in the number of A-level tourist attractions in Northwest China exhibits significant imbalance characteristics, with spatially agglomerated distribution and gradually intensifying agglomeration degree, presenting a “northwest-southeast” spatial distribution pattern, with the central axis lying along the line of “Turpan City—Jiuquan City—Haibei Tibetan Autonomous Prefecture—Lanzhou City—Baoji City—Xi’an City”, and the spatial structure of attractions has undergone an evolution process from “dispersed point-shaped—grouped patch-shaped—inverted L-shaped belt-shaped”. (2) Five factors—permanent population, per capita GDP, tourism revenue, road mileage, and policy intensity—have strong influence on the evolution of the spatial pattern of A-level tourist attractions. (3) The influence capacity of social factors shows an upward trend, manifesting as two stages of initial decline followed by steady increase; the influence capacity of economic factors shows an upward trend, manifesting as periodic fluctuations of increase-decrease; the influence capacity of environmental factors tends to rise, but with relatively stable variation amplitude.

Full Text

Preamble

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Spatiotemporal Distribution Pattern and Influencing Factors of A-Level Tourist Attractions in Northwestern China

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Abstract: The rational layout of regional tourist attractions is an inherent requirement and fundamental guarantee for achieving high-quality tourism development. Investigating the evolution of spatial patterns and their influencing factors holds significant importance for promoting regional tourism collaboration, economic sharing, and cultural integration. Based on A-level tourist attraction data from northwestern China, this study employs GIS spatial technology to analyze the spatiotemporal distribution characteristics of scenic spots, constructs an indicator system of influencing factors from social, economic, and environmental dimensions, and utilizes geographic detectors to clarify the internal mechanisms linking spatial pattern evolution to influencing factors. The results indicate: (1) The number of A-level tourist attractions in northwestern China exhibits significant imbalance, with spatially agglomerated distributions that intensify over time, presenting a “northwest-southeast” distribution pattern along an axis connecting Turpan City—Jiuquan City—Haibei Tibetan Autonomous Prefecture—Lanzhou City—Baoji City—Xi’an City. The spatial structure has evolved through a process from “scattered point pattern” to “clustered patch pattern” and finally to an “inverted L-shaped strip pattern.” (2) Resident population, per capita GDP, tourism income, road mileage, and policy intensity demonstrate strong influence on the spatial pattern evolution of A-level tourist attractions. (3) The influence of social factors shows an upward trend, manifesting as an initial decline followed by steady growth. Economic factors also exhibit an upward trend, characterized by cyclical fluctuations of rise and decline. Environmental factors tend to rise but remain relatively stable in magnitude.

Keywords: A-level tourist attractions; spatiotemporal distribution characteristics; influencing factors; northwestern China

Tourist attractions serve as the core carriers of tourism activities and are crucial for high-quality tourism development. A-level tourist attractions, as important benchmarks for measuring scenic area quality, represent a unique rating system in China and a key indicator of standardized tourism resource management. Creating A-level tourist attractions offers an effective pathway to enhance regional tourism market competitiveness and comprehensive scenic area quality

while improving economic and social benefits. As a frontier region for the Silk Road Economic Belt and a strategic corridor for China's opening-up to the west and north, northwestern China boasts abundant tourism resources, beautiful natural landscapes, and a long history with rich cultural heritage. With the implementation of the "New Pattern of Western Development" strategy, the advancement of the "Belt and Road" initiative, rapid economic and social development, and optimized regional industrial structures, the tourism industry in northwestern China has embraced a rare historical opportunity.

However, alongside the booming tourism development, issues have emerged such as hindered cross-regional flow of tourism elements, insufficient spatial cooperation among tourism stakeholders, and intense homogenized competition among tourist attractions. A-level tourist attractions, as the main body of high-quality tourism resources in northwestern China, warrant investigation into their spatial pattern evolution and influencing factors under the macro background of integrated territorial space. Such research holds important significance for integrating cross-regional scenic resources and promoting optimized tourism layout.

International research on tourist attractions primarily focuses on spatial distribution patterns, influencing factors, and tourist recreation behavior. For instance, Pearce studied the spatial layout of urban tourist attractions and found that attractions and tourism facilities mainly distribute linearly or in clusters. Hsinyu examined the spatial distribution characteristics of tourist attractions in Rotorua, New Zealand, revealing that tourism income, tourism resources, and travel motivation constitute key influencing factors. Other scholars have quantitatively analyzed the spatial structure and distribution characteristics of driving tourists' activities using tourism flow measurement models, demonstrating that tourism activities exhibit spatial network distributions.

Domestic scholars have also conducted mature research on tourist attractions, covering rural tourism key villages, educational tourism bases, and red tourism attractions. Methodologically, studies primarily employ mathematical statistics and spatial analysis methods such as nearest neighbor index, kernel density, and standard deviation ellipse to analyze the evolution characteristics of tourist attractions from spatiotemporal dimensions. Research scales mainly focus on provincial or urban levels to explore the spatial patterns of A-level attractions.

While existing research has made substantial progress in content, methodology, and theory, providing strong references for A-level tourist attraction studies, previous investigations have concentrated on independent administrative units such as individual provinces or cities, lacking cross-regional perspectives—particularly for resource-rich northwestern China. Moreover, most studies categorize influencing factors into natural and human dimensions, with statistical models for spatial analysis still in the exploratory stage. Therefore, this paper takes northwestern China (covering 51 prefecture-level cities and 5 prefectures) as the study area, employing nearest neighbor index, Thiessen polygons, kernel density, standard deviation ellipse, and geographic detector models to deeply investigate the spatiotemporal distribution patterns and influencing factors of

A-level tourist attractions, aiming to provide scientific references for the coordinated development of tourism in northwestern China.

1.1 Study Area Overview

Northwestern China is located deep in China's interior, featuring complex landforms and natural landscapes including plateaus, mountains, basins, deserts, and Gobi. The unique natural geographical environment and profound historical and cultural accumulation have nurtured a long-standing and colorful regional ethnic culture. Leveraging its location advantage as the central line of the "Silk Road Economic Belt," the region has effectively promoted China's political, economic, and cultural connections with Central and West Asia and the development of the "Belt and Road" urban tourism alliance. Northwestern China serves as both an important ecological security barrier and a crucial energy and raw material base in China, while also holding prominent geopolitical status as a frontier for China's westward opening and strategic depth for national defense consolidation. Its vast territory, complex terrain, arid water scarcity, and fragile ecology have long caused its economic development to lag behind eastern and central regions, making it a "territorial fortress" that must be conquered to achieve the second centenary goal. Developing tourism represents an important pathway to stimulate social consumption and drive regional economic growth.

The region comprises five provincial-level administrative units: Shaanxi Province, Gansu Province, Qinghai Province, Xinjiang Uygur Autonomous Region, and Ningxia Hui Autonomous Region, covering a land area of 311.69×10^4 km² (32.2% of China's total land area). In 2020, the region's GDP reached 5.54×10^{12} yuan, with a permanent resident population of 8.06×10^7 . *By 2020, northwestern China had 1.02 billion tourists and generating tourism revenue of 1.01×10^{11} yuan, officially entering the "trillion-yuan industry" era and becoming a pillar industry and important driving force for socio-economic development in northwestern provinces and autonomous regions.*

1.2 Data Sources and Indicator Selection

The A-level tourist attraction list was obtained from official websites of culture and tourism departments in northwestern China, with data current as of December 2020. The spatial distribution and evolution of A-level tourist attractions are jointly influenced by social, economic, and environmental factors. Building upon existing research by Wang Min, Wang Zhao, and Zhao Rui, and further considering the unique natural regional characteristics and development stage features of northwestern China, this study selects 10 variables from three dimensions—social, economic, and environmental—to construct an influencing factor indicator system (Table 1). Specific variable descriptions are as follows:

Social Factors: 1. **Policy Intensity (x_1):** Tourism development 离不开 gov-

ernment coordination and policy support, particularly as A-level tourist attraction designation and planning are largely influenced by policy strength. This is measured by the frequency of the term “tourist attraction” in municipal government work reports from 2010-2020. 2. **Resident Population (x_2):** As disposable income increases, residents’ tourism demand rises accordingly. Resident population size determines the local tourism market’s customer base and the scale of tourism-related employees, thereby influencing the formation and distribution of A-level tourist attractions. 3. **Road Mileage (x_3):** Transportation is a crucial tourism element connecting source markets and destinations. Regions with convenient transportation infrastructure facilitate the formation and development of A-level tourist attractions.

Economic Factors: 1. **Per Capita GDP (x_4):** Objectively reflects a city’s economic and social development level. Cities with higher per capita GDP have relatively complete supporting infrastructure and better service levels for receiving tourists, contributing to tourism development. 2. **Tertiary Industry Proportion (x_5):** Tourism is an important component of the tertiary industry, whose proportion largely reflects the overall development status of regional tourism. 3. **Tourism Income (x_6):** Includes all income generated from tourism activities (“eating, accommodation, transportation, sightseeing, shopping, entertainment, sports, learning, research, comprehension”) and is closely linked to scenic area construction and operation.

Environmental Factors: 1. **Elevation (x_7):** Natural resource-based attractions are widely distributed in mountains and basins, while cultural attractions are relatively concentrated in plains and oasis areas. Flat, low-altitude areas suitable for production and life also form richer tourism resources, making elevation a determinant of attraction types and distribution. 2. **Annual Precipitation (x_8):** A key factor in scenic area planning, closely related to scenic aesthetics and ecology, affecting seasonal landscape variations and scenic area planning. 3. **Annual Average Temperature (x_9):** Comfortable temperatures benefit human production and life, influence civilization development (forming cultural tourism resources), and facilitate the formation of natural landscapes. 4. **River Systems (x_{10}):** Rivers are cradles of civilization with concentrated human activities along their banks, influencing the distribution of cultural tourism resources while serving as attractive natural tourism resources themselves.

1.3 Methods

1.3.1 Nearest Neighbor Index The nearest neighbor index measures the degree of mutual proximity among point data in space, accurately reflecting the distribution patterns of point features. This study employs the nearest neighbor index to analyze whether A-level tourist attractions in northwestern China exhibit spatial agglomeration characteristics. The nearest neighbor index (R) is defined as:

$$R = \frac{r_1}{r_E}$$

where r_1 is the average of actual nearest neighbor distances, and r_E is the expected value of nearest neighbor distance. The actual nearest neighbor distance is calculated as:

$$r_1 = \frac{1}{n} \sum_{i=1}^n d_i$$

where d_i is the actual nearest neighbor distance, and n is the number of attractions. The expected distance is:

$$r_E = \frac{0.5}{\sqrt{n/B}}$$

where B is the study area's area. When $R < 1$, attractions show agglomerated distribution; when $R = 1$, random distribution; and when $R > 1$, discrete distribution.

1.3.2 Thiessen Polygon Analysis Thiessen polygons are a primary method for regionalizing discrete sampling points. This study uses Thiessen polygons and their coefficient of variation (C_v) to analyze the agglomeration degree and spatial distribution types of A-level tourist attractions in northwestern China. The calculation formula is:

$$C_v = \frac{T}{S} \times 100\% = \frac{\sqrt{\frac{1}{n} \sum_{i=1}^n (S_i - S)^2}}{S} \times 100\%$$

where T is the standard deviation of polygon areas, S is the mean polygon area, S_i is the area of the i th polygon, and n is the number of polygons.

1.3.3 Kernel Density Analysis Kernel density analysis calculates the unit density of point feature measurement values within a specified neighborhood range, intuitively reflecting the distribution of discrete measurement values in continuous areas. This study analyzes A-level tourist attractions in northwestern China through kernel density analysis, using contour lines to represent spatial distribution patterns. Higher kernel density values indicate greater agglomeration. The calculation formula is:

$$f_h(x) = \frac{1}{nh} \sum_{i=1}^n K\left(\frac{x - x_i}{h}\right)$$

where $f_h(x)$ is the kernel density estimate at point x , K is the kernel function, h is the specified radius, x_i represents points within distance h , and n is the number of points within distance h .

1.3.4 Standard Deviation Ellipse Analysis Standard deviation ellipse analysis reveals the spatial distribution morphology of A-level tourist attractions in northwestern China while indicating changes in the location of distribution centers and movement trends. The calculation formulas are:

$$SDE_x = \sqrt{\frac{\sum_{i=1}^n (x_i \cos \theta - y_i \sin \theta - \bar{X} \cos \theta + \bar{Y} \sin \theta)^2}{n}}$$

$$SDE_y = \sqrt{\frac{\sum_{i=1}^n (x_i \sin \theta + y_i \cos \theta - \bar{X} \sin \theta - \bar{Y} \cos \theta)^2}{n}}$$

where SDE_x and SDE_y are standard deviations along the x- and y-axes, (x_i, y_i) are the coordinates of the i th attraction, (\bar{X}, \bar{Y}) is the mean center, θ is the rotation azimuth angle, and n is the total number of attractions.

1.3.5 Geographic Detector The geographic detector model is employed to detect factors influencing the spatial pattern evolution of A-level tourist attractions. Factor detection measures the explanatory power of an independent variable X on the spatial differentiation of dependent variable Y , expressed as a q value:

$$q = 1 - \frac{\sum_{h=1}^L N_h \sigma_h^2}{N \sigma^2}$$

where h is the stratum of X or Y , N_h and N are the numbers of units in stratum h and the entire region respectively, and σ_h^2 and σ^2 are the variances of Y values in stratum h and the whole region. The q value ranges from $[0, 1]$.

2.1 Spatiotemporal Distribution Pattern Analysis

2.1.1 Evolution of Spatial Agglomeration Characteristics

From a regional differentiation perspective, the number of A-level tourist attractions in northwestern China shows significant imbalance. At the provincial scale, only Xinjiang Uygur Autonomous Region has more than 300 attractions, while Qinghai Province and Ningxia Hui Autonomous Region have fewer than 200. Comparing 2010 and 2020, the total number of A-level attractions increased by 636. Shaanxi Province, Xinjiang Uygur Autonomous Region, and Gansu Province added 155, 151, and 148 attractions respectively, while Ningxia Hui Autonomous Region and Qinghai Province saw smaller increases. By 2020,

the number of attractions was 2.66 times that of 2010, with Shaanxi, Ningxia, Gansu, Xinjiang, and Qinghai adding 155, 72, 148, 151, and 110 attractions respectively.

At the municipal scale, all cities in northwestern China have A-level tourist attractions, mainly concentrated in the Guanzhong Plain urban agglomeration, Lanzhou-Xining urban agglomeration, Ningxia Yellow River urban belt, and Tianshan North Slope urban agglomeration. In 2010, the cities with the most attractions were Xi'an, Tianshui, Yinchuan, Xining, and Changji Hui Autonomous Prefecture, while in 2020 they were Xi'an, Zhangye, Yinchuan, Xining, and Ili Kazak Autonomous Prefecture.

From an element agglomeration perspective, the nearest neighbor index analysis reveals spatial distribution types with values of 0.49, 0.47, 0.46, 0.45, and 0.44 for 2010, 2013, 2016, 2018, and 2020 respectively. All Z-scores are negative and pass significance tests, indicating that A-level tourist attractions exhibit agglomerated distribution with gradually intensifying agglomeration. The Thiessen polygon coefficient of variation method further validates these results. According to Duyckaerts' research, when $C_v > 0.64$, point targets show agglomerated distribution. The C_v values for northwestern China (Table 2) confirm the agglomerated distribution pattern, with 逐年 increasing C_v values demonstrating strengthening agglomeration.

Spatial agglomeration of tourist attractions facilitates tourism route planning and promotes regional tourism development, but also creates competitive relationships. Moderate competition improves service quality, while excessive competition may cause crowding-out effects. Therefore, studying spatial distribution characteristics and rationally planning spatial layouts are necessary to guide coordinated and orderly development.

2.1.2 Evolution of Spatial Morphology Characteristics

Using ArcGIS spatial statistics tools with one standard deviation, we calculated the main parameters of standard deviation ellipses for A-level tourist attractions from 2010-2020 (Table 3). The analysis focuses on the most concentrated areas to accurately describe distribution patterns. Overall, the distribution shows a “northwest-southeast” pattern along the axis of “Turpan City—Jiuquan City—Haibei Tibetan Autonomous Prefecture—Lanzhou City—Baoji City—Xi'an City.”

The standard deviation ellipse center of gravity shows an “S-shaped” trajectory. In 2010, the center was in Haibei Tibetan Autonomous Prefecture, Qinghai; in 2013 it shifted west to Zhangye, Gansu, due to the “Belt and Road” policy making northwestern China a key tourism development zone. In 2016, the center moved east, indicating that with the “New Pattern of Western Development,” Gansu emphasized developing modern services centered on cultural tourism. In 2020, the center shifted west again as Xinjiang and Qinghai increased attraction development efforts.

The long axis length gradually extended from 2010-2020, indicating strengthened tourism development in the northwest-southeast direction. The short axis length first shortened then lengthened, showing a contraction-expansion trend in the northeast-southwest direction. The large difference between long and short axes in 2010 indicates strong centripetal force and obvious directionality. The rotation angle shows consistent spatial evolution, gradually shifting from “northwest-southeast” to “west-east” orientation.

2.1.3 Evolution of Spatial Structure Characteristics

Kernel density analysis identifies the density distribution of A-level tourist attractions from 2010-2020 (Figure 4). The spatial structure evolved from “scattered point pattern” to “clustered patch pattern” and finally to an “inverted L-shaped strip pattern,” forming a multi-center cluster pattern with Xi’an, Urumqi, Lanzhou, Xining, and Yinchuan as agglomeration cores and surrounding areas as supplements.

Shaanxi Province shows a single-pole pattern centered on Xi’an. In 2010, Xi’an was most dense, followed by adjacent Xianyang and Baoji. Southern Shaanxi (Hanzhong, Ankang) and northern Shaanxi had fewer attractions. By 2020, attractions in Xi’an and surrounding cities became contiguous, with rapid growth in Yan’an and Yulin (red revolutionary bases). Southern Shaanxi developed slowly due to homogeneous resources, incomplete infrastructure, and scattered tourism routes.

Gansu Province maintained a relatively stable distribution pattern. Initial development centered on Tianshui, Lanzhou, Wuwei, and Jiayuguan. From 2010-2020, the density and distribution range continuously expanded, with significant increases in Qingyang, Longnan, Gannan Tibetan Autonomous Prefecture, and border areas.

Qinghai Province had fewer attractions initially concentrated in Xining and Haidong. From 2016, the number continuously increased, expanding outward from Xining. Eastern cities saw growing attraction distribution, while western and southern areas developed to some extent. However, attractions remain concentrated in areas with relatively convenient transportation; Haixi Mongolian and Tibetan Autonomous Prefecture and Yushu Tibetan Autonomous Prefecture have fewer attractions due to transportation lag, plateau climate, and sparse population.

Ningxia Hui Autonomous Region shows similar evolution to Qinghai, with slow overall development. Attractions are mainly concentrated in northern Yinchuan and central Shizuishan, gradually shifting from point to patch distribution, while central and southern cities consistently have fewer attractions.

Xinjiang Uygur Autonomous Region exhibits significant spatial imbalance, with northern Xinjiang having far more attractions than southern Xinjiang. Southern Xinjiang, despite rich tourism resources, lagged in A-level attraction

development due to economic and transportation constraints. Under the “Belt and Road” initiative and assistance policies, southern Xinjiang increased development efforts. From 2016-2020, the agglomeration range expanded significantly, showing a “patch-strip-patch” pattern from north to south. By 2020, most areas of Xinjiang saw increased kernel density values with slight area diffusion.

2.2 Analysis of Influencing Factors

2.2.1 Evolution of Individual Factor Influence

Using the geographic detector model, we calculated q values for influencing factors (Table 4). The influence capacity of each factor on the spatial pattern evolution of A-level tourist attractions from 2010-2020 varies significantly:

Social Factors (Figure 5a): Policy intensity (x_1) shows an upward trend with fluctuations. The q value declined from 2010-2013 but rose steadily from 2013-2020, particularly after the 2013 “Belt and Road” initiative, which effectively promoted diversified tourism development in northwestern China. The q value declined in 2020, indicating reduced government support during the COVID-19 pandemic. Resident population (x_2) shows an upward trend with cyclical fluctuations, reflecting periodic changes in tourism demand. Road mileage (x_3) demonstrates an upward trend, with continuous increases from 2018-2020 due to coordinated development of railways, highways, and civil aviation, including the 2014 opening of the Lanzhou-Xinjiang high-speed railway.

Economic Factors (Figure 5b): Tertiary industry proportion (x_5) shows an upward trend with cyclical fluctuations. Tourism income (x_6) exhibits an upward trend with minor fluctuations, though the 2020 COVID-19 outbreak caused a decline. Per capita GDP (x_4) shows an upward trend with periodic fluctuations, reaching its maximum in 2018 as northwestern provinces promoted economic structural optimization and industrial transformation.

Environmental Factors (Figure 5c): Elevation (x_7) shows relatively stable influence, with q values rising then stabilizing. Annual precipitation (x_8) demonstrates an upward trend, with q values rising then falling before rebounding in 2020 as increased precipitation facilitated landscape changes beneficial for tourism development. Annual average temperature (x_9) shows an upward trend with minor fluctuations. River systems (x_{10}) maintain stable influence, with q values ranging between 0.1506-0.1558.

The q value changes of five factors—resident population, per capita GDP, tourism income, road mileage, and policy intensity—are particularly significant, indicating they are dynamic influencing factors. Elevation and river systems, as environmental factors, remain relatively stable and can be considered static influencing factors.

2.2.2 Evolution of Factor Category Influence

Summing the q values of factors within each category reveals the overall influence evolution:

Social factors show an upward trend with a two-stage pattern of initial decline followed by steady increase, indicating strengthening influence on spatial pattern evolution. Relevant policies guide development direction, resident population provides customer and service personnel bases, and transportation network accessibility directly affects attraction designation.

Economic factors demonstrate an upward trend with cyclical fluctuations. Economically developed regions provide financial resources, infrastructure, and service management conditions that expand scenic area planning and promote tourism development. The influence pattern reflects periodic economic development cycles.

Environmental factors tend to rise but remain relatively stable. Topography forms the skeleton of tourist attractions, climate determines resource distribution differences, and river systems constitute important landscape elements. As ecological protection awareness increases, previously overdeveloped natural attractions have gained effective protection and management.

3 Discussion

This study reveals that from 2010-2020, the spatial pattern evolution of A-level tourist attractions in northwestern China shows regional imbalance characterized by “scattered point—clustered patch—inverted L-shaped strip” patterns, closely related to the region’s large geographical span and complex administrative relationships. Under current territorial and regional tourism integration contexts, cross-regional integration of scenic resources is urgently needed to form regional tourism demonstration zones that optimize “fewer administrative barriers, more tourism flows.”

The study finds that resident population, per capita GDP, tourism income, road mileage, and policy intensity significantly influence spatial pattern evolution, consistent with previous research on tourism spatial structure and accessibility. The difference lies in identifying these five factors as having particularly significant influence, while annual temperature, precipitation, tertiary industry proportion, elevation, and river systems also play important roles in attraction formation. Therefore, based on the concept of “protection through development and development through protection,” northwestern China should leverage both effective markets and proactive governments, using urban agglomerations as centers and transportation networks as linkages to enhance economic and social benefits, promote regional tourism linkage development, create high-quality tourism routes, establish cross-provincial tourism cooperation mechanisms, and optimize regional scenic spatial patterns.

Through a cross-regional perspective and spatial statistical models, this study

provides effective information support for government departments to formulate inter-regional tourism plans and establish economic development strategies, helping break through “administrative boundary economy” constraints, facilitate smooth cross-regional tourism element flows, strengthen spatial cooperation among tourism stakeholders, and address homogenized competition. However, limitations remain: artificially selected indicators are difficult to quantify comprehensively, and different attraction levels represent quality classifications. This study treats all A-level attractions as an integrated whole without exploring spatiotemporal patterns and influencing factors by level or type. Future research should investigate pattern evolution mechanisms and spatial integration pathways for different levels and types of attractions using multi-scale perspectives and differentiated indicators.

4 Conclusions

Based on GIS spatial technology and geographic detectors, this study examines the spatial pattern evolution and influencing factors of A-level tourist attractions in northwestern China from 2010-2020, reaching the following conclusions:

1. **Imbalanced quantity changes with intensifying spatial agglomeration:** A-level tourist attractions show significant quantitative imbalance with increasingly agglomerated spatial distribution along a “northwest-southeast” axis centered on “Turpan City—Jiuquan City—Haibei Tibetan Autonomous Prefecture—Lanzhou City—Baoji City—Xi’an City.” The spatial structure evolved from “scattered point pattern” to “clustered patch pattern” and finally to an “inverted L-shaped strip pattern.”
2. **Five dominant influencing factors:** Resident population, per capita GDP, tourism income, road mileage, and policy intensity strongly influence spatial pattern evolution. These five factors, along with tertiary industry proportion, annual precipitation, and annual average temperature, show rising influence over time, while elevation and river systems maintain relatively stable influence.
3. **Differentiated factor dynamics:** Social factors show a two-stage pattern of initial decline followed by steady increase. Economic factors exhibit cyclical rise-decline fluctuations. Environmental factors tend to rise but remain relatively stable in magnitude.

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Note: Figure translations are in progress. See original paper for figures.

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