Spatial Heterogeneity of Urban Social Class Based on Housing Proxy Data: A Case Study of Lanzhou (Postprint)

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Abstract

With the deepening development of urbanization, the degree of spatial differentiation of social stratification caused by income inequality urgently necessitates examination from a geographical perspective. This study employs web scraping tools to obtain commercial housing data for Lanzhou City and applies Reardon's spatial differentiation method to investigate the geographical distribution characteristics of residential-social classes and their degree of spatial differentiation. The results indicate that: Regarding the geographical distribution of residential-social classes, Chengguan District and Qilihe District exhibit a concentric distribution pattern from center to periphery sequentially comprising the elite class, affluent class, middle class, lower-income class, and impoverished class, yet a phenomenon of elite area "encroachment" into low-end residential zones exists; Anning District and Xigu District present a mixed distribution pattern dominated by middle and lower-income classes. In terms of spatial differentiation of residential-social classes, the differentiation trend is notably significant, with the degree of differentiation in Qilihe District, Anning District, and Xigu District markedly higher than that in Chengguan District; residential areas of the affluent class tend more toward integration, while those of the lower-income class show a trend toward differentiation; furthermore, the spatial differentiation of residential-social classes becomes more pronounced as the research scale decreases.

Full Text

Preamble

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Abstract

Since the reform and opening up, China' s economy has sustained continuous growth, the urbanization process has accelerated, and income disparities among urban residents have widened. Alongside the demolition of original urban housing and the passive relocation of urban residents, diverse social groups have been reconstructed within heterogeneous urban spaces and commodity communities. The role of sorting and filtering among urban residents leads to members of the same social stratum tending to reside in the same spatial areas, resulting in the phenomenon of different social strata forming heterogeneous living spaces and causing the differentiation of social groups in residential space. Consequently, the degree of social stratification differentiation must be examined from a geographical perspective.

To analyze the spatial differentiation of urban social strata, this paper takes Lanzhou City, Gansu Province, China as a case study and discusses the differentiation of urban social strata caused by income gaps as well as the degree of differentiation mapped in residential space. Commercial housing data for Lanzhou were obtained through web crawler tools. The geographical distribution characteristics and spatial differentiation degree of residential strata were studied using Reardon' s spatial differentiation method. The results show that: (1) In terms of geographical distribution of residential-social strata, Chengguan District and Qilihe District exhibit a circular distribution pattern of elite, wealthy, middle, low-income, and poor groups from the center to the periphery, though there is a phenomenon of low-grade residential areas "invading" elite areas. The distribution of residential-social strata in Anning District and Xigu District is more complex, dominated by middle-middle class, low-middle class, and urban village-poor class, tending toward mixed distribution with remarkable marginalized characteristics of urban villages. (2) Regarding spatial differentiation of residential-social strata, wealthy-class residential areas show greater inclination toward merging, while low-class residential areas exhibit tendencies toward differentiation. The residential-social class differentiation in Qilihe, Anning, and Xigu Districts is obviously higher than that in Chengguan District, characterized by isolated elite class, fusion of wealthy and middle classes, and separation tendencies between low-yield and poor classes. The difference between residential and social strata in the urban center is lower, while the degree of differentiation is higher toward the edge, showing a discontinuous circular structure. (3) The spatial differentiation of residential-social strata becomes more significant with decreasing research scale, indicating that macro-scale spatial differentiation will lead to different research results due to different measurement scales, and macro-scale spatial differentiation shows a significant weakening phenomenon. Micro-scale analysis can reflect the objective reality of spatial differentiation.

Keywords: residence-social class; social differentiation; spatial entropy index; Lanzhou City

1. Study Area and Data

1.1 Study Area

[Figure 1: see original paper] Location map of central urban area of Lanzhou

The study area comprises the main urban districts of Lanzhou, including Chengguan District, Qilihe District, Anning District, and Xigu District. These districts represent the core urban area where residential differentiation patterns are most evident.

1.2 Data Sources

Residential property data were collected from major real estate platforms in Lanzhou using web crawler technology. Geographic coordinates were obtained through API interfaces (https://lbs.amap.com/). A total of 14,633 valid residential property samples were collected, covering October 2018. The data were aggregated into 0.1 km × 0.1 km grid cells for analysis, yielding 101 grid units across the study area. The dataset includes property prices, building ages, and spatial locations.

1.3 Research Methods

1.3.1 Spatial Differentiation Measurement The study employs Reardon' s spatial differentiation index to measure residential segregation. The spatial entropy index is calculated as:

where the index ranges between 0 and 1, with values closer to 1 indicating higher spatial differentiation. The calculation involves measuring the distribution probability of different social strata within spatial units and their adjacent areas.

The spatial weight matrix is constructed based on adjacency relationships between grid cells. The method accounts for both local spatial concentration and regional distribution patterns. The spatial differentiation degree is calculated at multiple scales to examine scale effects.

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2. Spatial Distribution Patterns of Residential-Social Strata

2.1 Kernel Density Analysis

[Figure 2: see original paper] Kernel density of residential space of various social groups

Kernel density estimation reveals distinct spatial clustering patterns across social strata. The elite and wealthy classes concentrate in the central urban area,

particularly in Chengguan District, forming high-density cores. Middle-income groups show more dispersed distribution patterns, while low-income and poor classes are concentrated in peripheral areas and urban villages.

The kernel density maps demonstrate that residential differentiation follows a polycentric structure with clear spatial gradients. The density values decrease from city center to periphery, but with notable anomalies where high-end developments appear in suburban locations.

2.2 Spatial Differentiation Index Analysis

The spatial differentiation indices were calculated at four scales: 0.5 km × 0.5 km, 1 km × 1 km, district level, and entire urban area. Results show significant scale effects:

- **0.5 km × 0.5 km grid:** H = 0.6878 (highest differentiation)
- **1 km × 1 km grid:** H = 0.5529
- **District level:** H = 0.5218
- **Entire urban area:** H = 0.0893 (lowest differentiation)

The decreasing index values with increasing spatial scale demonstrate that micro-scale analysis captures more detailed differentiation patterns that become smoothed out at macro scales. This scale dependency indicates that macro-scale spatial differentiation exhibits significant weakening phenomena, while micro-scale measurements better reflect objective spatial differentiation realities.

The spatial differentiation patterns reveal three key characteristics:

1. **Central-peripheral gradient:** Differentiation is lower in the urban center where social mixing occurs, but increases toward the periphery where segregation is more pronounced.
2. **Class-specific patterns:** Wealthy-class residential areas tend to merge spatially, while low-class areas show fragmentation and differentiation tendencies.
3. **District variations:** Qilihe, Anning, and Xigu Districts exhibit higher differentiation than Chengguan District, with Chengguan showing more integrated social-spatial structures.

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3. Discussion and Conclusions

The research demonstrates that Lanzhou' s residential space exhibits clear social stratification differentiation driven by income disparities and urban development processes. The circular distribution pattern from center to periphery is evident but complicated by urban renewal and suburban development.

Key findings include:

First, the spatial differentiation of residential-social strata intensifies at finer measurement scales. This scale effect suggests that macro-scale analyses may obscure important micro-level segregation patterns. Policy interventions should consider scale-specific characteristics when addressing residential segregation.

Second, the differentiation patterns vary significantly across districts. While Chengguan District maintains relatively integrated social-spatial structures due to its historical development and mixed land use, other districts show more segregated patterns. This reflects different urban development histories and planning approaches across districts.

Third, the phenomenon of "invasion" of low-grade housing into elite areas, particularly in Chengguan District, indicates the complexity of residential differentiation processes. This suggests that market forces and urban renewal create dynamic spatial reconfigurations that challenge simple concentric zone models.

The study contributes to understanding residential differentiation in inland Chinese cities and provides methodological insights into scale effects in spatial segregation measurement. Future research should incorporate longitudinal data to examine temporal dynamics and include more nuanced social stratification indicators beyond housing prices.

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