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Research on Marine Economic Growth Data Mining based on Model of Multiple Industries and Shift-Share Analysis

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***Abstract*—This paper builds model of multiple industries to analyse contribution of Fujian marine industrial structure change to marine economic growth and apply shift-share analysis method to analyse effect of Fujian marine industrial structure change on marine economic growth. Research results show that the development speed of the secondary marine industry in Fujian province slows down, and the development speed of the tertiary marine industry is relatively fast, and the development level is high. The marine economic competitiveness of Fujian province - the core zone of the "maritime silk road", is strong, while the contribution of marine industrial structure to marine economic growth is insufficient. On this basis, the following policy suggestions on the development of Fujian marine economy are proposed.**

Keywords—Marine Industry Structure, Marine Economic Growth, Model of Multiple Industries, Shift-Share Analysis

I. INTRODUCTION

Industrial structure was an important factor that influenced economic growth. In the modern economic growth, industrial structure and economic development are closely related to the status of the industrial structure and economic structure condition reflects a country's economic development direction and the development level and restricts the economic development speed. Marine industry is in marine resources development and utilization of human developed industries. It is the same with land industry counterparts. Marine industry structure refers to the component ratio of various marine industries, as well as the interdependence and restriction among them. With the development of insight into marine resources and ability of marine resources exploitation, marine industry structure alteration plays an increasingly important role in social development. Fujian is a major coastal province in eastern China. It has an advantageous geographical location, and abundant marine resources. In 2013, the total output value from marine industries in Fujian reached RMB502.8 billion, accounting for up to 25% of the total output value of the entire region, and making Fujian rank fifth in China in respect of marine economic scale. Over the years, Fujian has been focusing on marine economy as the strategic core, paying much attention to the development of marine economy.

In 2014, the State Council consented and adopted the establishment of free trade pilot site in Fujian Province as China's first one with the largest area in a province including Fuzhou, Xiamen, and Pingtan district. Fujian Free Trade Zone focuses on further deepening cross-straits economic cooperation, developing the unique geographic superiority of Fujian Province with Taiwan Straits, and reinforcing the economic exchange and collaboration between two sides of Taiwan Straits, and meanwhile substantially exerts the leading-edge advantage of Fujian Province in opening to the outside world. In 2015, the National Development and Reform Commission (NDRC), Ministry of Foreign Affairs, and Ministry of Commerce have jointly launched "Mission and Vision on promoting Silk Road Economic Belt and the 21st-Century Maritime Silk Road". Fujian Province was positioned as the "core area of the 21st-Century Maritime Silk Road". Countries along "One Belt One Road" should strengthen collaboration between each other in policy communication, infrastructure connectivity, trade link, capital flow, and understanding among peoples. As the inception point of "Maritime Silk Road", Fujian should take advantage of the energetic support from the country and the opportunity of developing core zone of "Maritime Silk Road", to vigorously promote the progress of marine economy and optimize the industrial structure to achieve the sound and fast development of marine economy.

As a large coastal province of China, Fujian is both the "core area of the Maritime Silk Road in the 21st century" and a pilot area of free trade, which shows the importance paid by the state to the development of marine economy, and the important position of Fujian. In future development, the free trade area

and the "One Belt and One Road Initiative" inevitably will interact with and make their respective advantages complementary to each other, to raise the external cooperation and communication level of Fujian in marine economy. It is of great significance to Fujian in interacting with Taiwan and the entire globe. Meanwhile, according to the new policy, the marine economy of Fujian should advance with the times by continuously optimizing its industrial structure.

Only by understanding the impact of the adjustment of marine industrial structure in Fujian Province can effective policies be specifically proposed for the adjustment of marine economic industrial structure and improvement of the core competitiveness of marine economy so as to vigorously facilitate the development of marine economy in Fujian Province.

II. LITERATURE REVIEW

The United States, Japan, Norway, Korea, Canada and other developed countries initiated studies on marine economy very early.J.M.Armstrong, J.F.Robert, M.Reiner in US, Teruo Kiyomitsu and Jin Inada in Japan, E.M.Bowski in Canada and other famous scholars have discussed scientific methods of developing marine economy and marine industry, and used relevant theories of management science for scientific planning of marine industry and optimization of marine resource allocation, which have established positive guiding ideologies for the sustainable development of marine economy. Norwegian scholar Gabriel R.G.Benito and South Korean scholar Seung-Jun Kwak have made systematic researches on marine industry and the industrialization process of marine industry. Regarding theoretical studies, early in 1980s, American scholars had pointed out the contribution of marine economy in national economy(Pontecorvo G, 1980). Up to 1990s, coastal zone economy has been regarded as a significant driving force for national economy(Colgan CS 1997, Luger M 991). Pender(2003) made a detailed analysis of the interaction mechanism between industrial structure and economic growth, and demonstrated that industrial structure change is an important determinant of economic growth based on the data structure variable growth models of 28 OECD countries [1]. Henriela Hoagland (2004) has analyzed the conflicts and reconciles contradictions between correlative industries, discussed the relationship between commercial fishing, coastal tourism, international trading, and other relevant industries, and proposed suggestions to reconcile contradictions between relevant industries [2]. Kwaka(2005) has used input-output method to analyze the impact of Korean marine industry on its national economy and the result showed that reasonable industry structure and marine industry distribution would have a boosting effect and industry promoting effect on economy. With the development up to now, quite a number of studies have paid .attention to the influential role of marine economy in coastal areas. Marine trade and the development of marine resources have exerted an influence on the economy on coastal regions and will be of great importance for monitoring marine economic data(J.T.Kildow, 2010) [3]. Empirical studies about marine industry in Portland harbor district and Juno commercial area of US have fully proved the significant value of marine industry on regional economic development. Empirical studies on British Columbia of Canada has shown that marine industry has brought tremendous impetus for regional economy and ocean is making increasingly great contribution functioning scientific process and infrastructure which can never be ignored(Vancouver, B.C.,2007). Each section of British marine industry contributes to national economy. Offshore oil and gas industry makes much more contribution than other types of marine industries, which having the largest improving function on national economy. And the next few industries are port industry, marine shipbuilding industry and ocean leisure & entertainment industry (David Pugh, 2008). Empirical studies on the damage of issuing of fishery prohibition in seabed of the northwestward islands in Hawaii to its national economy has indirectly indicated the impact of marine industry on national economy(Makena Coffman,2009). Empirical studies on Irish marine economy have shown that the importance of marine industry on national economy and regional economy has not been much valued for a long time. But the empirical studies on the relationship between marine economy and national economy have embodied that Irish marine departments have played an important driving role on its national economy and labor employment(Karyn Morrissey,2011). Empirical studies on regional marine economy have also manifested hat productivity in marine-dominant regions is much higher than five of eight regions in Ireland. Viewing from the absolute value, marine industries in Dublin and southwestern areas contribute most(Karyn Morrissey, 2012). Empirical studies on the impact of Irish marine economy on regional economy, basing on input-output model, had shown that some marine industry sections especially marine shipping industry had brought about huge influence on Irish national economy in a large scale and range(Karyn Morrissey,2013) [4].

Domestic scholars have set about studies on marine economy since from the year of 1983. The number of marine industry related research literature has increased rapidly in recent years. From a macro perspective, related studies on marine industry have expanded from regional marine resource exploitation and marine industry structure optimization to the overall planning layout of marine economy development. From a micro perspective, marine industry related studies have deepened from major marine industry sections to those micro economic subjects in marine industry—enterprise, government and individual. Studies on this aspect mainly reflect four tendencies as below: 1. Analysis on marine industry and regional economic correlative mechanism(Yu Jinkai and Cao Yanqiao 2007, Yin Kedong and Zhang Dong 2012, Zhang Shuguang 2016, Fen Ruimin 2016); 2. Empirical researches on the relationship between marine industry and regional economy(Zhang Wenjie 2011, Zhou Dajun 2007, Wu Yefeng 2013, Ma Xuran 2011, Xie Ziyuan 2012, Hu Xiaodan 2016); 3. Studies on the influence of marine industry structure and industry agglomeration on regional economy(Yao Lei 2010, Jiang Xuzhao 2012, Ji Yujun 2016, Jiu Shoucai 2016); 4. Analysis on the matching and coordination between marine industry development and regional economic development(Huang Ruifen 2005, Zhu Nian 2010). China's industrial economics started relatively late. Most Chinese economists have proven the effect of China's industrial

structure change on economic growth. Xu Benshuang(2005) built a calculation model on the contribution of China's industrial structure change to economic growth [5]. Zhan Jiexiang(2009) drew a conclusion that China's industrial structure had a long-run equilibrium relationship with economic growth, and industrial structure change had a Granger cause relationship with economic growth through analysis [6]. Gai Mei and Chen Qian(2010) analyzed the contribution of ocean industrial structure change to ocean economic growth from 1997 to 2007 and revealed how ocean industrial structure affect the ocean economic development through shift-share analysis in LiaoNing province [7]. Hong Jinhui(2011) analyzed the driving effect of industrial structure optimization and upgrading on Fujian economic development with VAR model, and verified the causal relationship between Fujian economic growth and industrial structure change [8]. Wang Jing, Wu Shunchen and Yang Menghan(2012) analyzed the relationship between the growth of the three industries and economic growth of Jiangsu province from 1995 to 2010 with industrial economy growth contribution model and Moore structural change index method [9]. Wang Duanlan(2013) made research on the correlation between Change of marine industrial structure to marine economic growth in Fujian province through shift-share analysis [10]. Hu Xiaodan and Chen Zhao(2015)made research on the relationship between marine industrial structure to marine economic growth in Guangdong province through VAR analysis [11]. Yao Yanqing(2015) makes applied researches on the contribution of China regional industrial structure change to economic growth [12].

III. The Current Situation of Marine Industry Structure in Fujian Province

While the marine economy in Fujian province is taking on a speedy growth trend, the structure of marine industries also significantly changes.

It can be seen from the Fig.1 that from 1996 to 2000, the marine economy of Fujian province had kept a stable growth rate; from 2001 to 2005, the growth rate further rose, during which the total output value had doubled; from 2006 to 2013, the development of marine economy became more prosperous. Meanwhile, the marine industrial structure also has been changing. In 1996, the marine industrial structure of Fujian province appeared in a "primary-tertiary-secondary" pattern, the primary marine industry dominating, and the tertiary marine industry increasingly progressing. Since 2001, the development speed of the tertiary marine industry had become faster and faster, while that of the primary marine industry significantly had dropped. In 2005, the marine industrial structure of Fujian province appeared in a "tertiary - primary - secondary" pattern. Since 2005, the output value from the primary marine industry had been taking on a fall trend and the secondary & tertiary marine industry increasingly progressing until 2010, the tertiary marine industry had been dominating, and a pattern of "tertiary-secondary-primary" of the industrial structure had been being basically sustained.

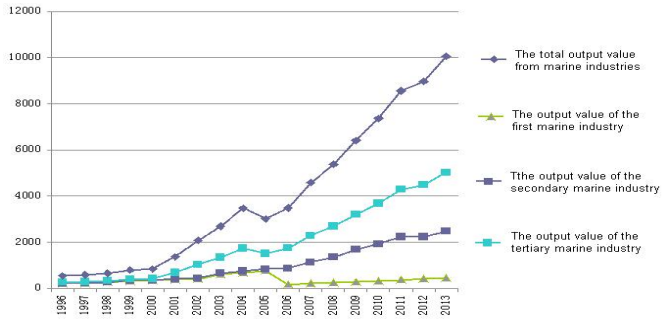

Fig. 1. Total output value of marine industries and output value of the three main marine industries in Fujian Province

Suppose r is the growth rate of the total output value of marine industries, and a growth rate formula is obtained as follows:

$$r = \sum_{i-1}^{n} a_i \bullet r_i \qquad (i = 1,2,3) \qquad (1)$$

Wherein, ai refers to the proportion of the ith marine industry to the whole marine industrial structure, and ri to the growth rate of the ith marine industry. The formula(1) shows that r is affected by ri and ai, namely the constitutive structure of each industry and the growth rate of each marine industry have positive correlation effect on the growth rate of the total output value of marine industries. In a word, the larger r, the growth rate of the total output value of marine industries and ai are, the larger the degree of contribution of the industry to marine economic growth is. The r and ri(i=1, 2, 3) calculated based on the formula are as below.

It can be seen from the Table Ⅰ that the growth rate of the total output value of marine industries is 12.16% in 2013. If the growth rates of the three marine industries in 2013 are calculated according to the structural formation of the three industries in 1997, then the growth rate of the total output value of Fujian marine economy is only 9.69%; if they are calculated according to structure of the three industries in 2005, then the growth rate of the total output value of Fujian marine economy is only 10.87%; if they are calculated according to structure of the three industries in 2010, then the growth rate of the total output value of Fujian marine economy is 12.14%. Thus, the rates of contribution of the three marine industries to the growth rate of marine economy are 2.47%, 1.29% and 0.02% respectively. This shows that the change in the marine industrial structure has certain impact on marine economic growth, and marine economy will take on a trend of developing faster and better with the constant optimization of the marine industrial structure. The rates of contribution of the marine industrial structure to the growth rate of marine economy are 2.47%, 1.29% and 0.02% respectively. This shows that the change of marine industrial structure has certain effect on marine economic growth, and marine economy takes on a situation of developing increasingly fast and better with the continuous optimization of marine industrial structure.

TABLE I. R AND RI(I=1, 2, 3) IN FUJIAN PROVINCE FROM 1997 TO 2013

Year	r	r1	r2	r3
1997	8.44	8.38	-12.71	13.23
1998	12.78	16.77	-93.14	14.82
1999	20.45	23.07	2695.38	-16.26
2000	6.61	8.73	-88.94	25.8
2001	63.21	8.43	2191.54	276.13
2002	51.60	3.52	14.57	127.61
2003	29..69	55.22	7.22	14.91
2004	29.23	13.29	16.88	44.40
2005	-13.48	10.25	24.04	-32.53
2006	15.91	-77.64	754.93	31.22
2007	31.39	31.32	29.66	32.81
2008	17.37	13.41	20.72	15.50
2009	19.15	7.98	28.35	13.70
2010	14.99	16.76	13.74	15.82
2011	16.32	13.76	16.44	16.67
2012	4.64	15.19	-2.68	9.44
2013	12.16	8.70	11.59	13.26

[a.] Data source: China MARINE Statistical Yearbook between 1998 and 2014

IV. CONTRIBUTION OF MARINE INDUSTRIAL STRUCTURE CHANGE TO MARINE ECONOMIC GROWTH

A. Model of Multiple Industries

Professor Ge Xinyuan put forward Model of Multiple Industries, in which an economic system is divided into multiple sub-systems, specific production function description of each sub-system is defined, and the overall economy is expressed as the sum of sub-economies [13]. The formula is as below:

$$\begin{cases} z^t = \Delta A^t \bullet G^t \\ P^t = \dfrac{z^t}{r^t} \times 100\% \end{cases}, \qquad (2)$$

$$\Delta A^t = A^t - A^{t-1}, \qquad (3)$$

In the Equation 2, Zt refers to the rate of contribution of the change in the marine industrial structure to marine economic growth in year t, At refers to the row vector constituted by the proportions of the total output values of the industrial sectors of marine economy in year t to the total output value of marine economy in year t, Gt refers to the column vector constituted by the growth rates of the marine industrial sub-sectors in year t, and Pt refers to the percentage of Zt in the growth rate of the total marine output value in the same year.

Tendency of Z value and P value in Fujian province from 1998 to 2013 are calculated based on the Equation 2 (see Table Ⅱ).

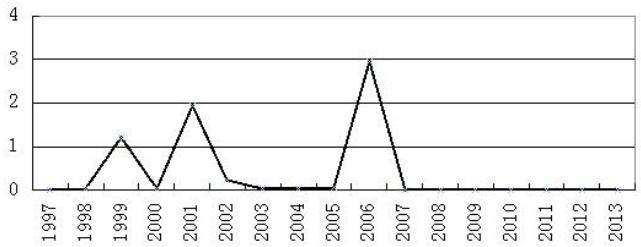

Fig. 2. Contribution of Fujian Marine Industrial Structure Change to Marine Economic Growth between 1998 and 2013

It can be seen from the Fig.2 that since the output value of the secondary marine industry increases rapidly in 1999, Z value changes obviously; since the growth rate of the secondary and tertiary marine industries quickens, Z value changes significantly; since 2005, the proportion of the output value of the secondary and tertiary marine industries became larger and larger as Fujian marine industrial structure had been gradually optimized, and Z value reached peak in 2006, which shows that the rate of contribution of marine industrial structure change to marine economy increased. Afterwards, since the pattern of "tertiary—secondary—primary" of Fujian marine industries had been basically formed, the industrial structure change was not very noticeable, and Z value tended to be stable.

TABLE II. P VALUE OF FUJIAN AND THE WHOLE NATION FROM 1997 TO 2013

Year	Fujian	The Whole Nation
1997	2.46	5.29
1998	26.60	13.62
1999	586.90	0.19
2000	67.43	6.45
2001	305.16	42.35
2002	45.84	2.26
2003	10.23	10.26
2004	6.38	1.26
2005	-41.41	0.71
2006	1856.22	187.64
2007	0.05	0.03
2008	0.37	1.20
2009	2.72	0.53
2010	0.08	0.74
2011	0.03	0.04
2012	9.21	0.26
2013	0.14	0.56

It can be seen from the Table Ⅱ that the mean value of Z value from 1997 to 2000 is 0. 3202 and the mean value of P value is 170.84%, indicating that 170.84% of the growth of the total output value of marine economy was caused by marine industrial structure change. The mean value of Z value from 2001 to 2005 is 0. 4540 and the mean value of P value is 65.24%, indicating that 65.24% of the growth of the total output value of marine economy was caused by marine industrial structure change. And the mean value of Z value

from 2006 to 2010 is 0. 5918 and the mean value of P value is 371.88%, indicating that 371.88% of the growth of the total output value of marine economy was caused by marine industrial structure change. And the mean value of Z value from 2011 to 2013 is 0. 0015and the mean value of P value is 0.31,since the marine industrial structure tended to be stable, and the industrial structure changed slightly during this period, only 0.31% of the growth of the total output value of marine economy was caused by industry changes. Furthermore, the national P value during 1997-2000 , 2001-2005, 2006-2010 and 2010-2013 are 6.38%, 11.37%, 38.03% and 0.29% respectively. The above data show that Fujian marine structural change has certain influence on marine economic growth, and the pattern of marine industrial structure changed from "primary—secondary—tertiary" to "tertiary—secondary—primary" and significantly contributed to marine economic growth.

B. Shift-Share Analysis of Fujian Marine Industrial Structure Change

Unit root test aims to test stationarity of time series. Quantitative analysis can be conducted for only stationary time series, or else quasi-regression may be easily caused. This paper adopts ADF method to test variable stationarity.

Shift- Share- Method is a method for dynamically analyzing industrial location and structure, mainly used for analyzing the influence of industrial structure change on economic growth. This method was put forward by Daniel and Creamer, two American economists, and further improved by Dunn et al. The core idea of Shift- Share- Method is to divide the change of the regional economic aggregate in a certain period(G) into three components, namely region growth deviation component(N), structure deviation component(P), and competitiveness deviation component(D). Through calculation, the values of indexes of certain region economy can be obtained. These values can reflect the cause of development or recession of economic system of certain region, assist in figuring out the advantages of industrial structure of certain region economy and the competitive power, and facilitate finding out the competitive industries of the region comparing with the reference region, so as to determine the future economic development direction of the region and the principle of industrial structure adjustment.

Y indicates the standard region, y the survey region, 0 the base year, and t the report period. Suppose both the economic aggregate and industrial structure of the region have changed after a period of [0, t]. Y0 and Yt refer to the total economic outputs of the standard region in the base year and the report period, respectively, and Yi0 and Yit(t=1,2,3) to the output values of the ith industry of the standard region in the base year and the report period, respectively. In the same way, y0 and yt refer to the total economic outputs of the survey region in the base year and the report period, respectively, and yi0 and yit(t=1,2,3) to the output values of the ith industry of the survey region in the base year and the report period, respectively.

Then, the rate of change of the ith industry of the standard region in the period of [0, t] is:

$$Ri = \frac{Y_{it}}{Y_{i0}}, \tag{4}$$

Then, the rate of change of the ith industry of the survey region in the period of [0,t] is:

$$r_i = \frac{y_{it} - y_{i0}}{y_{i0}}, \tag{5}$$

According to the proportion of each industrial sector in the country as a standard, the scale of each industrial sector of region i is standardized as below:

$$y_i^{'} = \frac{y_{i0} \times Y_{i0}}{Y_0}, \tag{6}$$

In the period of [0, t], the growth amount of the ith industry of the survey region is expressed as Gi. Gi can be divided into three components, namely Ni, Pi, Di, and then:

$$G_t = y_{it} - y_{i0} = N_i + D_i + P_i, \tag{7}$$

$$N_i = y_i \bullet R_i, \tag{8}$$

$$P_i = (y_{i0} - y_i) \bullet R_i, \tag{9}$$

$$D_i = y_{i0} \bullet (r_i - R_i), \tag{10}$$

Suppose Ti is the gross deviation component, and then Ti=Pi+Di . Wherein, if Ni>0, it is indicated that the actual growth rate of the ith industry of the survey region is higher than that of the standard region, otherwise is below the average of the standard region; if Pi>0, it is indicated that the industrial structure of the ith industry of the survey region is superior to that of the standard region, the contribution of the ith industry to economic growth is large, and it is unnecessary to make large-scale adjustment, otherwise it is indicated that the proportion of sector(s) in recession in the survey region is large, and it is urgent to adjust the industrial structure; if Di>0, it is indicated that the ith industry of the survey region is more competitive than that of the standard region (the larger the value is, the greater the effect of the competitiveness of the ith industry of the survey region on economic growth is).

The shift-share component is calculated out via Shift-Share models with Fujian province as the survey region and the national marine industries as the standard region in a time interval from 2001 to 2013 with the base years and report periods defined by five years, and based on the gross national marine output value and the gross output marine value of Fujian province, and the output value index of the primary marine industry and the secondary & tertiary marine industry, in 2001, 2005, 2006, 2010, 2011, 2013. The increments of the three marine industries of Fujian province and the country are calculated out according to the China Marine Statistics Yearbook(2002~2014) (as shown in Table Ⅲ, Table Ⅳ and Table Ⅴ). The shift-shares of marine industrial structure and marine economic growth of Fujian province are calculated out

with Shift- Share models(as shown in Table Ⅵ, Table Ⅶ and Table Ⅷ).

TABLE III. CHANGE OF THE PRIMARY, THE SECONDARY & TERTIARY MARINE INDUSTRY IN FUJIAN AND THE COUNTRY FROM 2001 TO 2005

Region	Industry	2001	2005	Increment	Rate of Increase
Fujian	Total Output Value	684.08	1503.79	819.71	1.198
	The Primary Marine Industry	377.06	756.78	379.72	1.007
	The Secondary Marine Industry	46.06	82.03	35.97	0.781
	The Tertiary Marine Industry	260.96	664.98	404.02	1.548
Country	Total Output Value	9518.50	17655.60	8137.10	0.855
	The Primary Marine Industry	646.30	1008.90	362.60	0.561
	The Secondary Marine Industry	4152.10	8046.90	3894.80	0.938
	The Tertiary Marine Industry	4720.10	8599.80	3879.70	0.822

TABLE IV. CHANGE OF THE PRIMARY, THE SECONDARY & TERTIARY MARINE INDUSTRY IN FUJIAN AND THE COUNTRY FROM 2006 TO 2010

Region	Industry	2006	2010	Increment	Rate of Increase
Fujian	Total Output Value	1743.1	3682.9	1939.8	1.113
	The Primary Marine Industry	169.2	317.7	148.5	0.878
	The Secondary Marine Industry	701.3	1602.5	901.2	1.285
	The Tertiary Marine Industry	872.6	1762.7	890.1	1.020
Country	Total Output Value	21592.3	39572.8	17980.5	0.833
	The Primary Marine Industry	1228.8	2008	779.2	0.634
	The Secondary Marine Industry	10217.8	18935	8717.2	0.853
	The Tertiary Marine Industry	10145.7	18629.8	8484.1	0.836

TABLE V. CHANGE OF THE PRIMARY, THE SECONDARY & TERTIARY MARINE INDUSTRY IN FUJIAN AND THE COUNTRY FROM 2011 TO 2013

Region	Industry	2011	2013	Increment	Rate of Increase
Fujian	Total Output Value	4284	5028	744	0.174
	The Primary Marine Industry	361.4	452.52	91.12	0.252
	The Secondary Marine Industry	1866	2026.28	160.28	0.086
	The Tertiary Marine Industry	2056.6	2549.2	492.6	0.240
Country	Total Output Value	45496	54313.2	8817.2	0.194
	The Primary Marine Industry	2381.9	2918	536.1	0.225
	The Secondary Marine Industry	21685.6	24909	3223.4	0.149
	The Tertiary Marine Industry	21428.5	26486.2	5057.7	0.236

TABLE VI. SHIFT- SHARE ANALYSIS OF MARINE INDUSTRIAL STRUCTURE AND MARINE ECONOMY GROWTH IN FUJIAN PROVINCE FROM 2001 TO 2005

Industry	Actual increment	N	P	D	Total deviation
Total Output Value	819.71	139.58	329.67	350.46	680.13
The Primary Industry	379.72	14.36	197.18	168.17	365.36
The Marine Industry	35.97	18.85	24.36	-7.24	17.12
The Tertiary Industry	404.02	106.37	108.13	189.52	297.65

b. N refers to region growth component, P refers to industrial structure component, D refers to competitiveness component.

TABLE VII. SHIFT- SHARE ANALYSIS OF MARINE INDUSTRIAL STRUCTURE AND MARINE ECONOMY GROWTH IN FUJIAN PROVINCE FROM 2006 TO 2010

Industry	Actual increment	N	P	D	Total deviation
Total Output Value	1939.80	632.10	803.19	504.51	1307.70
The Primary Industry	148.50	6.11	101.19	41.21	142.40
The Marine Industry	901.20	283.13	315.18	302.90	618.07
The Tertiary Industry	890.10	342.86	386.83	160.41	547.24

TABLE VIII. SHIFT- SHARE ANALYSIS OF MARINE INDUSTRIAL STRUCTURE AND MARINE ECONOMY GROWTH IN FUJIAN PROVINCE FROM 2011 TO 2013

Industry	Actual increment	N	P	D	Total deviation
Total Output Value	744.00	365.09	479.03	-100.12	378.91
The Primary Industry	91.12	4.26	77.08	9.78	86.86
The Marine Industry	160.28	132.21	145.16	-117.09	28.07
The Tertiary Industry	492.60	228.63	256.78	7.19	263.97

Take the survey region at the initial phase and at the final phase respectively, the proportion of the ith industry to corresponding industry in the standard region is

$$K_{i0} = \frac{y_{i0}}{Y_{i0}}, \tag{11}$$

$$K_{it} = \frac{y_{it}}{Y_{it}}, \tag{12}$$

and the relative growth rate of the survey region is L.

$$\begin{cases} W = \dfrac{\sum_{i=1}^{n} K_{i0} \bullet Y_{it}}{\sum_{i=1}^{n} K_{i0} \bullet Y_{i0}} : \dfrac{\sum_{i=1}^{n} Y_{it}}{\sum_{i=1}^{n} Y_{i0}}, \\ U = \dfrac{\sum_{i=1}^{n} K_{it} \bullet Y_{it}}{\sum_{i=1}^{n} K_{i0} \bullet Y_{it}} \end{cases} \quad (13)$$

Wherein, W and U refer to structure efficiency index and competitiveness efficiency index, respectively. If W>1, it is indicated that the proportion of industrial sector(s) which increase rapidly and whose development potential is good in economy of the region is large, the structure of the regional economic system is good, and the degree of contribution of industrial structure to economic growth is large. If U>1, it is indicated that the total economic development capability of the sectors of the region is strong, and is more competitive than the standard region.

According to the formula above, the relative growth rates(L), structure efficiency index(W) and competitiveness efficiency index(U) of Fujian province relative to the national marine industries are calculated out.

TABLE IX. SHIFT- SHARE ANALYSIS OF MARINE INDUSTRIAL STRUCTURE AND MARINE ECONOMY GROWTH IN FUJIAN PROVINCE FROM 2011 TO 2013

Period	L	W	U
2001-2005	1.185	0.909	1.303
2006-2010	1.153	0.995	1.159
2011-2013	0.983	1.003	0.980
2001-2005	1.185	0.909	1.303

It can be seen from the calculation results(From Table Ⅲ to Table Ⅸ) that, from 2001 to 2005, Fujian marine economy grew rapidly, and the growth rate of total output value reached 1. 198, much higher than the national average. During this period, the three marine industries developed rapidly, and Fujian marine industries were undergoing explosive growth. From 2006 to 2010, the secondary and the tertiary industries maintained rapid growth, the output value and growth rate of the primary industry declined, the total deviation value of the secondary and of the tertiary industry exceeded the national average by RMB RMB61.81 billion and RMB54.72 billion respectively, and the gross deviation reached RMB130.77 billion. During this period, the adjustment and optimization of marine industrial structure of Fujian province mainly focused on the tertiary and the secondary marine industries, turning from the "primary-tertiary-secondary" pattern into the "tertiary-secondary-primary" one. During the period from 2011 to 2013, the marine deviation of Fujian province is not large; indicating that the marine industrial structure adjustment of Fujian province became increasingly stable so that the gross deviation only reached RMB37.891 billion.

In respect of industrial structure deviation component and competitiveness deviation component, the structure deviation(P) of the three marine industrial structure of Fujian province from 2001 to 2013 are 329.67, 803.19 and 479.03 respectively, and the average value is 537.30, indicating that the adjustment of marine industrial structure of Fujian greatly boosted the development of marine economy of Fujian province. The competitiveness deviation component(D) of the three marine industrial structure of Fujian province from 2001 to 2013 are 189.52, 160.41 and 7.19 respectively. The competitiveness deviation component of the tertiary industry has never been below zero, indicating that the tertiary industry has certain advantages, and is a sustainable driving power of marine economic growth. The competitiveness deviation component of the secondary industry from 2006 to 2010 reached RMB30.29 billion, becoming a major driving force. Although the structure deviation component from 2011 to 2013 was above 0, the competitiveness deviation component was below 0, indicating that the competitiveness of the tertiary marine industry was not more competitive than the national average level any more.

Through analysis of structure efficiency index(W) and competitiveness efficiency index(U), the growth rate of Fujian marine economy relative to national marine economy from 2001 to 2005 reached 1.185, and the competiveness efficiency index was 1.303, higher than 1, indicating that the growth rate of Fujian marine economy was faster than that of the national average. Fujian marine industries were in a sound momentum of development, and of strong competitiveness, but structure efficiency index was below 1, indicating that the proportion of sectors in Fujian marine economy that were promising and increased rapidly was small. The structural coefficient continuously increased from 0.909 during the period from 2001 to 2005 to 0.995 during the period from 2006 to 2010, indicating that Fujian marine industrial structure had been continuously optimized. Yet the structure efficiency index of Fujian marine economy from 2011 to 2013 gradually tended to be 1, but U became below 1 thereafter, indicating that the marine industrial structure had obviously restricted and affected the development of marine industry, facing the adjustment and promotion of industrial structure in recent years.

V. CONCLUSIONS

Based on empirical analyses, the following suggestions are put forward to relevant departments of government for reference:

- Marine industrial structure is in a long-run synergic relationship with marine economic growth. Yet economic growth will not always timely respond to changes of industrial structure. In other words, it often lags behind. In a long run, however, changes of marine industrial structure certainly will affect economic growth, indicating that adjusting industrial structure is the key to realizing rapid economic growth. Thus, promote the integration and upgrading of marine industrial structure, and establish a more competitive marine production system. Fully exploit the advantages of marine economy in Fujian province, and further perfect the development of emerging strategic marine industries while further consolidating and developing the existing core competitive industries [14-15].

- With the development of Fujian marine economy, the tertiary industry has been dominating in recent years, developing rapidly, while the secondary industry develops slower than before, indicating that Fujian province has been mainly focusing on the development of the tertiary industry. This agrees with the demand side development stressed by the central authorities. Thus, the marine economy of Fujian province appears to be “extensive” with low content of high technology, becoming, comparing with the national marine economy, not as competitive as before. Thus, increase input in the secondary marine industry, start with the supply side to boost economic development and eliminate outdated capacity by emancipating the productive forces and promoting the competitiveness, and concentrate on emerging fields and innovation fields for development. Create new sources of economic growth, including accelerating the cultivation and concentration of high-end high-quality projects like marine bio-medicine, and the development of seawater comprehensive utilization, seawater power generation, sea water desalination, etc. Turn the development center from the tertiary marine industry to the secondary marine industry, so as to build a more competitive industrial structure[16].
- With regard to the tertiary marine industry, adjust the internal structure, and optimize its structure. Take advantage of the geographic location of Fujian as the core area of “the maritime silk road”, construct smooth traffic routes, and combine marine tourism with cultural industries, to establish special marine tourism & culture programs[17-18].

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