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Scientific Publishing

Evaluation of Coordinated Development of Transportation and Urban Industry

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Abstract: The development of a city is inseparable from the support of transportation and industry. Taking Changshou District of Chongqing as an example, this article explores the coordinated development of the transportation system and urban industrial system. The study collected indicator data from the region from 2017 to 2020 and constructed an evaluation index system based on the characteristics of the transportation and industrial systems. The entropy method is used for quantitative analysis to determine the weights of each indicator and calculate the comprehensive score for the coordinated development of transportation and industry in Changshou District. In conclusion, it was found that while there are differences and lags in the development of the two systems, the overall coordination is steadily increasing. Based on the economic and transportation network situation in Changshou District, development suggestions are proposed.

Keywords: Transportation System; Industry System; Entropy Method

1. Introduction

The transportation system and the economy are closely intertwined. The transportation system is an important carrier of industrial development, determining the level and speed of industrial development[1]. The pillar industries of the economy promote the formation of the surrounding transportation network, and transportation development drives the flow of economic factors. With the development of society, the concentration and distribution of economic activities will increasingly rely on the transportation system. Therefore, the evaluation of the coordinated development of transportation and the economy is of great significance for the future planning of cities. In recent years, many scholars have conducted research on the relationship between urban transportation and industry.Liu YH et al. collected data on the "Guanzhong-Tianshui Economic Zone" and found that the backward transportation system could become a hindrance to the development of the tertiary industry[2]. Shen F, Hua ML focused on the coupling coordination between transportation advantages and economic development levels[3-4]. Tang YC et al. constructed an evaluation model for transportation advantages and discovered the spatial differences in the transportation and economic development in the Yellow River Basin[5].Wang XM et al. starting from the perspective of "industry-transportation" coupling, explored the spatial development characteristics of the Beijing-Tianjin-Hebei urban agglomeration and concluded that the low degree of overlap between transportation and industry development is an important reason for the lack of regional coordination[6]. In summary, there is indeed a close connection between transportation and industry.

The geographical advantages and historical opportunities have laid the foundation for the development of Changshou District into an industrial city, and have also had an impact on the local economy, transportation, and urban layout. This article will analyze and evaluate the coordinated development of transportation and urban economy in the Changshou District in recent years from the perspectives of industry and transportation.

2. Research area and data sources

2.1 Research Area Overview

Changshou District is a bridgehead radiating to the southeast and northeast of Chongqing. In terms of economy, the district relies on support from the secondary industry, and the development of the primary and tertiary industries lags behind. In terms of transportation, it is located on the transportation corridor between Chongqing and the northeast region, serving as a crucial hub for the main urban area's external transportation links.

2.2 Data Sources and Data Analysis

The data in this article is sourced from official statistical bulletins from 2018 to 2021. The data indicates significant disparities in the output value of various industries in Changshou District, with the output value of the primary industry consistently below 50 billion yuan. The output value of the tertiary industry has shown minimal growth, while the secondary industry has the highest output value. Furthermore, the volume of road freight transportation in Changshou District has increased, while road passenger transportation has declined, and the proportion of waterway passenger and freight transportation is extremely low.

3. Selection of indicators and research methods

3.1 Selection of indicators

Following the principles of scientific rigor, comparability, and data availability, a comprehensive indicator system based on industrial and transportation systems will be constructed. This article will focus on the industrial and transportation systems, and will discuss industrial development, industrial structure, energy consumption, transportation capacity, and infrastructure as the five key aspects of the evaluation.

3.2 Research methods

The commonly used weighting methods can be divided into two major categories: objective weighting and subjective weighting. The entropy method, as an objective weighting approach, has strong operability and better avoids the controversial nature of subjective weighting. Therefore, this paper chooses the entropy method to determine the weights of the indicators.

Selecting data for n years and m indicators, X_{ij} represents the value of the j indicator in i year (i=1,2,3…,n; j=1,2,3…,m). P_{ij}represents the proportion of the j indicator in i year.

（1）Calculate the entropy value of indicator j.

$$e_j=-\frac{1}{\ln n}\sum_{i=1}^{n} p_{ij}\times \ln p_{ij} \quad (1)$$

（2）Calculate the weights of the indicators.

$$W_j=\frac{g_j}{\sum_{j=1}^{m} g_j}, j=1,2,3,...,m, g_j=1-e_j \quad (2)$$

（3）Calculate the comprehensive score K for each year.

$$K=\sum_{j=1}^{m} W_j\times x_{ij} \quad (3)$$

4. Weighting of indicators and analysis of results

Collect data for various indicators in Changshu district from 2017 to 2020, calculate the entropy, coefficient of variation and weights for each indicator, and derive the overall system score.

Table 1: Calculation Results of Various Indicators for Coordinated Development of the Transportation Industry

Target layer	Weighting of indicators	Indicator layer	e_j	W_j
Industrial system	Industrial development(0.2048)	Regional GDP	0.7118	0.0622
		Fixed assets	0.7140	0.0618
	Industrial structure(0.1158)	Number of large industrial enterprises	0.6258	0.0808
		Proportion of the output value of the secondary industry	0.6859	0.0678
		Proportion of the output value of the tertiary industry	0.7776	0.0480
	Energy consumption(0.1039)	Total energy consumption of large-scale industrial enterprises	0.5186	0.1039

Transportation system	Transportation capacity(0.4542)	Mileage of classified highways	0.4931	0.1094
		Road passenger traffic volume	0.7722	0.0492
		Road freight volume	0.5475	0.0977
		Waterway passenger traffic volume	0.4474	0.1193
		Waterway freight volume	0.6357	0.0786
	Infrastructure(0.1213)	Total number of motor vehicles	0.6699	0.0713
		Road density	0.7682	0.0500

Table 2: Score of Coordinated Development of Transportation and Industry

Year	2017	2018	2019	2020
Industrial System	0.2006	0.1820	0.1968	0.2065
Transportation System	0.0739	0.1409	0.3323	0.3986
Overall Score	0.2744	0.3299	0.5291	0.6051

In 2017, the score for the industrial system was higher than that of the transportation system. From 2018 to 2020, the transportation system's score surpassed that of the industrial system. From 2017 to 2020, the comprehensive score for the coordinated development of transportation and industry has been on the rise, indicating that, although there is a lag in the development of transportation and industry in Changshu, the overall development is good.

5. Conclusion

The article is based on the coordinated development of the industrial and transportation systems, constructing an evaluation index system consisting of 5 primary indicators and 13 secondary indicators. The entropy weight method was used to calculate the weights of each indicator, ultimately obtaining the comprehensive scores for the industrial-transportation system and individual systems. Through analysis, the following conclusions were reached:

(1) During the evaluation period, there is a lack of coordination and relative lag in the development of transportation and industry in Changshu, which results in mutual constraints.

(2) From the perspective of the comprehensive score of the coordination between transportation and industry, the development of transportation and industry in Changshu is in a stage of continuous improvement in coordination.

(3) Transportation and industry are closely related, and the lag in the development of the transportation system can become an important factor affecting economic and industrial development.

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