Industrial Engineering and Innovation Management (2022)
Clausius Scientific Press, Canada

DOI: 10.23977/ieim.2022.050605
ISSN 2522-6924 Vol. 5 Num. 6

Research on Comprehensive Evaluation of Logistics Environment in Fujian Province Based on Entropy Weight and DEA

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Keywords: Fujian Province, comprehensive evaluation, DEA, ntropy weight

Abstract: The logistics industry has gradually become an essential pillar of the service industry in Fujian Province of China. This paper takes the logistics environment of 9 prefecture-level cities in Fujian Province as the research object. We analyze the development status of the logistics environment and construct a comprehensive evaluation model of the logistics environment from the two aspects of regional logistics efficiency and regional logistics service quality. The logistics efficiency of each city in the province is calculated, and the entropy weight method is used to analyze each city's logistics service quality level. Finally, based on the comprehensive efficiency and service quality level, the comprehensive evaluation score of the logistics environment of each city in Fujian Province is obtained and combined with the empirical analysis conclusions, countermeasures, and suggestions to promote the development and construction of the logistics environment in Fujian Province are put forward in a targeted manner.

1. Introduction

1.1. Background of the Study

In recent years, with the development of economic globalization, domestic logistics enterprises have gone out of the country to meet international standards, and learn and absorb advanced management modes and related technology. The logistics industry is not only a product of economic globalization, but also an important industry that promotes the development of economic globalization and plays an indispensable role in promoting the vigorous development of the country. The improvement of the development level of logistics can help reduce the investment of logistics costs, and at the same time, it can also provide more convenient logistics services for other industries to help their rapid development and thus improve the national economy. To promote the development of the logistics industry, the State Council issued the Medium and Long-term Plan for the Development of the Logistics Industry (2014-2020) in September 2014, proposing that under the current conditions of rapid growth in logistics demand, the continuous emergence of new technologies and new management, the strengthening of resource and environmental constraints, and increasingly fierce international competition, the logistics industry should accelerate the level

of development, and by 2020, establish a reasonable layout, advanced technology, convenient efficient, green, safe and orderly modern logistics service system.

With the rapid economic development of Fujian Province, the logistics industry has attracted more and more attention from the government, and with a series of policies to promote the sustainable development of the logistics industry, the logistics industry has gradually become an essential pillar of the service industry in Fujian Province. In recent years, the construction of fast railroads, highways, ports, airports, and trunk highways to improve the development of the logistics industry in Fujian Province has laid the foundation. 2020 railroad mileage in Fujian Province reached 3774 kilometers, 11,118 kilometers of highway traffic; Fuzhou, Xiamen, Quanzhou, Zhangzhou, Putian, and other places have become essential nodes of the national logistics system.

With the introduction of logistics support policies and infrastructure construction, the logistics industry in Fujian Province has entered a stage of rapid development, but various problems have become increasingly evident in the process of development. Based on the above background, in order to understand the existing problems of logistics industry development in Fujian Province, this paper plans to conduct a comprehensive evaluation of the logistics environment of nine prefecture-level cities in Fujian Province, to compare the development of the logistics industry of each prefecture-level town horizontally, to study how to solve the existing problems of the logistics industry in Fujian Province, and how to improve the overall logistics environment construction in the future, which is of long-term significance to promote the successful development of logistics industry in Fujian Province.

1.2. Research Ideas and Methods

1.2.1. Research Ideas

Logistics environment generally contains several aspects, mainly logistics natural environment, logistics economic environment, logistics industrial environment, logistics policy and legal environment, logistics facilities and equipment environment, logistics service environment, etc. In addition to the logistics service quality environment, the above-mentioned logistics environment factors focus on reflecting the influence and constraints of logistics resources and technology level on the development of logistics activities in a region. The important index that can comprehensively reflect the ability and level of these factors on the development of logistics in a region is the regional logistics efficiency. Regional logistics efficiency refers to the ratio of logistics factor input to the output of each province, autonomous region, and municipality directly under the central government in a certain period, reflecting the technical level, scale level, resource factor allocation ability, and utilization degree of logistics development in the region. Therefore, regional logistics efficiency and service quality indexes for regional logistics environment analysis and evaluation can reflect a region's logistics development capacity and level more comprehensively and objectively.

1.2.2. Research Content and Framework

The research of this paper focuses on two aspects of regional logistics efficiency and regional logistics service efficiency, using data envelopment analysis and entropy method, respectively, to make a comprehensive evaluation of the regional logistics environment in Fujian Province. Through the horizontal comparison of 9 prefectures in Fujian Province, we analyze the current situation and differences of the logistics environment, discover the existing problems, and put forward targeted suggestions to promote the balanced development of the logistics environment in Fujian Province, improve the overall level of regional logistics in Fujian Province, so as to drive the development and construction of the economy.

2. Overview of Relevant Theories

2.1. Definition of Regional Logistics

Due to the different development of the logistics industry in each country, there is no uniform definition of regional logistics in the field of regional logistics research by domestic and foreign scholars, and scholars from different countries have different opinions on this. 1994 U.S. Handbook of Logistics defines regional logistics as all logistics activities contained within a region, including loading and unloading, transportation, packaging, storage and other aspects required for urban development. Dong Qianli et al. [1] define regional logistics as the planning and construction of logistics systems and their management related operations that promote the best strategies for socio-economic development in a specific region. Haifeng et al. [2] defined regional logistics as the act of effective physical activity of moving goods from supply to receipt within and outside the region in a specific regional environment, supported by large and medium-sized cities as the center and the scope and scale of the regional economy, with a ripple effect of logistics activities.

By summarizing and sorting out the relevant literature, this paper believes that regional logistics can be literally divided into "regional + logistics", which can be summarized as a regional logistics operation system built to meet the needs of regional development and to support economic, military and political activities in the region. It refers to the logistics of a country, economic zone, or city. Due to the differences in the environment and development of each region, regional logistics has its common nature and also has the uniqueness of each region. Regional logistics is an essential factor in promoting regional development, and improving the level of logistics development can further drive the development of other industries in the region and the improvement of the economic level.

2.2. Data Envelopment Analysis (DEA)

DEA is a method for evaluating the relative effectiveness of units of the same type with multiple input and output indicators using linear programming. The efficiency value of DMU is distributed between 0 and 1, and 1 means that DMU is on the frontier of DEA production efficiency, which means it is relatively effective. Since it was proposed by A. Charnes and W. Cooper in 1978, DEA method has shown its unique advantages in solving multi-indicator input and output problems. Nowadays, it is applied in different industries, including enterprise performance evaluation, land use efficiency evaluation, logistics efficiency evaluation, tourism industry efficiency evaluation, etc. When evaluating and analyzing regional logistics capacity, many researchers generally construct a calculation model of regional logistics capacity and analyze the value of logistics capacity by comparing the data of output indicators. Data envelopment analysis method has some limitations. It is not applicable to the body of indicators with strong correlation, DEA method also requires a small number of indicators of the research object.

2.3. Entropy Power Method

Entropy was first introduced into information theory by Shenon, who named the signal uncertainty of information sources in communication as information entropy and named the amount of signal uncertainty eliminated as information. According to the basic principles of information theory, entropy is a measure of system disorder, while information is a measure of system order. If the information entropy of an indicator is smaller, the more information it provides, the higher the role it plays in the study, and the larger the corresponding weight value. The entropy weighting method takes the original index data as the specimen, reflects the "information entropy" of the index through the difference between data, and determines the corresponding entropy weighting of the

index. The entropy weight method is a comprehensive evaluation method that can be used to study multiple indicators and multiple objectives, and is called the objective weighting method. Because it only relies on the variability of the index data itself, its evaluation results have objectivity. The evaluation method is objective and adaptable and widely used to determine the weights for quality assessment, performance assessment, capacity assessment, etc. However, the scope of use is generally only used to determine the weights.

3. The Regional Logistics Environment Comprehensive Evaluation Index System Construction

Since the DEA model method does not need to assume the relationship between input and output indicators in the evaluation of each decision but wishes, it does not need to dimensionless process the relevant indicator data, but directly analyze the data envelope, and the evaluation results obtained are more objective. However, in the DEA model, if there are too many input and output indicators, the efficiency of the final differentiated decision unit will be reduced, so the DEA empirical method requires that the sum of input and output indicators should not exceed twice the number of sample evaluation units. The evaluation object of this paper is the logistics efficiency of 9 prefecture-level cities in Fujian Province, so the sum of input and output indicators of the logistics efficiency evaluation index system established in this paper should preferably not exceed 5.

Therefore, based on the reference to existing literature, this paper finally determines a total of five input and output indicators for logistics efficiency evaluation by browsing the official websites of the Fujian Provincial Bureau of Statistics and Fujian Provincial Postal Administration, consulting the Fujian Provincial Statistical Yearbook and the Annual Report of the Postal Administration on Government Disclosure, combining the statistical frequency of indicators and ensuring the accessibility and representativeness of data. For the evaluation indexes of logistics service quality, this paper mainly refers to the evaluation system of logistics service quality constructed by Xu Xiaomin et al. It takes into account the accessibility of index data, makes appropriate adjustments to the indexes, and finally determines a total of 4 evaluation indexes of logistics service quality. The specific indicators are shown in Table 1.

Table 1: Logistics environment comprehensive evaluation index system.

Logistics efficiency evaluation indicators		Logistics service quality evaluation index
Input Indicators	Output Indicators	
Road mileage year-end arrivals	Cargo Turnover	The cumulative volume of express delivery service was completed
Transportation, storage, and postal industry unit year-end number of employees	Transportation, warehousing and postal industry value-added	Average daily postal delivery frequency
Transportation, storage, and postal industry Fixed assets investment amount	/	Number of courier service business outlets
/	/	Millions of effective complaints rate

4. An Empirical Study on the Comprehensive Evaluation of Logistics Environment in Fujian Province

4.1. The Current Situation of Logistics Environment Development in Fujian Province

In 2020, the added value of the logistics industry in Fujian province was 235.596 billion yuan, accounting for about 5.4% of GDP. The added value of the logistics industry in Fujian Province increased year by year during 2011-2020, but with 2016 as the boundary, the proportion of the added value of the logistics industry to GDP in Fujian Province during 2016-2019 showed a decreasing trend year by year, and the proportion of the added value of the logistics industry rose in 2020 compared with 2019. The proportion of the added value of the logistics industry to GDP has increased steadily since 2011. The phenomenon mainly depends on the "Outline of the 12th Five-Year Plan for National Economic and Social Development" adopted at the fourth session of the National People's Congress in 2011, which mentioned vigorously developing the modern logistics industry and strengthening the construction of logistics infrastructure. In the same year, Fujian Province implemented the "Regulations on Promoting the Development of Modern Logistics Industry in Fujian Province", which strongly supported the development of the logistics industry in Fujian Province. In 2019, due to the impact of the epidemic on the logistics industry the value-added of the logistics industry accounted for a large decline, but its overall operation showed a stable development trend, and in 2020, as the epidemic was brought under control, the development of logistics industry also improved.

In terms of logistics and transportation infrastructure, Fujian Province has basically formed a comprehensive transportation system with sea and airports as the hub, railroads and sea transport as the main channels, highways as the network, and inland rivers as the auxiliary. In land transport, the national highway network in Fujian has been basically completed, forming a "three vertical and eight horizontal" leading skeleton network, with 18 connecting channels with neighboring provinces. It has developed a well-connected road network. As of the end of 2021, the province's total road mileage exceeded 110,000 kilometers. In terms of port construction, the rise of modernized port groups along the southeast coast has accelerated, and the province's coastal ports have 430 productive berths, including 190 berths above 10,000 tons, which can dock the world's largest container ships, oil tankers, cruise ships, and bulk carriers. In terms of air transport, the province has six airports in Xiamen, Fuzhou, Quanzhou, Wuyishan, Longyan, and Sanming Shaxian, of which 290 routes are operated within and outside Fuzhou and Xiamen airports.

4.2. DEA-based Logistics Efficiency Evaluation

4.2.1. Calculation Steps

DEA models include CCR models and BCC models. The commonly used CCR model can evaluate both scale efficiency and technology efficiency. Still, its premise assumes that the scale payoff is fixed, i.e., the increase or decrease of production inputs is carried out in the same proportion. [3] Considering the variable payoffs of scale in the logistics industry, it is more appropriate to adopt the input-oriented BCC model for regional logistics efficiency evaluation here.

4.2.2. Data sources

The data for this part of the indicators are mainly from the "Fujian Province Statistical Yearbook" and the statistical yearbooks of each prefecture-level city in Fujian Province. Here to evaluate the logistics efficiency in Fujian Province, the relevant data from the 2020 Fujian Provincial Statistical Yearbook is selected from time; the relevant data of the 2020 Fujian

Provincial Statistical Yearbook of each prefecture-level city is selected from space, and the regional logistics development and construction of each prefecture-level city in Fujian Province is comparatively analyzed. The specific input and output data are shown in Table 2.

Table 2: Data of logistics efficiency-related indicators of prefecture-level cities in Fujian Province

Fujian Province prefecture-level city	Input Indicators			Output Indicators	
	Road mileage year-end arrivals (km)	Transportation, storage, and postal units Number of employees at the end of the year (persons)	Fixed asset investment in the logistics industry (Billions of dollars)	Cargo turnover (million-ton kilometers)	Value-added of transportation, storage and postal industry (billion yuan)
Fuzhou	11616.82	42700	152.85	2248133.80	331.26
Xiamen	2223.10	75132	303.18	25540988.48	251.63
Putian	6428	7813	254.21	650245	62.78
Sanming	15395	8512	310.76	841326	60.85
Quanzhou	18147	25224	285.58	26637101	344.21
Zhangzhou	7961	9802	199.14	925228	188.79
Nanping	15984	16900	94.72	976000	70.85
Longyan	14702	8838	228.62	1019756	113.63
Ningde	12275	8923	21.35	1281637	77.83

4.2.3. Efficiency Measurement Based on the DEA-BCC Model

In academic circles, technical efficiency is usually called comprehensive efficiency, and the analysis of comprehensive efficiency mainly includes two aspects: pure technical efficiency and scale efficiency, and the relationship between the three is: comprehensive efficiency = pure technical efficiency * scale efficiency. Pure technical efficiency refers to the use of human, financial and material logistics resources without considering the influence of scale factors, mainly affected by management level and institutional factors; scale efficiency refers to the impact of changes in the scale of the logistics industry on output, if increasing or decreasing returns to scale are not a manifestation of economies of scale, it is necessary to adjust the scale of production and operation to achieve constant returns to scale, which is the optimal scale of production. [4]

This paper uses DEAP2.1 software to measure logistics efficiency. The decision-making unit (DMU) is 9 prefecture-level cities in Fujian Province, and the selected model is the DEA-BCC model based on input perspective, and finally measures the changes in comprehensive efficiency, pure technical efficiency, scale efficiency, and scale payoff in 9 cities, and the results are shown in Table 3.

Table 3: Logistics efficiency measurement results in Fujian Province

DMU	Fuzhou	Xiamen	Putian	Sanming	Quanzhou	Zhangzhou	Nanping	Longyan	Ningde	Average value
Comprehensive efficiency	1.000	1.000	0.431	0.391	1.000	1.000	0.412	0.684	1.000	0.769
Technical efficiency	1.000	1.000	1.000	0.678	1.000	1.000	0.422	0.964	1.000	0.896
Scale efficiency	1.000	1.000	0.431	0.576	1.000	1.000	0.976	0.710	1.000	0.855
Compensation for size	-	-	irs	irs	-	-	drs	irs	-	-

Note: "drs", "irs", and "-" indicate decreasing returns to scale, increasing returns to scale, and constant returns to scale, respectively.

(1) Comprehensive efficiency analysis

From Table 3, we can see that the average value of the comprehensive efficiency of logistics of the cities in Fujian Province in 2020 is 0.769, among which the comprehensive efficiency of

Fuzhou, Xiamen, Quanzhou, Zhangzhou, and Ningde is 1, which reaches DEA effective and is in the leading position among the 9 prefecture-level cities in Fujian Province, indicating that the "input-output" of logistics in these 5 cities is more balanced, in the case of a certain input to achieve the maximum output. The five cities are located in the coastal urban contiguous belt, convenient transportation, logistics technology is more developed, and by the "Maritime Silk Road", freight demand has increased greatly, so the input can reach the maximum output. Putian, Sanming, Nanping, and Longyan's comprehensive efficiency did not reach the average, the reason for this phenomenon may be related to the economic structure and development direction of the four cities, including Sanming, Nanping, and Longyan's geographical location in the western part of Fujian Province, but most logistics enterprises will be warehouses, transit stations and other logistics facilities built in coastal cities in Fujian Province, resulting in a regional imbalance in logistics development.

(2) Pure technical efficiency analysis

As shown in Table 3, Fuzhou, Xiamen, Putian, Quanzhou, Zhangzhou, and Ningde all have a pure technical efficiency of 1 in 2020, which shows that these six cities make full use of logistics resources and can reasonably allocate and use human, material, and financial resources. However, by comparing the overall efficiency with the pure technical efficiency, Sanming and Nanping have a lower pure technical efficiency than the average value in Fujian Province, so these two cities should further make full use of the existing resources and promote the overall comprehensive efficiency of logistics by improving the pure technical efficiency.

(3) Scale efficiency analysis

Table 3 shows that the scale efficiency of Fuzhou, Xiamen, Quanzhou, Zhangzhou, and Ningde are all 1. Nanping City, although its scale efficiency is not 1, is on the edge of being effective, indicating that Nanping City only needs a slight adjustment in the scale of the logistics industry to achieve scale effectiveness. Among the nine cities in Fujian Province, the scale efficiency of Putian, Sanming, and Longyan are all below the average level, among which the technical efficiency of Sanming is 1, but because of its low scale efficiency, it affects its overall logistics efficiency. Therefore, Sanming should adjust its logistics industry's scale and structure to rationalize the industrial scale's development and improve the comprehensive efficiency of logistics.

(4) Compensation for scale

Among the nine prefecture-level cities in Fujian Province, Fuzhou, Xiamen, Quanzhou, Zhangzhou, and Ningde reach a constant scale payoff in 2020, Putian, Sanming, and Longyan have increasing scale payoffs, and only Nanping City had decreasing scale payoffs in 2020. Perhaps due to the limitations of Nanping's geographical location and labor market, the required inputs for the logistics industry are not met. The three cities of Putian, Sanming, and Longyan can further improve the comprehensive efficiency of logistics by adjusting the scale and structure of the logistics industry or enhancing the efficiency of resource allocation.

4.3. Evaluation of Logistics Service Quality Based on Entropy Power Method

4.3.1. Calculation Steps

Since there is little information on the evaluation of logistics service quality in Fujian Province, this paper adopts the objective weighting method to determine each index's weight to ensure the scientific rationality of the index weight setting. [5-6] The entropy weighting method is widely used today. In this paper, the weights of indicators are determined by standardizing the original data and using the entropy weighting method, and the weights of indicators related to logistics service quality in nine prefecture-level cities in Fujian Province are mainly calculated. [7]

4.3.2. Data Source and Processing

The data relating to logistics service quality in Fujian Province are mainly taken from the relevant bulletins of the Fujian Provincial Postal Administration and the postal administrations of prefecture-level cities in Fujian Province, some of which are calculated and collated by the authors. This paper mainly selects four indicators, such as the cumulative completion of express business volume, the average daily postal delivery frequency, the number of express service business outlets, and the effective complaint rate of one million pieces, as the relevant indicators for evaluating the regional logistics service quality in Fujian Province. The specific relevant index data are shown in Table 4.

Table 4: Data of logistics service quality-related indicators by prefecture-level cities in Fujian Province

Fujian Province prefecture-level city	Express delivery business volume cumulative completion (million pieces)	Average daily postal delivery frequency	Courier Service Number of sales outlets	Millions of pieces Effective complaint rate
Fuzhou	54353.58	2.31	1453	1.20
Xiamen	59050.73	3	609	1.26
Putian City	19799.64	2.37	743	1.61
Sanming	4766.69	1.92	492	0.85
Quanzhou	216624.16	1.93	781	0.69
Zhangzhou	37001.03	1.77	767	1.15
Nanping	6055.98	1.98	324	0.93
Longyan	7506.02	1.55	650	0.47
Ningde	9854.42	1.86	515	1.27

The indexes were standardized by Matlab software, and the relevant data after standardization are shown in Table 5.

Table 5: Standardization of logistics service quality-related indicators

Fujian Province prefecture-level city	Express business volume Cumulative completion	Average daily postal delivery frequency	Courier Service Number of sales outlets	Millions of pieces Effective complaint rate
Fuzhou	1.2341	1.5241	2.0000	1.6404
Xiamen	1.2562	2.0000	1.2524	1.6930
Putian	1.0710	1.5655	1.3711	2.0000
Sanming	1.0000	1.2552	1.1488	1.3333
Quanzhou	2.0000	1.2621	1.4048	1.1930
Zhangzhou	1.1522	1.1517	1.3924	1.5965
Nanping	1.0061	1.2966	1.0000	1.4035
Longyan	1.0129	1.0000	1.2888	1.0000
Ningde	1.0240	1.2138	1.1692	1.7018

4.3.3. Service Quality Evaluation Based on Entropy Method

(1) Determination of weights

The program is executed to obtain specific values of the relevant indicators' normalization matrix, Eigen weight, conditional entropy, entropy value, coefficient of variation, or entropy weight. The Weights of logistics service quality indicators in Fujian Province are shown in Table 6.

Table 6: Weights of logistics service quality indicators in Fujian Province

Indicators	Express business volume Cumulative completion	Average daily postal delivery frequency	Courier Service Number of sales outlets	Millions of pieces Effective complaint rate
Entropy value	0.9875	0.9910	0.9916	0.9916
Entropy power	0.3262	0.2352	0.2185	0.2201

(2) Service quality scoring results

The final evaluation results of logistics service quality in Fujian Province are shown in Table 7. The overall data results show that there are three cities above 1.5, namely, Fuzhou, Xiamen, and Quanzhou, indicating that these three cities are in the leading position in Fujian Province, with good service quality and can meet the needs of local residents. 1.2 to 1.5 cities include Putian, Zhangzhou, and Ningde, while Sanming, Nanping, and Longyan are below 1.2, indicating that their logistics service quality needs further improvement. The overall logistics service quality in Fujian Province is good. The overall logistics service quality in Fujian Province is good, but there are still relatively obvious differences between cities in the east and west.

Table 7: Evaluation results of logistics service quality in Fujian Province

Fujian Province prefecture-level city	The cumulative volume of express delivery service was completed	Average daily postal delivery frequency	Courier Service Number of sales outlets	Millions of pieces Effective complaint rate	Logistics Services Quality
Fuzhou	0.4026	0.3585	0.4371	0.3610	1.5591
Xiamen	0.4098	0.4704	0.2737	0.3726	1.5264
Putian City	0.3494	0.3682	0.2996	0.4401	1.4573
Sanming	0.3262	0.2952	0.2511	0.2934	1.1659
Quanzhou	0.6524	0.2968	0.3070	0.2625	1.5188
Zhangzhou	0.3759	0.2709	0.3043	0.3513	1.3023
Nanping	0.3282	0.3049	0.2185	0.3089	1.1605
Longyan	0.3304	0.2352	0.2816	0.2201	1.0673
Ningde	0.3341	0.2855	0.2555	0.3745	1.2495

4.4. Analysis of the Results of the Comprehensive Evaluation of the Logistics Environment in Fujian Province

According to the above data of evaluation results of logistics efficiency and logistics service

quality of 9 prefecture-level cities in Fujian Province, after standardized processing, the entropy weight method is once again adopted. Through the calculation, the final evaluation results of the logistics environment of 9 prefecture-level cities in Fujian Province are obtained, and the comprehensive rating of the logistics environment of each city is ranked, as shown in Table 8.

The complete data of comprehensive evaluation shows that 5 cities in Fujian Province have a comprehensive evaluation value of 1.5 or more in a logistics environment, and 2 cities between 1.2 and 1.5, indicating that more than 2/3 of cities in Fujian Province have a better development of logistics environment, but there are still 1/3 of cities that need further construction and development of logistics environment. From the spatial perspective, the development of the logistics environment in coastal areas of Fujian Province is higher than that of inland cities in Fujian Province, and there is the problem of uncoordinated regional logistics development, and corresponding measures should be taken to ensure the balanced development of overall logistics industry in Fujian Province.

Table 8: Comprehensive evaluation results of regional logistics environment in Fujian Province

Ranking	Fujian Province prefecture-level city	Regional logistics efficiency Rate the value	Regional Logistics Service quality evaluation value	Regional Logistics Environment Comprehensive evaluation value
1	Fuzhou	1	1.559	2.0000
2	Xiamen	1	1.526	1.9731
3	Quanzhou	1	1.519	1.9669
4	Zhangzhou	1	1.302	1.7889
5	Ningde	1	1.25	1.7455
6	Putian	0.431	1.457	1.3597
7	Longyan	0.684	1.067	1.2866
8	Nanping	0.412	1.161	1.0971
9	Sanming	0.391	1.166	1.0810

5. Suggestions for the Development of the Logistics Environment in Fujian Province

Through the empirical analysis of the comprehensive evaluation of the regional logistics environment in Fujian Province, it can be found that most of the cities with high comprehensive scores of logistics environment are located in the more developed coastal economic areas, and the logistics efficiency and logistics service quality of inland or economically backward cities are generally lower. Through the analysis of the logistics environment of each city in Fujian Province, it is found that there are some differences in the development level of the logistics industry in the east and west of Fujian Province due to the differences in resource allocation, economic investment, and infrastructure construction of each city. In the comprehensive conclusion of the above empirical analysis, in order to improve the level of regional logistics in Fujian Province and promote the development of the overall logistics industry in Fujian Province, the following suggestions are made.

5.1. Optimize the Division of Labor among Cities and Improve the Spatial Layout of Logistics

By analyzing and sorting out the current situation of regional logistics development and logistics environment of each city in Fujian Province, it is found that Sanming, Nanping, and Longyan, as the western cities in Fujian Province, have lower comprehensive logistics evaluation than the eastern cities in Fujian Province, which indicates that there is the problem of uncoordinated development of each place in Fujian Province. If each local government acts separately, this will

not be conducive to the flow of logistics resources among cities, which will easily cause the waste of some logistics resources and the problem of insufficient logistics resources in some areas. Therefore, it is necessary to integrate logistics resources cross-city in order to deepen the reform of the logistics management system. By optimizing the division of labor and collaboration among cities, we can make full use of the advantages of each city's resources and geographical location, reduce the differences existing in the regional logistics spatial layout in Fujian Province, and then improve the overall level of the regional logistics environment in Fujian Province. On the one hand, through hiring consulting companies or cooperating with authoritative universities or scientific research institutions in the field of logistics to conduct research and analysis, we can put forward practical suggestions on the overall development plan of regional logistics in Fujian Province and promote the rationalization of urban logistics division of labor. On the other hand, through the formulation of relevant incentive policies, the market and policy barriers of each city can be eliminated, and the rational allocation of logistics resources such as human, material, and financial resources in the province can be guided.

5.2. To Enhance Regional Economic Development and Solidify the Foundation of Logistics Development

By reviewing the relevant literature, we can find that the construction and development of the logistics environment are closely related to the level of regional economic development. The construction of "One Belt and One Road" should be the focus, and Fujian Province, as the core area of the "21st Century Maritime Silk Road", has a rare historical opportunity for economic development. However, at present, there are problems such as uneven distribution of economic spatial structure, lack of radiation in the central cities of the economy, and obvious differences in the level of economic development among cities in Fujian Province. Fujian Province mainly takes Xiamen City and Fuzhou City as the economic center cities, but compared with other economic center cities in China, there is still a certain gap in their development level, and it is difficult to play a radiating role in the economic development of neighboring cities. Therefore, Fujian Province should give priority to strengthening the economic construction of Xiamen and Fuzhou, and at the same time, the potential of economic growth should be fully explored for the relatively backward cities. For example, Sanming City has rich graphite resource reserves, and if Sanming City is guided to transform and upgrade its traditional industrial structure to a new industrial city, then Sanming City's economic development will have great development potential. Only by upgrading the overall economic development of Fujian Province can we provide a basic guarantee for the development of regional logistics.

Through the analysis and measurement of logistics efficiency of cities in Fujian Province, it is found that the scale efficiency of Putian, Sanming, and Longyan is low. There are two main reasons for the low scale efficiency, one is the lack of production factor inputs to produce the scale effect, and the other is that all kinds of production factor inputs are not reasonably allocated and fail to give full play to their roles. By analyzing the specific data of each city, we can find that Sanming, Nanping, and Longyan all lack the investment of infrastructure, among which Sanming also lacks the investment of capital. Logistics infrastructure as a fundamental element in supporting the development of logistics, including roads, railroads, ports, and other comprehensive transportation infrastructure networks and logistics parks, outlets, and other logistics operation facilities. Compared with the other six prefecture-level cities in Fujian Province, the three cities are located in the interior of Fujian Province, limited by the constraints of the hilly terrain. The economic hinterland is relatively small. Therefore, Fujian Province should increase the construction of logistics infrastructure in Sanming, Nanping, and Longyan City, and improve the financial support

in order to further promote the development of the logistics industry and thus enhance the overall economic development of Fujian Province. [8]

5.3. Strengthen the Logistics Industry Technology Innovation, Improve Resource Utilization

By analyzing the logistics efficiency of each city, we can find that the pure technical efficiency of Sanming and Nanping is lower than the average level of each city in Fujian Province. The low pure technical efficiency is mainly due to the cities' insufficient technological innovation and failure to effectively utilize the cities' logistics resources, resulting in the low utilization of logistics production factors. In order to improve the problem of low utilization efficiency, the government needs to create a suitable environment for logistics technology innovation and strengthen the importance and investment in technology innovation. The Yangtze River Delta region has developed an economy and gathered a large number of universities with outstanding scientific research and innovation ability, compared with the weak innovation ability in Fujian Province. First of all, the government can encourage enterprises and research institutions to make innovative attempts in logistics facilities, technology, and management mode by setting up special funds, hiring experts to provide remote technical guidance, and encouraging logistics enterprises to reach cooperation with universities in production, learning, and research, etc., so as to provide more personalized logistics services that can meet the needs of today's market. Secondly, the government should improve the policy of talent introduction and talent incentive to attract more outstanding talents to Fujian for employment, improve the logistics innovation environment in Fujian Province, and enhance the logistics innovation capability. Finally, the government can guide logistics enterprises to cooperate by establishing logistics industry alliances, jointly promoting the construction of logistics informatization, innovating the form of information sharing, and forming the scale of operation, so as to optimize the allocation of resources and improve the utilization efficiency of logistics resources in each city. [9-10]

6. Conclusion

This paper takes the regional logistics environment in Fujian Province as the research object, analyzes the current situation of the logistics environment in Fujian Province on the basis of a comprehensive review of the existing literature and relevant theoretical studies, and analyzes the problems and reasons for the development of regional logistics in Fujian Province. The main conclusions of this paper are as follows.

First, the logistics industry in Fujian Province is currently in a stage of rapid development, the scale of the logistics industry is expanding, and the infrastructure is becoming more and more perfect, but the added value of the logistics industry as a proportion of GDP has declined in recent years, mainly due to its infrastructure settings and supporting services are not perfect, the relevant departments of the logistics industry in Fujian Province is not enough to coordinate the supervision, the overall competitiveness of logistics enterprises is not strong, so the development of the logistics environment in Fujian Province There is still more room for improvement.

Second, by referring to previous research results, this paper establishes corresponding evaluation index systems for logistics efficiency and logistics service level, respectively. Regarding the evaluation of logistics efficiency, this paper selects three input indicators from three perspectives of economy, infrastructure, and human resources: The number of road miles reached at the end of the year, the number of employees in transportation, storage, and postal industry units at the end of the year, and the amount of investment in fixed assets in transportation, storage, and postal industry, and two output indicators from two perspectives of business volume and revenue: the amount of cargo turnover, and the added value of transportation, storage, and postal industry. Regarding the

quality of logistics services, four indicators are selected in this paper: cumulative completion of express business volume, average daily postal delivery frequency, number of express service business outlets, and effective complaint rate of one million pieces.

Thirdly, this paper takes nine prefecture-level cities in Fujian Province as the research objects for the comprehensive evaluation of the logistics environment, measures the logistics efficiency of each city with the help of the DEA model, and draws the following main conclusions. From the perspective of the comprehensive efficiency of the logistics environment of each city in Fujian Province, Sanming City has the lowest comprehensive efficiency of logistics, and there are large differences in the logistics efficiency of each city. Among them, Putian City has high technical efficiency, but its scale efficiency is low, which affects its comprehensive efficiency value, and the lack of scale of its logistics industry is an important reason for the low scale efficiency.

Fourth, this paper evaluates the logistics service quality of each city in Fujian Province with the help of Matlab software and the entropy weight method. The empirical results show that the logistics service quality of Sanming, Nanping, and Longyan is also relatively low, which shows that the logistics service quality is closely related to the construction and investment of logistics infrastructure, and Fujian Province should make good use of the resources and advantages of coastal cities to vigorously develop and finance inland cities to meet the demand of urban development for the logistics industry, and then improve the logistics service quality.

Finally, the entropy weight method is used again for the comprehensive evaluation of logistics efficiency and service quality. Based on the results of the empirical analysis of the comprehensive evaluation of the logistics environment in Fujian Province, it can be found that Fuzhou, Xiamen, and Quanzhou have the highest comprehensive rating of the logistics environment in Fujian Province, while Sanming, Nanping, and Longyan have relatively low comprehensive ratings. Given the above phenomenon, this paper puts forward the corresponding measures and suggestions in a targeted manner.

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