

Evaluation on the Coordinated Development of Comprehensive Transportation and Regional Economy in Henan Province

Mingran Wang*

College of Energy Science and engineering, Henan Polytechnic University, Jiaozuo 454002, China;

* Corresponding author: Mingran Wang

Abstract: The coordinated development of transportation and regional economy is the key support for achieving high-quality regional development. In order to explore the interactive relationship between the two, this paper constructs a comprehensive evaluation index system for the comprehensive transportation system and regional economy in Henan Province. Based on the ten-year statistical data of Henan Province from 2012 to 2021, the entropy value method was used to determine the index weight, and the coupling coordination degree model was used to conduct an empirical analysis of the coupling and coordinated development level of the two. The research results show that: (1) In terms of time series changes, the comprehensive development level of the regional economy in Henan Province has shown an overall upward trend, and the growth rate is better than that of the integrated transportation system; the development level of the integrated transportation system has generally shown a fluctuating upward trend. Affected by the adjustment of statistical caliber and the impact of the epidemic, there has been a significant decline in 2014 and 2020 respectively. (2) In terms of coupling degree, the two have been at a high level of coupling for a long time, close to the benign resonance stage, and have a strong correlation, indicating that there is significant interdependence and restriction between transportation and economy. (3) In terms of coupling coordination degree, during the study period, the coupling coordination degree of the two gradually transitioned from 0.4487 (on the verge of maladjustment) to 0.9161 (high-quality coordination). The overall coordination level has been continuously improved and optimized, and there will only be minor fluctuations in 2020 due to the impact of the epidemic.

Keywords: Comprehensive transportation, Regional economy, Entropy method, Coupling coordination degree.

1. Introduction

Transportation is the basic and leading industry of the national economy and the core engine of regional economic development; and the prosperity of the regional economy is the material foundation and source of demand for the continuous optimization of the transportation system. There is a dialectical coupling relationship of interdependence and mutual restriction between the two. Studying the coupling coordination measurement model of comprehensive transportation and regional economy can accurately identify restrictive development factors and reasonably evaluate the adaptive development level between the two.[1] In terms of integrated transportation systems, most scholars have studied the comprehensive development level of the system. Lv Zi Wen et al.[2] evaluated and analyzed the development level of comprehensive transportation in Shaanxi Province and the impact of various transportation modes on comprehensive transportation based on the entropy value method and gray correlation. Liu Yin Ying et al.[3] conducted a ranking and evaluation analysis of the comprehensive transportation development levels of provinces across the country based on the principal component analysis method, and based on this, they explored the regional similarities and differences in transportation development levels. Lian Qi Cai[4] used expert survey method and analytic hierarchy process to evaluate the comprehensive transportation status of Chongqing. Yan Shao Le et al.[5] proposed an improved TOPSIS evaluation method, established an evaluation model for urban passenger transport integrated transport hubs, and evaluated five schemes. Lin Fa Jin et al.[6] (based on the

subjective and objective weighting method) constructed an evaluation index system for comprehensive transportation development in central cities in my country, and conducted a comprehensive evaluation and comparison. In terms of comprehensive transportation coordination, scholars have done corresponding research. Liu Shanshan et al.[7] used the principal component analysis method to measure the comprehensive development level of each transportation mode in my country. On this basis, they established a coordination model of the comprehensive development level of each transportation mode and analyzed the coordinated development between different transportation modes. Wu Li Mei et al.[8] used the DEA method to evaluate and analyze the coordinated development of the comprehensive transportation system in Henan Province, and also explored the coordination degree between different transportation modes. Pei Da Ju et al.[9] used the entropy method to calculate the weight of the indicators of Hubei Province's passenger transportation system and socio-economic system, established a coupling coordination model between the two, and evaluated their adaptability. Ma Jia Xin et al.[10] constructed the index system of bus line resource allocation and passenger flow status, used structural equation to establish effective indicators, and used the improved DEA model to comprehensively evaluate the coordination of the two. Guo Zi Hui et al.[11] established a corresponding evaluation model by using the combination evaluation method of analytic hierarchy process (AHP) and improved BP neural network, and carried out a comprehensive evaluation of Wuhan comprehensive transportation. The above research results have laid a theoretical foundation for this study, but

most of the research focuses on the internal comprehensive transportation system, that is, the coordinated development between different transportation modes, or the coordinated relationship between a certain level of a single transportation mode and economic development. There are few studies on the interaction between comprehensive transportation and economic development. Therefore, this article builds an index system for the comprehensive transportation system and regional economy based on the entropy value method, uses the coupling coordination degree model to analyze the coordinated development between the comprehensive transportation system and the regional economy in Henan Province, and puts forward corresponding countermeasures and suggestions for the future coordinated development of transportation and economy in Henan Province.

2. Evaluation Indications and model construction

2.1. Construction of evaluation index system

The evaluation of the comprehensive transportation system

should be a dynamic evaluation that integrates multiple methods, involves the entire region's social economy, and reflects the overall benefits[4]. The comprehensive transportation system includes a total of five transportation modes. Since pipeline transportation is only suitable for the transportation of oil, gas and other goods, and does not involve passenger transportation and other goods, this article does not take the pipeline transportation mode into consideration, and only considers the four transportation modes of road, railway, water transportation, and aviation. This paper constructs an evaluation index system for the comprehensive transportation system from two aspects: scale and structure, as shown in Figure 1. The regional economic system is a huge system involving many complex factors of human activities[1]. By referring to relevant literature, this article selects two aspects: economic scale and social scale to construct an indicator system for the regional economy. The economic scale includes regional GDP and per capita disposable income of residents; the social scale includes the total population and urbanization rate, as shown in Figure 2.

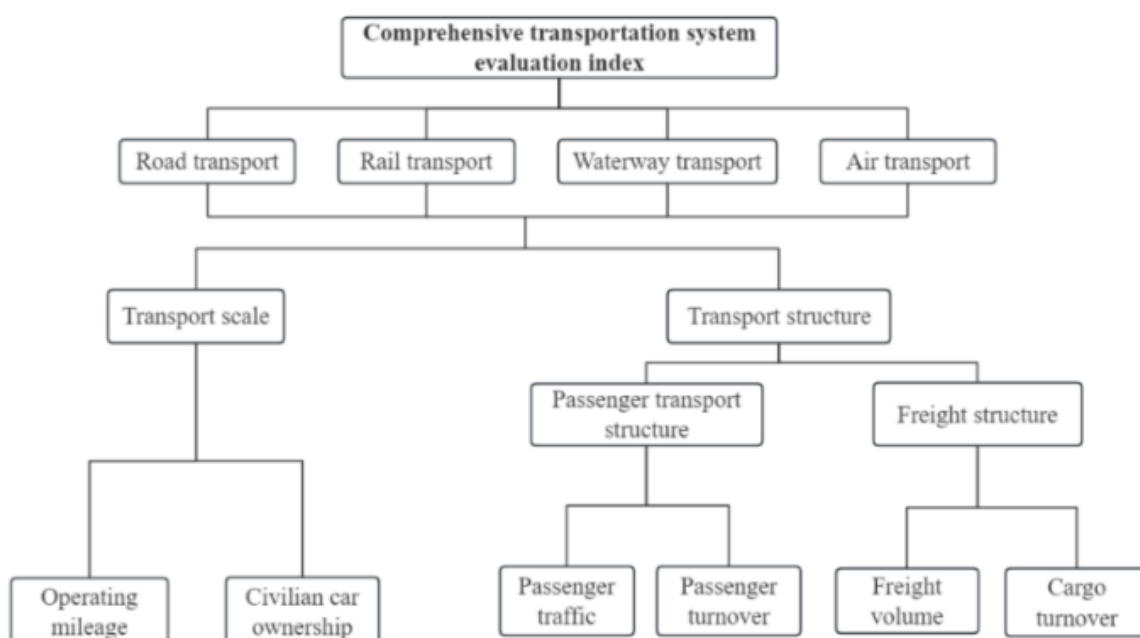


Figure 1 Evaluation index system of comprehensive transportation system

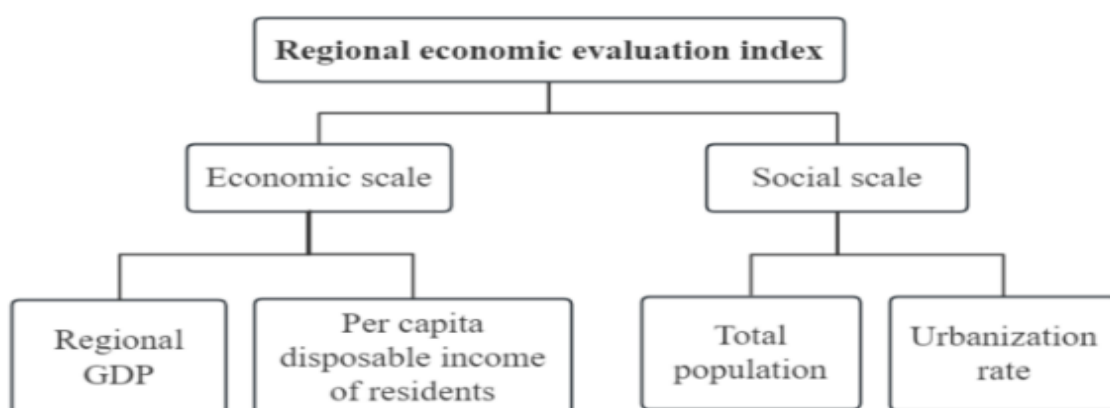


Figure 2 Regional economic evaluation index system

2.2. Entropy method

The entropy method is an objectively empowered multi-index decision analysis method and is widely used in comprehensive evaluation problems. It is based on the concept of entropy, uses the principle of information entropy to determine the weight of each indicator, and reflects the discrete degree of indicator data. The greater the entropy value, the greater the volatility and uncertainty of the data, and the less effective information it carries, so the smaller the weight given. The basic steps of this method are shown below.

Step 1 Data Standardization: The original data matrix is normalized to eliminate the influence of dimensions between different indicators. The commonly used methods are range standardization and Z-score standardization. According to the nature of the indicators selected in this paper, the range method is used for standardization.

For positive indicators:

$$X'_{ij} = \frac{x_{ij} - \min(x_j)}{\max(x_j) - \min(x_j)} \quad (2.1)$$

For negative indicators:

$$X'_{ij} = \frac{\max(x_j) - x_{ij}}{\max(x_j) - \min(x_j)} \quad (2.2)$$

In the formula(2.1), (2.2), $\max(x_j)$ and $\min(x_j)$ are the maximum and minimum values of indicator j in all years, respectively, and X'_{ij} prime is the standardized value.

Step 2 Calculate the proportion of the index: Calculate the proportion of the i th year 's value in the j index to the total index P_{ij} .

$$P_{ij} = \frac{X'_{ij}}{\sum_{i=1}^n \sum_{j=1}^m X'_{ij}} \quad (2.3)$$

Step 3 Calculate the entropy weight:

$$e_j = -\frac{1}{\ln n} \sum_{i=1}^n P_{ij} \ln(P_{ij}) \quad (j = 1, 2, \dots, m) \quad (2.4)$$

$$d_j = 1 - e_j \quad (2.5)$$

$$W_j = \frac{d_j}{\sum_{j=1}^m d_j} \quad (2.6)$$

In the formula(2.6), W_j is the objective weight of the index j .

Step 4 Calculate the comprehensive evaluation value:

$$U_i = \sum_{j=1}^m W_j X'_{ij} \quad (2.7)$$

In the formula (2.7), U_i represents the comprehensive development level score of a system in the i year.

2.3. Coupling Coordination Degree Model

2.3.1. Coupling formula

The coupling degree mainly reflects the degree of interdependence and mutual restriction between systems. The calculation formula is as follows:

$$C = \sqrt{\frac{U1 \times U2}{(\frac{U1 + U2}{2})^2}} = \frac{2\sqrt{U1 \times U2}}{U1 + U2} \quad (2.8)$$

In the formula(2.8), $U1$ and $U2$ are the comprehensive evaluation indexes of the two systems respectively; C is the coupling degree, and the value range is $0 \leq C \leq 1$. The larger the C value, the smaller the degree of dispersion

between systems, the better the coupling degree, and the stronger the interaction. The classification standard of coupling degree is shown in Table 1.

Table 1. Division standard of coupling stage

Serial number	C value	Stage
1	$C = 0$	irrelevant
2	$0 < C \leq 0.3$	Low level coupling
3	$0.3 < C \leq 0.5$	rivalry
4	$0.5 < C \leq 0.8$	Grinding coupling
5	$0.8 < C \leq 1$	High level coupling
6	$C = 1$	Benign resonance

2.3.2. Coupling coordination degree formula

In order to make up for the defect that the simple coupling index cannot reflect the overall development level of the system, the comprehensive coordination index T is introduced to reflect the synergistic effect and contribution level of the integrated transportation system and the regional economic system. The calculation formula is as follows:

$$T = \alpha U1 + \beta U2 \quad (2.9)$$

In the formula(2.9), T is the comprehensive coordination index of the comprehensive transportation system and the regional economic system; α and β are undetermined coefficients, which reflect the importance of each system in collaborative development and satisfy $\alpha + \beta = 1$. Since the two systems are equally important for social development, this article takes $\alpha = \beta = 0.5$. [12]

The coupling coordination degree integrates the coupling degree and the comprehensive development level, which can more fully reflect the level of coordinated development between systems. The calculation formula is as follows:

$$D = \sqrt{C \times T} \quad (2.10)$$

In the formula (2.10), D is the coupling coordination degree, and the value range is $0 \leq D \leq 1$. The larger the D value, the higher the level of coupling and coordination between transportation and regional economy, and the more orderly the development. The classification criteria of coupling coordination degree are shown in Table 2.

Table 2. Coupling coordination type division standard

Serial number	D value	Stage
1	$0 < D \leq 0.4$	maladjustment
2	$0.4 < D \leq 0.5$	On the verge of disorder
3	$0.5 < D \leq 0.6$	Reluctant coordination
4	$0.6 < D \leq 0.7$	Primary coordination
5	$0.7 < D \leq 0.8$	Intermediate coordination
6	$0.8 < D \leq 0.9$	Good coordination
7	$0.9 < D \leq 1.0$	High quality coordination

3. Example Application

3.1. Current situation of comprehensive transportation and economic development in Henan Province

Henan Province is located in the hinterland of my country's Central Plains. It is known as the "hinterland of nine states and the thoroughfare of ten provinces". It is an important transportation hub connecting the east to the west and connecting the south and the north. It is also an important economic, populous and agricultural province in the country. Against the national strategic background of promoting the rise of the central region, ecological protection and high-quality development in the Yellow River Basin, Henan Province's comprehensive transportation system and regional economy have achieved leapfrog development.

Based on its advantageous geographical position, Henan Province regards transportation superiority as a key driver of development and aims to construct a modern integrated transportation network linking internal and external areas and radiating across eastern, central, and western China. A comprehensive transport system has been established, characterized by a railway and highway framework, supported by the coordinated advancement of civil aviation and waterborne transport. By 2021, Henan Province had a total highway length of over 170,000 kilometers, among which expressways accounted for more than 8,000 kilometers. The highway network in Henan Province is highly dense, exhibiting a hub-and-spoke structure with Zhengzhou as the core and connections extending to neighboring urban areas. Expressways including the Lianhuo and Daguang Expressways pass through the province, significantly enhancing interregional economic interaction and logistics flows. Furthermore, Henan Province has made substantial progress in rural road development, accomplishing the objectives of providing asphalt roads to every township and road access to every village. In terms of railways, centered on Zhengzhou, Henan Province took the lead in constructing a national "rice-shaped" high-speed railway network. Regarding rail transportation, Zhengzhou serves as the hub for China's first "rice-grid" high-speed railway system, covering multiple directions. With the commissioning of high-speed rail corridors including the Beijing-Guangzhou, Xuzhou-Lanzhou, Zhengzhou-Taiyuan, Zhengzhou-Hefei, and Zhengzhou-Jinan lines, all major cities in Henan Province now have high-speed rail connectivity. This has established a "0.5–3-hour" high-speed rail economic zone that covers central China and extends nationwide, significantly shortening travel time and facilitating the interregional movement of resources and production factors. Water transportation also occupies an important position in Henan Province. Tributaries of the Yellow River and the Yangtze River are distributed within Henan Province, providing convenient conditions for water transportation. The primary navigable watercourses in Henan Province are the Huaihe River and the Hanjiang River, among others. Since the reform and opening-up, Henan Province has invested significant funds in the construction and improvement of water transportation infrastructure, including the expansion and dredging of ports and waterways, resulting in a substantial enhancement of water transport capacity. In the field of aviation, Zhengzhou Xinzheng International Airport is the largest aviation hub in central China and one of the important air cargo centers in Asia. According to 2021 data, the cargo throughput of Xinzheng International Airport ranked among

the highest in China, while passenger traffic also maintained steady growth. The airport has opened hundreds of domestic and international routes, connecting numerous major cities worldwide. In recent years, with the proposal of the "Air Silk Road," the strategic status of Xinzheng International Airport has become increasingly prominent, greatly promoting the opening-up and economic development of Zhengzhou and Henan Province.

As a strategic highland for inland economic development, Henan Province has experienced continuous expansion of its economic aggregate and significant enhancement of its comprehensive strength in recent years, and is currently in a critical period of transformation from high-speed growth to high-quality development. From 2012 to 2020, Henan Province's gross domestic product (GDP) maintained a steady growth trend, with its total volume ranking fifth in the country and first in central and western China for a long time. With the further advancement of the Central Plains Urban Agglomeration construction, the core growth effect led by Zhengzhou has become increasingly prominent, radiating and driving the continuous upgrading of the province's economic level. Henan Province has gradually reduced its reliance on the traditional single path of an agricultural province, and its levels of industrialization and urbanization have increased significantly. The proportion of the tertiary industry has increased year by year, and emerging industries such as modern logistics, the digital economy, and high-end equipment manufacturing have developed vigorously. Particularly with the construction of national-level platforms such as the Zhengzhou Airport Economy Zone, the export-oriented economy has developed rapidly, with total import and export volumes repeatedly reaching new highs, injecting new vitality into the regional economy. With the support for Zhengzhou to build a national central city, Henan Province's position in the national regional development pattern has been further enhanced. By implementing the "Strong Provincial Capital" strategy and constructing Luoyang as a sub-central city, Henan Province is building a new regional economic layout characterized by complementary advantages and coordinated development.

3.2. Data source

The data in this article mainly come from the "Henan Province Statistical Yearbook". Because there are many indicators of the integrated transportation system, they are no longer listed one by one. Taking air transport as an example, the statistical data of the index system of air transport and regional economy are shown in Table 3 and Table 4.

Table 3. Air transport index system

Year	Route mileage (km)	Passenger throughput (million)	Mail throughput (ten thousand tons)
2012	1439	1268.87	15.31
2013	1439	1412.86	25.79
2014	1439	1693.64	37.31
2015	1589	1860.69	40.58
2016	1589	2229.09	45.90
2017	1589	2596.58	50.51
2018	1589	2955.74	51.73
2019	1675	3184.70	52.42
2020	1725	2405.84	64.10
2021	1725	2191.72	70.65

Table 4. Regional economic index system

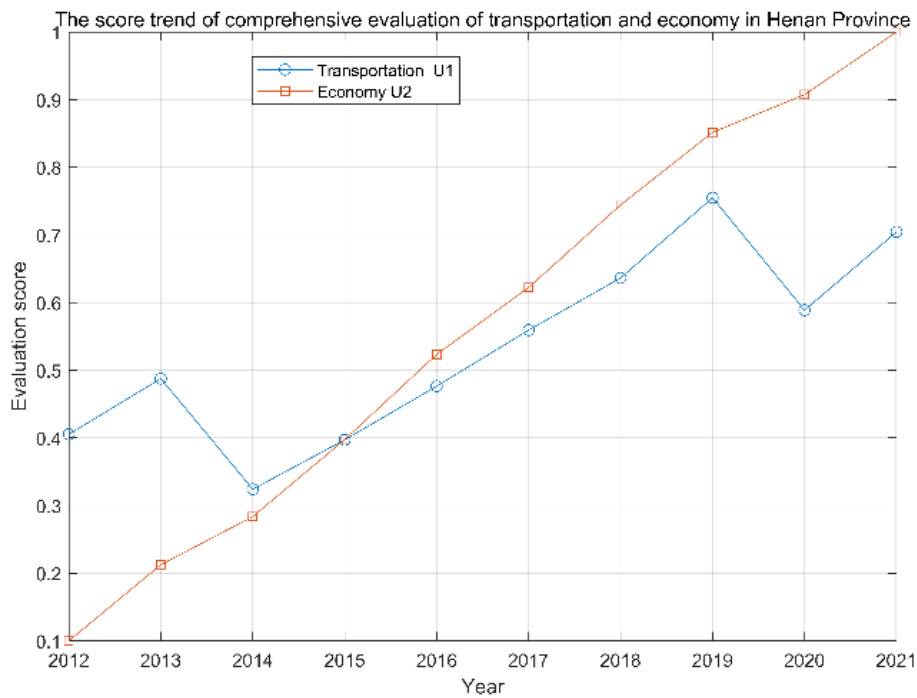
Year	Gross regional product (billion yuan)	Per capita disposable income of residents (yuan)	Total population (10,000 people)	Urbanization rate (%)
2012	28961.92	13712	10932	41.99
2013	31632.50	15449	11039	43.60
2014	34574.76	15695	11102	45.05
2015	37084.10	17125	11217	47.02
2016	40249.34	18443	11370	48.78
2017	44824.92	20170	11377	50.56
2018	49935.90	21964	11444	52.24
2019	53717.75	23903	11486	54.01
2020	54259.43	24810	11526	55.43
2021	58887.41	26811	11533	56.45

3.3. Comprehensive development evaluation and coupled coordinated development analysis

3.3.1. Comprehensive transportation and regional economic development level

Based on the calculation steps of the entropy method, we

can derive the comprehensive evaluation values of the integrated transportation system and the regional economy, the trend chart of which is presented in Figure 3. It is evident from the graph that between 2012 and 2021, both composite indices $U1$ and $U2$ demonstrated a general growth trajectory; however, the specific patterns of their evolution diverged significantly.

**Figure. 3** Comprehensive evaluation score of system

The comprehensive evaluation score of the regional economy exhibited a strictly monotonically increasing characteristic, with a smooth curve showing no significant fluctuations. This indicates that over the past decade, with the in-depth construction of the Central Plains Urban Agglomeration and the superimposed implementation of national strategies, Henan Province's economic aggregate has continued to expand, its industrial structure has been continuously optimized, and the regional economy has maintained strong and stable growth momentum, remaining largely undisturbed by local factors. In contrast, the evolution process of the integrated transportation system's evaluation score appears relatively tortuous. After reaching a phased high in 2013, the curve experienced a noticeable decline in 2014. An analysis of the actual situation reveals that this was primarily due to a major adjustment in the statistical caliber of passenger and freight traffic volumes by the Ministry of Transport that year, leading to a "cliff-like" drop in turnover

volume at the statistical level, rather than a decline in actual transportation capacity. In the subsequent five years, benefiting from the accelerated formation of the "rice-shaped" high-speed railway network and the advancement of the highway "Double Thousand Project," the score rebounded steadily and reached a peak of approximately 0.75 in 2019. However, by 2020, impacted by the external shock of the COVID-19 pandemic, resident travel was restricted, and passenger and freight volumes shrank significantly, causing the 2020 score to plummet to below 0.6. With the normalization of epidemic prevention and control and the advancement of work resumption and production recovery, the transportation system score rebounded rapidly in 2021, demonstrating the system's strong resilience and recovery capability.

By comparing the relative positions of $U1$ and $U2$, we can discern their interactive relationship, which can be divided into two phases: Phase I is the transportation-leading

development type ($U1 > U2$). During this period, the blue curve remained above the orange curve, indicating that Henan Province's stock of transportation infrastructure was relatively abundant, sufficient to support the scale of economic development at that time, manifesting as an advanced construction state of "roads waiting for vehicles." A comparison of the relative positions of $U1$ and $U2$ reveals the nature of their interaction, which is divisible into two distinct phases. Phase I represents a transportation-leading development pattern ($U1 > U2$), where the blue curve consistently outpaces the orange curve. This indicates a relative abundance in the stock of transport infrastructure, sufficient to accommodate the prevailing scale of economic activity, representing a state of "supply-leading" or "roads waiting for cars." The intersection of the two curves between 2015 and 2016 marked a reversal of the supply-demand relationship, signaling the entry into Phase II. Phase II is the transportation-lagging development type ($U2 > U1$). Since 2016, the orange curve has surpassed and remained above the blue curve. This indicates that with the explosive growth of Henan Province's economic aggregate, the demand for transportation services has increased sharply. Although transportation construction has continued, its growth rate has lagged relatively behind that of the economy. The current transportation system has begun to exhibit certain lags and shortcomings in meeting the demands of high-quality

economic development (such as multimodal transport efficiency and service quality).

3.3.2. Coupling coordination analysis of comprehensive transportation and regional economic development

Based on the coupling degree and coupling coordination degree models, calculations were performed according to formulas (2.8), (2.9), (2.10), and the results regarding the coupling coordination between integrated transportation and regional economic development are presented in Table 5. It is evident from the data that throughout the research period, the coupling degree between Henan's transportation and economic systems maintained a high level, averaging 0.9668 and remaining above 0.9 for the majority of the period, thus characterizing a "high-level coupling phase." This indicates that there exists an extremely strong correlation between Henan Province's transportation system and its regional economy, with the two systems being interdependent and mutually constraining. In 2012, the coupling degree was relatively low (0.7968), primarily due to the relatively advanced state of transportation construction not being fully matched by the economic aggregate at that time; in 2020, impacted by the pandemic, the transportation system suffered far more severe damage than the economic system, leading to a widening gap in their development and a temporary decline in the coupling degree (0.9771), although it still remained within the high-level range.

Table 5. Coupling coordination degree of comprehensive transportation and regional economy

Year	Coupling degree	Coupling coordination degree	Coordination level
2012	0.7968	0.4487	On the verge of disorder
2013	0.9197	0.5675	Reluctant coordination
2014	0.9978	0.5507	Reluctant coordination
2015	1.0000	0.6303	Primary coordination
2016	0.9989	0.7067	Intermediate coordination
2017	0.9986	0.7681	Intermediate coordination
2018	0.9969	0.8296	Good coordination
2019	0.9982	0.8955	Good coordination
2020	0.9771	0.8550	Good coordination
2021	0.9849	0.9161	High quality coordination

The coupling coordination degree can further reflect the level of mutual promotion and coordinated development between the systems. The data shows that the coupling coordination degree between Henan Province's integrated transportation and regional economy rose from 0.4487 in 2012 to 0.9161 in 2021, achieving a leap from "imbalance" to "high-quality coordination." According to the evolution of the coordination grades, this process can be divided into three main stages. Stage I: The Transitional Adjustment Period (2012—2014). During this stage, although Henan Province's transportation infrastructure scored relatively high due to advanced construction, its compatibility with economic development was insufficient, and an efficient synergistic effect was not formed. With the approval of Zhengzhou Airport Economic Comprehensive Experimental Zone and the promotion of the Central Plains Urban Agglomeration Strategy, transportation and economy have begun to run in, and the imbalance has gradually improved. Stage II: The Steady Improvement Period (2015—2019). During this stage, the coordination grade experienced a continuous leap from "primary coordination" to "intermediate coordination" and then to "good coordination." This period was a golden age for Henan Province's transportation construction (with the formation of the "rice-shaped" high-speed railway network and the densification of highways), and at the same time, the

regional economic aggregate reached a new level. Transportation effectively supported industrial agglomeration and population mobility, and economic growth, in turn, provided sufficient financial guarantees for transportation construction, forming a positive interactive cycle mechanism between the two. Stage III: The High-level Resonance Period (2020—2021). Although the coupling coordination degree between the two experienced a temporary decline to 0.8550 in 2020 due to external shocks, it rebounded rapidly to 0.9161 in 2021, with the coordination grade reaching "high-quality coordination." This marks that Henan Province's integrated transportation and regional economy have entered a stage of deep integration. The transportation network not only meets economic demands in terms of scale but also achieves optimal allocation in terms of structure and efficiency. The system possesses strong resilience, enabling it to recover rapidly from external shocks such as the pandemic and maintain a high-level dynamic balance.

4. Conclusion and recommendations

4.1. Conclusion

This article constructed an evaluation index system for the coupling coordination between the comprehensive transportation system and regional economy in Henan

Province, and conducted an empirical study on the spatiotemporal evolution characteristics from 2012 to 2021 using the entropy method and the coupling coordination degree model. The main conclusions are as follows:

1) The comprehensive strength of comprehensive transportation and regional economy in Henan Province has been significantly enhanced, but there are differences in the ability to resist risks. During the study period, the regional economic system showed extremely high stability and was the leading force in improving the overall coordination level. Although the comprehensive transportation system has achieved remarkable results driven by the construction of the "meter"-shaped high-speed railway and the airport area, it shows a certain degree of vulnerability in the face of external shocks such as the epidemic, and the recovery cycle is slightly longer than that of the economic system.

2) The coupling and coordination relationship between the two has evolved from running-in antagonism to high-level coordination. The period from 2012 to 2014 was the transition and running-in period, when transportation and the economy were in a low-level state of barely coordinated coordination; the period from 2015 to 2019 was the period of rapid improvement, with the degree of coordination rising steadily with the release of infrastructure dividends; the period from 2020 to 2021 was the period of high-quality coordination. Even under external shocks, the system still maintained extremely high coupling correlations, reflecting strong system resilience.

3) The lag between transportation and economic development has gradually become apparent. Empirical data shows that in recent years, Henan Province's economic development has been faster than the improvement of the transportation system. This means that the extensive development model that relies solely on expanding the scale of the road network has encountered a bottleneck, and there is an urgent need to shift to connotative development with the core of improving transportation efficiency and service quality in the future.

4.2. Countermeasures and suggestions

1) Make up for shortcomings and deploy transportation infrastructure appropriately in advance. In view of the current relatively lagging behind in transportation development, Henan Province should continue to adhere to the "transportation first" strategy. Focus on the core areas of the Central Plains urban agglomeration, intensify the intercity railway and urban rail transit networks, and eliminate traffic congestion points. At the same time, for relatively weak economic areas such as western Henan and southern Henan, investment in transportation infrastructure should be increased to guide the gradient transfer of industries through the improvement of transportation accessibility and narrow the development gap within the region.

2) Optimize the structure and vigorously develop the multimodal transport system. In response to the problem that the system score dropped due to the obstruction of a single mode of transportation during the epidemic in 2020, it is recommended to accelerate the construction of a modern comprehensive three-dimensional transportation network that seamlessly connects "road, rail, water and air". Give full play to the hub advantages of Zhengzhou Airport and China-Europe Express, increase the proportion of multimodal transport, enhance the substitutability and robustness of the

transportation system in the face of emergencies, and ensure the safety of regional supply chains and industrial chains.

3) Digital empowerment promotes the deep integration of transportation and economy, transforming from "hard connectivity" to "soft connectivity". Use big data, cloud computing and other technical means to build a provincial comprehensive transportation information platform to achieve real-time interaction between logistics information and economic operation data. Develop "hub economy" and "channel economy", transform transportation advantages into industrial advantages, and promote the deep integration of transportation industry with modern logistics, advanced manufacturing, cross-border e-commerce and other industries.

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