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Research on the Industrial Distribution of Chinese Marine Engineering Equipment Manufacturing Industry——A case of 32 Listed Companies

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Abstract. Article based on the size of the total assets of 32 listed companies carries out a qualitative description about Chinese marine engineering equipment manufacturing industry. And also quantitative analysis on reality concentration, degree of market concentration and spatial agglomeration level were analyzed by G_{EG} coefficient, HHI index and γ_{EG} coefficient. It is found that Chinese marine engineering equipment manufacturing industry develops unbalanced in the region, the degree of concentration has decreased in general and spatial agglomeration level is not higher. And reasonable suggestions are put forward for Chinese marine engineering equipment manufacturing industry which are optimization of industrial distribution, the formation of industrial agglomeration and cultivations of science and technology human resources.

Introduction

China's equipment manufacturing industry output value in 2014 exceeded 20 trillion Yuan, which accounted for more than one-third of the world's, and ranked first in the world. Equipment manufacturing industry is not only a pillar industry of national economic development, but also play the most important role in the real economy. The high-end equipment manufacturing industry, which is characterized by technology-intensive, high added value, large growth space and strong driving effect, is an important development engine for the future sustainable development of the national economy.

The marine engineering equipment manufacturing industry is an important component of the strategic emerging industry and an important direction of the high-end equipment manufacturing industry, which is characterized by intensive knowledge and technology, less consumption of material resources, great growth potential and good comprehensive benefits, and it is the leading industry to develop marine economy. "Twelfth Five-Year" National Strategic Emerging Industry Development Plan "put the marine engineering equipment industry into one of the strategic emerging industries that the national focused on supporting. The state plans to increase the percent of strategic emerging industries as a percentage of GDP in 2020 to 15% to 115,000 Billion Yuan, which will create about 8 trillion market scale, and greatly promote the development of marine engineering equipment industry. February 2012, the Ministry of Industry and Information Technology and other departments jointly developed “Medium and Long - term Development Planning of Marine Engineering Equipment Manufacturing Industry". The "planning" will play an important guiding significance in upgrading the scale, innovation ability and comprehensive competitiveness of marine engineering equipment industry, and completing industrial system and industrial agglomeration.

Marine engineering equipment is a general term for all types of equipment used in the development, utilization and protection of marine activities. It is the prerequisite and foundation of marine economic development and is at the core of the marine industry value chain. Promoting the development of marine engineering equipment and optimizing the layout of marine engineering equipment are not only the country's goals and requirements to promote China to become the world's major marine engineering equipment manufacturing, but also are important steps to promote the restructuring and upgrading of Chinese marine engineering industry, which is of great

significance to safeguard national marine rights and interests, accelerate marine development, ensure the safety of strategic transportation and promote the sustained growth of the national economy.

Theoretical Basis and Literature Review

Industrial distribution refers to the dynamic combination of various sectors of a country or area in the region, which is a concrete manifestation of the development law of various departments of the national economy [1]. The industrial layout theory was formed in the middle of the 19th century to the middle of the 20th century, mainly through the three stages of Du Neng's "isolated garden", Weber's industrial location theory and modern location theory. In view of the limited resources of the author, there are few literatures focused on the layout of the relevant issues of marine engineering equipment manufacturing industry, and are also still no special research on marine engineering equipment manufacturing abroad.

In an existing literature, Anonymous (2010) [2] provided in-depth analysis and a detailed understanding of China's 2010 navigation, meteorological and ocean equipment manufacturing industry, market drivers, key enterprises and their strategies, as well as technology and investment conditions, risks and trends Et al., but did not involve the research of the space layout of Chinese marine engineering equipment manufacturing industry.

Chinese scholars research a lot on the marine engineering equipment manufacturing industry, generally based on industrial chain, international competitiveness, growth evaluation, industrial clustering and financing efficiency research.

From the qualitative perspective, Tao and Chen (2010) [3] analyzed the development strategy of China's marine engineering equipment industry based on SWOT analysis, and proposed the development strategy of Chinese marine engineering equipment industry, such as growth strategy, diversified business strategy, reverse strategy and defensive strategy. Du and Jiang (2013) [4] did a research on the process, status and problems in the development process of Chinese marine engineering equipment manufacturing industry from the necessity of the development of marine engineering equipment manufacturing industry, finally put forward some recommendations to improve Chinese marine engineering equipment manufacturing industry competitiveness. Su and Tao et al. (2013) [5] built a collaborative model of marine engineering equipment supply chain based on incentive measures starting from the upstream supplier uncertainty and marine engineering equipment supply chain. Li (2010) [6], Cheng and Jia (2014) [7] did some research respectively from the government function orientation of "internationalization" manufacturing industry strategy in China and the government regulation of Chinese marine engineering equipment manufacturing enterprise development. Hong and Chen et al. (2015) [8] analyzed the development of marine engineering equipment industry's external environment from the aspects of technology development of China, and studied the overall competitive environment of marine engineering equipment industry from industry division and competitors. At the same time, it concluded that although Chinese marine engineering equipment industry was in a disadvantageous position in the international industrial division of labor, it was also equipped with the conditions of participating in international competition.

From a quantitative perspective, Wu and Huang (2013) [9] constructed the index system of the correlative factors of marine engineering equipment industry based on the "Diamond Model" .They calculated the grey correlation degree of the correlation factor index and the market performance of marine engineering equipment using the data of five provinces of Liaoning, Shandong, Jiangsu, Shanghai and Guangdong. Zhang and Zhou et al. (2015) [10] used SWOT method to systematically analyze the key factors affecting the development of Chinese marine engineering equipment industry, and used the analytic hierarchy process (AHP) to calculate the weight of each factor, and finally on this basis put forward the development strategy of marine engineering equipment industry in China. Tang and Xiao et al. (2015) [11] did empirical research on network embedding, agglomeration imitation and knowledge spillovers of university-derived enterprises on the basis of the three major marine engineering equipment manufacturing clusters in China, and introduced the

new network characteristics - spatial clustering structure and found that the cluster spillover of Chinese enterprise cluster existed spatial imitation effect. Wu and Huang et al. (2015) [12] got the comprehensive effect, Center degrees and cause degrees of each problem, and built a multi-level hierarchical system structure model reflecting the interaction between the problems, which used the construction of marine engineering equipment industry development problem system and integrated DEMATEL / SIM method. Guo (2011) [13] studied the development and layout of Chinese marine engineering equipment manufacturing industry, but that was only a simple qualitative statement. Wei (2013) [14] did a research about the cluster competitiveness on China's Bohai Economic Circle of marine engineering equipment manufacturing industry, did not involve the national level.

At present, although the research about marine engineering equipment manufacturing industry has made some achievements, but on the overall view of the layout of the research are still relatively few and lacks of effective tools to optimize the marine engineering and equipment manufacturing industry layout. Reasonable layout of marine engineering equipment manufacturing industry is the prerequisite for the comprehensive utilization of marine resources, also is the comprehensive expression of the use of the overall function and effectiveness of the sea [15]. So the research on the layout of Chinese marine engineering and equipment manufacturing industry has a strong empirical study meaning and practical significance.

Method for Determination of Industrial Agglomeration Degree

There are many methods for determining the degree of industrial agglomeration, Duranton and Overman (2005) divided the evolution of the measure of industrial agglomeration into three generations: the first was the measure of industrial geographic concentration, which mainly contained the concentration rate, HHI, the regional Gini coefficient and Hoover localization coefficient etc.; The second was about the measurement of industrial agglomeration, mainly related to the γ_{EG} coefficient (also known as EG coefficient), γ_{MS} coefficient etc.; the third was based on the distance measurement of industrial agglomeration methods. Usually the measure of industrial agglomeration level should at least meet: any measure of agglomeration must be comparable across all industries, and the measure must be able to control the size of regional economic aggregates. In addition, the measurement of industrial agglomeration should control its concentration level.

As an evaluation index system, the indicators chosen should reflect the economic characteristics and evaluation requirements of the evaluation objectives. The evaluation index system for different objectives, the index collection, scope, object, evaluation methods, etc. will be very different. Based on the existing research work in this paper, measure and analysis are completed from the regional level in 2010-2014 Chinese marine engineering and equipment manufacturing industry cluster based on the γ_{EG} coefficient method. The analysis method of γ_{EG} coefficient was developed by Ellison and Glaeser in 1997, it can be obtained by the following formula:

$$\gamma_{EG} = \frac{G_{EG} - (1 - \sum_r x_r^2)H}{(1 - \sum_r x_r^2)(1 - H)} \tag{1}$$

In Eq.1, $G_{EG} = \sum_r (x_r - s_r)^2$, x_r is the proportion of the total number of workers in the regions r in all trades of the country, s_r is the number of workers of the industry i in the region accounted for the number of workers in the industry of the country. H is the industry Herfindahl coefficient($H = \sum z_i^2$)reflecting the size distribution of the enterprise (also known as market concentration). z_i Is the percentage of company k's employees (including 1, ..., k) in the total number of employees in industry.

The coefficient takes into account the total employment (response the distribution of the final demand) and industrial concentration factors, and does a correction of the concentration factor to

remove the layout of enterprises in the process of market-oriented layout of the behavior of the so-called clustering, and also to avoid the illusion of industrial agglomeration that one or two enterprises.

Industrial Distribution of Chinese Marine Engineering Equipment Manufacturing Industry

Our research object are 32 listed companies of marine engineering equipment manufacturing industry. These companies generally involve a lot of industries, but we find that relevant data by the listed companies in marine engineering equipment and shipbuilding industry occupies a large proportion, and will not have a great impact on our analysis.

Industrial Distribution of Chinese Marine Engineering Equipment Manufacturing Industry

Basic Situation of Industrial Development of Chinese Marine Engineering Equipment Manufacturing Industry. The marine engineering equipment industry is the material and technological foundation for the development and utilization of marine resources, and is a strategic emerging industry that accelerates the cultivation and development of China. The top three orders of the world's marine engineering equipment in 2013, South Korea, China, Singapore, took up the global market share are 42%, 24%, 18%.

Chinese marine engineering equipment (including marine vessels) orders amounted to $18 billion, accounting for 29.5% of the total global order, in 2014 1-8 months, the order amount reached $10.07 million, accounting for about 33% of global orders.

Now, China has been involved in the construction of the marine to increase the number of enterprises, the various types of platforms and other large equipment construction enterprises have reached more than 20, the construction of marine engineering vessels up to more than 100. China has become the largest manufacturer of self-elevating platforms and marine auxiliary vessels. But it is not the power of marine engineering equipment manufacturing industry. By the research on Chinese marine engineering equipment industry layout, questions can be found in industrial layout, and promote the development of marine engineering equipment of China on structural adjustment.

Basic Characteristics of Chinese Marine Engineering Equipment Manufacturing Industry Layout Size Distribution. From the area's total assets, the proportion of the eastern three economic circle area reached 97.56%in 2014 which was in a large dominant position while the Midwest accounted for 1.54%. There are still large gaps in the total scale of marine engineering equipment manufacturing industry compared with the eastern region, as shown in Fig. 1.

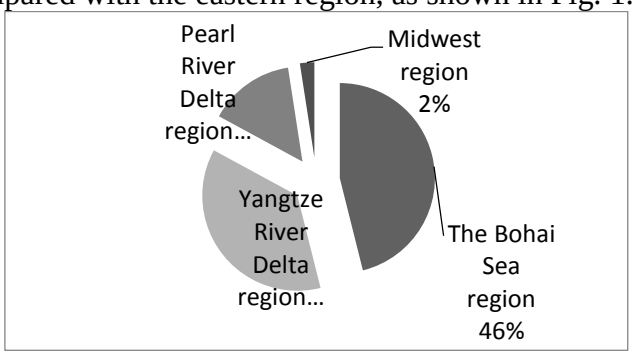

Figure 1. Finite Total assets of Chinese marine engineering equipment manufacturing industry in the region in 2014

The total distribution of assets of Chinese marine engineering and equipment manufacturing industry in 2014 had a big difference in inter-provincial. Shanghai is China's largest marine engineering equipment manufacturing industry, accounting for 34.47% of the total, ranked second in Beijing, accounting for 21.07%, followed by Guangdong Province, Tianjin, Liaoning Province , Shandong Province, the total assets of these six provinces accounted for 94.79%.

Analysis of Industry Agglomeration of Chinese Marine Engineering Equipment Manufacturing Industry Based on γ_{EG} Coefficient

Data Sources. Research data is from 31 provinces and cities in mainland China by the end of 2010-2014 number of employees, which can be found in provinces and cities statistical yearbook and China Statistical Yearbook; the number of employees of Chinese marine engineering equipment manufacturing industry by the end of 2010-2014 is from the wind database.

Determination of Agglomeration Degree and Results. Based on the data of the selected region, the results are shown in Fig. 2 and Table 1, respectively.

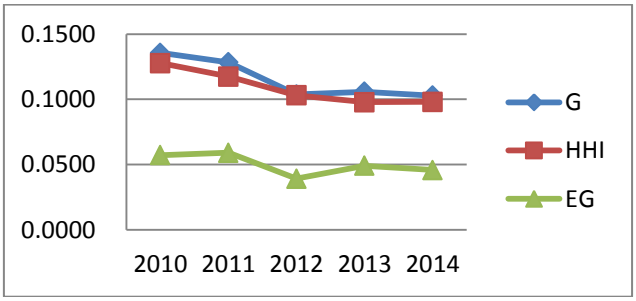

Figure 2. Finite the trend of G_{EG} coefficient, HHI index and γ_{EG} coefficient of Chinese marine engineering equipment manufacturing industry in 2010-2014

Table 1 the agglomeration level of Chinese marine engineering equipment manufacturing industry in 2010-2014

Year	G_{EG}	HHI	γ_{EG}
2010	0.1355	0.1277	0.0572
2011	0.1283	0.1175	0.0590
2012	0.1037	0.1030	0.0391
2013	0.1058	0.0978	0.0490
2014	0.1029	0.0980	0.0458

Based on analysis of G_{EG} coefficient

To construct the coefficients, Ellison and Glaeser (1994, 1997) first designed the "raw concentration index", which measures the degree of real concentration in each industry. From Fig. 3 we can see that there is a further downward trend of the degree of real concentration of Chinese marine engineering equipment manufacturing industry, and a slight rebound in the trend in 2013, and then declined.

Based on the analysis of the HHI index

The HHI index is the industry Herfindahl coefficient reflecting the size distribution of enterprises (it can be called market concentration). The higher the value, the higher the market concentration. When the market is in complete monopoly, $HHI = 1$; when there are many firms on the market, and the scale is the same, $HHI = 1/n$,the n tends to infinity and tends to zero. It can be seen from Fig. 3 that the HHI index of Chinese marine engineering equipment manufacturing industry has been declining year by year in general and a slight recovery in 2014, which shows that the concentration of Chinese marine engineering equipment manufacturing industry has a further trend of decreasing, showing the competitiveness of enterprises in the market Further enhanced.

Based on analysis of γ_{EG} coefficient

We can learn from Zhang (2007) [16] to determine the degree of evaluation of Chinese manufacturing industry spatial agglomeration level, $\gamma_{EG} < 0.026$ represents a low industry

regional concentration; $0.026 \leq \gamma_{EG} < 0.098$ represents a moderate industry regional concentration; $\gamma_{EG} > 0.098$ represents a high industry regional concentration. The overall spatial agglomeration degree of Chinese marine engineering equipment manufacturing industry is not high, which belongs to the moderate industry regional agglomeration, but has a year-on-year decline trend, a slight rebound in 2013, and then decline. The coefficient reflects the level of spatial agglomeration of Chinese marine engineering equipment manufacturing industry, and also compensates for the shortcomings of the G_{EG} coefficient and HHI .

Conclusion and Recommendations

Reasonable marine engineering equipment manufacturing industry layout helps to play regional comparative advantage and absolute advantage, improve the efficiency of resource use, and promote the improvement of marine economic efficiency. The main problems of Chinese marine engineering equipment manufacturing industry are imbalanced levels in regional, a downward trend of the overall concentration, a not high level of spatial clustering and so on. Therefore, combined with the layout of the characteristics of Chinese marine engineering equipment manufacturing industry, recommendations should be followed:

There are many factors affecting the industrial layout, including the raw material factor, the driving force factor, the market factor, the transportation factor, the labor factor, the time factor and the original industrial base. The layout of the Chinese marine engineering equipment manufacturing industry should follow the industrial layout principles, the combination of concentration and dispersion, and form a reasonable industrial layout according to local conditions. The formation of a clear division of labor, rational layout and coordinated development pattern cannot do without fully considering the comprehensive utilization of resources, organization of enterprise collaboration, joint production, which promotes rapid development of the industry cluster of marine engineering equipment manufacturing.

Marine engineering equipment manufacturing industry needs to improve the marine infrastructure as a supporting condition, such as transportation infrastructure, marine power generation. It should actively guide the marine infrastructure construction relying on urban agglomerations, and strengthen the sharing of facilities with related industries. The industrial layout will show a trend of regional agglomeration when economic develops to a certain stage. In the form of industrial space, the formation of industrial chain should through the active promotion of industrial agglomeration. Measures should be took to promote the implementation of demonstration area industrial spatial layout planning, establish linkage mechanism between city and district, promote the implementation of major projects of the park.

Ocean engineering equipment manufacturing industry should be laid out in the neighborhood of scientific research institutions, increase the training of marine professionals and support the funding of marine engineering equipment of universities or research institutes. At the same time, we should encourage and support scientific research institutions to actively undertake major national standardization issues, which has a positive role in promoting innovative and normative of the marine engineering equipment industry in the design, construction and management. Enterprises can also strengthen cooperation with relevant national research institutions to jointly develop the high-end equipment required for market products. To a certain extent, Chinese manufacturing industry strives to occupy the global market with the quality to get rid of the move by winning the market at low prices.

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