A SHIFT-SHARE ANALYSIS ON MARINE INDUSTRIAL STRUCTURE – A CASE OF THE NORTHERN MARINE ECONOMIC CIRCLE OF CHINA

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ABSTRACT. *Marine industrial structure is an important factor affecting the development of marine economy. This paper mainly takes the northern marine economic circle as the study area, compares the three marine industries in this area, through the data of Liaoning, Hebei, Shandong provinces and Tianjin city in China from 2001 to 2015, evaluates the industrial structure of the northern marine economic circle by using the dynamic shift-share method, and puts forward targeted policy recommendations in order to further develop the marine economy.*
Keywords: Marine industrial structure, Marine economy, The northern marine economic circle, Shift-share analysis

1. **Introduction.** In [1], the marine economy has a certain impact on the national economy, and that understanding of the marine economy can help the government solve future problems caused by resource and population factors. Using a variety of research methods, in [2], this paper studied the economic impact of South Africa's marine industry by using the GDP of marine industry, and concluded that the contribution rate of South Africa's marine industry to the economy is about 4.4% in 2010. There are abundant research results on marine industry in domestic academy. In the work of [3-6], different viewpoints on marine industry are put forward from different perspectives. Paper studied the relationship between the coordinated development of regional industrial structure, and researched the rationalization and upgrading of industrial structure. In [7,8], scholars discussed the marine industrial structure of Liaoning province and determined the leading marine industry, and finally, provided scientific basis for optimizing the marine industrial structure.

Marine industrial structure is the basic structure of marine economy. To a certain extent, it reflects the level of marine economic development. Therefore, this paper will use the shift-share method to analyze the marine industrial structure and competitiveness of the northern marine economic circle, in order to accurately evaluate the marine economic development of three provinces and one city. The structure of this paper is as follows: the second part analyses the characteristics of industrial structure change in the northern marine economic circle from 2001 to 2015; the third part establishes corresponding models; the fourth part explains and discusses the data and analysis results; the fifth part draws conclusions and puts forward suggestions.

2. **Studying the Whole Situation of Regional Marine Economy.** The northern marine economic circle consists of Liaodong Peninsula, Bohai Bay and Shandong

Peninsula. It is an important opening-up platform in northern China and has advanced manufacturing and modern service industries. Recently, the marine economic development in the northern marine economic circle has maintained a steady and sustained growth trend. From 2001 to 2015, the gross marine product increased from 158.735 billion yuan to 230.029 billion yuan, the proportion of primary industry decreased from 53.3% to 5.6%, the proportion of secondary industry increased from 26.5% to 45.9%, and the proportion of tertiary industry increased from 20% to 48.5%. From 2006 to 2014, the marine industrial structure of the northern marine economic circle maintained the "231" structure for eight years. The development of marine tertiary industry is fast. In 2015, the three marine industries initially formed a "321" pattern. The marine industrial structure is becoming more and more rational and advanced (See Figures 1 and 2).
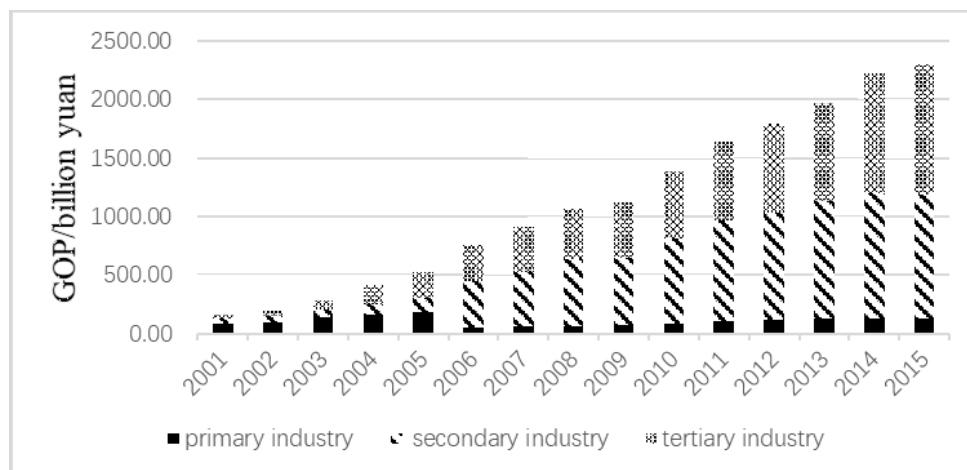

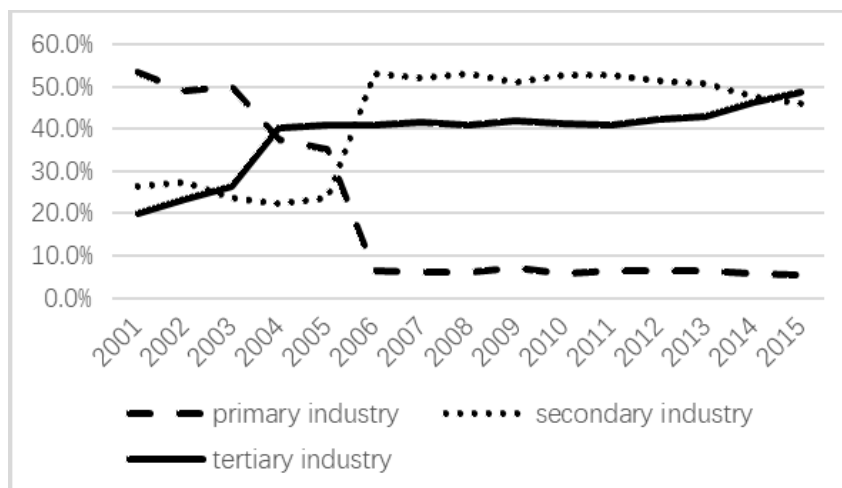FIGURE 1. Gross ocean product and three marine industries in the northern marine economic circle

FIGURE 2. Changes in the proportion of three marine industrial structures in the northern marine economic circle (Source: China Ocean Statistics Yearbook 2002-2016)

3. **Research Methods.**

3.1. **Basic principles.** The shift-share method is a mathematical method widely used to analyze industrial structure changes and regional economic disparities. Its basic idea is to regard the regional economic change as a dynamic process, and take the economic development of its superior region as the standard region. It compares the whole research

region with the standard region. It is considered that the total regional economic volume is related to three factors: the national growth share, the industry mix share and the competitive position share. By calculating the extent of the three factors, this paper explains the disparity of regional economic growth rate, and evaluates the industrial structure and competitiveness of the region.

3.2. **Model establishment.** Assuming that the research period is $[0, t]$, in which the total economic volume and structure have changed, G represents the overall growth, N represents the national growth share, P represents the industry mix share, D represents the competitive position share, T represents the net shift share, E and e represent the standard area and the research area.

The model of shift-share analysis can be expressed as:

$$G_i = N_i + P_i + D_i \quad (i = 1, 2, 3) \tag{1}$$
$$N_i = e_i' \cdot R_i \tag{2}$$
$$P_i = (e_{i0} - e_i') \cdot R_i \tag{3}$$
$$D_i = e_{i0} \cdot (r_i - R_i) \tag{4}$$
$$T_i = D_i + P_i \tag{5}$$

In the above formulas, $R_i = (E_{it} - E_{i0})/E_{i0}$ is the total economic growth rate of industry in the standard area; E_{it} is the output value of industry in the end of the standard area; E_{i0} is the output value of industry in the initial period of the standard area; $e_i' = (e_{i0} \cdot E_{i0})/E_0$ is the standardization of the economic scale of the industries in the study area; e_{i0} is the output value of industry in the initial period of the study area; E_0 is the output value of all industries in the initial period of the standard area; $r_i = (e_{it} - e_{i0})/e_{i0}$ is the total growth rate of industry in the study area; T_i is the net shift share, indicating the overall growth advantage of industry.

4. **Data Sources and Result Analysis.**

4.1. **Data sources and computation.** The data in this paper are from China Ocean Statistics Yearbook from 2002 to 2016. The research period is from the "10th Five-Year Plan" to the "12th Five-Year Plan" (2001-2015). In order to judge the effect and competitiveness of marine industrial structure more accurately, the fifteen years data are divided into three periods, "10th Five-Year Plan", "11th Five-Year Plan" and "12th Five-Year Plan". It is hoped that through the comparative analysis of three periods of data, the result of dynamic shift-share analysis can be formed.

The coastal regions of China are taken as the standard regions, and the three provinces and one city in the northern marine economic circle are taken as the research regions. Then the data of the gross domestic product of three marine industries in Tianjin, Hebei, Liaoning and Shandong are selected. Finally, the influence of marine industrial structure on marine economic level is analyzed.

4.2. **Result analysis.** According to the shift-share analysis model, we can get the results of three periods of the "10th Five-Year Plan", "11th Five-Year Plan" and "12th Five-Year Plan" (see Tables 1-3).

From the analysis in Table 1, it can be concluded that:

1) During the "10th Five-Year Plan" period and the "11th Five-Year Plan" period, the total output value of marine primary industry in three provinces and one city increased in varying degrees. During the "10th Five-Year Plan" period, Shandong had the highest total output value (73.193 billion yuan), while Liaoning's output value of primary industry declined during the "12th Five-Year Plan" period. The national growth share of four regions in the three periods are positive, indicating that the real growth rate of the primary industry in the northern marine economic circle is higher than the national

TABLE 1. Shift-share of primary industry in northern marine economic circle (unit: billion yuan)

Period	Region	G	N	P	D	T
10th Five-Year Plan	Tianjin	0.224	0.226	0.498	−0.499	−0.002
	Hebei	1.761	1.338	2.950	−2.527	0.423
	Liaoning	24.479	7.886	17.395	−0.802	16.593
	Shandong	73.193	17.792	39.242	16.159	55.401
11th Five-Year Plan	Tianjin	0.260	0.014	0.251	−0.005	0.246
	Hebei	2.230	0.101	1.776	0.353	2.129
	Liaoning	16.940	0.597	10.485	5.858	16.343
	Shandong	13.710	1.251	21.979	−9.520	12.459
12th Five-Year Plan	Tianjin	0.800	0.015	0.271	0.514	0.785
	Hebei	1.620	0.127	2.299	−0.806	1.493
	Liaoning	−3.300	0.909	16.448	−20.656	−4.209
	Shandong	24.910	1.124	20.353	3.432	23.786

average. 2) In the three periods, the industry mix share of the four regions is greater than zero, and Shandong is far larger than other provinces and cities, which shows that the overall internal structure of the marine primary industry in the northern marine economic circle is reasonable. For the net shift share, except Tianjin was negative (−0.002 billion yuan) during the "10th Five-Year Plan" period and Liaoning was negative (−4.209 billion yuan) during the "12th Five-Year Plan" period, other regions showed positive values in three periods, which indicated that the development level of primary industry in Hebei and Shandong was higher than the national average level during the three research periods. 3) During the "12th Five-Year Plan" period, the competitive position share of Tianjin and Shandong was positive, accounting for 0.514 billion yuan and 3.432 billion yuan, respectively, indicating that the primary industry in the above-mentioned regions contributed more to economic growth.

TABLE 2. Shift-share of second industry in northern marine economic circle (unit: billion yuan)

Period	Region	G	N	P	D	T
10th Five-Year Plan	Tianjin	34.533	4.652	22.404	7.477	29.881
	Hebei	7.059	1.632	7.858	−2.431	5.427
	Liaoning	16.416	2.508	12.077	1.831	13.908
	Shandong	24.488	6.894	33.199	−15.605	17.594
11th Five-Year Plan	Tianjin	107.880	38.772	45.161	23.948	69.108
	Hebei	9.980	23.842	27.771	−41.633	−13.862
	Liaoning	34.590	34.051	39.662	−39.122	0.539
	Shandong	176.580	76.881	89.549	10.150	99.699
12th Five-Year Plan	Tianjin	39.290	31.716	34.823	−27.249	7.574
	Hebei	17.270	10.707	11.756	−5.192	6.563
	Liaoning	−20.900	19.022	20.886	−60.808	−39.922
	Shandong	156.050	52.130	57.238	46.682	103.920

From the analysis in Table 2, it can be concluded that:

1) During the "10th Five-Year Plan" period, Tianjin was the fastest growing second industry in the northern marine economic circle, and Shandong had the greatest growth advantage during the "11th Five-Year Plan" period and the "12th Five-Year Plan" period. 2) In the three periods, the industrial mix share of three provinces and one city are

all positive, indicating that the internal structure of the marine secondary industry in the northern marine economic circle is good, and the industrial structure advantage of Shandong has been the most prominent for 15 consecutive years. 3) During the "10th Five-Year Plan" period, the competitive position share of Hebei and Shandong was negative; during the "11th Five-Year Plan" period, the competitive position share of Hebei and Liaoning was negative; during the "12th Five-Year Plan" period, only the competitive position share of Shandong was positive (46.682 billion yuan), indicating that Hebei's competitiveness has been weak. For the net shift share, the four regions are all positive during the "10th Five-Year Plan" period, which shows that the economic growth rate of the second industry in the northern marine economic circle is higher than the national average level; during the "11th Five-Year Plan" period, the net shift share of Hebei is negative, indicating that the development speed of the second industry in Hebei is not as good as that in other regions; and during the "12th Five-Year Plan" period, the net shift share between Liaoning and Shandong is quite different, respectively, -39.922 billion yuan and 103.922 billion yuan, which shows that the overall development level of secondary industry in Liaoning is not as good as in Shandong.

TABLE 3. Shift-share of tertiary industry in northern marine economic circle (unit: billion yuan)

Period	Region	G	N	P	D	T
10th Five-Year Plan	Tianjin	83.127	8.519	7.987	66.621	74.608
	Hebei	12.063	1.886	1.768	8.409	10.177
	Liaoning	26.859	3.069	2.878	20.912	23.790
	Shandong	60.072	6.297	5.904	47.871	53.775
11th Five-Year Plan	Tianjin	57.110	18.292	19.486	19.332	38.818
	Hebei	-6.130	20.214	21.533	-47.876	-26.344
	Liaoning	62.540	21.312	22.703	18.525	41.228
	Shandong	149.240	62.440	66.515	20.285	86.800
12th Five-Year Plan	Tianjin	100.340	31.737	35.646	32.957	68.603
	Hebei	48.750	16.608	18.653	13.490	32.142
	Liaoning	42.570	42.137	47.326	-46.893	0.433
	Shandong	258.370	101.584	114.095	42.691	156.786

From the analysis in Table 3, it can be concluded that:

1) In the three periods, the economic growth of marine tertiary industry in Tianjin and Shandong has shown a rapid development trend, which is far higher than the average growth rate of the whole country. Compared with the "11th Five-Year Plan" and the "12th Five-Year Plan", Liaoning's overall growth has declined, from 62.54 billion yuan to 42.57 billion yuan. 2) The industry mix share of the marine tertiary industry structure of three provinces and one city are positive in three periods, which shows that the internal structure of the marine tertiary industry is better. During the "10th Five-Year Plan" period, Tianjin is more prominent. During the "11th Five-Year Plan" period and the "12th Five-Year Plan" period, Shandong is more prominent. 3) During the "10th Five-Year Plan" period, the competitive position share of three provinces and one city were all positive; during the "11th Five-Year Plan" period, the competitive position share of Hebei province was negative; during the "12th Five-Year Plan" period, the competitive position share of Liaoning province was negative, indicating that the competitiveness of marine tertiary industry in Tianjin and Shandong has been strong.

From the analysis in Table 4, it can be concluded that:

1) In terms of the industry mix share, the industry mix share of three provinces and one city is positive, which indicates that the marine industrial structure of the northern

TABLE 4. Shift-share of gross production in northern marine economic circle (unit: billion yuan)

Period	Region	G	N	P	D	T
10th Five-Year Plan	Tianjin	117.884	13.397	30.888	73.599	104.487
	Hebei	20.883	4.855	12.577	3.451	16.028
	Liaoning	67.754	13.464	32.350	21.941	54.290
	Shandong	157.753	30.982	78.345	48.426	126.771
11th Five-Year Plan	Tianjin	165.250	57.078	64.897	43.274	108.172
	Hebei	6.080	44.157	51.080	−89.157	−38.077
	Liaoning	114.070	55.960	72.849	−14.739	58.110
	Shandong	339.530	140.572	178.044	20.914	198.958
12th Five-Year Plan	Tianjin	140.430	63.468	70.740	6.222	76.962
	Hebei	67.640	27.441	32.708	7.491	40.199
	Liaoning	18.370	62.068	84.660	−128.358	−43.698
	Shandong	439.330	154.839	191.686	92.805	284.491

marine economic circle is reasonable and helps to promote the marine industrial structure of the northern marine economic circle to be more rational. 2) In terms of the competitive position share, the competitive position share of the four regions is positive, during the "11th Five-Year Plan" period, which indicates that the competitive position share of Tianjin and Shandong has been better. Compared with the national average level, Hebei and Liaoning still have a certain gap. 3) In terms of the net shift share, Shandong's net shift share has remained the first in three periods, indicating that the growth advantage of Shandong in the northern marine economic circle is the most obvious, and the growth rate of its gross marine product is higher than the national average. The net shift share of Hebei and Liaoning showed negative values during the "11th Five-Year Plan" and the "12th Five-Year Plan", which indicated that the development level of the four regions in the northern marine economic circle was not balanced.

5. **Conclusions.** To sum up, the main problems existing in the marine industrial structure of the northern marine economic circle are as follows.

1) The development of marine industrial structure in different regions is not balanced, and there are significant differences in the development of marine economy, resulting in polarization. In 2015, the marine output value of Shandong province was ranked second in the country, first in the northern marine economic circle, far exceeding that of other regions. Tianjin's marine industrial structure showed a "231" layout, which was different from the overall layout of the northern marine economic circle. Hebei was faced the shortage of marine science and technology talents, which is not conducive to its marine development.

2) The transformation process of marine industrial structure is slow. The economic benefits among the major marine industries are low. Some marine industries have large labor input, extensive mode of production and low labor productivity. Emerging marine industry develops late and its conversion rate is low. The second industry not only has a low scientific and technological content, but also its development is stagnant.

3) Marine environmental problems have been neglected, offshore resources have been overexploited, marine ecosystems have been damaged, and marine resources regeneration capacity has declined significantly.

Therefore, the northern marine economic circle must break through the regional boundaries, strengthen cooperation and realize the diversification of marine economy among provinces and municipalities in the region; control the exploitation of offshore resources, increase the development of modern fisheries such as deep-sea container; improve the

added value of marine tertiary industry, continuously improve the professional quality of the employees involved in the sea, and apply advanced subjects. We should learn from technology to improve the scientific and technological content of services, actively develop new marine industries, strengthen the ability of marine scientific and technological innovation, strengthen the prevention and control of marine pollution. Finally, realize the sustainable development of marine economy. Due to the slow updating of marine economic statistics, the data in this paper will only be updated to 2015. It is hoped that with the continuous updating of the data, we can continue to study the development of the marine economic structure in the northern marine economic circle.

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