The Evaluation Research of Guangxi Beibu Gulf Port Production Efficiency based on Super Efficiency DEA

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Abstract-The production efficiency of the Beibu Gulf port of Guangxi is studied. The author selects the input output index system, including the input parameters of the terminal length, the number of berths, berth cargo capacity, the annual capacity of the berth container, and the output indicators include cargo throughput and container throughput. And then the CCR-DEA and DEA evaluation models are established. The study found that the technical efficiency and scale efficiency of the Beibu Gulf port in the 10 major ports in the coastal area were the lowest, and the scale efficiency decreased. In the past years, the comprehensive efficiency of the Beibu Gulf port increased year by year.

Keywords-Super Efficiency DEA; Input; Output; Production Efficiency; Port

I. INTRODUCTION

Beibu Gulf port area includes Beihai harbor area, Fangcheng harbor and Qinzhou harbor, with business scope including port and dock construction, international and domestic container, internal and external trade miscellaneous pieces of bulk cargo loading and unloading, and storage of goods transit, transit of dangerous goods storage, cargo agents, ocean shipping tally, commerce and trade. It has 241 berths, 241 kilometers long pier length, berth cargo capacity of 12611 kilometers and the annual cargo throughput reaches 186740000 tons.

Beibu Gulf port grasps the opportunity to play to the strengths, transfer and adjustment of structure, developing and expanding the port operation industry, further taping the potential of south southwest of new sources, focusing on exploring new sources of the ASEAN countries, strengthening the administration of ports and corporate governance, and promoting the construction of port infrastructure, and in 2014 it completed port throughput of 123 million tons, an increase of 12%, of which the container finish throughput completed 112 million TEUs, an increase of 11.6%.It achieved operating income of 4237727700 yuan, an increase of 13.87%, total profit of 707954500 yuan, an increase of 3.06%.

The production efficiency of the port is the capacity of the port to allocate the input reasonably, and to obtain the best output.

In the 90s of the 20th century, people began to use DEA models on the port efficiency analysis. Roll and Hayuth (1993) [1] used the DEA models on the analysis of port, but the actual data are not collected to analysis, and the research only stayed in the theoretical level. Martinez-Budria (1999) [2] used the BBC-DEA model for the first time to analyze the cost and efficiency of 26 ports.

Tongzon (2001) [3] used the CCR-DEA model and the DEA model to analyze the data of the 4 ports in Australia and the other 12 international container ports in 1996.

Teng-Fei and Cullinane et al. (2003) and (2006) [4, 5] used the DEA model to evaluate the technical efficiency of the international container ports.

The DEA model is used to study the efficiency of the port and originated from the 90s of the 20th century in China. Chen Junfei et al. (2004) [6] selected tradable shares as input indicators, earnings per share as the output index, and applied the ccr-dea model the relative operational efficiency evaluation on 15 ports listed companies. Pang Ruizhi (2006) [7] studied the technical efficiency of China's 50 major ports with the data from 1999 to 2002. Based on the DEA model, Kuang Haibo et al. (2007)[8,9] used the principal component analysis method to analyze the main influencing factors of port efficiency, and calculated the technical efficiency of the 8 major ports in China. With above comprehensive analysis of domestic and foreign about DEA model in the application of port, this paper can obtain most of the literature are the port cargo throughput and container throughput of port technology research as output indicators.

In this paper, the production efficiency of the Beibu Gulf port is analyzed from two aspects: vertical and horizontal. First of all, the input and output of the main ports in China's coastal regions are compared and analyzed, and then the input and output efficiency of the Beibu Gulf port of 2007-2014 is studied. The countermeasures and suggestions for improving the production efficiency of the Beibu Gulf port are given.

II. INDEX SELECTION AND DATA PROCESSING

The input parameters include the length of the pier, the number of berths, the annual capacity of the berth cargo container, the annual throughput of the berth container, and

the output index include the cargo throughput and container throughput.

TABLE I. INPUT AND OUTPUT INDICATOR DATA OF MAJOR PORTS IN CHINA'S COASTAL AREAS

Serial Number	Port Name	Pier Length	Capacity of Berths	Berth Cargo Capacity	Berth Container Annual Capacity	Cargo Throughput	Container Throughput
1	Beibu	30872	241	12611	355	18674	100
2	Zhanjiang	15542	146	1619	91	18006.18	45.18
3	Guangzhou	55996	696	36460	1174	47200	1550.45
4	Shenzhen	29384	147	23599	2433	23397.96	2327.85
5	Shantou	9627	87	3445	90	5037.90	128.80
6	Haikou	2772	21	1549	101	5619.6	116.8
7	Quanzhou	14619.41	86	2541.4	123.63	10804.51	170.06
8	Xiamen	24431.5	143	14174	964	19087.8	800.8
9	Ningbo	48247	328	20469	1197	49600	1677.4
10	Shanghai	123988	1191	34286	2004	50000	2004

TABLE II. INPUT AND OUTPUT INDICATOR 2007-2013 DATE IN THE BEIBU GULF PORT

Serial Number	Port Name	Pier Length	Capacity of Berths	Berth Cargo Capacity	Berth Container Annual Capacity	Cargo Throughput	Container Throughput
1	2013	30872	241	12611	355	18674	100
2	2012	30624	227	12311	350	17438	82.43
3	2011	27136	217	11181	220	15330.6	73.82
4	2010	24694	211	10341	130	11923.04	130
5	2009		201	9676	130	9407.9	34.87
6	2008		165	8089	55	7785.9	33.6
7	2007		166	6668.5	55	7190.2	27.42

III. EFFICIENCY ANALYSIS

A. *Horizontal Contrast Analysis*

As can be seen from the above table, the overall efficiency of the ports is relatively effective: Zhanjiang port, Shenzhen port, Shantou port, Haikou port, Quanzhou port, and Ningbo port. The technical efficiency and the scale of efficiency of Beibu Gulf port are at the lowest in all 10 ports, and Returns to scale declined in revenue.

TABLE III. EFFICIENCY TABLES OF THE PORTS

Firm	crste	vrste	scale	lb
Beibu	0.508	0.731	0.695	drs
Zhanjiang	1.000	1.000	1.000	-
Guangzhou	0.940	0.964	0.975	drs
Shenzhen	1.000	1.000	1.000	-
Shantou	1.000	1.000	1.000	-
Haikou	1.000	1.000	1.000	-
Quanzhou	1.000	1.000	1.000	-
Xiamen	0.741	0.828	0.895	drs
Ningbo	1.000	1.000	1.000	-
Shanghai	0.714	1.000	0.714	drs

As can be seen from Table 4, in the fixed input the same premise, to further increase container throughput 2,979,790 tons, it can be seen from Table 5, in keeping output unchanged, redundancy into each input indicators respectively quay length 7523.382 km, berth number 51.557, berth annual capacity of 64,925,420 tons of goods.

TABLE IV. OUTPUT INDACATORS SLACK VARIABLE VALUE (LESS OUTPUT VALUE)

Firm	Cargo Throughput	Container Throughput
Beibu	0.000	297.979
Zhanjiang	0.000	0.000
Guangzhou	0.000	35.752
Shenzhen	0.000	0.000
Shantou	0.000	0.000
Haikou	0.000	0.000
Quanzhou	0.000	0.000
Xiamen	0.000	0.000
Ningbo	0.000	0.000
Shanghai	0.000	0.000

TABLE V. INPUT INDACATORS SLACK VARIABLE VALUE (INPUT REDUNDANCY VALUE)

Firm	Port Name	Pier Length	Capacity of Berths	Berth Cargo Capacity
Beibu	7523.382	51.557	6492.542	0.000
Zhanjiang	0.000	0.000	0.000	0.000
Guangzhou	8429.122	371.785	16382.998	0.000
Shenzhen	0.000	0.000	0.000	0.000
Shantou	0.000	0.000	0.000	0.000
Haikou	0.000	0.000	0.000	0.000
Quanzhou	0.000	0.000	0.000	0.000
Xiamen	2422.237	0.000	3011.095	151.390
Ningbo	0.000	0.000	0.000	0.000
Shanghai	0.000	0.000	0.000	0.000

TABLE VI. BEIBU GULF PORT INPUT AND OUTPUT OF EACH INDICAOR TARGET

Variable	Original Value	Radial Movement	Slack Movement	Projected Value
Cargo Throughput	18674.000	6873.562	0.000	25547.562
Container Throughput	100.000	36.808	297.979	434.788
Port Name	30872.000	0.000	-7523.382	23348.618
Pier Length	241.000	0.000	-51.557	189.443
Capacity of Berths	12611.000	0.000	-6492.542	6118.458
Berth Cargo Capacity	355.000	0.000	0.000	355.000

IV. DYNAMIC ANALYSIS OF THE PRODUCTION EFFICIENCY OF BEIBU GULF PORT

TABLE VII. 2007-2013 EFFICIENCY VALUE OF BEIBU GULF PORT

DMU	2013	2012	2011	2010	2009	2008	2007
Score	100.00%	100.00%	93.40%	100.00%	65.66%	65.00%	72.82%
DMU	2013	2012	2011	2010	2009	2008	2007
Score	108.16%	104.67%	93.40%	162.52%	65.66%	65.00%	72.82%

TABLE VIII. THE INPUT ANED OUTPUT OF EACH INDICATOR TARGET NUMBER OF BEIBU GULF PORT IN 2007-2013

Serial Number	Year	Pier Length	Capacity of Berths	Berth Cargo Capacity	Berth Container Annual Capacity	Cargo Throughput	Container Throughput
1	2013	30872.000	241.000	12611.000	355.000	18674.000	100.000
2	2012	30624.000	227.000	12311.000	350.000	17438.000	82.430
3	2011	27136.000	217.000	11181.000	220.000	15330.600	73.820
4	2010	24694.000	211.000	10341.000	130.000	11923.040	130.000
5	2009	24694.000	201.000	9676.000	113.501	10941.805	108.055
6	2008	24694.000	165.000	8089.000	55.000	7785.900	33.600
7	2007	24694.000	166.000	6668.500	55.000	7190.200	27.420

V. COUNTERMEASURES AND SUGGESTIONS

On the basis of the actual situation of the overall listing of major asset restructuring, the Beibu Gulf port needs to further improve the strategic positioning and deployment, get Function adjustment and orientation of Beihai Port, Qinzhou Port, Fangchenggang zone, create specialized port services platform to enhance the efficiency of port services and business competitiveness to create a professional port service platform, improve the port service efficiency and business competitiveness.

Strengthen the port infrastructure construction and technological transformation, improve the port service refinement management, and constantly improve the efficiency and service level. Promote the management of port operations information. Strengthen the management of the scene. Actively expand the sea rail transport business, encryption liner routes, sea and rail transport continued to develop steadily, and the port sector to achieve new progress in communication and cooperation.

Formulate and revise a series of internal control management system, strengthen internal management to adapt to the new situation, new work requirements, the production of business management to achieve the basic system, standardization, process oriented. The company's overall management level has been significantly improved, the development strategy to promote the plan. After the text edit has been completed, the paper is ready for the template. Duplicate the template file by using the Save As command, and use the naming convention prescribed by your conference for the name of your paper. In this newly created file, highlight all of the contents and import your prepared text file. You are now ready to style your paper.

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