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Supply-side Reform Background Research on the Competitiveness of Petroleum Equipment Manufacturing Industry in the Yellow Triangle

Qian Gao*
School of Chinese, Law and Economic Management
ShengLi College
China University of Petroleum
ShanDong, China
gaoqian-slupc@foxmail.com

***Abstract*—There are some problems in the petroleum equipment manufacturing industry in the Yellow River delta region, such as unbalanced development of sub-industries, lack of core competitiveness of products, and lack of industrial cluster effect. The paper selects the industrial economic operation data from 2014 to 2016. Firstly, it USES factor analysis method to rank the competitiveness of the four sub-industries of the oil equipment industry in the Yellow River delta region. The t-test method was then used to determine the difference of industrial situation in the region in the past three years, as well as the difference of industrial competitiveness and national average level, so as to supplement the relevant conclusions obtained by factor analysis. Through empirical evaluation, three basic principles of developing regional competitiveness improvement strategy are obtained. Based on the influence of supply-side reform on the industry, specific strategies for competitiveness improvement are proposed from three aspects, namely, optimizing industrial structure, enhancing supply-side strength, and innovation and upgrading.**

Keywords—Supply-side reform; Yellow Triangle region; Petroleum equipment manufacturing industry; Competitiveness

I. INTRODUCTION

As one of the important supports of China's industrial industry, the petroleum equipment manufacturing industry is an important field of action for the government's supply-side reform. Here, the three forces (policy, environment, resources) summarize their impact on the industry.

From the policy level, the policy role is clear, flexible, and the frequency of the industry is relatively higher than the institutional level. For example, the government's "first (set) policy" in the manufacturing sector encourages companies to engage in major technological breakthroughs through government financial subsidies to enhance China's ability to build independent intellectual property rights [1]. The petroleum equipment manufacturing industry should fully grasp the government's policy of encouraging core technology research and development, innovation and breakthroughs in innovation, and move toward high-end and intelligence.

From an environmental perspective, with the rising cost of factors and the continued low investment in low oil prices, the mode of economic development has shifted from "extensive scale" to "quality and efficiency". The lack of effective supply has increasingly highlighted the weakening of demand management. The government has tried to create a good political and ecological environment by removing regulations, cutting taxes and clearing fees, and eliminating monopoly, and removing risks in the financial and financial fields. This requires the industry to focus on reducing operating and market transaction costs, and to play a role in market regulation in resource allocation.

From the perspective of resources, the supply-side reform will promote the development of the industry from the three aspects of capital, technology and entrepreneurial talents. First, it is conducive to loosening the supply of capital to relieve the existing financial repression, to some extent ease the current situation of corporate financing channels; second, it is conducive to improving technology supply, building a platform for independent innovation and transformation of results; third, effective for entrepreneurs Supply, train a team of professional managers.

II. REGIONAL INDUSTRY STATUS

A. The Operational Indicators of the Petroleum Equipment Manufacturing Industry in the Yellow Triangle Region Rank Among the Top in China

At present, there are more than 500 oil and gas manufacturing enterprises above designated size in the region, with total assets of 255.92 billion yuan. In 2016, the main business income was 123.25 billion yuan, a year-on-year increase of 1.1%, and the total profit was 8.541 billion yuan, down 10.3% year-on-year [2]. As the largest petroleum equipment manufacturing base in China, the Yellow Triangle region, the number of enterprises above the scale of the region

and the economic aggregate account for about one-third of the national industry indicators. In the list of the top 50 industries announced in 2016, the enterprises in the Yellow Triangle region occupy 7 seats, of which ShanDong Kerui Petroleum Equipment Co., Ltd. ranks first in China.

B. *Affected by the Sluggish Development of the Oil and Gas Industry and the Impact of Investment Compression, the Overall Performance of the Regional Industry Is Weak.*

Before the fall of international oil prices in 2014, only the oil drilling equipment sub-sectors were executed in 2015 and 2016 with the inventory orders signed with customers. The other three sub-sectors were greatly affected by the industry downturn.

C. *The Development Level of the Sub-sectors Is Uneven, and the Advantages of the Sub-sectors Are Outstanding.*

Among the 33 products of the oil drilling equipment selected by the industry famous brand products in 2016, 10 products including the Kerui brand/1000HP AC variable frequency towed drilling rig were selected in the Yellow Triangle. The oil drilling equipment has obvious advantages in the industry, and the other three sub-sectors have no star products on the list.

D. *Innovation Capacity Continues to Increase*

Many of the star products in the region have benefited from continuous innovation. For example, the production capacity of drilling rigs, pumping units and heavy oil development units ranks first in the country, and the production capacity of submersible pumps ranks second in the country. At the same time, in order to build the integration of industry, education and research, and integrate the regional technology research and development resources, a number of professional scientific research institutions have been established. The number of technical achievements that have been introduced and independently researched and developed has reached 853, and 13 national and provincial scientific and technological progress awards have been won [3].

E. *Insufficient Cluster Effect*

In recent years, the government has vigorously supported key enterprises in the Yellow Triangle region. SMEs have benefited from the technological spillovers of key enterprises, and the synergy effect has been remarkable, which has strengthened the cluster power. However, the regional market is still concentrated in the surrounding areas of DongYing, and it is difficult for industrial clusters to radiate larger areas.

III. ANALYSIS OF INDUSTRY COMPETITIVENESS IN THE YELLOW RIVER DELTA REGION

A. *Evaluation Method Selection and Index System Construction*

Firstly, Combination of factor analysis and t-test.Using the data obtained, and using SPSS statistical software, firstly, the current development status of the four sub-sectors in the Yellow Triangle region is comprehensively scored and ranked by factor analysis, and then the difference between the regional and national industry averages is compared by t-test. Formulate the basic principles for improving the competitiveness of the industry.

Secondly, Index system construction. Based on the preliminary research results and the main influencing factors of industrial competitiveness, based on the current situation in the region, a three-level evaluation index system for comprehensive competitiveness is established: three first-level indicators, five second-level indicators, and three third-level indicators. The first-level indicators are: scale competitiveness, efficiency competitiveness, and scientific and technological innovation competitiveness; the second-level indicators are: scale effect, profitability, market possession ability, resource allocation efficiency, and technological innovation capability. In terms of scale competitiveness, it includes five levels of indicators: total assets X1, average number of employees X2, total industrial output value X3, main business income X4, and total profit X5. Measuring the competitiveness are three secondary indicators, seven tertiary indicators: in terms of profitability, including sales profit margin X6, asset profit margin X7 and cost expense profit margin X8 three indicators; consider the market capacity indicators, Including market share X9 and product export rate X10; in terms of resource allocation efficiency competitiveness, it is measured by the labor productivity X11. In terms of technological innovation competitiveness, including the proportion of research and experimental development personnel X12, research and experimental development funding intensity X13 two indicators [4].

Finally, Data source description. The data of the total industry and sub-sectors (oil drilling equipment, refining and chemical equipment, offshore engineering equipment, metal pressure vessels) of the national and yellow triangle regions in the index system from 2014 to 2016 were collected. The evaluation system data is derived from the China Petroleum and Petrochemical Equipment Industry Yearbook (2016), Shandong Statistical Yearbook (2013-2015), and China Science and Technology Statistical Yearbook (2013-2015), and has achieved the indicator system and The specific industry data is 390 (slightly) [5][6].

B. *Comprehensive Evaluation*

1) Factor analysis: The calculation process of the competitiveness score of the petroleum equipment manufacturing industry in the Yellow Triangle is as follows:

a) Correlation analysis: By constructing a matrix of correlation coefficients, it is found that the coefficients have a high linear relationship, which is more suitable for extracting common factors and can be factor analysis.

b) KMO inspection standard: After calculation, the KMO value is 0.718>0.7, combined with the KMO test standard (0.9<KMO, very suitable; 0.8<KMO<0.9, suitable; 0.7<KMO<0.8, general; 0.6<KMO<0.7, not suitable) ; KMO < 0.6, not suitable) and Bartlett's test results concluded that at a 5% significance level, the significance probability is less

than 0.001, and this study satisfies the basic criteria for doing the main analysis.

c) Extract the variance of the common factor: The extraction of the common factors of the 13 indicators is between 0.793 and 0.999, which can reflect the content of the original information extracted by the common factors, reflect the commonality of the variables, and the extraction effect is good, satisfying the requirements of factor analysis.

d) The analysis and mapping of the gravel map shows a downward trend: When the fourth common factor is down, the eigenvalues become smaller and the contribution is lower. It is difficult to explain the importance of the contribution of the original variables. Therefore, the choice of extracting 3 common factors can achieve the research purpose.

e) The main component is extracted: According to the principle that the eigenvalue is greater than 1, the principal component analysis method is used to extract three factors, and the variance contribution rate is obtained after rotation: 47.956%, 28.019%, 17.843%, and the cumulative variance contribution rate is reached. 93.818%, according to the formula W = common factor variance contribution rate / cumulative variance contribution rate, calculate the three common factor weights: W1 = 0.51, W2 = 0.29, W3 = 0.19.

f) The matrix of component score coefficients is obtained: By orthogonal rotation, 13 indicators are divided into three types of factors:

The scale factor F1 can explain six variables (total assets X1, average number of employees X2, total industrial sales value X3, main business income X4, total profit X5, market share X9), reflecting the size of the industry.

The benefit factor F2 can explain four variables (sales profit margin X6, asset profit margin X7, cost expense margin X8, R&D personnel share X12), reflecting business capability.

The innovation factor F3 can explain three variables (product export rate X10, labor productivity X11, R&D expenditure input intensity X13), reflecting investment and innovation capabilities.

g) Calculate the common factor and the composite score and rank: The common factor score is calculated by SPSS software, see column 5 of Table I, to construct the industry competitiveness evaluation model of the region:

$$Fi=w1*f1i+ w2*f1i+ w3*f1i \quad (1)$$

where Fi is the comprehensive score of the industry in the region, w1 , w2, w3 are common factor weights, and get a comprehensive score of the competitiveness of the industry.

According to the score, get the conclusion:

On one hand, the overall competitiveness of oil drilling equipment has strong strength in the region, and the overall competitiveness level is outstanding; refining and chemical equipment and offshore engineering equipment are at a mid-stream level, which is relatively stable; metal pressure vessel equipment is at the middle and lower reaches.

TABLE I. COMPREHENSIVE SCORES OF VARIOUS FACTORS AND INDUSTRY COMPETITIVENESS

industry	f1	f2	f3	Score	Ranking
Entire Industry	846.92	-127.19	-47.15	386.08	1
Oil drilling equipment	438.7	-52.67	65.56	220.92	2
Refining and chemical equipment	113.48	-0.88	161.48	88.3	3
Marine engineering equipment	109.84	-10.53	120.72	75.9	4
Metal pressure vessel	77.68	-7.17	70.23	50.88	5

On the other hand, the competitiveness structure of the four major sub-sectors has commonalities, that is, the scale competitiveness is relatively strong, while the efficiency competitiveness and technological innovation competitiveness are weak. Among the three types of competitiveness, the efficiency competitiveness of the four major sub-sectors is generally weak, especially in the oil drilling equipment sub-industry. Although the comprehensive competitiveness score ranks first, the efficiency competitiveness ranks the lowest.

2) T-test: The above factor analysis method is used to rank the competitiveness of the four sub-sectors in the Yellow Triangle. Because it is difficult to collect industry data from other regions in China, the existing sample size is small. Therefore, this part adopts the t-test method, first for the Yellow Triangle region 2014-2016. The three-year data is analyzed by t-test, and then the t-test analysis is carried out on the 2014 data of the Yellow Triangle and the national average to determine the difference of the industry situation in the three years and the difference between the regional and the national level. Supplementary explanation of the relevant conclusions drawn by the factor analysis method.

a) Difference test of industry indicators in the Yellow Triangle Region in 2014-2016: Combined with the data in Table I, the difference between the indicators of the industry in the Yellow Triangle region in 2016, 2015 and 2014 was calculated by the spss software. Under the 5% significance level, the significance probability was greater than 0.05, which was considered to be not statistically significant. Therefore, there is no significant difference in the level of industrial competitiveness during the three years of the Yellow Triangle in 2016, 2015 and 2014.

b) Comparison of Industrial Indicators between the Yellow Triangle Region and the National Industry in 2014: Combined with the data in Table I, the difference between the indicators of the national and yellow triangle regions is compared by the calculation of spss software. Under the 5% significance level, the significance probability is greater than 0.05, which is considered to be of no statistical significance. There is no significant difference in the competitiveness of the industry.

IV. INDUSTRY COMPETITIVENESS IMPROVEMENT STRATEGY

Based on the results of comprehensive factor analysis and t-test on the evaluation of industry competitiveness in the Yellow Triangle, the basic principles for formulating the competitiveness improvement strategy in the region are drawn:

First, the Yellow Triangle region was affected by the continued decline in international oil prices in 2014-2016. There was no significant change in the level of competitiveness during the three-year period, indicating that the industry is still in a global economic downturn in the short term, and it is necessary to comply with the severe situation of insufficient market demand. The new thinking of supply-side reform starts with improving the efficiency of supply-side and improving the competitiveness of the industry.

Second, the development of the four sub-sectors in the region is uneven. We can start from the causes and the status quo, give full play to the advantages of each sub-sector, and seize the new opportunities of "One Belt and One Road" and supply-side reforms to enhance the whole industry. Overall competitiveness.

Thirdly, the t-test results show that the level of industrial competitiveness development in the Yellow Triangle region is comparable to the national average, and there is no significant difference. Therefore, the path of upgrading the competitiveness of the industry at the national level is also of reference value for the competitiveness of the region.

A. Optimize the Structure: Consolidate the Advantages of the Main Featured Products, Expand the Development of High-end Advantages and Sub-industries

The oil drilling equipment market has a higher overall scale factor score. However, the benefit factor score is not satisfactory, and the profit margin index is ranked lower, indicating that the sub-sector still has a large space for improving product added value, total cost reduction, and profit improvement. In order to improve the quality and reduce costs, we can consider from two aspects: First, increase the intensity of technological innovation, and move forward to high-end products and customization. Second, innovative management methods, such as trying to implement the amoeba management, reduce costs and increase efficiency according to local conditions. Amoeba management refers to the internal business unit of oil drilling mining enterprises (for example, according to the product line or business division), through the independent accounting of small modules, to encourage all employees to participate in the operation of the modern management system [7]. Through the practice integration of amoeba management and management accounting, operators can enhance accounting and profit and loss awareness, enhance the correlation between assessment indicators and profits, and cut off loss-making business units.

Among the three major competitiveness of market scale, efficiency and technological innovation, the three sub-sectors of refining and chemical equipment, marine engineering equipment and metal pressure vessels do not have significant competitive advantages. They can be considered from the perspective of technical marketing: First, we should broaden our thinking. Integrate technical strength, adopt reasonable development methods to enhance the flexibility of R&D design, and enhance product brand competitiveness. Second, develop a product platform strategy to drive product cost structure improvement, product value-added capability enhancement and product life cycle optimization. Third, the transition from traditional marketing to technical marketing, from "heads on technology" to "looking at the market", the implementation of product line and customer line "double line operations." In view of the high value and complex structure of petroleum equipment, it can form a "triangular" collaborative team composed of account managers, solution experts and product delivery experts, with professional expertise to deal with customer relationships, brand design, project services, and more. Good, faster response to customer needs.

B. Improve Supply-side Strength: Enterprises Above the Scale Can Improve Supply Quality and Efficiency Through Diversified Means

First, make full use of scale and resource advantages to improve the industrial chain system and the network of suppliers. Petroleum equipment manufacturing enterprises should enhance product strength through industrial integration, promote the extension of business value chain, and effectively connect manufacturing supply and user demand. Second, promote the expansion of enterprises above designated size into one-stop, one-stop, EPC general contracting services. . The business of petroleum equipment manufacturers should not be limited to equipment manufacturing. It is necessary to fully grasp the geographical advantages of the Yellow Triangle and integrate the technological advantages of Shengli Oilfield to carry out the forward integration of the industry. We can also use advanced technology to provide customers with cost-effective technical services. Third, we will use the traction of policies to provide financing value-added services in cooperation with project cooperation. The use of financing services by petroleum equipment manufacturers can help customers solve the problem of capital bottlenecks in bulk equipment procurement and large EPC projects. Fourth, enhance customer stickiness and supply quality through value-added services and extended warranty. Enterprises can provide value-added services from R&D design, production control, installation and commissioning, delivery acceptance and other nodes, and can also extend the warranty period and enhance customer stickiness.

C. Innovation and Upgrade: Two-wheel Drive, Focusing on New Energy Development Trends

It is estimated that China's natural gas demand will reach 320 billion to 360 billion m3 in 2020. However, the new supply of conventional natural gas in China is difficult to meet new demand. In order to effectively fill the shortage of natural gas supply and demand and increase the development of unconventional oil and gas, it is expected to become a strategic choice to alleviate this contradiction between supply and demand. Corresponding to this strategic choice, "two-wheel drive" enterprises under equipment manufacturing + technical services have stronger ability to adapt to new energy development challenges than TF equipment manufacturers [8].

From the perspective of "two-wheel drive", industrial innovation and upgrading can start from three perspectives: First, customer orientation, focusing on customer needs and strategic model changes, and continuously creating maximum value for customers. Second, we will seize the opportunity of new energy development with integrated services and take the

initiative in the market. Third, firmly grasp the support and traction of the circulation industry in the transformation and upgrading of the manufacturing industry, and promote synergy between industries. As an important link connecting various key links of manufacturing industry, modern logistics service industry has been embedded in the manufacturing value chain. Its efficient and high-quality standardization and professional services have optimized the internal structure of manufacturing industry, improved the efficiency of industrial chain integration and responded. Speed, an important function of building the core competitiveness of the industry [9].

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