ChinaRxiv

AI translation · View original & related papers at
chinarxiv.org/items/chinaxiv-201909.00143

Industrial Diversification in Resource-Based Regions: A Case Study of Shanxi Province (Postprint)

Authors: Wang Tao, Wang Qingqing, Zhao Dan, Tong Chao, Wang Tao

Date: 2019-09-11T00:00:00+00:00

Abstract

Through a comprehensive analysis of Shanxi Province' s industrial development status using input-output tables and extended input-output tables from 2002 to 2015, the 42 sectors in the input-output tables were aggregated based on the characteristics of Shanxi's industrial development. Input-output indicators were employed to track and describe Shanxi' s industrial development status, while diffusion sensitivity coefficients and diffusion capacity coefficients were adopted to track the evolving patterns of key industries in economic development. The entropy index was utilized to measure the degree of industrial diversification in Shanxi Province, enabling quantitative tracking and evaluation of Shanxi' s industrial diversification development process. Simultaneously, social network analysis methods were applied to construct an input-output association network diagram for Shanxi Province, providing an intuitive examination of industrial linkages and industrial development clusters in Shanxi. The results indicate that Shanxi Province' s industrial diversification process was hindered during 2002–2015, and by 2015, two important industrial clusters had formed: one centered on the coal resources industry and the other centered on the construction industry.

Full Text

Preamble

DOI: 10.12118/j.issn.1000-6060.2019.05.28
Journal: Arid Land Geography

Authors: WANG Tao[1], WANG Qing-qing[2], ZHAO Dan[2], TONG Chao[3]
[1] School of Statistics, Shanxi University of Finance and Economics, Taiyuan 030006, China
[2] School of Public Finance and Economics, Shanxi University of Finance and

Economics, Taiyuan 030006, China
[3] School of Statistics, Shanxi University of Finance and Economics, Shanxi Provincial Bureau of Statistics, Taiyuan 030006, China

Abstract: China is a resource-rich country with abundant resources in many provinces. However, resource-based provinces rely excessively on resource development to drive their economies, leading to a singular economic structure that cannot achieve sustainable development. Therefore, resource-based provinces should develop industrial diversification in a timely manner to form a pattern of common development across multiple industries. As a typical resource-based province, Shanxi' s economy is particularly dependent on resource-based industries. This paper takes Shanxi Province as a case study to comprehensively examine its industrial diversified development. First, according to the characteristics of resource-based economic development in Shanxi, 42 industries were merged into 22 industry categories. Then, through input-output tables and extension tables from 2002 to 2015, we comprehensively analyzed Shanxi' s industrial development. We found that the total input ratio in the coal resources industry was significantly higher than in other industries in recent years, with the non-coal resources industry ranking second. From the perspective of intermediate input ratio, the construction industry maintained a high level, followed by the non-coal resources industry. Secondly, according to the diffusion induction coefficient and diffusion influence coefficient, we tracked the changing patterns of key industries in economic development. In 2002, the diffusion influence coefficients of the coal resources industry and consumer goods industry were not obvious. By 2015, the coal resources industry, non-coal resources industry, consumer goods industry, equipment manufacturing industry, and material chemical industry had become key sectors of industrial development in Shanxi Province. The financial industry and transportation industry had changed from leading industries to non-leading industries, while changes in other industries were not very obvious. Thirdly, the service industry was merged into 13 industries. We then used the entropy index to measure the degree of industrial diversification in Shanxi Province from 2002 to 2015. The results showed that Shanxi' s industrial structure had gradually become more concentrated over time and the industries had become more specialized. Finally, using social network analysis and according to certain mathematical processing and constraints, we constructed Shanxi Province' s input-output correlation diagram to visually examine the associations and development patterns of various industries. We found that two important industrial clusters had formed in 2015: one dominated by the coal resources industry and supported by non-coal resources industry, equipment manufacturing industry, transportation industry, and finance industry; the other dominated by the construction industry and supported by non-coal resources industry and material chemical industry. After more than ten years of development, Shanxi' s industrial development had become more concentrated and formed industrial clusters led by the coal industry and construction industry, with development focusing on these two clusters.

Keywords: resource-oriented economics; input-output table; industrial diver-

sification; social network analysis; entropy index

Funding: Supported by the Shanxi Province Philosophy and Social Science Planning Project (18BTJ018), Shanxi Province Soft Science Research Project (2016323), and Shanxi Province Graduate Education Innovation Project (SSKLZDKT2017038)

Received: 2019-02-01; **Revised:** 2019-05-11

1 Introduction

The input-output table is an important tool for analyzing industrial structure and economic development. Based on the input-output tables and extension tables of Shanxi Province from 2002 to 2015, this study examines the industrial development patterns of this resource-based province. Previous research has extensively studied resource-based economies. Vanderhoeke [1] analyzed the resource curse phenomenon and its mechanisms. Woolcock [2] discussed the social foundations of poor economic growth in resource-rich economies, noting that excessive resource dependence leads to industrial structure singularization. Perez [4] examined resource-based development strategies, while Bryan [5] studied the advantages and challenges of resource-based economies.

Recent domestic research has also made significant progress. Studies [12, 13] have analyzed industrial diversification in resource-based regions, exploring pathways for economic transformation. The entropy method has been widely applied to measure industrial diversification, providing quantitative tools for analyzing industrial structure evolution.

This paper employs three analytical methods: First, using input-output tables to calculate total input ratios and intermediate input ratios across industries; second, applying the entropy index to measure the degree of industrial diversification; and third, utilizing social network analysis to visualize industrial associations and identify cluster patterns.

2 Methodology

2.1 Data Sources and Processing

The study uses input-output tables and extension tables for Shanxi Province from 2002, 2007, 2012, and 2015. The 42 original industries were consolidated into 22 categories based on resource-based economic characteristics. The service industries were further merged into 13 categories for diversification analysis.

The input-output relationship can be expressed as:

$$\sum_{i=1}^{n} x_{ij} + N_j = X_j \quad (j = 1, 2, \ldots, n)$$

where x_{ij} represents intermediate input from industry i to industry j, N_j is value-added, and X_j is total output.

2.2 Entropy Index Method

The entropy index measures industrial diversification by calculating the dispersion of industrial linkages. For each industry i, we first calculate the proportion of its output to industry j:

$$b_{ij} = \frac{x_{ij}}{X_i}$$

Then we compute the entropy value:

$$S_i = -\sum_{j=1}^{n} \left(\frac{b_{ij}}{\sum_{j=1}^{n} b_{ij}} \right) \ln \left(\frac{b_{ij}}{\sum_{j=1}^{n} b_{ij}} \right)$$

where S_i represents the entropy of industry i, with higher values indicating greater diversification.

We also calculate diffusion coefficients: - Forward diffusion coefficient: $f_j = \frac{\sum_{i=1}^{n} b_{ij}}{\frac{1}{n}\sum_{i=1}^{n}\sum_{j=1}^{n} b_{ij}}$ - Backward diffusion coefficient: $f_i = \frac{\sum_{j=1}^{n} b_{ij}}{\frac{1}{n}\sum_{i=1}^{n}\sum_{j=1}^{n} b_{ij}}$

Industries are classified into four types based on these coefficients: - Type A: $f_j < 1$, $f_i > 1$ (basic industries) - Type B: $f_j > 1$, $f_i > 1$ (key industries) - Type C: $f_j < 1$, $f_i < 1$ (non-key industries) - Type D: $f_j > 1$, $f_i < 1$ (final demand industries)

2.3 Social Network Analysis

Social network analysis examines industrial relationships as networks where nodes represent industries and edges represent input-output linkages. Using mathematical processing and constraint conditions, we construct correlation diagrams to visualize industrial clusters and their evolution.

3 Results and Analysis

3.1 Input-Output Structure Analysis

shows the input-output structure of Shanxi Province. The total input ratio represents the proportion of intermediate inputs to total output. The coal resources industry consistently shows the highest ratio, reaching 31.3% in 2012 before declining to 22.6% in 2015. The non-coal resources industry ranks second, with ratios between 10-13%.

presents the total input ratios for all industries. The construction industry maintains high intermediate input ratios around 70-80%, indicating its strong

backward linkages. The non-coal resources industry also shows high intermediate input ratios, reflecting its integrated role in the industrial chain.

details intermediate input ratios by industry. The coal resources industry shows ratios of 69-79%, significantly higher than other sectors. The consumer goods industry has relatively low ratios of 25-54%, suggesting weaker industrial linkages.

3.2 Industrial Diversification Analysis

Using the entropy index, we measured diversification across 13 service industries from 2002 to 2015. shows the entropy values, which decreased over time, indicating that Shanxi' s industrial structure became more concentrated and specialized. The entropy index declined from higher values in 2002 to lower values by 2015, particularly for the coal resources industry and construction industry, which became increasingly dominant.

3.3 Social Network Analysis

The social network analysis reveals two major industrial clusters formed by 2015 [Figure 1: see original paper]. The first cluster is centered on the coal resources industry, with strong linkages to non-coal resources industry, equipment manufacturing, transportation, and finance. The second cluster is dominated by construction industry, supported by non-coal resources industry and material chemical industry.

These clusters demonstrate that Shanxi' s industrial development has become more concentrated around these two poles. The network analysis shows dense connections within each cluster but relatively weak connections between them, indicating a dualistic industrial structure.

4 Conclusion

This comprehensive analysis of Shanxi Province' s industrial development from 2002-2015 reveals several key findings. First, the coal resources industry maintains dominant linkages, though its influence has slightly declined. Second, industrial diversification has decreased, with structures becoming more specialized and concentrated. Third, social network analysis identifies two distinct industrial clusters centered on coal and construction industries. These findings suggest that resource-based economies like Shanxi face challenges in achieving balanced diversification and may be developing new forms of industrial concentration.

References

[1] VANDERHOEKE. Resource curse and economic development mechanisms [J]. Economic Review, 2014, 35(6): 134-137.

[2] WOOLCOCK M. The social foundations of poor economic growth in resource-rich economies [M]. New York: Oxford University Press, 2001.

[3] AUTY R M. Resource abundance and economic development [M]. New York: Oxford University Press, 2001.

[4] PEREZ C. A vision for Latin America: A resource-based strategy [J]. Journal of Economic Issues, 2002, (4): 10-15.

[5] BRYAN H. The advantage trap of resources and the ways of natural-resource-based economic transformation [J]. China Population, Resources and Environment, 2002, (4): 10-15.

[7] TIAN Juan-juan. Empirical analysis of industrial diversification and economic growth in micro-economies: Based on data from Macau [J]. China Soft Science, 2011, (6): 1-9.

[8] LI Ling' e, ZHOU Rong-fei. The discounted effect of industrial diversification-based on the perspective of economic externalities [J]. Management World, 2016, (4): 176-177.

[9] JIA Yu-zhen. International practice and experience of sustainable development of resource-based economy [J]. Economic Review, 2012, (4): 93-95.

[11] JI Chun-li, ZENG Zhong-lu. Industrial diversification and performance of broadcasting and television media industry [J]. Journal of Hebei University of Economics and Trade, 2014, 35(6): 134-137.

[12] ZHANG Fu-ming. The advantage trap of resources and industrial transformation [J]. China Journal of Economics, 2015, (2): 86-94.

[13] LIN Yi-fu, LONG Xiao-ning, ZHANG Xiao-bo. China' s industrial diversification [J]. China Journal of Economics, 2014, 1(2): 83-97.

[16] WU Qing-long, GUO Yu-bin, WANG Yun, et al. Analysis of the evolution of Shanxi coal market status from the perspective of natural-resource-based regional transformation [J]. Journal of Arid Land Resources and Environment, 2016, 30(1): 7-13.

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

Source: ChinaXiv —Machine translation. Verify with original.