International Journal of Research in Engineering and Science (IJRES)
ISSN (Online): 2320-9364, ISSN (Print): 2320-9356
www.ijres.org Volume 09 Issue 12 ǁ 2021 ǁ PP. 25-31

Evaluation on Coordinated Development of Logistics Industry in Six Provinces of Central China

Kexin Liu
School of Business and Economics, Monash University, Clayton 3800, Melbourne, Australia

***Abstract**: Based on the demand factors in the logistics industry development of the economy, logistics industry and logistics support factors in three dimensions, build the index system of the coordinated development of six provinces in central provincial logistics, adopt comprehensive evaluation -- entropy weight method to evaluate, the results showed that six provinces in central logistics industry comprehensive development level and the coupling coordination degree exists obvious difference, the coupling six provinces have differentiation characteristics and spatial distribution, The coordination degree from high to low is Henan Province, Hubei province, Hunan Province, Anhui Province, Jiangxi Province, Shanxi Province. In terms of specific measures, Jiangxi and Shanxi need to strengthen logistics infrastructure, Hunan and Hubei need to expand and strengthen the logistics industry, and Henan and Anhui need to improve the efficiency of the logistics industry.*
***Keywords**: logistics industry, six provinces in central China, coupling degree*

Date of Submission: 02-12-2021 Date of acceptance: 16-12-2021

I. Introduction and literature review

Central China, east coastal, west inland, according to the order from north to south, including Shanxi, Henan, Anhui, Hubei, Jiangxi, Hunan, six neighboring provinces, based on the national strategy to promote the development of central China, the rise of central China, the study of emerging development industries in central China (logistics industry) is very important. Central region is an important hub connecting east, west, north, south, ports and inland. As a cargo and information transfer channel, logistics industry has become a core industry coordinating the allocation of resources and cross-regional flow, providing strong support for the industrial transformation and agglomeration of the north and the South as well as the improvement of the comprehensive competitiveness of each region.

In recent years, with the improvement of consumption level, the rapid development of transportation and logistics industry, the rise of logistics and distribution industry and the growth of the number of logistics and distribution enterprises, scholars have carried out extensive research on the development of regional logistics, mainly focusing on the following aspects: First, the research on the coordinated development of logistics and economy. Qian and Ma (2007) analyzed the correlation between the development level of modern logistics and economic growth through measurement methods such as co-integration test and causality test. Liu (2009) studied the relationship between Logistics and economic growth in China. Liu (2012) Research on the relationship between regional logistics and regional economic growth based on VAR model. The second is the study on the function of logistics industry and the change of function. Zhao and Liu (2014) Analysis on regional logistics, transportation layout and logistics function construction of Urban agglomeration in Beijing-Tianjin-Hebei Region. Hu (2015) Research on logistics operation mode under e-commerce environment. Third, evaluate and judge the development efficiency of logistics industry under various political and economic situations. Tang Jianrong and Lu Longzhu analyzed the comprehensive efficiency of logistics industry by using the three-stage DEA model combined with environmental load and low carbon constraint. Liu and Ding (2002) International comparison and development measures of China's logistics industry. Lin and Wang (2008) Analysis of regional logistics efficiency in China based on SFA method. Fourth, logistics industry in the regional and international competitiveness research. Xue *et al.* (2012) Comparative study on logistics competitiveness of Inland central cities in China. Zhu (2019) constructed a three-dimensional evaluation system based on the coexistence of resources, technology, and market from the perspective of niche theory, and evaluated and ranked the competitiveness level of logistics industry in key provinces along the route. Zhong (2020) studies the impact of China-Europe railway on economy by taking Chongqing International Logistics Center as a case.

To sum up, the research of domestic and foreign scholars on the development of regional logistics industry mainly focusses on the measurement of development level, function allocation, efficiency evaluation, international and regional competitiveness evaluation and the coordinated economic development of other industries. Logistics industry as a type, however, has gradually evolved into a set assembly, warehousing, distribution, transportation, communications, six aspects as one of the large systems, and the current research on

logistics of all, the research emphasis of the scholars mainly lies in the development of logistics industry and the coordination between the external factors are neglected the coordinated development within the logistics industry. In view of this, this paper constructed an evaluation index system for the coordinated development of logistics industry in the provinces along the "six Central Provinces" and evaluated the coupling and coordination relationship within the logistics industry system, providing some reference for promoting the coordinated development of regional logistics industry.

II. Measurement of coordinated development level of logistics industry in six provinces in central China

Logistics industry is a set of transportation, circulation, distribution, and other industries integrated into a new composite industry. The development of regional logistics not only promotes the growth of regional economy but also improves the efficiency of various industries. Due to the lack of professional data entry of logistics industry, this paper adopts the data of transportation, storage and postal service to reflect the development status of logistics industry in six central provinces.

2.1 Index system construction

Through the collection and analysis of historical documents, it is found that there are many factors that directly or indirectly affect the development of logistics industry, and a single index such as freight volume and total retail sales of consumer goods is not enough to comprehensively and systematically evaluate the coordinated development level of logistics industry in the six central provinces. So, considering the index selection is scientific and the feasibility of data acquisition, this paper from the logistics industry and economic environment, logistics demand and logistics support factors three aspects dimension, this paper selected 15 secondary indicators to build "the coordinated development of six provinces in central region logistics index evaluation system, a comprehensive measure of six provinces in central logistics industry coordinated development level and the coupling coordination degree. The selected 15 indicators cover a wide range, basically covering the external impact of the development of logistics industry and the internal factors that affect the development of logistics industry, the evaluation system is relatively scientific. The specific indicators constructed are shown in Table 1. In the indicator nature, "+" represents a forward indicator and "-" represents a backward indicator.

Table 1: Evaluation index system of coordinated development of logistics industry in six central provinces

The evaluation target	Primary indicator	Secondary indicator	unit	indicator nature
Coordinated development of logistics in the six central province	Economic environment of logistics industry	Gross regional product X1	One hundred million yuan	+
		Per capita GDP X2	Yuan/person	+
		Secondary industry increase	%	+
		The value is X3	Thousands of dollars	+
		Total imports and exports X4	Ten thousand yuan	+
	Demand factors	Freight X6	Ten thousand tons-km	+
		Highway freight volume proportion X7	Ten thousand yuan	+
		Cargo turnover X8	Million ton-km	+
		Highway cargo turnover proportion X9	%	+
		Total post and telecommunications service X10	One hundred million yuan	+
	Support factors	One - level highway accounted for grade highway mileage X11	%	+
		Number of trucks X12	Thousands of quantities	+
		Railway operating mileage X13	km	+
		Grade highway mileage X14	km	+
		Long distance cable line X15	km	+

2.2 Data sources and processing

The original data of all secondary indicators in the above indicator system came from the yearbook data of secondary indicators in each region in China Statistical Yearbook from 2011 to 2019. Due to the different order of magnitude and unit of each evaluation index, this paper uses the normalization method for dimensionless quantitative processing of all the original data. This paper builds a model of comprehensive evaluation-entropy method to analyze the development level of logistics industry in six provinces in central China. Based on the historical literature review, there are many indicators of different dimensions that affect the development of logistics industry, so this paper chooses the entropy method to judge the dispersion degree of

selected indicators and its influence on comprehensive evaluation. In addition, to more objectively reflect the actual situation of the development level of logistics industry along the six provinces in central China, this paper adopts the method of combining comprehensive evaluation and entropy value method to analyze.

Comprehensive evaluation index calculation formula:

$$E = \sum_{j=1}^{n} W_j \times X'_{ij} \quad (1)$$

Decomposition of formula:
E:The evaluation index,
n:Number of selected indicators
W_j:Weight of the Jth evaluation index
X'_{ij}: Standard value after normalized treatment

Expert scoring method, chromatography analysis method and so on subjective values.the method, using a relatively hard and with a certain emotional color of the requirements, and entropy value method is not only the requirement of the data is lower, and the data point is very clear, also not influenced by subjective factors, entropy value method as a method of uncertainty of measurement has been widely used in various disciplines. Based on the above research, entropy method is adopted in this paper to assign weights to various indicators, and the specific steps are as follows:

Step 1: Standardization:X'_{ij} Denotes the standardized value of the ith evaluation object under the jth evaluation index;

Step 2: Calculate the contribution matrix:$Y_{ij} = \frac{X'_{ij}}{\sum_{i=1}^{m} X'_{ij}}$;

Step 3: Calculate information entropy:$e_j = -k \sum_{i=1}^{m} y_{ij} * lny_{ij}$;

Step 4: Calculate the coefficient of variation:$d_j = 1 - e_j$;

Step 5: Calculate the weight of each indicator:$w_j = \frac{d_j}{\sum_{j=1}^{n} d_j}$; N indicates the number of indicators. Coupling coordination degree model construction. Coupling refers to a physical form of interaction and influence of two or more systems. The degree of coordination can further measure the degree of influence and effect. Coupling coordination degree model is widely used in coordination and collaborative development calculation and research due to its simplicity and intuition. The calculation formula is as follows:

$$U = \sum_{j=1}^{m} X'_{ij} W_j \quad (2)$$

Where U is the comprehensive evaluation index of the index, ij is the standard value of the index, Wj is the weight, and m is the number of evaluation indexes.

This paper focuses on analyzing the coordination relationship among the three systems of logistics industry development economic environment, logistics industry demand and logistics industry support factors, and constructs the coupling degree formula as follows:

$$C = \left\{ \frac{U1 \times U2 \times U3}{\left(\frac{U1 \times U2 \times U3}{3}\right)} \right\}^{1/3} \quad (3)$$

Where, C is the coupling degree, and C∈[0,1].
Then calculate the comprehensive coordination index and coupling coordination degree:

$$T = \alpha U_1 + \beta U_2 + \lambda U_3 \quad (4)$$

$$D = \sqrt{C \times T} \quad (5)$$

In the formula, T said economic environment, the development of logistics industry in the logistics demand, logistics support factor index of three subsystems of comprehensive coordination, logistics industry and economic environment - D said demand factors - support the coupling coordination degree of the total system, as a positive indicator, the greater the D value, show that the stronger the coordination between the three systems, alpha, beta, lambda for three of undetermined coefficients. This paper assumes that the logistics industry development economic environment, logistics industry demand and logistics industry support factors are equally important, so α=β=λ=1⁄3,At the same time $T\epsilon[0,1], D\epsilon[0,1]$.Based on the data collection of coordination among the three subsystems and the research work of coordination evaluation, the grade classification standard of coupling coordination degree is established as shown in Table 2.

Table 2. Classification standard of coupling coordination degree

D value interval of coupling coordination degree	Coordination level	Degree of coupling coordination
（0.0-0.3）	1	Low-level coordination
（0.3-0.5）	2	Primary coordination
（0.5-0.7）	3	Intermediate coordinate
（0.7-0.9）	4	Advanced coordination

III. Empirical results and analysis

3.1 Development level of logistics industry in six central provinces

The comprehensive evaluation-entropy method model was used to calculate the calculation results and change trends of the overall development level of logistics industry in the six central provinces from 2011 to 2019, as shown in Figure 1.

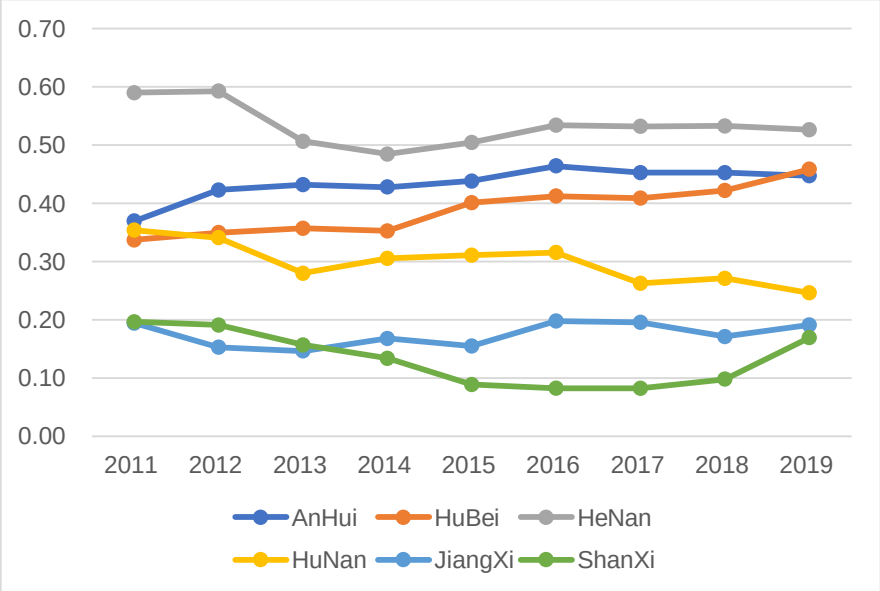

Figure 1 Logistics development level of six central

Overall, the development level of the logistics industry in the six provinces of central China showed a steady development trend from 2011 to 2019, but there were obvious differences among provinces.

The development level of logistics industry in Henan province ranked first. Although the development level declined in 2013, the supporting factors and demand factors of logistics development were relatively high. The development level of logistics industry in Anhui province is in the second place, with little change in development level. The supporting factors and demand factors of logistics development are higher, but the economic environment value of logistics development is lower. The development level of logistics industry in Hubei province is in the third place, and the development level is increasing year by year. The economic environment and supporting environment of logistics industry development are high, but the demand factor index value of development is low. The development level of logistics industry in Hunan province is in the fourth place, and the development level is decreasing year by year. The demand factors and supporting environment of logistics industry are decreasing year by year. Jiangxi and Shanxi are at the bottom of the list. The logistics development level of Shanxi decreases first and then increases, and the economic environment and supporting factors are both decreasing, while Jiangxi develops steadily and has little change in the past decade.

The comprehensive development index of the six central provinces increased from 0.4563 in 2011 to 0.4464. Through a review of secondary indicators, found that the development of logistics industry under the three subsystems of economic indicators in the 10 years all have varying degrees of growth, due to the limitation of the terrain in central region, logistics support factors had no significant optimization and growth, and in the central state vigorously construction of cases, the logistics industry has been a steady rise in the economic environment in, For example, the rapid growth of GDP and total imports and exports. It can be predicted that in the future, with the development of logistics related industries and the continuous improvement of people's consumption potential, logistics demand will continue to increase, and the overall development level of logistics industry in the six central provinces will be on a higher level in the future.

3.2 Analysis of coordination degree of logistics industry in six central provinces.

Overall, the coordination degree of logistics industry in the six central provinces varies greatly from 2011 to 2019.

Table 3 Calculation results of overall coordination degree of logistics in six central provinces from 2011 to 2019

Region	coupling degree C	value coordination degree	Coupling coordination	Coupling coordination degree T	Coordination level	Coupling coordination	Coupling degree D value	Coordination level	Coupling coordination
Anhui	0.3101036	2	primary	0.6083874	3	The intermediate	0.43433727	2	primary
Hubei	0.2952786	1	low-level	0.5125808	3	The intermediate	0.3889979	2	primary
Henan	0.3875782	2	primary	0.7356598	4	senior	0.53386852	3	The intermediate
Hunan	0.2421714	1	low-level	0.3685755	2	primary	0.29868591	1	low-level
Jiangxi	0.1547242	1	low-level	0.1976577	1	low-level	0.17481743	1	low-level
Shanxi	0.0988209	1	low-level	0.1808657	1	low-level	0.1333633	1	low-level

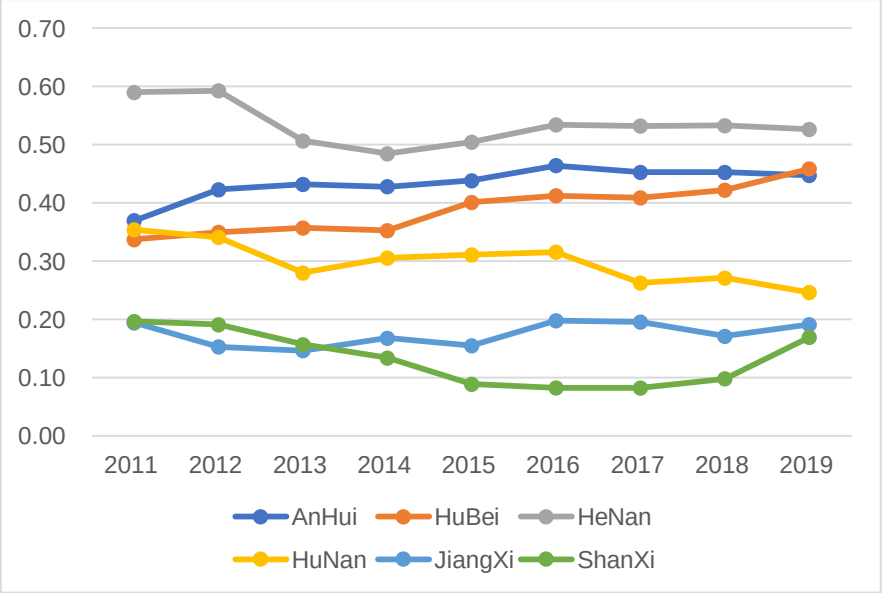

Figure 2 Overall coordination degree of logistics in six

In the past 9 years, the coordination degree of Henan province ranked the highest among the six provinces, with an average of 0.53 in the past 10 years. Although the overall coordination of logistics in Henan province declined significantly from 2012 to 2013, the coordination degree of logistics in Henan Province still ranked the first among the six provinces. Thanks to Henan province in 2010 to promote the healthy development of modern logistics industry in Henan by the five-year plans for the development of modern logistics industry in Henan province and pointed out in "planning" in Henan province as an inland area to build Henan international logistics center and the construction of logistics park, besides the Henan province will be the construction of infrastructure, including railway, civil aviation, etc. This greatly enhances the logistics channel capacity. At the same time of the implementation of the Plan, Henan province also established the logistics industry association, which played a role of a link between the policy issuance and implementation, and also strengthened the coordination and cooperation among the three subsystems of Henan logistics industry. This is the main reason for the rapid development of Henan logistics industry from 2011 to 2019.

The overall coordination degree of logistics ranked second in Anhui Province, the average of the total coordination degree of logistics in 10 years was 0.43, the same as Henan Province, Anhui Provincial People's Government also issued the "Development Planning of Modern Logistics in Anhui Province", because Anhui province is located in the Hinterland of the Yangtze River and the Yangtze River Delta, so the main tasks in the planning are: Build logistics infrastructure connected with the Yangtze River Delta region, vigorously develop

third-party logistics and accelerate the development of international logistics and bonded logistics. This also makes Anhui province to build a river transport system connecting rivers to the sea, coupled with policies to encourage industrial and commercial enterprises to separate outsourcing business, greatly improving the procurement, transportation, warehousing business volume of third-party logistics enterprises, these reasons jointly contributed to the steady growth of logistics coordination in Anhui province in the past 10 years.

Logistics coordination degree in Hubei province from 2011 to 2019 was ranked third, with a mean of 0.39, Hubei province, although there is no issue about the long-term development of the logistics industry, but in Hubei logistics network is established in 2010, the site will all aspects of logistics information on the Internet of the public to break the traditional way of logistics information, The website takes the Internet as a link to help enterprises and individuals to achieve information sharing, which is also a new milestone for logistics development, which has also led to the rapid development of logistics industry in Hubei province in the past 10 years, and in 2019, Hubei province surpassed Anhui Province to become the second logistics coordination among the six provinces.

The logistics industry in Hunan province declined significantly from 2011 to 2013, and improved after 2014, which benefited from the completion of Hunan Logistics Headquarters in 2014. Although it only integrated part of the logistics industry, Coordination among the various subsystems of the logistics industry did not grow significantly in the absence of policy and financial support, but this also acted as a stop loss for the development of the decade.

Jiangxi province and Shanxi Province in 2011-2019 total logistics coordination degree only 0.17 and 0.13 are low-level coordination, unlike other provinces, in Jiangxi province and Shanxi Province and without the support of policy and information, technical support of supply chain, the whole logistics industry is in a state of scattered, logistics three subsystems cannot very good collaboration with each other, There are only some independent logistics enterprises to carry out transportation and storage services, and the functions of the whole logistics industry are not systematically integrated and integrated.

IV. Policies and Suggestions

In Jiangxi and Shanxi Province, to build the logistics integration, informatization, highly effective complex industry become the important component of the modern industry system as the goal, in Jiangxi province and Shanxi Province need government intervention in the formulation and implementation of the logistics industry development planning, including strengthening the construction of logistics infrastructure, the construction of logistics distribution system, and improve and logistics park, the coordination of international logistics center, In addition, Jiangxi province and Shanxi Province also need to invest information technology and block chain technology in the logistics industry, in order to realize the comprehensive development of the logistics industry.

As the center of the development of human and Hubei province, although they are symmetrical, the development trend of gradual increase in Hubei, Hunan gradually decline, but the two provinces have their own single subsystem development advantages, total logistics system still lack of coordination, although growth in the third industry and the provincial level economic development at a high level, the performance of the logistics industry is still at a medium level of coordination, Hunan and Hubei governments are relatively good at supporting logistics factors, so they can focus on how to coordinate the development of the whole logistics industry and promote the development of logistics demand factors.

In Henan and Anhui provinces, the six provinces in central overall coordination of the logistics industry the highest two provinces, in keeping the policy after implementation of the logistics industry under the high speed development, should be combined with the development of information technology industry, more under the improvement of the infrastructure in the paper improve logistics efficiency, increase through put is the key point of the development of the two provinces of the next stage.

Reference

[1]. Xue Dongqian, Guo Jing, Dang Shuying. A Comparative study on logistics competitiveness of Inland Central Cities in China: A Case study of Xi 'and Zhengzhou [J]. Areal Research and Development,2012(2):59-61,81.
[2]. Lin Tan, Wang Ling. Analysis of regional logistics efficiency in China based on SFA method [J]. Port Economics,2008(12):46-49.
[3]. Tang Jianrong, Lu Lingzhu. Analysis of logistics efficiency under low carbon constraint -- a case study of ten eastern provinces and cities [J]. China Circulation Economy,2013(1):40-47.
[4]. Hu Yue. Research on logistics management Innovation under e-commerce Environment [J]. Brand,2015(11):44-45.
[5]. Zhao Liqin, Liu Jingyan, Zi Hongbing. Analysis of beijing-Tianjin-Hebei Regional logistics and urban agglomeration logistics function construction [J]. Journal of Shijiazhuang Tiedao University: Social Sciences Edition,2014(3):13-19.
[6]. Qian Xiaoying, Ma Chuanxiu. Cointegration analysis of the impact of logistics on economic growth [J]. Journal of Hunan University: Natural Science,2007(4):84-87.
[7]. Liu Peng. Research on the relationship between regional logistics and economic growth based on VAR model [J]. Logistics Technology,2012(7):218-220.
[8]. Liu, S.. A Research on the relationship of logistics industry development and economic growth of china [J]. International Business Research,2009(2), 1-4.

[9]. Yuko Aoyama, Samuel J. Ratick . Trust, Transactions, and Information Technologies in the U.S. Logistics Industry [J]. Economic Geography, 2007(2), 159-180.
[10]. Yang Zhongzhen, Yu Sun, Paul Tae-Woo Lee, Impact of the Development of the China-Europe Railway Express -- A case on the Chongqing International Logistics Center, Transportation Research Part A: The Policy and Practice, Volume 136202, Pages 244-261, ISSN 0965-8564, https://doi.org/10.1016/j.tra.2020.03.022.