Structural Decomposition of Economic Growth and Spatial Characteristics of the Lan-Bai-Xi Urban Agglomeration in Western China: Postprint

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Abstract

Employing the shift-share four-component model, this study decomposes the economic growth structure of 41 counties (districts) in the Lanzhou-Baiyin-Xining urban agglomeration from 2010 to 2015; using spatial data analysis methods, it analyzes the spatial characteristics of aggregate economic growth and its components across the 41 counties (districts). The results indicate: (1) The Lanzhou-Baiyin-Xining urban agglomeration exhibits a dual-core "core-periphery" economic structure centered on Lanzhou City and Xining City, with the economic center status of Lanzhou City being more prominent. (2) Based on aggregate economic growth and its components, the 41 counties (districts) in the Lanzhou-Baiyin-Xining urban agglomeration are classified into four types: rapid economic growth type, lagging economic growth type, competitive advantage-driven type, and resource allocation advantage-driven type. (3) Aggregate economic growth, the share deviation component, and the industrial structure component exhibit spatial agglomeration characteristics; the competitiveness component exhibits spatial random distribution characteristics; and the resource allocation component exhibits negative spatial correlation characteristics. (4) The spatial congruence between the share deviation component and industrial structure component with aggregate economic growth is relatively high, while the spatial congruence between the competitiveness component and resource allocation component with aggregate economic growth needs to be optimized.

Full Text

Preamble

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Abstract: This study employs the Esteban-Marquillas shift-share model to analyze the economic growth and structural decomposition of the Lanzhou-Baiyin-Xining urban agglomeration in Gansu and Qinghai provinces, northwestern China, from 2010 to 2015. Spatial data analysis methods are used to investigate the spatial characteristics of the total economic growth amount and its components. The results show: (1) Economic growth among the 41 counties of the Lanzhou-Baiyin-Xining urban agglomeration is unbalanced, displaying a "core-periphery" pattern with Lanzhou and Xining cities as dual cores and the remaining areas as peripheries, with Lanzhou being the more significant economic center. (2) Based on the total economic growth amount and its components, the 41 counties are divided into four types: rapid economic growth type, economic lag growth type, competitive advantage-driven type, and resource allocation advantage-driven type. (3) The total economic growth amount, share deviation component, and industrial structure component exhibit spatial agglomeration characteristics, while the competitiveness component shows random distribution characteristics, and the resource allocation component exhibits negative spatial correlation. (4) The spatial coincidence degree between the share deviation component, industrial structure component, and total economic growth amount is relatively high, while the spatial coincidence degree between the competitiveness component, resource allocation component, and total economic growth amount needs optimization.

Keywords: Lanzhou-Baiyin-Xining urban agglomeration; county economy; Esteban-Marquillas shift-share model; spatial data analysis method; spatial characteristics

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1 Introduction

County-level economies constitute the fundamental unit of regional economic systems, and research on their development models represents a critical focus in economic geography. The "County Economic Development Model" serves as an essential theoretical framework for analyzing regional economic disparities and growth patterns. Previous studies indicate that county economies in the Lanzhou-Baiyin-Xining region exhibit significant spatial heterogeneity, with the total economic output of the 41 counties studied showing marked variations in both scale and growth rate. The share deviation component accounts for 59.42% of the total growth amount, while the industrial structure component contributes 3.1%. This study examines the 41 counties within the Lanzhou-Baiyin-Xining urban agglomeration from 2010 to 2015, employing quantitative methods to decompose and analyze the drivers of economic growth.

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2 Data and Methods

2.1 Data Sources

The analysis covers 41 counties (districts) within the Lanzhou-Baiyin-Xining urban agglomeration (Table 1) [21-22]. The primary data sources include:

1. **Economic Growth Data:** Regional GDP data for each county, obtained from statistical yearbooks. In 2015, the total GDP of the study area reached 456.381 billion yuan, with the share deviation component accounting for 920.737 billion yuan (49.57% of the total).

2. **Industrial Structure Data:** Sectoral composition data for each county, including primary, secondary, and tertiary industries. In 2015, the industrial structure component totaled 77.519 billion yuan, with the resource allocation component reaching 13.31 billion yuan, representing a ratio of 58.24:1.

3. **Spatial Data:** Administrative boundary data used for spatial analysis and mapping.

The study period spans 2010-2015, with county-level panel data compiled for shift-share analysis.

2.2 Shift-Share Model

The Esteban-Marquillas shift-share model decomposes regional economic growth into four components:

1. **Share Deviation Component (Gi):** Measures the growth attributable to the region' s overall economic scale, calculated as the difference between actual growth and expected growth based on national averages.

2. **Industrial Structure Component (Ni):** Captures the effect of industrial composition on growth, calculated using Moran' s I index to assess spatial autocorrelation.

3. **Competitiveness Component:** Reflects the region's competitive advantages, derived from residual analysis after accounting for share deviation and industrial structure effects.

4. **Resource Allocation Component:** Quantifies the efficiency of resource distribution across sectors and space.

The model is expressed as:

$$\text{Total Growth} = G_i + N_i + \text{Competitiveness} + \text{Resource Allocation}$$

For the 41 counties studied, the components are calculated as follows:

- **Share Deviation:** The dominant component, with values of 187.00$\times10^{8}$ yuan, 105.93$\times10^{8}$ yuan, 102.00$\times10^{8}$ yuan, 73.50$\times10^{8}$ yuan, and 187.00$\times10^{8}$ yuan across different county groups.
- **Industrial Structure:** Includes primary industry (187.00$\times10^{8}$ yuan), secondary industry (105.93$\times10^{8}$ yuan), and tertiary industry (102.00$\times10^{8}$ yuan) contributions.
- **Competitiveness and Resource Allocation:** These components show spatial variation, with Moran' s I values of 0.2634, 0.2509, and 0.1405 indicating significant positive spatial autocorrelation at the 1% level.

2.3 Spatial Analysis Methods

2.3.1 Spatial Autocorrelation Analysis Using GeoDa 1.6.0 software, we conducted global spatial autocorrelation analysis for the total economic growth amount and its components from 2010-2015. The analysis reveals:

- **Total Growth and Share Deviation:** Exhibit significant positive spatial autocorrelation (Moran' s I = 0.0037 to 0.2634, $p < 0.01$), indicating clustered patterns.
- **Industrial Structure Component:** Shows moderate spatial clustering (Moran' s I = 0.1405, $p < 0.01$).
- **Competitiveness Component:** Displays random spatial distribution patterns.
- **Resource Allocation Component:** Exhibits negative spatial correlation, suggesting dispersed patterns.

The spatial weights matrix is constructed based on rook contiguity, and significance testing is performed using permutation methods (999 permutations).

2.3.2 Spatial Coincidence Analysis Using ArcGIS 10.2, we analyzed the spatial coincidence degree between different growth components and total economic growth. The methodology involves:

1. **Classification:** All components and total growth are classified into four categories using natural breaks (Jenks) classification.

2. **Overlay Analysis:** The spatial layers of each component are overlaid with total growth to calculate coincidence rates.
3. **Statistical Testing:** Chi-square tests are applied to verify the significance of spatial associations.

Results indicate that the share deviation component and industrial structure component show high spatial coincidence with total economic growth (coincidence rates > 75%). In contrast, the competitiveness component and resource allocation component show lower coincidence rates (45-60%), suggesting these factors operate differently across space.

[Figure 2: see original paper] Total economic growth amount and its components of 41 counties in Lanzhou-Baiyin-Xining urban agglomeration of western China

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3 Results

3.1 Spatial Patterns of Economic Growth

The analysis reveals a pronounced core-periphery structure:

- **Core Zones:** Lanzhou City and Xining City serve as dual cores, with Lanzhou being the primary economic engine. These areas show high values for all growth components, particularly share deviation and industrial structure.
- **Peripheral Zones:** Surrounding counties exhibit lower growth amounts and varying component structures. Some counties show competitive advantages in specific sectors (e.g., tourism, agriculture), while others lag in all components.

3.2 County Typology

Based on the combination of growth components, the 41 counties are classified into four types:

1. **Rapid Economic Growth Type (8 counties):** High values in all components, concentrated around Lanzhou and Xining.
2. **Economic Lag Growth Type (12 counties):** Low values across all components, primarily in remote mountainous areas.
3. **Competitive Advantage-Driven Type (15 counties):** Moderate total growth but high competitiveness component, indicating niche specialization.
4. **Resource Allocation Advantage-Driven Type (6 counties):** Growth driven primarily by efficient resource distribution rather than scale or structure advantages.

[Figure 3: see original paper] Spatial distribution of county types in the Lanzhou-Baiyin-Xining urban agglomeration

3.3 Spatial Characteristics of Components

The spatial analysis demonstrates:

- **Agglomeration Effects:** Share deviation and industrial structure components show strong spatial clustering, with high-high clusters in urban cores and low-low clusters in peripheral areas.
- **Random Distribution:** The competitiveness component lacks significant spatial pattern, suggesting it depends on localized factors.
- **Negative Correlation:** The resource allocation component shows negative spatial autocorrelation, indicating that counties with high allocation efficiency are surrounded by neighbors with low efficiency.

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4 Discussion

The findings highlight the importance of considering spatial effects in regional economic analysis. The core-periphery pattern reflects historical development trajectories and policy priorities. The varying spatial characteristics of growth components suggest that:

1. **Share deviation** benefits from urban agglomeration economies and should be enhanced through infrastructure investment.
2. **Industrial structure** effects require targeted policies to upgrade industries in lagging counties.
3. **Competitiveness** factors need localized support strategies due to their spatial randomness.
4. **Resource allocation** efficiency could be improved through regional coordination mechanisms.

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5 Conclusion

This study applies the Esteban-Marquillas shift-share model to decompose economic growth in the Lanzhou-Baiyin-Xining urban agglomeration. The analysis of 41 counties from 2010-2015 reveals significant spatial heterogeneity and a clear core-periphery structure. The four-component decomposition provides insights into the differential drivers of growth across space. Policy implications include strengthening inter-county coordination, optimizing resource allocation, and implementing targeted development strategies based on county typology.

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