Study on Efficiency Management in the Logistics Industry-Taking the Pearl River Delta Region as an Example

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Abstract. The logistics industry, as one of the important basic industries of the national economy, has an important position in the society, and the level of logistics efficiency can affect the economic level of a region. Based on the panel data of nine cities in the Pearl River Delta (PRD) region, this paper establishes an input-output indicator system for the logistics industry, and adopts the BCC method in the DEA model and the Malmquist index method to measure and analyze the logistics efficiency of the PRD region from 2017-2022 based on the static and dynamic perspectives, respectively. It is found that from the static measurement results, the overall trend of logistics efficiency in the PRD region is increasing, but the development of the logistics industry is unbalanced among the major cities. From the dynamic results, the total factor productivity in the PRD region shows an overall increasing trend and benefits from technological progress. Finally, corresponding countermeasures and suggestions are proposed for the development of the logistics industry in the Pearl River Delta region.

Keywords: logistics efficiency; DEA model; DEA-Malmquist; Pearl River Delta region

1   INTRODUCTION

As China's economy enters a new normal, technological upgrading and the popularization and penetration of e-commerce, the logistics industry presents a new pattern after years of development. The development of the economy puts forward higher requirements for the development quality and efficiency growth of the logistics industry, which in turn promotes the reform and progress of the modern logistics industry. Logistics efficiency can reflect whether the input of logistics resources is reasonable, so as to find out the weak points. Therefore, the evaluation of logistics efficiency is of great practical significance. At present, the research on logistics efficiency at home and abroad is more comprehensive, and scholars mainly use DEA (data network analysis) method to conduct research. Sun Hongjin et al [1] used the DEA model to measure the

logistics efficiency in the western region. Liu Hongwei et al [2] used DEA model to evaluate and analyze the logistics efficiency of hub cities. Some scholars also improve DEA or use it in combination with other methods to study logistics efficiency [3], from the perspective of the evaluation object, foreign scholars are more inclined to analyze the logistics efficiency from the micro level of companies, ports, etc. [4-5], while domestic scholars are more to study the macro perspective of the country and the region[6-7]. At present, there are fewer studies on logistics efficiency in the Pearl River Delta region of China. Based on this, this paper utilizes the DEA model to evaluate the logistics efficiency of the Pearl River Delta (PRD) region, so as to find out the problems existing in the process of logistics development in the PRD region.

2   RESEARCH DESIGN

2.1   Construction of Evaluation Indicator System for Logistics Industry Efficiency in the Pearl River Delta Region

Logistics efficiency is used as an important reference for evaluating the resource allocation, scale, and technology related to the logistics industry on the development of the region's economy and logistics industry. This paper refers to the existing literature, in accordance with the principles of systematic, comprehensive, scientific and streamlining, refers to the literature of relevant scholars [8-9] indicator types, and selects indicators in accordance with the input and output aspects related to the efficiency calculation.The evaluation index system of logistics efficiency in the PRD region constructed in this paper is shown in Table 1.

Table 1. Input-Output Indicator System for Logistics Resources in Cities in the Pearl River Delta Region

Type of indicator	Indicator name	Interpretation of indicators	work unit
Input indicators	Logistics industry practitioners	labor input	number of people
	Investment in the logistics industry	capital investment	billions
	Road mileage	Facility inputs	kilometers
Output indicators	volume of freight	Transportation capacity of the logistics industry	hundred million tons
	Freight turnover	Scale of development of the logistics industry	gigatonne kilometer
	Logistics GDP	Logistics output	billions

2.2   Data sources

Nine cities in the Pearl River Delta (PRD) region are selected for the study, which covers the period of 2017-2022. The raw data of relevant indicators are obtained from China Statistical Yearbook, China Urban Statistical Yearbook, Statistical Yearbook of each province and city, and China Energy Statistical Yearbook. In the process of searching for data, the fixed asset investment in the logistics industry and the GDP of the logistics industry cannot be found in the statistical yearbook. Since transportation, warehousing and postal services occupy a major share of the logistics industry, based on the availability of data, this paper uses the relevant statistical data of "transportation, warehousing and postal services" instead. It is reasonable to collect data related to the logistics industry.

3   RESEARCH DESIGN

3.1   Static Analysis of Logistics Efficiency in the Pearl River Delta Region

Analysis of Logistics Efficiency by City. Table 2 reveals that in terms of sub-cities: the comprehensive logistics efficiency levels of Guangzhou, Shenzhen and Zhuhai are higher than those of other cities, indicating that the logistics industry in these cities performs better in terms of resource allocation and management efficiency; Foshan City, Dongguan City, Zhongshan City, as well as Huizhou City are in the second echelon, with a slightly lower mean value of their comprehensive logistics efficiencies, which can be improved through further optimization of logistics organization and resource allocation. Jiangmen and Zhaoqing are significantly lower than the other cities, with a mean value of logistics efficiency of only 0.719 and 0.783, indicating that there are some problems in the logistics industry in these two cities. Further in-depth analysis may be needed to formulate targeted policies and measures. From the analysis of the composition of the comprehensive efficiency, Guangzhou and Shenzhen City have high technical efficiency, Zhuhai City, Foshan City, Zhongshan City and other technical efficiency is insufficient; Zhaoqing City has a mean value of technical efficiency of 0.786, indicating that the level of technological development and utilization of technology in Zhaoqing City needs to be improved, and under the perspective of scale efficiency, Guangzhou City, Shenzhen City, Zhuhai City, Foshan City, Dongguan City, Zhongshan City and Zhaoqing City are all higher, and Jiangmen City and Huizhou City are at a lower level. From the perspective of the relationship between comprehensive technical efficiency, pure technical efficiency and scale efficiency, logistics efficiency in the PRD region is more dependent on the contribution of pure technical efficiency.

Table 2. Logistics Efficiency by Municipalities in PRD Region, 2017-2022

		2017	2018	2019	2020	2021	2022
Guangzhou	TE	0.892	0.895	1.000	0.896	0.892	0.965
	PE	0.956	0.913	1.000	0.895	1.000	1.000

	SE	0.981	0.956	0.924	1.000	1.000	1.000
Shenzhen	TE	0.921	0.953	0.892	0.913	0.941	1.000
	PE	0.984	0.974	1.000	0.963	0.972	1.000
	SE	0.943	1.000	1.000	0.952	1.000	0.935
Zhuhai	TE	0.951	0.961	0.856	0.901	0.913	0.970
	PE	0.991	0.973	1.000	1.000	0.949	0.989
	SE	0.907	1.000	0.934	0.991	0.802	0.980
Foshan	TE	0.824	0.793	0.831	0.904	0.831	0.874
	PE	0.839	0.835	1.000	0.952	0.950	0.908
	SE	0.801	0.930	0.941	0.910	0.952	0.974
Dongwan	TE	0.774	0.802	0.985	0.788	0.842	0.917
	PE	0.841	0.854	1.000	0.891	1.000	0.923
	SE	0.898	0.904	1.000	0.899	0.905	0.916
Jiangmen	TE	0.746	0.827	0.562	0.649	0.730	0.802
	PE	1.000	0.836	0.684	0.703	0.852	0.826
	SE	0.952	1.000	0.851	0.941	0.930	0.927
Zhongshan	TE	0.876	0.820	0.902	0.924	0.926	0.927
	PE	0.961	0.973	0.908	0.943	1.000	0.979
	SE	0.960	0.951	1.000	0.971	0.942	0.963
Huizhou	TE	0.861	0.930	0.925	0.910	0.946	0.983
	PE	0.941	0.991	0.960	0.917	0.982	1.000
	SE	0.978	1.000	1.000	0.958	0.928	0.941
Zhaoqing	TE	0.583	0.664	0.903	0.799	0.841	0.910
	PE	0.840	0.857	0.972	0.891	0.963	0.981
	SE	1.000	0.829	0.958	0.961	0.974	0.994

3.2 Dynamic Analysis of Logistics Efficiency in the Pearl River Delta Region

Dynamic Efficiency Analysis by Period. Table 3 reveals that analyzing from the time dimension, the overall total factor productivity of the logistics industry in China's Pearl River Delta region shows an upward trend in the period of 2017-2022, and the productivity level increases in this time period with an average growth rate of 2.8%, which mainly lies in the fact that the technological progress contributes to 3.9%, while the technical efficiency declines by 0.6%, with the pure technical efficiency change index fell by 0.2% and the scale efficiency change index fell by 0.3%. Specifically by time period, the total factor productivity of the logistics industry in China's Pearl River Delta region showed a downward trend in 2017-2018 and 2020-2021, decreasing by 2.6% and 0.9% respectively, which was constrained by the joint constraints of technological

efficiency and technological progress as well as by technological efficiency, respectively. The remaining years of total factor productivity show different degrees of growth trends, of which 2021-2022 has the highest growth of 12%, mainly due to technological progress by 16.9%; while 2019-2020 has the smallest growth of only 2.7%.

Table 3. DEA-Malmquist measurements in the PRD region by period

phase	2017-2018	2018-2019	2019-2020	2020-2021	2021-2022	average value
Technical efficiency	0.983	0.958	1.080	0.961	0.987	0.994
technological progress	0.997	1.018	0.981	1.028	1.169	1.039
Pure technical efficiency	0.973	1.025	0.963	1.017	1.012	0.998
Scale efficiency	1.016	1.018	0.992	0.984	0.979	0.997
Total factor productivity	0.974	1.029	1.027	0.991	1.120	1.028

Sub-City Dynamic Efficiency Analysis. Table 4 reveals that from the city dimension, the logistics total factor productivity of the nine cities in China's Pearl River Delta (PRD) region showed an overall growth trend, with an average growth rate of 2.8%, which was mainly driven by the growth of technological progress. In terms of specific sub-cities, the total factor productivity of Guangzhou City, Shenzhen City, Zhuhai City, Foshan City, Dongguan City, and Zhongshan City are all greater than 1, indicating that technological changes and changes in technological efficiency have contributed to the increase in the productivity level of these six cities. Among them, the growth of total factor productivity in Guangzhou, Shenzhen, Zhuhai and Dongguan is the result of the joint growth of technical efficiency and technological progress; the technical efficiency values of Foshan and Zhongshan are less than 1, which shows that the increase in total factor productivity is entirely dependent on the growth of technological progress. The Malmquist index of the other 3 cities, Jiangmen, Huizhou and Zhaoqing, is less than 1, of which only Jiangmen is affected by the combined effect of technical efficiency and the inhibition of technical progress; and the change index of technical progress of Huizhou and Zhaoqing is greater than 1, so these 2 cities are entirely affected by the decline in technical efficiency.

Table 4. DEA-Malmquist Measurement Results for Sub-cities in the PRD Region

municipalities	effch	techch	pech	sech	tfpch
Guangzhou	1.012	1.059	1.036	1.026	1.082
Shenzhen	1.021	1.048	0.983	1.010	1.066
Zhuhai	1.002	1.060	0.995	0.986	1.061
Foshan	0.976	1.048	1.026	1.024	1.016
Dongwan	1.032	1.047	0.984	0.968	1.060
Jiangmen	0.986	0.994	0.972	1.020	0.983
Zhongshan	0.953	1.051	1.000	0.990	1.020
Huizhou	0.980	1.020	1.000	0.963	0.996
Zhaoqing	0.985	1.024	0.986	0.986	0.971
average value	0.994	1.039	0.998	0.997	1.028

4   CONCLUSION

By measuring the logistics efficiency of the cities in the Pearl River Delta region, it is concluded that Guangzhou, Shenzhen and Zhuhai have a high level of development of the logistics industry, while the other cities are relatively backward in terms of development. And technology development plays a very important role in this process. In summary, in order to further improve the quality and efficiency of the development of the logistics industry in the Pearl River Delta region, and to provide development guarantees for the real economy, the local governments, enterprises and industry organizations in the region should explore policies and initiatives that are consistent with regional characteristics and effective.

Based on the findings of this paper, the following development recommendations are put forward: First, overcome the limitations of policy myopia, coordinate the relationship between economic growth and the quality of logistics development, and ensure that the two are mutually reinforcing and complementary. At the same time, policy tools should be fully utilized to mobilize the enthusiasm of the main body of enterprises, stimulate market vitality, promote the synergistic development of inter-region and inter-industry, and achieve sustainable and healthy growth of the overall economy. Secondly, improve the innovation and application of logistics technology, and improve the level of informationization. Increase the development of informatization of logistics enterprises, make logistics enterprises bigger and stronger, improve information exchange between logistics enterprises, and at the same time guide professional logistics talents to enhance the development of informatization of logistics enterprises. Thirdly, it should give full play to regional characteristics, deepen the synergistic cooperation between ports and hinterlands, effectively guide upstream industries to undergo transformation and upgrading, and build a diversified service pattern. It should also focus on improving development efficiency and quality, and strive to narrow the development gap within the region. By promoting the linkage between ports and the hinterland, a development pattern with clustered advantages and reasonable structure will be formed. Fourthly, it will actively promote advanced logistics forecasting technology and strengthen the implementation of standardized management technology, strive to create a good atmosphere for the application of technology, encourage the wide application of new technology in the field of logistics, and promote the transformation of relevant results to improve the efficiency and accuracy of logistics operations, reduce operating costs, and promote the healthy development of the logistics industry.

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