Analysis on the Factors of Economic Growth of Marine Fisheries in Fujian Province

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Abstract

Based on the relevant data of Fujian Province from 2002 to 2017, this paper uses the Cobb-Douglas production function to calculate the impact of capital, technology and labor on the economic growth of marine fisheries. The empirical results show that the elasticity coefficients of capital, technology and labor input are 0.4621, 0.2064 and 0.3315, respectively. The contribution rate of capital to the growth of marine fishery economy is much higher than that of labor and technology factors, and the contribution rate of technology increases fastest, but it is still at a low level, while the contribution rate of labor is decreasing，Fujian Marine fishery is still in the extensive growth stage that relies on capital input. Therefore, we should take technology as the driving force, increase the investment of technology in personnel, products and management, and promote the transformation and upgrading of marine fisheries.

Keywords

Marine Fishery; Economic Growth; Contribution Rate; Fujian Province.

1. Introduction

Fujian province has a vast sea area, excellent geographical location and superior climatic conditions. So the ocean is the advantage, motive force and prospect of Fujian's development. Marine fishery is one of the leading industries in the development of marine economy in Fujian Province. Therefore, exploring the relationship between the quantity change of input factors and output of marine fishery in Fujian Province and demonstrating the mode of economic growth of marine fishery and its influencing factors are of great practical significance for promoting the sustainable development of marine fishery in Fujian Province.

At present, scholars at home and abroad have done a lot of theoretical research on the economic growth of marine fisheries. For example, Shi Lei (2009) analyzed the transformation mechanism of fishery economic growth from four aspects: factor input, industrial structure, foreign trade and institutional change [1]. In empirical research, some scholars use comprehensive evaluation method to analyze the impact of various factors on the economic growth of Marine Fisheries[2]. Others use DEA (Data Envelopment Analysis) method to analyze the efficiency of Marine Fisheries growth[3], and the most common one is the C-D production function. For example, Foreign scholars David Doloreux , Yannik Melancon (2009) pointed out that the technical support of scientific and technological institutions is an important factor in the rapid development of Marine Fisheries through his research on Canadian marine fisheries[4]. Domestic scholars, Yang Zheng-yong (2003) analyzed the production function of the National Marine fishery. The results show that labor contributes more to the economic growth of marine fishery than capital and technology [5]. Shen Jin-sheng (2013), Yang Wei (2014) and Feng Hao (2017) have also used different regional data to make an empirical analysis of the impact of production function on various factors of marine fishery economy [6-8]. It can be seen that the C-D production function method is also applicable to the analysis of the mode of marine economic growth and its influencing factors in Fujian Province.

2. Construction of Economic Growth Model of Marine Fisheries

2.1 Constructing the Production Function of Marine Fisheries

Cobb-Douglas production function can be expressed as: $Y=A(t)L^{\alpha}K^{\beta}$,$0 < \alpha,\beta < 1$ where Y represents the total output value, $A(t)$ represents the level of science and technology, L represents the level of science and technology, K represents the input factor of capital, α and β represent the elasticity coefficient of labor and capital investment, respectively. In this paper, the three input factors of capital, labor and technology are applied to the Cobb-Douglas production function, and the expression of the production function of Marine Fisheries in Fujian Province is as follows.

$$Y=A(t)I^{b}S^{c}L^{d} \quad 其中 A(t)=A_0 \cdot e^{at} \tag{1}$$

In formula (1), Y represents the output value of Marine Fisheries in Fujian Province, T represents time, $A(t)$ represents the level of science and technology, I represents the input of marine fishery capital , L represents the labor input of marine fishery, and S represents the technical input of marine fishery. Then b, c and d are the elasticity coefficients of capital, science and technology and labor, respectively.

2.2 Measurement of contribution rate of each factor of production

2.2.1 Calculation of Elasticity Coefficient of Each Factor of Production

First, take logarithms on both sides of Formula (1) to get Formula (2) as follows:

$$LnY=LnA_0+at+bLnI+cLnS+dLnL \tag{2}$$

Second, divide the two sides of Formula (2) by L to get Formula (3) as follows:

$$Ln\frac{Y}{L}=LnA_0+at+bL\text{n}\frac{I}{L}+cL\text{n}\frac{S}{L} \tag{3}$$

In formula 3, Y/L is the per capita output value of marine fisheries, I/L is the per capita capital input of marine fisheries, and S/L is the per capita technical input of marine fisheries.

Finally, the coefficients B and C obtained by fitting the regression equation are the elastic coefficients of capital and technology, respectively. Under the assumption of constant scale reward, i.e. b+c+d=1, the elastic coefficient of labor can be obtained.

2.2.2 The Measurement of Contribution Rate of Each Factor of Production

The growth equation of the economic output of Marine Fisheries in Fujian Province can be derived from the total differential equation of formula (1). The growth equation can be seen in formula (4).

$$y=a+bi+cs+dl \tag{4}$$

In the formula (4)， y is the growth rate of marine fishery output value, and a, i, s and l are respectively expressed as the growth rate of scientific and technological level, capital, technology and labor. b, c and d are the elasticity coefficients of capital, technology and labor factors in the marine fishery economy of Fujian Province.

Divide the two sides of Formula (4) by y to get Formula (5) as follows:

$$1=\frac{a}{y}+b\frac{i}{y}+c\frac{s}{y}+d\frac{l}{y} \tag{5}$$

In formula (5), the contribution rate of each input factor is divided by the growth rate of marine fishery output value and multiplied by the output elasticity coefficient of each input factor.

3. Empirical Analysis on Economic Growth of Marine Fisheries in Fujian Province

3.1 Index Selection and Data Processing

The data of Marine Fisheries in Fujian Province from 2002 to 2017 were obtained from China Fisheries Statistical Yearbook and Fujian Statistical Yearbook.

(1) The output index Y, which reflects the output capacity of marine fisheries by the total output value of marine fisheries, consists of two parts: the output value of marine fishing and the output value of marine culture.

(2) Capital input index I. Using the income of marine fishermen as an index to measure their capital input, it is equal to the total income of fishermen multiplied by the proportion of the output value of marine fisheries to the total output value of fisheries.

(3) Labor input index L. Using the amount of marine fishery labor to reflect the input level of labor factors in marine fishery in Fujian Province.

(4) Technical input index S. Using the number of employees of marine scientific and technological institutions to represent the technical input of Marine Fisheries.

(5) Description of other indicators. A (t) is used to represent other scientific and technological levels that cannot be quantified.

(6) Description of missing data. The missing data is replaced by the moving average method, that is, the missing data is replaced by the average of the five years before the missing data.

3.2 Construction of Production Function and Elastic Calculation of Input Factors

The production function model of marine fishery economy in Fujian Province from 2002 to 2017 is estimated by least square method. The regression results are shown in Table 1.

Table 1 Regression results of marine fishery production function in Fujian Province

variables	Coefficients	Standard deviations	T statistics	P-values
C	-0.2846	0.643768	-0.442129	0.6663
I/L	0.4620	0.198745	2.324867	0.0384
S/L	0.206449	0.096114	2.147966	0.0528
Adjusted R2 0.9929			F statistic 557.5481	
DW-value 2.3342				

The regression results of Table 1 show that the model has passed F test, and the overall fitness of the equation is high. The explanatory power of all input factors to the economic growth of Marine Fisheries in Fujian Province reaches 99.29%. The results of DW test show that there is no autocorrelation between the residual, and the elasticity coefficients of per capita capital and per capita technology input have passed the t test. Accordingly, the regression equation of marine fishery in Fujian Province is expressed as follows: Ln(Y/L)= -0.285+0.462Ln(I/L)+0.206LN(S/L). According to the condition $b+c+d=1$ the elasticity coefficients of capital, technology and labor are b=0.4621, c=0.2064, d=0.3315, and the production function of marine fishery is: $Y=0.06I^{0.4621}S^{0.2064}L^{0.3315}$

The above production function of Marine Fisheries shows, that the output value of Marine Fisheries increases by 0.4621% for every 1% increase in capital input, 0.264% for every 1% increase in technical input, and 0.3315% for every 1% increase in labor input. The elasticity coefficient of capital input is obviously higher than that of labor input and technology input. That is to say, the marine fishery economy in Fujian Province is a capital-intensive economy.

3.3 Calculation of Contribution Rate of Input Factors in Marine Fisheries

3.3.1 Estimation of the Annual Average Growth Rate of Each Input Factors

The formula for calculating the annual average growth rate is as follows:

$$\overline{X} = \sqrt[t]{X_t / X_0} \times 100\% \tag{6}$$

In formula (6), X_t is the value of t year, and X_0 is the value of the first year. According to the calculation of formula (6), the annual average growth rate of the output value of Marine Fisheries and input of each factor in Fujian Province is obtained as shown in Figure 1.

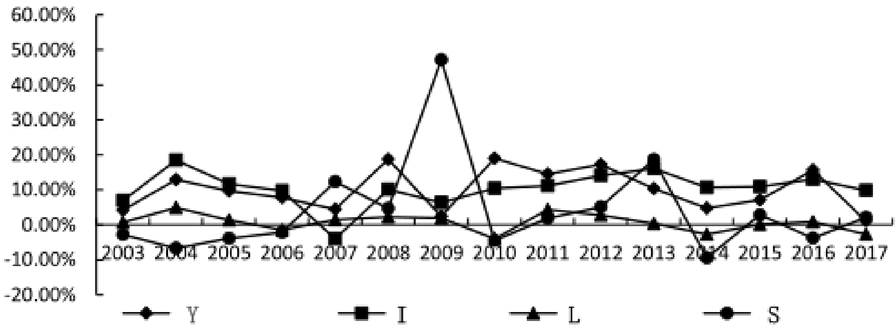

Figure 1 Annual Growth Rate of Marine Fisheries in Fujian Province during 2002-2017

Generally speaking, the growth rate of marine fishery output value in Fujian Province fluctuates around 20%. During the 15 years, the average growth rate was 9.85%, and the steady growth of marine fishery output value was closely related to the contribution of each input factor. The growth trend of capital input is similar to that of marine fishery output, while the growth rate of labor input is decreasing, and the growth rate of technology input is coupled with the growth rate of marine fishery output in stages. Since 2008, with the increase of capital and technology investment, the use of new equipment and technology has replaced part of labor input, and the output value of marine fisheries has steadily increased.

3.3.2 The calculation of contribution rate of each input factor

The average annual growth rate and the elastic coefficient of each variable are introduced into equation (5) to calculate the contribution rate of each input factor. The results are shown in Table 2:

As can be seen from Table 2. Firstly, the contribution rate of capital input to the economic growth of Marine Fisheries in Fujian Province in 2002-2017 is much higher than that of labor input and technology input. The growth of marine fishery output value in Fujian Province is mainly based on capital investment. From 2002 to 2017, the increase of capital investment in marine industry is mainly in infrastructure construction, which has a positive impact on the growth of marine fishery economy. Its contribution rate has increased from 41.84% to 50.19%. However, with the gradual improvement of marine fishery infrastructure, the economic growth momentum relying on capital investment is insufficient. Secondly, the contribution of technology input to the economic growth of Marine Fisheries in Fujian Province increased the fastest, with the contribution rate increasing from 0.15% to 2.48%. Since 2009, the role of technology input in the economic growth of marine fisheries has become prominent, but the average contribution rate is only 7.05%, which is still at a low level. Increasing technological input will be a new growth point for the development of marine fishery economy in Fujian Province in the future. Thirdly, the contribution rate of labor input to the economic growth of Marine Fisheries in Fujian Province is the lowest and shows a downward trend, indicating that the marine fisheries in Fujian Province is not a labor-intensive industry. With the rise of labor cost and the increase of capital and technology investment, part of labor input will be squeezed. When labor input reaches a stage, the contribution rate of labor input will decrease.

Table 2 Contribution Rate of Each Input Factor of Marine Fisheries in Fujian Province

year	Contribution Rate of Capital Input	Contribution Rate of Technical Input	Contribution Rate of Labor Input
2002-2008	41.84%	0.15%	5.36%
2009-2017	50.19%	2.48%	-0.45%
All Average	48.13%	7.05%	2.23%

4. Conclusion and Suggestion

The empirical analysis shows that the contribution rate of capital input is the highest, the contribution rate of technology input is the fastest, and the contribution rate of labor input is declining. The marine fishery in Fujian Province is still in the extensive growth stage relying on capital input. However, such growth is unsustainable. We should actively explore new growth points and accelerate the transformation of Marine Fisheries in Fujian Province to an intensive development driven by science and technology. The specific recommendations are as follows:

4.1 Improving the Utilization Rate of Resources and Optimizing the Industrial Structure of Marine Fisheries

In recent years, the growth of marine fishery economy in Fujian Province is mainly based on the demand for inshore resources. In order to alleviate the pressure of inshore resources, it is necessary to increase technical investment to develop offshore resources. In this way, the proportion of ocean fishery will be increased, the industrial structure will be adjusted and the comprehensive ability of ocean fishery will be improved.

4.2 Promoting the Quality of Workers and Constructing Specialized Employees

The contribution rate of labor input to the economic growth of Marine Fisheries mainly depends on the improvement of the quality of practitioners. Therefore, on the one hand, we should increase the investment in scientific research and development, especially in scientific research personnel. By introducing marine fishery scientific research personnel, to create a professional team with high quality and skills. On the other hand, we should strengthen the scientific and technological innovation of marine fisheries, improve the conversion rate of scientific and technological products, and strengthen the skills training of Marine Fisheries practitioners to guide the development of Marine Fisheries towards modernization and specialization.

4.3 Improving the Application of Information Technology in Marine Fisheries Management

Marine fishery is a high-risk industry with the characteristics of long output time, high cost of capital input and slow return cycle. It is greatly affected by natural disasters, environmental factors and other systemic risks. Therefore, in the face of the unknown and changeable marine world, we should do a good job of pre-prevention and post-remedial work, that is, we should use advanced information technology to construct a digital marine disaster monitoring and early warning system to improve maritime emergency measures and enhance the effect of risk resistance.

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