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Research on the Accounting Method of Marine GDP Based on Tertiary Industries

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ABSTRACT

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The accounting of gross marine product provides technical support for a comprehensive understanding of marine industrial structure, overall scale, and regional layout, accurately measuring the contribution of marine economy to national economy, serving marine economic management, and achieving sustainable development of marine economy. The accuracy of accounting results is directly related to the validity of policies and development plans, and the research of its accounting methods is of great significance. In this paper, Hainan's gross marine product is classified according to the three-industry classification method, and the value index and physical index of each industry are described in detail. Then, the accounting mechanism of gross marine product is discussed, and a framework research method is established.

ADDITIONAL INDEX WORDS: *Gross marine product, accounting methods, tertiary industries, basic accounting model.*

INTRODUCTION

As a resource treasury for human survival and development, the ocean has become the main area of competition in the world. Marine economy is and will continue to be a new growth point of global economy. Grasping the strategic opportunities of global marine economic development is one of the key issues for China's future economic development to gain new impetus (Gao and Huang, 2016). The basis of realizing all this is to accurately calculate the gross domestic product of the marine economy, which is helpful to understand the distribution of the regional marine economy, the development trend of marine industrial structure, the development space of various marine industries, the important source and new growth point of marine economic development power, and the driving effect on national economic growth.

China's marine economic statistics began in the late 1980s, but until 2006, the statistical scope involved only major marine industries, focusing on the gross output value of major marine industries and the added value of major marine industries. Since 2006, with the continuous advancement and implementation of the National Marine strategy, a single national marine statistical system has been unable to meet the needs of marine economic development in various places. Along with the higher requirements of marine economic development for the marine economic monitoring system, some relatively developed coastal provinces and cities in China began to gradually promote the pace of local gross marine product accounting. Among the 11 coastal governments, Zhejiang, Guangdong, Jiangsu, Shanghai, other provinces, and municipalities have basically completed their respective research on marine economic accounting system and methods (Feng and Zhou, 2013).

At present, China's marine economic statistics work is still in its infancy, and the advantages and disadvantages of accounting work are prominent. The favorable factors are mainly manifested in the small scale of marine economy, the high degree of industrial concentration in some marine industries, and the relatively small workload of statistical accounting. The disadvantageous factors are mainly manifested in the weak statistical basis of marine economy, the lack of data and lagging behind, and the lack of existing theoretical research, which makes the marine economic accounting methods proposed by some existing studies unable to be directly applied to the accounting of marine gross domestic product. When the provincial gross marine product accounting system has not yet been established, it is of great significance to take cities and counties as units to perform accounting.

Other developed coastal provinces and cities in China have done a lot of work in the accounting of gross marine product. For example, Zhoushan City in Zhejiang Province started early in the accounting of marine economic output value and has formed a set of mature accounting mechanism and system (Zhao, 2013), which has a good statistical basis. Because only the municipal gross marine product needs to be accounted for, the method is simple and easy, and the existing yearbooks, bulletins, and statements become important data sources for accounting. These data mainly include marine statistical yearbooks, statistical bulletins, and other data such as fishery company data and input-output tables.

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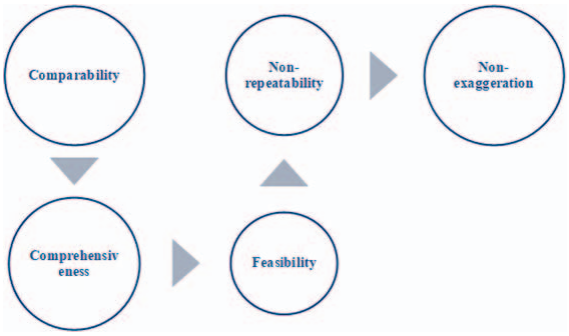

Figure 1. Principles of marine economic accounting.

PRINCIPLES OF MARINE ECONOMIC ACCOUNTING

On one hand, the marine economy is an integral part of the national economy. Obviously, its accounting principles also need to follow the accrual basis, current market prices, and other principles of national economic accounting (Lu and Yang, 2013).

On the other hand, marine economic accounting should measure its own development and its impact on the national economy. In the process of accounting, many-to-one and one-to-many problems occur between marine industry and national economic industry. Therefore, its accounting should follow the principles of comparability, comprehensiveness, feasibility, nonrepeatability, and non-exaggeration, as shown in Figure 1. Comparability means that the marine economic accounting takes the national economic accounting as the reference frame and keeps consistent in the overall framework and calculation methods. Marine economic accounting should be comprehensive, that is, reflect the marine economy in an encompassing way, covering the main content of the marine economy but not for industries that have not yet formed a scale. The accounting method should be feasible, that is, the accounting results should be able to be obtained by actual operation. Non-repeatability means that the marine industry cannot be separated from the national economy repeatedly in the classification accounting. Non-exaggeration means that accounting errors should be allowed according to the category of marine economy, but they should not be too much included in the concept of nonmarine economy.

COMPOSITION OF GROSS MARINE PRODUCT BY TERTIARY INDUSTRIES

The classification of marine industry is the basis for the accounting of marine gross domestic product (GDP), which determines the accounting scope of marine GDP. To connect with GDP accounting and to take into account the principle of classification of marine industries, a production method is adopted to calculate gross marine product, i.e. gross marine product is accounted for separately according to industrial categories, with added value as the core, and gross marine product is equal to the sum of added value of each industry. The main accounting methods are gross marine product = added value of marine primary industry + added value of marine secondary industry + added value of marine tertiary industry (see Figure 2). Among them, the tertiary industries are as follows: marine primary industry, including marine aquaculture, marine fishing, and other marine fishery services; agricultural and forestry planting activities performed in the ocean; and activities related to agricultural and forestry production.

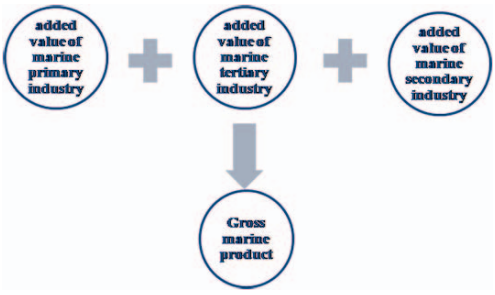

Figure 2. Accounting method of gross marine product.

The marine secondary industry includes the exploitation of marine natural resources; the processing of seawater products; the manufacturing of marine bio-health products; the processing of marine crude oil; the manufacturing of marine chemical products; the processing of marine mineral products; the manufacturing of marine fishing gear, fishing gear materials, and fishing machinery; the manufacturing of marine vessels and repairs; the manufacturing of other marine equipment; the marine electric power and the utilization of seawater (Xu, 2014), civil engineering construction, line and pipeline installation, cross-sea bridge construction, and other activities of coastal wharf; and housing construction, decoration, and decoration that serves for coastal tourism and other marine construction industry. Marine tertiary industry includes transportation; warehousing; wholesale; retail; trade; catering industries in which seawater, seawater products, or ocean space are used as production processes; coastal tourism that serves production and living; financial industry; environmental protection; marine climate; marine geological exploration; and other services that serve the production and living of marine-related departments. It also includes scientific research, education, social services, and management activities closely related to marine economy.

BASIC MODEL OF GROSS MARINE PRODUCT ACCOUNTING

Under the current marine economic accounting system, marine authorities at all levels are the main body of marine industry statistics and marine economic information dissemination, whereas data acquisition mainly comes from the level-by-level reporting of relevant marine industry authorities (Wang and Zhu, 2008). Because of the lack of necessary statistical teams and scientific and standardized means of statistical investigation, in the process of layer-by-layer statistics, accounting, and reporting, the process of authenticity and accuracy of data identification and verification is lacking; some industry data are easily missing or distorted. At

the same time, the relationship between the subject of marine economic information publishing and the subject of marine economic data accounting is similar to the principal-agent relationship. That is to say, in the process of marine economic accounting, the competent marine authorities at all levels, as clients, hope that the relevant competent marine industry departments can provide real and reliable statistical data of marine industry, whereas the competent marine industry departments as agents aim to complete the relevant tasks of marine industry accounting. Unlike the general principal-agent relationship, it is difficult for the marine authorities to evaluate the quality of the data obtained, that is, the principal cannot actually reward and punish the agent according to the observed information, which means that the relevant departments of the marine industry as an agent will choose their efforts mainly according to the cost of accounting tasks. As stated previously, the ability and subjective behavior of accounting subjects will largely determine the accuracy of accounting data.

To establish the research framework of the marine economic accounting mechanism under the decision of accounting subjects, the multitask agent utility model is constructed as the basic model according to the linear principal-agent model of Holmstmm and Milgrom (Qiao, 2011). Under the condition of complete information, all of the information of other market participants can be known to all participants. At this time, the effort signals of agents in different task dimensions can be completely transmitted to the principal. The efforts and achievements made by agents in Task 1 and Task 2 can be easily measured, and no client's appraisal cost occurs for the quality of statistical data. Then, the agent utility model is:

$$U_A = W - C(t) = \propto^T (t_1, t_2) - C(t_1, t_2)$$

because: $C(t_1,\ t_2) = 0$ under the assumption of complete information, the principal utility model is:

$$U_C = \beta^T t - C(t) = \beta^T (t_1, t_2) - C(t_1, t_2)$$

At the same time, under the assumption of complete information, for the principal, the information signals generated by the agent's effort level on Task 1 and Task 2 can be fully observed, that is, the principal will definitely observe the agent's effort distribution, so $\alpha_1 = \alpha_2$. At the same time, for the convenience of analysis, it is assumed that the client's initial evaluation mechanism for statistical data is $\beta_1 = \beta_2$, that is, the client gives the same evaluation weight to Tasks 1 and 2.

The agent utility function can be written as follows:

$$U_A = \propto_1 \bar{t} - C(t_1, t_2)$$

According to the principle of optimization under constraints, the optimization problem of the model can be expressed as follows:

$$\max U_A = \propto_1 \bar{t} - C(t_1, t_2)$$

$$s.t. t_1 + t_2 = \bar{t}$$

Construct Lagrange function:

$$L(t_1, t_2, \mu) = \propto_1 \bar{t} - C(t_1, t_2) - \mu(t_1 + t_2 - \bar{t})$$

The first-order condition is that:

$$\frac{\partial L}{\partial t_1} = -2t_1 - \mu = 0$$

$$\frac{\partial L}{\partial t_2} = -2t_2 - \mu = 0$$

$$\frac{\partial L}{\partial \mu} = t_1 + t_2 - \bar{t} = 0$$

Solution:

$$t_1 = \frac{\bar{t}}{2},\ t_2 = \frac{\bar{t}}{2},\ \mu = -\bar{t}$$

According to the previous calculation results, when the effort time allocated by the agent in Task 1 and Task 2 is $\frac{\bar{t}}{2}$, the accounting cost is the smallest, and the utility is the greatest.

This means that under the condition of complete information, the agent's effort time on Task dimension 1 and Task dimension 2 of statistical data quality is averagely allocated in the process of economic data accounting of major marine industries, and the agent's utility is the greatest at this time. Because of the reasonable allocation of the agent's effort time for the task dimension of data quality, the quality of marine economic statistics is also higher.

Under the condition of incomplete information, the utility function of agent and principal has changed compared with that under the condition of complete information (Li and Zhou, 2011). Because of the existence of asymmetric information, the client's assessment cost of Task 1 and Task 2 of the agent is different. The practical significance is that it is easier for the higher authorities to evaluate the statistical data of local marine management departments in terms of timeliness and comprehensiveness. To facilitate analysis, it is assumed that no information asymmetry in the principal's assessment of the completion of Task 1 exists, that is, the information signal vector α_1 produced by the agent's efforts on Task 1 is the same size in different marine industries. The more difficult it is to evaluate the accuracy of the output value of marine industry, the smaller the information signal α_2 produced by the principal according to his observation of the agent's effort level in Task 2.

According to the principle of optimization under constraints, the optimization problem of the model can be expressed as follows:

$$\max U_A = W - C(t) = \propto^T (t_1, t_2) - C(t_1, t_2)$$

$$s.t. t_1 + t_2 = \bar{t}$$

Construct Lagrange function:

$$L(t_1, t_2, \mu) = \propto_1 t_1 + \propto_1 t_2 - C(t_1, t_2) - \mu(t_1 + t_2 - \bar{t})$$

The first-order condition is that:

$$\frac{\partial L}{\partial t_1} = \propto_1 - 2t_1 - \mu = 0$$

$$\frac{\partial L}{\partial t_2} = \propto_2 - 2t_2 - \mu = 0$$

$$\frac{\partial L}{\partial \mu} = t_1 + t_2 - \bar{t} = 0$$

Solution:

$$t_1 = \frac{\alpha_1 - \alpha_2 + 2\bar{t}}{4} = \frac{\alpha_1 - \alpha_2}{4} + \frac{\bar{t}}{2},$$

$$t_2 = \frac{\alpha_2 - \alpha_1 + 2\bar{t}}{4} = \frac{\alpha_2 - \alpha_1}{4} + \frac{\bar{t}}{2},$$

$$\mu = \frac{\alpha_1 + \alpha_2 - 2\bar{t}}{2}$$

This means that under the condition of incomplete information, the more difficult it is to evaluate the accuracy of marine industry output value, the smaller the information signal α_1 produced by the principal according to his observed agent's effort level in Task 2. When α_2 remains unchanged, the smaller $\alpha_1 - \alpha_2$ is, the more effort time the agent allocates to Task 1 and the less effort time allocated to Task 2, the worse the accuracy of the industry accounting data.

CONCLUSIONS

The composition of gross marine product accounting under the tertiary industrial classifications, as well as the value index and physical index of each industry, are explained. It is an important basis for accounting gross marine product. The economic data are used to calculate the representative marine fishery, marine engineering construction, and marine transportation industries in the tertiary industries. The calculation formulas and results are given. The calculation method can be extended to other industries. The greatest advantage of accounting gross marine product according to tertiary industries is to link up with the index system of national economic accounting. First, it is helpful to improve the comparability of index and data. When calculating marine output value, the relevant data of national economic statistics can be directly used, or the ocean data can be estimated by inference algorithm and stripping coefficient method. Second, it is helpful to measure the contribution of marine industry in the national economy from the industrial structure and to provide a more scientific reference for the development of marine economy and industrial adjustment. Third, it is conducive to reducing the workload of repeated statistics and economic data submission by marine departments and improving work efficiency.

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