A Study on Development Ability of Fishery Economy in China Based on Factor Analysis

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Abstract: The thesis adopts the factor analysis method, taking 11 indicators reflecting the fishery economic development capacity as the research object, and measures the output capacity, input capacity and comprehensive development capacity of China's fishery economy from 2009 to 2018. The results show that the input capacity of the fishery economy is significantly higher than the output capacity of the fishery economy; the pulling effect of the input capacity of the fishery economy on the output capacity of the fishery economy varies from strong to weak; the speed gradually slowed down.

1. Introduction
In the past five years, the growth rate of China’s total output value of fishery economy has exceeded 10%, reaching 2.586447 billion yuan in 2018 [1]. The fishery economy has become an important part of the national economy. Some scholars have studied the importance of the fishery economy to economic growth. PING Ying and ZHAO Ling-rong (2018) found each 1% increase in the output value of the primary, secondary and tertiary industries could respectively bring 0.17%, 0.43% and 0.35% of the total economic output value [2]; CAI Ge jin and FU Hai in (2019) used the time series ARIMA model to predict the total output value of the fishery, and performs error analysis based on the model prediction results [3]. There are also some scholars who study the influencing factors of fishery economic development. LI Yuangang and XU Zhong (2016) selected seven variables such as marine aquaculture output, marine fishing output and the number of marine motorized fishing vessels to calculate the combination of various factors and the economic output value of marine fishery. Gray correlation [4]. Zhang LT (2019) studied the impact of fishery technology advancement on the continued increase in fishermen’s income, and found that both coastal fishing and aquaculture technology advancements have a significant positive effect on fishermen’s income increase; inland areas, only farming technology advancement has a significant income increase effect and fishing technology advancement The income increase effect is not obvious [5]. However, in recent years, it has also been found that the development of traditional fishery economy has fallen into a bottleneck. On the one hand, the decline of fishery resources is prominent [6]; to this end, it is urgent to study the development methods and capabilities of China's fishery economy, adopt technology as a support, change the traditional fishery production method based solely on fishing and low-level artificial stocking, and realize fishery production "Farming, animal husbandry and fishery" new fishery transformation [7] [8].
2. Research methods and Variable selection

2.1. Research methods
The research method used in the thesis is factor analysis. The factor analysis method is an analysis method for evaluating abstract factors based on explicit variables, that is, specific indicators. It was first proposed by psychologist Charles Spearman in 1904. The basic idea is to first group variables according to the size of correlation so that the variables in the same group correlation is high, and the correlation of different groups of variables is low. Each group of variables represents a basic structure, and then through analysis of the factor load matrix, etc., according to the size of the variance contribution rate, several common factors that can cover a large number of original data Build a factor model to decompose the original observation variables into a linear combination of factors, and finally evaluate the research object based on the comprehensive score. This method is widely used in comprehensive evaluation in many fields such as society, natural sciences, and economic management. The basic model is as follows.

\[
\begin{align*}
  x_1 &= a_{11}F_1 + a_{12}F_2 + \cdots + a_{1m}F_m + \beta_1\xi_1 \\
  x_2 &= a_{21}F_1 + a_{22}F_2 + \cdots + a_{2m}F_m + \beta_2\xi_2 \\
  \vdots \\
  x_p &= a_{p1}F_1 + a_{p2}F_2 + \cdots + a_{pm}F_m + \beta_p\xi_p \\
\end{align*}
\]

(1)

In the formula, \(x_1, x_2, \cdots, x_p\) is an original variable \(p\), \(a_{ij}\) is a standardized scalar with a mean value of 0 and a standard deviation of 1; \(F_1, F_2, \cdots, F_m\) are Common factor of original variable, \(m < p\), \(\xi_1, \xi_2, \cdots, \xi_p\) are Special factor of original variable, Common factor \(F_i\) and Special factor \(\xi_i\) Are independent variables, And the normal ones are \(N(0, \sigma^2)\); The matrix \(a_{pm}\) is factor load, Its elements \(a_{pi}\) Represents the load of the sub-variable \(i\) on the \(j\) main factor. The matrix expression of the factor analysis model is:

\[
X = AF + \beta \xi \quad (2)
\]

2.2. Variable selection and Data source
According to the relevant literature, the first level index of fishery economic development ability is divided into three specific indexes: fishery economic output value (100 million yuan), total aquatic products (10000 tons), average income of fishery economic practitioners (yuan); fishery economic fixed assets investment ability, including two specific indexes: Fishery fixed assets investment (100 million yuan), fishing boat ownership Quantity (10000 tons); investment capacity of fishery economic variable assets, including three specific indicators: aquaculture area (1000 hectares), fishery practitioners (10000 people), fishery practitioners (10000 people); fishery economic and technological promotion capacity, including three specific indicators: Fishery Technology Promotion Fund (10000 yuan), fishery technology promotion personnel (people), fishermen technical training quantity (10000 yuan) Person time). There are 11 secondary indicators in total, as shown in Table 1.

The data of this paper comes from the 2010-2019 China fishery economic statistics yearbook. According to the Yearbook, the data of the above 11 indicators in the 10 years of 2009-2018 are sorted out. Spss22.0 software is used for data processing. Firstly, Kmo and Bartlett are used to test the original data to confirm whether principal component analysis can be done; secondly, standardization is carried out to eliminate the influence of different dimensions; finally, principal component analysis is carried out for the standardized data.
Table 1 Evaluation indicators of China's fishery economic development capacity

| First level indicators                           | Secondary level indicators                                      | Variable symbols |
|-------------------------------------------------|---------------------------------------------------------------|------------------|
| Economic output capacity of fishery              | Fishery economic output value (100 million yuan)              | X1               |
|                                                  | Total aquatic products (10000 tons)                           | X2               |
|                                                  | Average income of fishery economic practitioners (yuan)       | X3               |
|                                                  | Fishery fixed assets investment (100 million yuan)            | X4               |
| Investment capacity of fishery economic fixed assets | Fishing boat ownership (10000 tons)                          | X5               |
|                                                  | Breeding area (1000 HA)                                      | X6               |
| Investment capacity of variable assets in fishery economy | Number of aquatic seedlings invested (100 million)          | X7               |
|                                                  | Fishery practitioners (10000 person)                          | X8               |
|                                                  | Aquatic Technology Promotion Fund (10000 yuan)                | X9               |
| Extension ability of fishery technology          | Fishery technology promotion personnel (person)              | X10              |
|                                                  | Number of technical training for fishermen (10000 person times)| X11              |

3. Empirical analysis

3.1. Kmo and Bartlett test
In order to verify whether the data can be used for principal component analysis, Kmo and Bartlett tests are generally carried out first. Spss22.0 software is used to test the original data of 11 indicators in 2009-2018. From the output results, see Table 2. Kmo statistic is 0.784 > 0.6; Bartlett's sig value of sphericity test is 0.000 < 0.005, rejecting the original hypothesis, so the index data is suitable for principal component analysis.

Table 2 Kmo and Bartlett test

| Kaiser-Meyer-Olkin | Bartlett's sphericity test |
|--------------------|-----------------------------|
|                    |                             |
| 0.784              | Approximate chi square 1612.732 |
|                    | df 91                       |
|                    | Sig 0.000                   |

3.2. Extraction of common factor
Using spss22.0 as principal component analysis, the eigenvalues of correlation coefficient matrix and corresponding eigenvectors are calculated, and thenAs for the variance percentage of principal component interpretation, the calculation results are shown in Table 3. Common factors are extracted according to the principle of eigenvalue greater than 1. It can be found that the initial score eigenvalues of the first two common factors are 6.480 and 3.496, which are greater than 1, and the initial eigenvalues of the other nine common factors are less than 1, and the cumulative contribution rate of variance of the two common factors is 59.912% and 31.786%, respectively. The sum of the cumulative contribution rate of variance is up to To 90.698%, far more than 70% of the basic
requirements, indicating that the first two common factors can well reflect the information of 11 research indicators, so the first two common factors can be extracted, respectively the main components.

Table 3 Total variance of interpretation

| Factor | Initial eigenvalue | Sum of load squares |
|--------|-------------------|---------------------|
|        | Total Variance    | Cumulative%         | Total Variance | Cumulative% |
| 1      | 6.480             | 58.912              | 6.480          | 58.912      |
| 2      | 3.496             | 31.786              | 3.496          | 90.698      |
| 3      | 0.590             | 5.363               |               |             |
| 4      | 0.221             | 2.006               |               |             |
| 5      | 0.170             | 1.548               |               |             |
| 6      | 0.033             | 0.298               |               |             |
| 7      | 0.008             | 0.077               |               |             |
| 8      | 0.001             | 0.009               |               |             |
| 9      | 8.581E-05         | 0.001               |               |             |
| 10     | -4.777E-19        | -4.342E-18          |               |             |
| 11     | -1.463E-16        | -1.330E-15          |               |             |

Extraction method: principal component analysis.

In order to better show the effect of common factor extraction, Kaiser standardized orthogonal rotation is adopted in spss22.0, and convergence is achieved in three iterations. The principal component $F_1$, $F_2$. See Table 4 for the load on each research index, and classify according to the load value of index factor > 0.5.

The principal component $F_1$ is used to explain the indexes of fishery economic output value (x1), total aquatic products (x2), average income of fishery economic practitioners (x3). It can be found that these indexes are all the output of fishery economy; therefore, the principal component can be defined as the output capacity of fishery economy.

Table 4 Factor load matrix a after rotation

| Variable | Factor |
|----------|--------|
|          | F1     | F2     |
| X1       | 0.977  | -0.193 |
| X2       | 0.888  | 0.236  |
| X3       | 0.937  | -0.334 |
| X4       | -0.570 | 0.811  |
| X5       | 0.043  | 0.989  |
| X6       | 0.339  | 0.875  |
| X7       | 0.323  | 0.657  |
| X8       | -0.330 | 0.909  |
| X9       | -0.330 | 0.909  |
| X10      | -0.327 | 0.932  |
| X11      | -0.079 | 0.958  |

Extraction method: main analysis. Rotation method: orthogonal rotation with Kaiser standardization. a. It converges in three iterations.

Principal components $F_1$ is used to explain the indexes such as fixed assets input (x4), fishing boat ownership (x5), aquaculture area (x6), aquatic seedlings input (x7), fishery practitioners (x8), Aquatic
Technology Promotion Fund (x9), number of aquatic technology promotion personnel (X10), number of fishermen technical training (X11). These indexes are the fixed assets input and variable assets input of fishery economy Technology input, so the main component can be defined as the input capacity of fishery economy.

3.3. Calculation factor score

According to the expression (3), (4) and (5) of principal component function, calculated the scores of principal component $F_1$, $F_2$, $F$ in 2009-2018 by Excel software, See Table 5 and figure 1 for details.

$F_1 = 0.997X_1 + 0.888X_2 + 0.937X_3 + \cdots - 0.079X_{11}$ (3)

$F_2 = -0.193X_1 + 0.236X_2 - 0.334X_3 + \cdots + 0.958X_{11}$ (4)

$F = (0.58912F_1 + 0.31786F_2) / 0.90698$ (5)

| Year | F1 | F2 | F   |
|------|----|----|-----|
| 2009 | -0.63 | -1.13 | -0.81 |
| 2010 | -0.50 | -1.09 | -0.71 |
| 2011 | -2.83 | -0.27 | -1.93 |
| 2012 | -0.10 | 1.40  | 0.43 |
| 2013 | 0.36  | 1.27  | 0.68 |
| 2014 | 0.85  | 1.49  | 1.08 |
| 2015 | 1.65  | 2.24  | 1.98 |
| 2016 | 2.17  | 2.59  | 2.45 |
| 2017 | 2.51  | 3.41  | 2.50 |
| 2018 | 2.62  | 3.59  | 2.78 |

According to table 5, in general, it can be found that the output capacity of the fishery economy, the input capacity and the comprehensive capacity of the fishery economy in 2009-2018 are increasing. Through figure 1, three trends can be found. First, the input capacity of fishery economy is significantly higher than the output capacity of fishery economy. After 2012, the input ability score of fishery economy began to increase significantly, while the output ability of fishery economy began to increase rapidly in 2015, because the output of fishery economy depends on the input of fishery economy, and has certain lag in time. Second, the pull effect of fishery economic input on fishery economic output is from strong to weak. From 2009 to 2015, fishery economic input has a significant effect on fishery economic output capacity; after 2015, fishery economic input capacity has increased substantially, but the growth of fishery economic output capacity is weak, and the effect of input on output capacity is not good, because on one hand, the law of marginal decline, on the other hand, the productivity of input is underground, such as traditional fixed assets investment. Third, the comprehensive capacity of fishery economy shows a trend of decreasing first and then increasing. Before 2012, the comprehensive capacity of the fishery economy was in a decreasing trend, mainly because the output capacity and input capacity of the fishery economy were very weak; after 2012, with the substantial improvement of the output capacity and input capacity of the fishery economy, the comprehensive capacity of the fishery economy grew rapidly; however, the growth rate began to slow down from 2016.
4. Conclusions and Suggestions
This paper uses factor analysis method to measure the output capacity, input capacity and comprehensive development capacity of China’s fishery economy in 2009-2018, taking 11 indicators reflecting the development capacity of fishery economy as the research object. The results show that the input capacity of fishery economy is significantly higher than the output capacity of fishery economy; the pull effect of fishery economic input capacity on fishery economic output capacity is from strong to weak; the comprehensive capacity of fishery economy shows the trend of first decreasing and then increasing. According to the above research results, in order to improve the development ability of fishery economy, first of all, it is necessary to increase the output of industries with higher added value in fishery economy, such as fishery service industry, reduce the dependence on traditional fishery, and effectively improve the output ability of fishery economy; secondly, it is necessary to reduce the input of traditional fixed assets and increase the input of scientific and technological innovation, which can effectively improve the output of fishery economy; thirdly, promoting the upgrading of fishery industry structure, getting rid of the dependence on traditional fishery production structure in the past and realizing the upgrading of fishery industry can improve the comprehensive ability of fishery economic development.

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