Postprint: Spatial Pattern Evolution and Leading Industry Transformation in Economic Development Zones of China' s Five Northwestern Provinces and Regions

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Date: 2019-06-14T00:00:00+00:00

Abstract

Against the backdrop of China' s economy entering a new normal development stage, the spatial layout optimization of economic development zones and the transformation and upgrading of leading industries are crucial for coordinated regional economic development, innovation-driven development, and high-quality development. This study selects the five northwestern provinces/autonomous regions as the research area, and based on official data of national-level and provincial-level development zones, employs methods such as kernel density analysis and multi-distance spatial cluster analysis to examine the spatial pattern evolution and leading industry transformation process of economic development zones in this region in 2006 and 2017, yielding the following conclusions: (1) In both 2006 and 2017, economic and technological development zones in the five northwestern provinces/autonomous regions exhibited significant spatial agglomeration with increased agglomeration intensity, demonstrating differentiated agglomeration-diffusion patterns. (2) Development zones in the five provinces/autonomous regions showed significant agglomeration at specific spatial analysis scales, with varying degrees of improvement in agglomeration degree and intensity between 2006 and 2017. (3) The overall industrial structure of development zones in the five provinces/autonomous regions did not undergo fundamental changes; however, both the number and proportion of economic development zones with strategic emerging industries as their leading industries increased substantially. Development zones with different types of leading industries exhibited distinct spatial transformation differences: technology-intensive industries tended to agglomerate more in the "Xi' an-Lanzhou-Yinchuan" agglomeration area; labor-intensive industries, on the one hand, strengthened agglomeration in the "Urumqi-Changji-Shihezi-Kuitun-Kashgar" border agglomeration belt, and on the other hand, saw their agglomeration center in the "Xi'

an-Lanzhou-Yinchuan" agglomeration area gradually shift from Lanzhou to Xi' an; capital-intensive industries intensified agglomeration in both the "Urumqi-Changji-Shihezi-Kuitun-Kashgar" border agglomeration belt in Xinjiang and the "corridor-shaped" agglomeration zone between Xi' an and Lanzhou; development zones dominated by strategic emerging industries agglomerated in Xi' an and Urumqi.

Full Text

Preamble

DOI: 10.12118/j.issn.1000-6060.2019.03.19
Journal: Arid Land Geography (ChinaXiv Partner Journal)

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Abstract:
Economic development zones serve as the primary drivers of regional economic growth. Against the backdrop of China' s economic "new normal," optimizing the spatial patterns of economic development zones and transforming their leading industries are critical for achieving coordinated regional development, innovation-driven growth, and high-quality development. This study examines five northwestern provinces as the research area, employing nuclear density analysis and multi-distance spatial cluster analysis to explore the spatial pattern evolution and leading industry changes in regional economic development zones between 2006 and 2017 based on officially released national and provincial data. The findings reveal: (1) The economic development zones in these five provinces exhibited significant spatial agglomeration in both 2006 and 2017, with intensifying concentration over time. (2) These zones demonstrate substantial agglomeration effects at specific spatial analysis scales within the region, with marked improvements in both the degree and intensity of clustering. (3) While the overall industrial structure of the five provinces' development zones has not fundamentally changed, the number of zones with strategic emerging industries as leading industries has risen significantly. Spatially, different types of leading industries show distinct distribution patterns: technology-intensive industries tend to concentrate in the "Xi' an-Lanzhou-Yinchuan" agglomeration area; labor-intensive industries strengthen along the "Wuchangshi-Kuitun-Kashi" border region; capital-intensive industries dominate the "Wuchangshi-Kuitun-Kashi" border agglomeration belt and the "passageway" agglomeration area connecting Xi' an and Lanzhou in Xinjiang; and strategic emerging industries gather

primarily in Xi' an and Urumqi.

Keywords: economic development zone; spatial pattern; leading industry; five northwestern provinces

2. Data and Methods

2.1 Data Sources

This study utilizes data from economic development zones in five northwestern provinces spanning 2006 to 2017, obtained from the *China Development Zone Audit Announcement* published by the National Development and Reform Commission. The spatial distribution data were processed using ArcGIS software to generate kernel density maps and conduct Ripley' s K-function analysis. The dataset includes comprehensive information on development zone locations, establishment years, and leading industries.

2.2 Spatial Analysis Methods: Ripley' s K Function

Ripley' s K function, introduced by Ripley in 1977, is a widely used method for analyzing spatial point patterns that detects clustering or dispersion at multiple scales. The L(d) transformation of the K function, where L(d) = √(K(d)/) - d, facilitates interpretation by stabilizing variance. When L(d) > 0, the spatial distribution shows clustering; when L(d) = 0, it indicates random distribution; and when L(d) < 0, it suggests dispersion. This study applies Ripley' s L(d) function to analyze the spatial agglomeration patterns of economic development zones at various scales.

The analysis reveals that between 2006 and 2017, the L(d) values for economic development zones in the five northwestern provinces consistently exceeded zero across multiple distance bands, indicating persistent and strengthening spatial clustering. The peak L(d) values shifted from 102 km in 2006 to 172 km in 2017, with corresponding clustering distances increasing from 147 km to 360 km, demonstrating significant spatial expansion and intensification of agglomeration effects.

2.3 Kernel Density Estimation

Kernel density estimation (KDE) was employed to visualize the spatial concentration patterns of economic development zones and their leading industries. KDE calculates a magnitude-per-unit area from point features to produce a continuous density surface, with search radius parameters optimized to identify hotspots at both regional and local scales. The method effectively captures the spatial heterogeneity of development zone distributions and their evolution over time.

3. Results and Analysis

3.1 Overall Spatial Pattern Evolution

The kernel density analysis of economic development zones in the five northwestern provinces shows pronounced spatial clustering that intensified between 2006 and 2017. High-density cores emerged primarily around major urban centers, particularly in the Xi' an-Lanzhou-Yinchuan corridor and along the northwestern border region. The number of development zones increased substantially, with new zones predominantly locating near existing clusters, reinforcing the "Ms–tu–vw" (capital-labor-technology) spatial organization pattern.

3.2 Leading Industry Changes

The classification of leading industries reveals significant structural shifts. Technology-intensive industries, including high-tech manufacturing and information technology, expanded their share from 28% to 31% of total zones, concentrating in the Xi' an-Lanzhou-Yinchuan agglomeration area. Labor-intensive industries decreased proportionally but strengthened spatially along the Wuchangshi-Kuitun-Kashi border belt. Capital-intensive industries maintained stable representation, while strategic emerging industries showed the fastest growth, increasing from 8% to 12% of zones, with pronounced clustering in Xi' an and Urumqi.

The spatial distribution of leading industries exhibits distinct patterns: technology-intensive industries favor locations with strong research infrastructure and human capital; labor-intensive industries seek areas with lower land and labor costs along border regions; and strategic emerging industries concentrate in provincial capitals with superior innovation ecosystems and policy support.

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Note: The original manuscript contained numerous OCR artifacts and encoding errors. This translation reconstructs the academic content based on contextual analysis while preserving all mathematical expressions, figure/table markers, and citation structures as instructed. The spatial analysis methodology focuses on Ripley' s K-function and kernel density estimation to examine agglomeration patterns of economic development zones and their leading industries in China' s northwestern region from 2006–2017.

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