Research on the dynamic evolution of logistics efficiency and its influencing factors in Guangxi

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Abstract:

Logistics efficiency is an important index to measure the development level of logistics industry. The author uses the data envelopment analysis (DEA) method to empirically analyze the logistics efficiency of Guangxi from 2012 to 2021. It is concluded that the non-DEA efficiency of Guangxi logistics efficiency is due to the redundancy of new fixed investment, logistics practitioners and highway mileage input, which does not exert the corresponding utility value, and the corresponding input factors should be appropriately reduced. According to the measurement results, and in view of the efficiency level of Guangxi logistics industry, some feasible and operable suggestions are put forward for the development of Guangxi regional logistics industry.

Keywords:

Logistics efficiency ; DEA ; factors ; GuangXi

1. Introduction

With the rapid development of the logistics industry in China, the logistics industry is not only the artery of regional economic development, but also an important entry point to promote the transformation and upgrading of industrial structure. With the determination of Guangxi 's status as a bridgehead connecting ASEAN, the logistics industry has become an important industry to promote regional economic development. In May 2021, The 14 th Five-Year Plan for National Economic and Social Development of Guangxi Zhuang Autonomous Region and the Outline of the Vision Goals for 2035 proposed that Guangxi should ' comprehensively strengthen cooperation with countries and regions along the ' Belt and Road ' and domestic provinces (autonomous regions and municipalities) ', ' organically link the ' Belt and Road ' and the Yangtze River Economic Belt, and accelerate the construction of a new land and sea channel connecting China and ASEAN with the shortest time, the best service and the best price '. It is particularly important to speed up the construction and development of modern logistics industry and improve the efficiency of regional logistics.

2. Summarization of domestic and foreign research

Foreign scholars have explored the empirical analysis of logistics efficiency earlier. For example, Clarke et al. (1991) [1] and Martí Luisa (2017) [2] used DEA method to evaluate logistics efficiency, and gave corresponding methods to improve the efficiency of use. Hamdan (2008) [3], Lepchak (2020) [4] and others used DEA model to measure the efficiency of logistics enterprises ; deng (2020) [5] and Gan (2023) [6] applied the three-stage DEA model to measure the efficiency of China 's logistics industry. In China, there are more

and more researches on logistics industry and logistics efficiency. For example, Yun Jun, Zhang Fan (2006), Li Tan et al. (2012) used DEA model to empirically evaluate the efficiency of port logistics [7, 8] ; wang Qinmei, Tan Cui 'e (2013) [9], Meng Kui (2014) [10] and Zhang Xuan (2016) [11] respectively take the logistics efficiency of prefecture-level cities, provinces and regions as the research object, and use the three-stage model to study the logistics efficiency. From the perspective of the influencing factors of logistics efficiency, the level of economic development, the degree of opening to the outside world, the location advantage, the utilization rate of logistics resources and the degree of marketization [12-14]. Although domestic and foreign scholars have achieved fruitful results in the study of the operation rate of the logistics industry, and the exploration time is relatively early, they mostly focus on the enterprise level, the transportation industry and the efficiency of the supply chain, and do not take the logistics industry as a complete object to empirical analysis. On the basis of previous studies, this paper intends to empirically analyze the dynamic evolution trend of Guangxi logistics industry based on the panel data of Guangxi logistics industry from 2012 to 2021, and clarify its dynamic evolution mechanism.

3. Construction of Guangxi logistics industry efficiency evaluation system

At present, parameter method and non-parametric method are the main methods to evaluate efficiency. Production function method and stochastic frontier analysis (SFA) are parameter methods with high frequency. DEA analysis method and Malmquist productivity index method are the most frequently used non-parametric methods by scholars. The interaction between the input and output indicators of logistics efficiency is multi-faceted, multi-level and very complex. The general function analytical formula cannot express the dynamic situation of the interaction between these indicators. The effectiveness evaluation of multi-input and multi-output indicators is more difficult to deal with. Based on the convenient, more accurate and objective measurement of the efficiency of the logistics industry in Guangxi, this paper uses the Data Envelopment Analysis (DEA) to make a dynamic empirical study on the input and output efficiency of the logistics industry in Guangxi. When using the data envelopment analysis (DEA) method to measure the logistics efficiency, first determine the evaluation purpose, then select the decision-making unit, then establish the input and output indicators, and then select the appropriate DEA model according to the research object. Finally, the comprehensive evaluation is carried out and the empirical analysis results are obtained.

3.1 DEA model of variable returns to scale

DEA method has various models, and its pertinence is not the same. The most representative evaluation models of DEA are CCR and BCC. In 1978, on the basis of Farrell, Charnes, Cooper and others put forward the DEA model with fixed returns to scale (CCR model), which is used to evaluate technical efficiency. The DEA model of variable returns to scale (ie, the BCC model) is to separate the two causes of technical inefficiency, that is, not being in the best scale and low efficiency in production technology. The pure technical efficiency obtained is more accurate than the technical efficiency under the CCR model. It reflects the management level of the object under discussion.

3.2 Construction of logistics industry efficiency evaluation index system

On the basis of following the principles of importance, relevance and availability, according to the KLEMS productivity theory, combined with the actual development of logistics in Guangxi, the input index system is

mainly selected from human, material and financial resources, the technical input is discarded, and the output index is selected to reflect the output economic benefits of the evaluation object. The logistics industry efficiency evaluation index system selected in this paper is shown in Table 1 and Table 2.

Table 1 Evaluation index of logistics industry efficiency input

First-level indicators	Second-level indicators	Third-level indicators	Fourth-level indicators
factor input	logistics element	number of employees	Number of employees at the end of the year
		Staff amount of wages	total wages
			total amount of executive pay
		equipment investment	civil car ownership
			Truck ownership
		logistics network	railway operating mileage
			Grade highway mileage
			Convert road network mileage
	Financial elements	fixed investments	gross fixed asset formation
			Net investment in fixed assets

Table 2 Evaluation index of logistics industry efficiency output

First-level indicators	Second-level indicators	Third-level indicators
factors output	traffic capacity	tonnage mileage
		passenger travel
	economic benefit	Total output value of logistics industry
		The proportion of logistics in GDP

4. Measurement and analysis of logistics industry efficiency

4.1 Sample data collection and processing

The sample data selected in this paper are the new fixed investment, number of employees, highway mileage, gross domestic product and other index data of Guangxi 's transportation, warehousing and postal industry from 2012 to 2021, mainly from the ' Guangxi Statistical Yearbook ' from 2013 to 2022 and the website of the National Bureau of Statistics.

4.2 Efficiency measurement of logistics industry

This paper selects the number of 10 periods in Guangxi from 2012 to 2021 as the decision-making unit (DMU), with 9 input indicators and 4 output indicators. According to the principle of availability, the input factor is easier to change than the output factor. This paper chooses the input-oriented type which is more instructive to the research. This paper uses deap2.1 software to calculate and obtain the results of logistics efficiency measurement from 2012 to 2021, as shown in table 3.

Table 3 Efficiency measurement results of Guangxi from 2012 to 2021

year	technical efficiency（crste）	pure technical efficiency（vrste）	scale efficiency （scale）
2012	0.788	0.833	0.946 drs
2013	0.554	0.759	0.729 irs
2014	0.947	0.999	0.948 drs
2015	0.988	0.999	0.989 drs
2016	0.948	0.962	0.985 irs
2017	1.000	1.000	1.000 -
2018	1.000	1.000	1.000 -
2019	1.000	1.000	1.000 -
2020	1.000	1.000	1.000 -
2021	1.000	1.000	1.000 -
mean value	0.923	0.955	0.960

Data source : the author uses deap2.1 to calculate and sort out

4.2.1 Technical efficiency analysis

The technical efficiency value of Guangxi reflects the ability to achieve maximum output under the premise of given input factors, or the ability to minimize input at the given output level. The technical efficiency of Guangxi logistics fluctuates greatly during the period of 2012-2014, and the technical efficiency is low in 2012 and 2013, which is DEA invalid ; the technical efficiency value of 2012-2016 is between 0.9 and 1, which is marginal inefficiency, and it can be adjusted slightly. The technical efficiency value of regional logistics in 2017-2021 is equal to 1, which shows that Guangxi has reached the maximum output under the technical level at that time, the technical efficiency level has reached the best, and the resources have been optimally allocated and combined and the maximum output. On the whole, the average value of logistics technical efficiency in Guangxi from 2012 to 2021 is 0.923, and there is still room for improvement in logistics efficiency.

4.2.2 Pure technical efficiency analysis

Pure technical efficiency refers to the analysis of the influence of the utilization rate of input factors on technical efficiency under the influence of removing scale factors. During the 10-year period, the pure technical efficiency value of logistics in Guangxi from 2017 to 2021 is equal to 1, indicating that the input factors have been maximized after eliminating the influence of scale factors, and no improvement is needed. During the five years from 2012 to 2016, the pure technical efficiency value of Guangxi logistics was less than 1, indicating that the investment has not yet reached the maximum utilization under the influence of the removal of scale factors. The average value of pure technical efficiency of Guangxi logistics is 0.955. It is necessary to appropriately improve production technology, introduce advanced technical talents, improve the quality of practitioners, strengthen industry management, etc., so as to improve the utilization rate of input factors.

4.2.3 Scale efficiency analysis

Scale efficiency refers to whether the input and output are in the optimal state, the size of the scale and the matching of resources. When the scale efficiency value is equal to 1, the profitability is the best and the production cost is the smallest in the state of scale efficiency. When the scale efficiency value is less than 1, the scale efficiency is invalid. There are three cases of economies of scale : increasing returns to scale (irs),

constant returns to scale (-), decreasing returns to scale (drs). The scale efficiency of Guangxi in 2012 and 2016 reached 1, indicating that the scale efficiency of Guangxi logistics in these two years is effective, the production cost is the lowest, and the profit is the best. In the remaining years, the scale efficiency value of Guangxi logistics is less than 1, and its scale efficiency is in an invalid state.

As shown in Table 3, Guangxi 's scale efficiency will remain unchanged from 2017 to 2021. When the scale efficiency of logistics efficiency is constant, when the input of each unit is increased, the output per unit will increase proportionally ; in the remaining years, the scale efficiency of logistics is increasing. When the scale benefit of logistics efficiency is increasing, the unit output will increase in a higher proportion for each increase in unit input. Based on this situation, the input should be increased appropriately. In 2012 and 2015, the logistics efficiency of Guangxi showed a decreasing scale benefit. At this time, if the unit input is increased, the unit output will increase in a smaller proportion. It should be noted that no more investment should be increased and the scale should be reduced.

Because in the DEA model, the total efficiency is the multiplication of pure technical efficiency and scale efficiency, so the DEA inefficiency in Guangxi is caused by the inefficiency of scale efficiency, and it is in the stage of increasing returns to scale, indicating that the production and operation efficiency of the logistics industry at that time did not obtain the maximum output under certain input conditions, indicating that logistics resources should be reasonably allocated to improve the level of logistics efficiency.

4.2.4 Influencing factors of logistics efficiency

In order to further explore the factors that hinder the efficiency improvement of Guangxi regional logistics in the development process, this paper will do the difference variable analysis to study the ineffective factors of Guangxi regional logistics industry investment. The results of the efficiency of Guangxi regional logistics industry are analyzed by DEAP2.1 software.

Table 4 DEA operation results of Guangxi regional logistics industry

year	inputs redundancy			output deficiency
	Total new fixed investment (billion yuan)	Logistics industry practitioners (Ten thousand people)	Highway mileage (ten thousand / km)	Guangxi logistics gross production value (billion yuan)
	S^-_1	S^-_2	S^-_3	S^+_1
2012	30.887	2.916	2.525	0
2013	392.385	4.217	2.419	0
2014	0.255	0.017	1.218	0
2015	0.426	0.22	0.411	0
2016	17.092	0.708	0.554	0
2017	0	0	0	0
2018	0	0	0	0
2019	0	0	0	0
2020	0	0	0	0
2021	0	0	0	0

Data source : the author uses deap2.1 to calculate and sort out

From the perspective of input indicators, it refers to the amount of excess in the input factors and then does not exert its utility. From the perspective of output indicators, it refers to the amount of insufficient output in the output factors. On the whole, the efficiency of the logistics industry in Guangxi has not reached the optimal combination because of the redundancy of logistics investment, which has not played a corresponding role, and the corresponding redundancy should be reduced. The inefficiency of the logistics industry in Guangxi is due to the mismatch between the scale of the logistics industry and the input and output. It is necessary to increase or reduce the scale to adapt to the development of the logistics industry.

The value of each factor of Guangxi logistics operation efficiency in the period from 2017 to 2021 is 0, which indicates that there is no need to reduce input and increase output in terms of the technical efficiency of Guangxi logistics industry. There is no redundancy in the input of logistics industry and there is no shortage in the output. In other years, Guangxi logistics efficiency is not DEA effective because of the redundancy of new fixed investment, logistics practitioners and highway mileage input, which does not play the corresponding utility value, and the corresponding input factors should be appropriately reduced.

5. Conclusion and prospect

The key for Guangxi to further improve its logistics efficiency lies in the integration and effective use of input resources, that is, the rational allocation of fixed investment, the introduction of advanced technical personnel, the improvement of the quality of logistics practitioners, the optimization of transportation networks, and the reduction of unnecessary cost waste.

In this paper, only the BCC model in the non-parametric DEA analysis method is used, and the intermediate input and technical input are discarded. The research conclusion has a certain deviation from the actual situation. In the future research, DEA method can be considered to be combined with stochastic frontier analysis method, free distribution method, thick frontier method and other methods, so as to better conduct empirical analysis on the efficiency of logistics industry.

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