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Qualitative Comparative Analysis of the Factors Affecting the Logistics Capacity of Coastal Ports

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Abstract: By using the method of fuzzy set qualitative comparative analysis (fsQCA), taking 15 coastal ports in China as research samples, this paper selects five representative variables from the two dimensions. This paper makes a configuration analysis of the factors affecting the logistics capacity of coastal ports. It is found that the logistics capacity of coastal ports is affected by many factors; the berths of 10,000-ton terminals and the total GDP of port cities are the key factors affecting port logistics capacity.

Keywords: Port; Logistics Ability; Configuration; QCA

Introduction

As the distribution center and hub of the integrated marine transport network, the functional optimization and structural upgrading of the port are of great significance to the global transportation system.

Research on the evaluation of port logistics capability: Du Linjuan [1]analyzed the strengths, weaknesses, opportunities and threats of Lianyungang port, and constructed the evaluation index system of port logistics capability. Guo Donglei[2]uses the correlation-principal component analysis method to screen the indicators of Tianjin Port logistics capacity and hinterland economy, and uses the compound system collaborative evaluation model to evaluate, which confirms the common development and interdependence of port logistics capacity and hinterland economy. Research on the influencing factors of port logistics capability: Sun Xiaobo[3] selects the scale of port logistics, supporting facilities, the ability of sustainable development of port logistics and the economic situation of port economic hinterland as the first-class index to analyze the logistics capacity of Zhuhai Port. Research on the analysis method of port logistics capability: Liu Kui[4]combines grey correlation analysis and factor analysis to extract the main factors that affect the development of port logistics in "Belt and Road Initiative" country. Guo Zhen[5]makes a comparative analysis of the port logistics competitiveness of Qinzhou Port and other domestic ports based on factor analysis.

To sum up, most studies are limited to single factor analysis after selecting indicators, and there are few studies on the configuration of multiple concurrent causality among the influencing factors. Therefore, this paper uses QCA method to analyze the logistics capacity of 15 coastal ports, puts forward the corresponding optimization methods from the key factors affecting port logistics capacity.

1. Research and design

1.1 Sample selection and data sources

This paper selects 15 coastal ports, and takes the berths of 10,000-ton wharf, the total amount of GDP in port cities, the proportion of tertiary industry in GDP, the volume of water cargo transport and the growth rate of foreign trade import and export volume as samples to collect data.

1.2 Variable selection

1.2.1 Result variable

This paper adopts the viewpoint of Lin Hua[6]and Yue Chaolong[7], and thinks that the economic benefit of the port is the core element to reflect the value of the port, the data of container throughput and cargo throughput can be used to show the relevant situation of port economic benefits.

1.2.2 Conditional variable

(1) Basic supporting capacityberth number of 10,000-ton wharf——berth number of 10,000-ton wharf. LV Liqun[8]pointed out that the number and size of berths are very important to cargo throughput and are important indicators of port scale, and stressed that the number of berths in 10,000-ton wharves can more directly reflect port cargo throughput.

(2) The supporting capacity of the port hinterland——the total GDP of the port city, the proportion of the tertiary industry in regional GDP, the transport volume of waterborne goods, and the growth rate of foreign trade import and export.

a) Chen Liuying[9]believes that the direct economic aggregate of the hinterland near the port is an important index to evaluate the logistics capacity of a port.

b) Zhuang Yankun[10]believes that the development of the tertiary industry in port-adjacent cities is an important source of port throughput, and the larger the agglomeration scale, the greater the demand for port services.

c) Mo Jinju[11] takes the waterway freight volume as one of the indicators to reflect the scale of port logistics in the evaluation of port logistics capacity,the results show that the freight volume in a certain period of time can reflect the achievements and economic status of transportation production.

d) Foreign trade is also one of the important indicators to evaluate economic development. There is a positive correlation between the import and export volume of urban foreign trade and the role of port logistics.

2. Application analysis

2.1 Research methods

QCA emphasizes the causal relationship between conditional configuration and results, because a single cause element can not determine the final result, and it is necessary to produce a specific result through the combination of multiple elements.

2.2 Data calibration and conversion

In this paper, the direct calibration method of fsQCA is adopted.The anchor point is determined by using the quartile, and the upper quartile (75% quartile), the mean (50% quartile) and the lower quartile (25% quartile) of the sample data are used as the full membership point, intersection point and complete non-membership point of the calibration. The results are shown in tables 1:

Table 1 Calibration anchor point for each variable

Variable type	Variable name	Anchor point		
		Completely subordinate	Intersection	Not subordinate at all
Result variable	Logistics capacity of coastal ports	18791.5	11605.5	6607.4
Conditional variable	Berth number of 10,000-ton wharf	100.5	75	51.5
	Total GDP of port city	14056	7002	1949
	The proportion of tertiary industry in regional GDP	0.63	0.53	0.48
	Waterborne cargo transport volume	11736	5255	890
	Growth rate of foreign trade import and export volume	0.097	0.018	-0.029

2.3 Results of data analysis

2.3.1 Necessity analysis

Necessity test is an important part of QCA, which is used to test whether the result depends on a certain variable. The necessity of a single conditional variable affecting the result variable is less than 0.9, indicating that each conditional variable can not be used as a necessary condition for the result variable.

Table 2 Necessity detection of single conditional variable

Variate	Consistency	Coverage rate
Waterborne cargo transport volume	0.747159	0.686684
Growth rate of foreign trade import and export volume	0.522727	0.506887
Berth number of 10,000-ton wharf	0.849432	0.8125
Total GDP of port city	0.866477	0.847222
The proportion of tertiary industry in regional GDP	0.704546	0.67483
~ Growth rate of foreign trade import and export volume	0.548295	0.498708
~ Berth number of 10,000-ton wharf	0.274148	0.252618
~ Waterborne cargo transport volume	0.397727	0.381471
~ Total GDP of port city	0.318182	0.287179
~ The proportion of tertiary industry in regional GDP	0.450284	0.414379

2.3.2 Configuration analysis

In this paper, following the suggestion of Du Yunzhou[12], the consistency threshold is set to 0.8, and the case frequency threshold is set to 1. The complex solution, simplified solution and intermediate solution are obtained by using faQCA3.0 software.

Table 3 Configuration results of the improvement of Port Logistics capability

Conditions	Configuration 1	Configuration 2	Configuration 3	Configuration 4
Waterborne cargo transport volume	⊗	•	•	⊗
Growth rate of foreign trade import and export volume	⊗	•	⊗	•
Berth number of 10,000-ton wharf	●	●	●	●
Total GDP of port city	●	●	●	●
The proportion of tertiary industry in regional GDP	⊗	⊗	•	•
Consistency	0.946236	1	0.922865	1
Original coverage	0.125	0.174716	0.475852	0.159091
Unique coverage	0.0411932	0.112216	0.37642	0.103693
Total coverage rate		0.757102		
Total consistency		0.941696		

Note: "•"and"⊗" represent the edge condition,"●"and"⊗" represent the core condition.

(1) Path 1 indicates that the number of berths of 10,000-ton wharf and the total port GDP are the core conditions, the coordination of the two can improve the logistics capacity of the port, and the other is the marginal condition.(2) The second path indicates that the growth rate of waterborne goods transport volume and foreign trade import and export volume is not only an auxiliary condition, but also an indispensable factor, and the proportion of the tertiary industry in regional GDP is the marginal condition.(3) Path 3 indicates that the volume of waterborne goods and the proportion of the tertiary industry in regional GDP are indispensable auxiliary conditions, while the growth rate of foreign trade import and export volume is the marginal condition.(4) Path 4 indicates that the growth rate of foreign trade import and export volume and the proportion of tertiary industry in regional GDP are the supporting conditions, while the volume of waterborne goods is the marginal condition.

3. Countermeasure and suggestion

(1) The berth number of 10,000-ton wharf is the basis of port foundation supporting capacity, so we should focus on the construction of port infrastructure, such as increasing the number of berths of large-scale specialized wharf and improving the carrying capacity of goods. The total GDP of the port city is the basis of the supporting capacity of the port hinterland, which promotes the development of coastal port logistics through the economic development of the port hinterland.

(2) Through the four paths, we can see that none of the conditional variables can directly promote the improvement of port logistics capacity, and the sufficient condition for the promotion of port logistics capacity is the configuration of multiple

conditional variables, therefore, each port should not only pay attention to a single influence factor, but should promote the improvement of logistics capability from an overall point of view.

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