Comparative Study on Industrial Isomorphism and Trend Forecasting in Northern Shaanxi Energy Development Zone: Postprint

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Abstract

A proper understanding of regional industrial isomorphism status and evolution trends holds significant practical implications for formulating scientific economic development policies, particularly industrial development policies. Taking Yulin City in the Northern Shaanxi Energy Development Zone as the research object, this study analyzes Yulin City' s industrial structure pattern based on three-sector industry data from 1995-2015, measures Yulin City' s industrial isomorphism through the industrial structure similarity coefficient, conducts comparative analysis of industrial isomorphism from both horizontal and vertical dimensions, and additionally employs R/S analysis method to predict future evolution trends of industrial isomorphism. Research findings indicate: (1) Yulin City' s industry exhibits a typical "secondary-primary-tertiary" industrial structure pattern, with the secondary industry accounting for a substantial proportion and becoming the dominant force driving the city' s economic development. (1) The degree of industrial structure convergence within Yulin City' s six northern counties and six southern counties belongs to a relatively high level, with industrial structure homogenization being extremely severe; this is particularly prominent in Shenmu County-Fugu County (0.976 2) and Jia County-Qingjian County (0.967 5). The industrial isomorphism degree between most districts and counties in the southern six counties and northern six counties remains below 0.9, where industrial convergence phenomena are not evident. (3) The H-value (1995-2015) of the industrial structure similarity coefficient between Yulin City' s southern six counties and northern six counties is 0.611 2 > 0.5. If development continues under existing conditions, Yulin City' s future industrial isomorphism degree will intensify, albeit with periodic variations. The study concludes that under conditions of similar energy resources, increasingly close economic exchanges and connections, and continuously converging economic development levels, the convergent development of Yulin City' s industrial structure possesses certain inevitability, which should be clearly recognized when

formulating policies to promote economic development in the future.

Full Text

A Comparative Study of Industrial Isomorphism and Trend Forecasting in the Energy Exploitation Area of Northern Shaanxi Province

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Abstract:
A correct understanding of the situation and evolution trend of regional industrial isomorphism is of great practical significance for formulating scientific economic development policies, especially industrial development policies. Taking Yulin City, the energy exploitation area of northern Shaanxi Province, China, as the study area, the industrial structure model was firstly analyzed using three-industry data during the period from 1995 to 2015. The industrial isomorphism was then measured by the similarity coefficient of industrial structure and compared from both horizontal and vertical dimensions. Additionally, R/S analysis was adopted to forecast the evolution trend of industrial isomorphism in Yulin City. The results revealed as follows: (1) The industrial structure in Yulin City presented a typical pattern of "secondary > tertiary > primary," meaning the secondary industry constitutes a large portion and has become the leading force driving economic development. (2) The industrial isomorphism in northern Yulin (covering six counties) is at a high level, as is that in southern Yulin (covering another six counties). Especially, the similarity coefficient is 0.9762 between Shenmu County and Fugu County, and 0.9675 between Jiaxian and Qingjian County. The majority of similarity coefficients between the six counties in the north and the other six counties in the south are less than 0.9, indicating less obvious industrial isomorphism. (3) The similarity coefficient of industrial structures between the six counties in the north as a whole and the six counties in the south as a whole is 0.6112 (>0.5), which indicates that if industries continue to be developed without change under the current circumstances, the level of industrial isomorphism will keep increasing in a periodic variation. The study suggests that the industrial isomorphism in Yulin City has

its own inevitability because of the similarity in resources and tight connection in economic development among the counties, and people should realize this when setting up future policies to promote regional economic development.

Keywords: industrial structure; industrial isomorphism; similarity coefficient; R/S analysis; Yulin City

1 Introduction

Understanding regional industrial isomorphism is crucial for formulating scientific economic development policies, particularly industrial policies [**?**, **?**, **?**]. Since the 1984 World Bank report on China' s long-term development issues and programs [**?**], scholars have extensively studied regional industrial convergence and isomorphism. Research has shown that regional integration can promote market unification [**?**], while industrial structure convergence may have both positive and negative effects [**?**, **?**]. The energy exploitation area of northern Shaanxi, with Yulin City as its core, represents a typical resource-based region where industrial structure evolution and isomorphism trends warrant detailed investigation.

1.1 Study Area

Yulin City, located in northern Shaanxi Province, is a major energy exploitation base in China. The region is administratively divided into 12 counties, with six counties in the northern part and six in the southern part. The area is rich in coal, oil, and natural gas resources, making it an important energy production base. The economic development among these counties exhibits strong interconnections due to similar resource endowments and industrial bases.

1.2 Data and Methods

This study utilizes statistical data from 1995 to 2015, focusing on the three-industry classification system (primary, secondary, and tertiary industries). The data were processed using ArcGIS 10.0 for spatial analysis. Two main analytical methods were employed: the similarity coefficient method for measuring industrial isomorphism and R/S analysis for trend forecasting.

1.2.1 Similarity Coefficient Method The similarity coefficient between industrial structures is calculated using the following formula:

$$S_{ij} = \frac{\sum_{n=1}^{N} X_{in} X_{jn}}{\sqrt{\sum_{n=1}^{N} X_{in}^2 \sum_{n=1}^{N} X_{jn}^2}}$$

where X_{in} represents the output value of industry i in year n, X_{jn} represents the output value of industry j in year n, and S_{ij} is the similarity coefficient between industries i and j, with $0 \leq S_{ij} \leq 1$. The coefficient C is derived as $C = 2H - 1 - 1$, where H is the Hurst exponent.

The similarity coefficient ranges from 0 to 1, where values closer to 1 indicate higher similarity between industrial structures. In this study, a threshold of 0.9 is used to identify significant industrial isomorphism.

1.2.2 R/S Analysis Method R/S analysis, developed by Mandelbrot and Sugihara [**?**, **?**], is used to detect long-term persistence and trends in time series data. The Hurst exponent H is calculated through the relationship:

$$R/S = K(n)^H$$

where R/S is the rescaled range, n is the time span, and K is a constant. The Hurst exponent H indicates the nature of the time series: - $0 < H < 0.5$ indicates anti-persistence (mean reversion) - $H = 0.5$ indicates random walk - $0.5 < H < 1$ indicates persistence (trend reinforcement)

In this study, R/S analysis is applied to forecast the evolution trend of industrial isomorphism in Yulin City from 2016 to 2035.

2 Results and Analysis

2.1 Industrial Structure Evolution

Table 1 presents the output values of tertiary industries in Yulin City from 1995 to 2015. The data show that the total output value increased from 48.94×10^8 in 1995 to 2491.89×10^8 in 2015, representing a 50.92-fold increase with an average annual growth rate of 1.54%. The secondary industry has consistently dominated the industrial structure, followed by the tertiary and primary industries, forming a "secondary > tertiary > primary" pattern typical of resource-based economies.

2.2 Industrial Isomorphism Analysis

2.2.1 Horizontal Comparison The horizontal comparison reveals high levels of industrial isomorphism among counties within the same region. In northern Yulin, the similarity coefficient between Shenmu County and Fugu County reaches 0.9762, while between Jiaxian and Qingjian County it is 0.9675. The majority of similarity coefficients among the six northern counties exceed 0.9, indicating strong industrial isomorphism. Similarly, the six southern counties show high internal similarity coefficients.

However, when comparing counties across the north-south divide, most similarity coefficients fall below 0.9, suggesting distinct differences in industrial

structure between the two regions. This divergence is attributed to differences in resource distribution, economic development stages, and policy implementation.

2.2.2 Vertical Comparison The vertical analysis across the 1995-2015 period shows that the overall similarity coefficient between the northern six counties and southern six counties is 0.6112, which exceeds 0.5. This indicates a moderate but significant level of industrial isomorphism between the two regions. The time series analysis reveals periodic fluctuations in isomorphism levels, with notable increases during periods of rapid economic growth and resource exploitation.

The trend shows that industrial isomorphism has been strengthening over time, particularly since 2000, when energy prices surged and stimulated extensive development of resource-based industries across the region.

2.2.3 R/S Analysis and Forecasting R/S analysis of the industrial isomorphism time series yields a Hurst exponent $H = 0.6112 > 0.5$, indicating persistent trends. This suggests that if current development patterns continue, industrial isomorphism in Yulin City will maintain its increasing trend with periodic variations.

The forecasting model predicts that from 2016 to 2035, the similarity coefficient between northern and southern Yulin will continue to rise, potentially reaching 0.7-0.8 by 2035. This trend reflects the continued reliance on resource-based industries and the challenge of industrial diversification in the region.

The persistence indicated by $H > 0.5$ implies that policy interventions will be necessary to alter the trajectory of industrial isomorphism. Without strategic adjustments, the region may face increased risks of industrial homogenization, resource depletion, and economic vulnerability.

3 Discussion and Policy Implications

The high level of industrial isomorphism in Yulin City is both inevitable and concerning. On one hand, the similarity in resource endowments and economic development stages naturally leads to comparable industrial structures among counties. On the other hand, excessive isomorphism may lead to redundant construction, vicious competition, and inefficient resource allocation.

Policy makers should: 1. Recognize the objective basis of industrial isomorphism while promoting differentiated development strategies based on local advantages 2. Strengthen regional coordination to avoid redundant construction and 恶性竞争 (malicious competition) 3. Accelerate industrial transformation and upgrading, particularly in developing non-resource-based industries 4. Use the R/S analysis results to monitor trends and adjust policies timely

The study demonstrates that combining similarity coefficient analysis with R/S analysis provides an effective framework for understanding and forecasting industrial structure evolution in resource-based regions.

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