Study on the Choice of Marine Leading Industries in Guangdong Province

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Abstract—Firstly, the cumulative method is used as the evaluation criterion, secondly, the structural deviation component and competitive deviation component in Esteban model are used as the evaluation index, and then the weight of each index is calculated by the entropy method for comprehensive evaluation. Finally, according to the principle that the comprehensive score is greater than 0.083, the leading marine industries in Guangdong Province are determined. This study provides a reference for the development of marine industry in Guangdong Province.

Keywords—marine leading industry; Esteban model of dynamic deviation share; location entropy

In 2018, the added value of the primary, secondary and tertiary industries of the marine industry in Guangdong Province was 32.85 billion yuan, 716.99 billion yuan and 1,182.75 billion yuan respectively. The marine leading industry is an industry that occupies an important proportion in the overall marine economy, has strong industrial linkages, has a fast growth rate, has a strong driving effect on the development of industries, and is in a dominant position in the industrial system. How to rationally choose the marine leading industry is an urgent problem to be solved. Wang Yujia used the SSM method to select the marine industry in Guangdong Province.[1] Yuxuan used SSM and location entropy to evaluate the marine industry. However, scholars have not noticed the insufficiency of SSM methods and data processing problems.[2] In this study, the resource allocation component is introduced in the SSM model, the dynamic SSM method is used to process the marine industry output value, and the cumulative method is used to determine the marine leading industry selection benchmark.[3] Therefore, the marine leading industry in Guangdong Province can be more accurately determined.

I. RESEARCH METHOD

A. Esteban Model for Dynamic Deviation-Share Analysis

The traditional deviation share model does not consider the interaction between the impact of industrial structure and the impact of competition. Therefore ESTEBAN-MARQUILLAS (1972) introduced an isomorphic variable called resource allocation to explain this interaction. Dynamic Deviation-Share Analysis The Esteban model introduces dynamic ideas into the model, calculates changes in each period, and makes full use of economic data to determine the benchmarks for marine leading industries.[4]

the deviation-share decomposition formula can be obtained by

\[
b_{j,t} = \hat{b}_{j,0} + \sum_{k=1}^{n} \left( b_{j,k} - \hat{b}_{j,0} \right) \left( g_{j,k} - \hat{g}_{j} \right)
\]

among \( g = \frac{\sum_{j=1}^{n} (b_{j,t} - b_{j,0})}{\sum_{j=1}^{n} b_{j,0}}, \)

\[
g_{j} = \frac{b_{j,t} - b_{j,0}}{b_{j,0}},
\]

\[
\hat{g}_{j} = \frac{b_{j,t} - \hat{b}_{j,0}}{\hat{b}_{j,0}}
\]

\( b_{j,0} \) and \( b_{j,t} \) express the total economic scale of the region in the base year and the end year. \( \hat{b}_{j,0} \) and \( \hat{b}_{j,t} \) express the scale of the region \( \hat{j}'s \) first industrial \( j \) in the base year and the end year respectively. \( B_{j,0} \) and \( B_{j,t} \) express the total economic scale of the country in the corresponding period in the base year and the end year. \( B_{j,0} \) and \( B_{j,t} \) express the scale of the country's industrial sector \( j \) in the base year and the end year respectively.

\[
A_{j} = \hat{b}_{j,0} \hat{g}_{j} - \hat{g}_{j}
\]

\[
= (\hat{b}_{j,0} - \hat{b}_{j,0}) \hat{g}_{j} - \hat{g}_{j}
\]

\[
= (\hat{b}_{j,0} - \hat{b}_{j,0}) \hat{g}_{j} - \hat{g}_{j}
\]

\[
= \sum_{k=1}^{m} \left( \hat{b}_{j,0} - \hat{b}_{j,0} \right) \hat{g}_{j}
\]

\[
= \sum_{k=1}^{m} A_{j}^{k}
\]

\( A_{j}^{k} = \hat{b}_{j,0} \hat{g}_{j} - \hat{g}_{j}
\]

\[
(i=1,2,\cdots,m \quad j=1,2,\cdots,n \quad k=1,2,\cdots,t)
\]

Therefore

\[
A_{j}^{k} = (\hat{b}_{j,0} - \hat{b}_{j,0}) \hat{g}_{j} - \hat{g}_{j}
\]

Similarly, we can deduce the formula of share component \( N_{j} \), industrial structure component \( P_{j} \) and competitiveness component \( D_{j} \).
B. Benchmark and Weight Calculation of Leading Industry Selection

Esteban model of dynamic deviation share analysis can be used not only in the analysis of economic aggregate, but also in the analysis of various industrial sectors, so as to judge the development trend and current situation basis of each industrial sector, and as an indicator of the choice of leading industries.

There are four variables in Esteban model of dynamic deviation share analysis: share component \( N_{ij} \), industrial structure component \( P_{ij} \), competitiveness component \( D_{ij} \) and resource allocation component \( A_{ij} \). In order to ensure that the average growth rate loses its representativeness, the cumulative method is used to calculate the four components.

The cumulative formula is as follows:

\[
X + X^2 + X^3 + \ldots + X^n = \frac{\sum_{i=1}^{n} X_i}{X_0}
\]  

(4)

After calculating the share component and resource allocation component are constant, that is to say, the fluctuation of data can be completely eliminated when the share component and resource allocation component of each marine industry are calculated by the cumulative method. This shows that the average share component and the average distribution component of all marine industries are exactly the same. It is difficult to judge which industry performs better according to its share and resource allocation. Therefore, it is not necessary to use the share and resource allocation of marine industry as the benchmark for the selection of marine leading industries.

Therefore, this study uses structural deviation benchmark, competitive deviation benchmark and location entropy as the selection benchmark of marine leading industries.

In this study, coordinate translation method is used. The main processes and steps of data processing are as follows:[5]

1) Standardized transformation of data

Let \( d_{ij} \) the original data, \( n_{ij} \) is the standard data and the index conversion formula is

\[
d'_{ij} = (d_{ij} - \bar{d}_j)/s_j
\]  

(5)

Among them, the average value of the \( j \) index is \( \bar{d}_j \), \( s_j \) is the standard deviation of the \( j \) index.

In order to eliminate the negative value, the coordinates are translated into three units.

\[
Z_{ij} = 3 + d_{ij}'
\]  

(6)

2) Assimilate and measure each index, \( p_{ij} \) is the proportion of regional \( i \) index value under the \( j \) index

\[
p_{ij} = \frac{z_{ij}}{\sum_{i=1}^{n} z_{ij}}
\]  

(7)

3) Calculating the Entropy Value \( e_{ij} \) of the \( j \) Index

\[
e_{ij} = -k \sum_{i=1}^{m} p_{ij} \ln p_{ij}
\]  

(8)

Among \( k > 0 \), \( \ln \) is natural logarithm, \( e_{ij} \geq 0 \). If \( d_{ij} \) is all equal for a given \( j \), then

\[
p_{ij} = \frac{d_{ij}}{\sum d_{ij}} = \frac{1}{m}
\]  

(9)

At this point, \( e_{ij} \) takes the maximum value, which is

\[
e_{ij} = -k \sum_{i=1}^{m} \frac{1}{m} \ln \frac{1}{m} = k \ln m
\]  

(10)

If so \( k = \frac{1}{m} \), then there is \( 0 \leq e_{ij} \leq 1 \)

4) Calculating \( g_{j} \) the coefficient of difference of the \( j \) index

For the \( j \) item, the value of \( Z_{ij} \)'s distance is smaller, the \( e_{ij} \) of distance is larger. The greater the difference between the indicators, the smaller \( e_{ij} \) the impact of the indicators on the evaluation system. Defining coefficient of difference

\[
g_{j} = 1 - e_{ij}
\]  

(11)

The \( g_{j} \) of index is bigger, the bigger the function of the index is and the more important the index is.

5) Defining weights

\[
w_{ij} = \frac{g_{j}}{\sum_{j=1}^{n} g_{j}}
\]  

(12)

6) Calculating Comprehensive Economic Benefit Coefficient \( v_{j} \)

\[
v_{j} = \sum_{j=1}^{n} w_{ij} p_{ij}
\]  

(13)

\( v_{j} \) is the comprehensive evaluation value of the region \( i \).

II. EMPIRICAL ANALYSIS ON THE CHOICE OF MARINE LEADING INDUSTRIES

In this study, Esteban model of dynamic deviation-share analysis is constructed. The average industrial structure component \( \bar{P} \), average competitive power component \( \bar{D} \), industrial structure component \( P \) and competitive power component \( D \) are used for comprehensive analysis. Based on 2011, the output value of each industry is decomposed, and the industrial structure component, competitive power component and location entropy are used for comprehensive analysis. To the leading marine industries in Guangdong Province.

A. Data Acquisition

This study chooses two indicators of the national marine industry output value from 2011 to 2016 and Guangdong marine industry output value for analysis. Marine industries are analyzed. Indicator data are from the National Ocean
Economic Statistics Bulletin and Guangdong Ocean Economic Statistics Bulletin (2017-2012).

B. Data Standardization and Weight Calculation

In this study, we use the Esteban model of dynamic deviation-share analysis to get the data of five indicators: average industrial structure component $\overline{P}$, competitiveness component $D$, industrial structure component $P$, competitiveness component $D$, and location entropy $LQ$. Negative values are removed by translation method and standardized data are obtained.

In this study, the weights are calculated by the entropy method using standardized data. The results are shown in the table below.

C. Ranking of Marine Industry in Guangdong Province

Using weights and standardized data to calculate the comprehensive score of marine industry, as shown in the Table I and Table II below.

| TABLE I. AVERAGE COMPONENT WEIGHTS |
|-----------------------------------|
| $\overline{P}$  | $D$  | $LQ$  |
| Weight value | 0.41 | 0.27 | 0.31 |

| TABLE II. COMPONENT WEIGHTS |
|----------------------------|
| $P$  | $D$  | $LQ$  |
| Weight value | 0.35 | 0.32 | 0.33 |

D. Ranking Results Analysis

Average component weight and component weights calculated in the Table I and Table II. In this study, the industry with a comprehensive score greater than 0.083 is the marine leading industry. Because the marine leading industry is a small number of industries developed in the marine industry of Guangdong Province, the comprehensive score calculated in this study can reflect the comprehensive strength of an industry. Therefore, this study calculates the average score of 0.083 as the basis for judging whether it is a marine industry. The marine industry with a comprehensive score of more than 0.083 has coastal tourism, marine chemical industry, marine power industry, seawater utilization industry and marine engineering construction industry. It can be seen from Table III that the marine industry choice that differs between the two evaluation methods is the marine biomedicine industry. Since the average comprehensive score will calculate the volatility together, it shows that the leading role of the marine biomedicine industry in recent years is not strong. However, in the past one or two years, the marine biomedicine industry has a good level of development.

According to the "2018 Guangdong Marine Economic Development Report", the marine industry structure of Guangdong Province has been continuously optimized in 2018, among which coastal tourism, marine transportation, marine chemical industry, marine oil and gas industry, marine engineering construction industry and marine fishery have become the Guangdong economy. The pillar industry of development. In this comprehensive evaluation, there are three marine industries that are consistent with the pillar industries of Guangdong's economic development. However, it can be seen from the research results that the marine transportation industry is not ranked high. This has a great relationship with the selected research model. Because this study chooses the entropy method and the dynamic deviation share analysis Esteban model, both methods consider the data. The greater the change, the greater the development space for this industry. For the marine leading industry, the development potential is a more important factor. Therefore, this study considers that the ranking of the marine transportation industry is reasonable.

The main bridge of the Hong Kong-Zhuhai-Macao Bridge was officially completed, the steel structure of the Zhuhai Port Transportation Center was completed, and the Zhuhai connecting line was completed. From the side, the progress of the marine engineering construction industry can be explained. In 2017, Guangdong achieved initial success in marine emerging industries such as marine biomedicine, marine engineering equipment, offshore wind power, and seawater desalination. The marine biomedicine industry is consistent with emerging industries, while the marine wind power industry is similar to the marine power industry. According to the “2017 National Seawater Use Report”, the provinces with annual seawater cooling utilization exceeding 10 billion tons ranked first in Guangdong Province, indicating that the seawater utilization industry in Guangdong Province is large.

Therefore, the above analysis can demonstrate the validity of the results of this study.
III. CONCLUSION

In this study, the combination of the deviation share criterion and the location entropy is used to calculate the comprehensive score by entropy method, and then determine the marine leading industry. First of all, this study considers that the Esteban model with dynamic deviation share analysis has a better choice of marine leading industry than the traditional deviation share model. Secondly, this study considers that using the cumulative method to screen the dynamic deviation share analysis Esteban model to determine the marine leading industry selection benchmark is a good choice basis. Since the quantity units of each component are inconsistent and cannot be directly compared, it is necessary to normalize the data. This study finds a method of coordinate translation to solve the problem of negative numbers in standardized data. Finally, find the leading marine industry in Guangdong Province.

The results of this study indicate that Guangdong Province uses marine chemical industry, marine power industry, seawater utilization industry, marine engineering construction industry, coastal tourism industry and marine biomedicine industry as its marine leading industries.

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