Research on Spatial Heterogeneity of Consumption Vitality and Its Driving Factors in Xining City, China

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Abstract: Based on POI data, the spatial differentiation of consumption vitality in Xining City was analyzed by kernel density analysis; the factors influencing urban consumption vitality were analyzed based on geodetector. The results show that: (1) Consumption vitality in Xining City shows obvious spatial heterogeneity, and its high-value centers are mainly located in commercial agglomeration areas, showing obvious high-value multi-core agglomeration, and high-value centers gradually diminishing to low-value areas, which is in line with the distribution pattern of "multi-core" of commercial centers in Xining City; (2) The factor detection results show that residential distribution, company distribution and road network density have a greater driving force on urban consumption vitality; the interaction detection results are generally higher, showing synergistic enhancement, of which the driving force is the highest under the interaction between company distribution and residential distribution, and road network density and residential distribution.

Keywords: urban consumption vitality; driving factors; geodetector; kernel density analysis; Xining city

1 Introduction

In recent years, with the development of society, China has gradually undergone a rapid transformation to a modern society. Consumption has become an important part of people's life and is the most lasting driving force for economic development. The study of urban consumption vitality is conducive to exploring the direction of urban development and consumption potential in depth, and further provides a reference basis for urban economic development.

At present, domestic and foreign research on urban consumption vitality is mainly divided into two aspects, on the one hand, it is mainly a comprehensive study on the impact of urban economy, politics, culture, etc., such as Zheng Huimin put forward countermeasures to release

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the local cultural consumption vitality for the current situation of the development of Beijing-Tianjin-Hebei cultural industry and the development of Beijing-Tianjin-Hebei cultural agglomeration[1];Wang Jia et al. put forward countermeasures for releasing the local cultural consumption vitality through the research on the impact of atmospheric pollution on the urban consumption vitality[2]; and Li Yuan et al. put forward countermeasures through the research on the impact of Research on the impact of atmospheric pollution on urban consumption vitality [3]. Through the research on the impact of atmospheric pollution on urban consumption vitality [2]; Li Yuan et al. found that the consumption vitality of cities is the most durable driving force of the economy and an important factor in promoting stable economic development[3]; Zhao Linxia, based on the study of digital retailing, found that digital retailing can increase the consumption vitality of rural residents[4].The statistics of Pivo and Fisher found that most of the consumption behaviors are related to walking[5]; Hack also found that pedestrian-friendly business districts tend to be more Chengdu[6]. On the other hand, research analysis mainly focuses on the inter-regional variability of consumption vitality and its influencing factors, e.g., Shu Tianheng used kernel density analysis to analyze the spatial heterogeneity of consumption vitality of the five evaluation indexes selected in Chengdu, and compared and summarized the driving factors of consumption vitality in the city of Chengdu[7]; Yan Zhaoxia et al. used POI data, and analyzed consumption vitality of the city of Shanghai through the kernel density computation, correlation analysis method, and Simpson's Index to calculate the impact of roads on consumption vitality in Shanghai[8]; Xu Yong et al. studied the spatial heterogeneity of consumption vitality in megacities using POI and nighttime lighting data[9]; Peng Chong et al. found that the higher the density density of the road network with a low grade is more conducive to the improvement of consumption vitality[10].

Since the 1980s, China has entered a consumer-oriented society, with more and more factors affecting urban consumption vitality, and during this period, studies have found that consumption vitality can pull local economic growth and promote the development of weak urban consumption zones. And most of the studies in China have taken large cities as the object of research, with less research on small and medium-sized cities. In recent years, under the macro-control and strong support of the state, the commercial center of Xining City has developed from a "single core" to a "multiple core". It is of high practical significance and theoretical value to explore the consumption vitality and its driving factors in Xining City, which is the "throat of Tibet and the sea"[11].

2 Overview of the study area

Xining City is located in the northeastern part of the Qinghai-Tibetan Plateau and the northeastern part of Qinghai Province, with a longitude of 101.56°-101.91° East and a latitude of 36.47°-36.76° North. By the end of 2022, the resident population of Xining will reach 2.468 million, the GDP will reach 137.298 billion yuan, the total retail sales of consumer goods will reach 57.357 billion yuan, and the per capita disposable income of the residents will reach 24,037 yuan. The research scope of this paper is the main urban area of Xining City, including the east, north, west and city center (Huanghuangzhong District has just withdrawn from the county and set up a district, not included in the scope of this paper for the time being).

3 Data sources and research methodology

3.1 Data sources

The base map of Xining City's administrative division comes from the 1:4 million database of the National Center for Basic Information, the house price data is obtained from the second-hand house trading platform of 58 Tongcheng through crawler technology, and the POI data of the service industry and the road network data of Xining City are obtained from .

3.2 Research methodology

(1)Kernel density analysis

Kernel density analysis is a spatial analysis method that characterizes the spatial variation of point element density[12].

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

$f(x)$ represents the kernel density estimate at x, n represents the total number of sample points x, h denotes the search radius of the kernel density function, $x - x_i$ denotes the distance between the sample point x and the estimated point x_i, and K is the weight of the distance.

(2) Geodetector

Geodetector is a tool for detecting spatial dissimilarity and its drivers for statistical analysis, and its method was proposed by Wang Jinfeng[13] et al.

$$q_{D,U} = 1 - \frac{1}{n\sigma_U^2}\sum_{i=1}^{m} n_{D,i}\sigma_{U_{D,i}}^2 \tag{2}$$

$q_{D,U}$ represents the indicator of detecting power of consumption vitality drivers, n is the total number of samples, σ_U^2 is the discrete variance, m is the number of classifications, $n_{D,i}$ and $\sigma^2_{U_{D,i}}$ represent the total number of samples in the ith classification and the variance of consumption vigor, respectively. $q_{D,U}$ takes the value of the interval of [0,1].

4 Spatial Analysis of Consumption Vitality in Xining City

Based on formula (1), the kernel density analysis is carried out in ArcGIS 10.6 by setting 1000m search radius for POI data of five types of service facilities in Xining City, and the distribution density of each service facility point in Xining City is obtained as Figure 1(a)-(e). On this basis, each type of consumer service is stacked and summed by assigning weights, and Figure 1(f) is obtained, with high values of consumer vitality clustered in the city center.

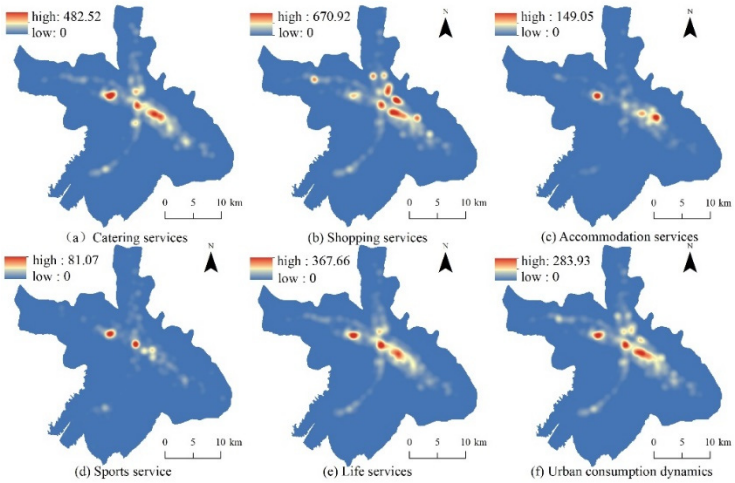

Fig 1 Density distribution of urban services and consumption dynamics kernels

Consumption vitality is highly concentrated in the prosperous commercial areas in the city center, and the estimated kernel density of consumption vitality is up to 283.93. The areas with high kernel density in the western part of the city are mainly distributed in the areas of Wanda Plaza, Wangfujing Elephant City and Haihu Plaza of Haihu New District; the areas with high consumption vitality in the city center are mainly located in the areas of Xinning Plaza, Limin Commercial Pedestrian Street, Xinhua Department Store and Wangfujing Department Store; the areas with high consumption vitality in the eastern part of the city are mainly distributed in the vicinity of Wangfujing Department Store and Grand Cross Department Store. High-value areas are mainly located in the neighborhoods of Wangfujing Department Store and Daxue Department Store. Consumption vitality in Xining City shows the phenomenon of high-value multi-core agglomeration, and the high-value agglomeration centers show a gradually decreasing trend in all directions. In the northern part of the city, there is a low-value agglomeration area, which is slightly lower than the three high-value agglomeration centers, but also clearly shows the phenomenon of low-value agglomeration of consumption vitality.

5 Driving factors of consumption vitality in Xining City

Through literature research, combined with field survey, the main factors influencing consumption vitality in Xining City are house price, distribution of companies and enterprises, distribution of attractions, distribution of road network density, and distribution of residences. The data of house price is interpolated by Kriging, and the remaining four types of data are calculated by kernel density analysis respectively. Considering the data discrete requirement of geodetector, the above data is classified into six levels by natural discontinuity method, after which it is corresponded to the spatial grid, and data extraction is carried out by point sampling, and the degree of the driving effect of each factor on the heterogeneity of the consumption vitality can be further obtained based on the Equation 2. See Table 1, Table 2.

Table 1 Factor detection results

	House price	Road density	Company distribution	Attractions	Residential distribution
Driver detectability indicator (q)	0.128	0.651	0.697	0.485	0.775

Table 2 Interaction detection results

	House price	Road density	Company distribution	Attractions	Residential distribution
House price	0.128				
Road density	0.673	0.651			
Company distribution	0.720	0.786	0.697		
Attractions	0.562	0.712	0.783	0.485	
Residential distribution	0.782	0.803	0.839	0.795	0.775

5.1 Factor Detection of Drivers

Factor detection to get the detection power of each driver on consumption vitality (Table 1), according to the detection power in descending order: residential distribution > company distribution> road network density > attraction distribution > house price Among them, residential distribution has the highest impact on consumption vitality, the dense residential distribution area has high population density and many kinds of daily consumption, so the population density can directly reflect the number of consumers in the inter-regional area, which is consistent with the reality of the consumption situation in most of the cities, and it can be seen that the selection of this factor has a high degree of accuracy. The distribution of company enterprises has the second highest impact on consumption vitality, and the layout of company enterprises can drive the economic development in the region, so the location of company enterprises is generally a region with a higher level of economic development, and the increase in the level of economic development drives the consumption vitality in the region, which indicates that the consumption vitality in Xining City matches the current situation of economic development. Road network density detection force is 0.651, in general, the city consumption vitality center tends to layout in the traffic junction, regional traffic convenience can intensify the population flow and business gathering, road density and road node density, the greater the formation of urban consumption vitality is more favorable. Attractions distribution and housing prices have a low impact on urban consumption dynamics, both lower than 0.5, especially housing prices only 0.128, which can be seen that housing prices have a very small impact on consumption dynamics. Attractions distribution detection force is 0.484, almost close to 0.5, attractions dense area, the city consumption has a certain role in driving, but the scenic spots are susceptible to social, political and natural factors such as the limitations of the region can not be brought to the region for a long period of time and stable consumption, and thus is not an important factor affecting the consumption vitality of Xining City.

5.2 Interaction Detection of Drivers

Through the interaction probes among the drivers of consumption dynamics in Xining City, we can explore the impacts of different factors on the city's consumption dynamics, as shown

in Table 2, and the interaction impacts are, in descending order: distribution of companies and residences, road density and residences, attractions and residences, road density and companies, companies and attractions, house prices and residences, house prices and companies, road density and attractions, house prices and road density, house prices and road density, house prices and attractions, and house prices and road density. density, house prices and attractions. It can be seen that the results of the interaction detection between the distribution of company enterprises and residential distribution, and road network density and residential distribution are most obvious, and the impact on urban consumption vigor is greater under the influence of interaction relative to the detection of individual factors, both above 0.5, and the synergistic enhancement effect among the drivers is shown, which indicates that the heterogeneity of urban consumption vigor can be narrowed under the influence of interaction of the drivers.

6 Conclusion and Discussion

(1)The spatial distribution of consumption vitality in Xining City is more heterogeneous, and the high-value concentration area of consumption vitality is mainly located in the commercial concentration area, which shows the obvious phenomenon of high-value multi-core concentration, and the gradual decrease of high-value centers to low-value areas, which is in line with the distribution pattern of "multi-core" of Xining City's commercial centers.

(2)The results of urban consumption vitality factor detection show that: residential distribution, corporate distribution and road network density have the greatest role in driving consumption vitality in Xining City, which is an important driver of consumption vitality in Xining City, and the improvement of consumption vitality in the region should pay attention to the role of these three driving factors.

(3)The results of the interaction detection of the drivers of urban consumption vitality are generally high, all above 0.5, among which the distribution of companies and residential distribution, road network density and residential distribution are the highest, and the synergistic enhancement effect between the drivers of consumption vitality is shown, indicating that the joint influence of any two drivers is conducive to the improvement of urban consumption vitality.

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