Evaluation and Influence Factor Analysis on Industrial Competitiveness of Manufacturing Industry of Pearl River Delta

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Abstract. This paper divides the manufacturing industry into four types, analyzes the development of four types of manufacturing industry in the Pearl River Delta (PRD), uses labor productivity as the evaluation index of industrial competitiveness, establishes panel data model to analyze the influencing factors of manufacturing industry competitiveness in the Pearl River Delta, draws research conclusions and puts forward suggestions. The results show that the capital intensive and technology intensive industries in the manufacturing industry of the Pearl River Delta have strong competitiveness, the competitive disadvantage of labor-intensive industries is gradually revealed, and the competitiveness of high-tech industries is gradually enhanced; the per capita equipment rate, average industrial scale, turnover rate of current assets and industrial added value rate all have a positive impact on the competitiveness of the manufacturing industry of the Pearl River Delta.

Keywords: Pearl River Delta, Manufacturing Industry, Industrial Competitiveness Evaluation Index

1. Research Background
Since the reform and opening up, the Pearl River Delta has become one of the regions with the highest degree of economic openness and the most dynamic, and has become a world-wide manufacturing base. At present, the economic downward pressure is increasing, the demographic dividend is disappearing, the competitive advantage of traditional industries is gradually losing and the transformation and upgrading are difficult, and the development of the second industry (manufacturing industry) in the PRD region is facing various difficulties. Improving the competitiveness of manufacturing industry will be helpful for the long-term development of manufacturing industry. This paper studies the competitiveness of the second industry (manufacturing industry) in the PRD region and its influencing factors, which will help the transformation and improvement of manufacturing industry in the PRD region.
2. Literature Review and Research Status

The research on industrial competitiveness in foreign countries began in the 1980s. In 1980, the Swiss Institute of International Management and Development and the World Economic Forum jointly established the international competitiveness evaluation index system. Michael Porter proposed the theory of "Diamond Model" in 1990. Daniela Livia Trascajméno and other scholars evaluated the competitiveness of Romania's manufacturing industry and studied the ways to raise the competitiveness of Romania's manufacturing industry [9]. Domestic scholars also discussed the establishment of industrial competitiveness index system [1,2,3], some scholars also used the index evaluation system to evaluate the regional industrial competitiveness [4,5,6]. This paper uses the index system to evaluate the manufacturing competitiveness of the Pearl River Delta.

3. Manufacturing Development in the Pearl River Delta

According to the latest national standard of classification of national economic industries in 2017, the manufacturing industry category includes 31 categories with code 13-43. Based on the relative density of labor, capital, technology and resources in each manufacturing industry, this paper divides the manufacturing industry in the PRD region into four categories: labor-intensive, capital-intensive, technology-intensive and resource-intensive. The specific classification refers to the manufacturing industry grouping standards sorted out by Cao Zongping [7].

Table 1. Development of manufacturing industry in PRD

| Annual gross output value | labor intensive | Capital intensive | technology intensive | resource intensive |
|---------------------------|----------------|-------------------|---------------------|-------------------|
|                           | Output value   | proportion        | Output value        | proportion        |
|                           | Output value   | proportion        | Output value        | proportion        |
|                           | Output value   | proportion        | Output value        | proportion        |
|                           | Output value   | proportion        | Output value        | proportion        |
| 2009                      | 53309.01       | 0.1725            | 2873.49             | 0.0170            | 33187.9           | 0.6225            | 8047.71           | 0.1509            |
| 2010                      | 66358.24       | 0.1701            | 3711.12             | 0.0199            | 41032.6           | 0.6183            | 10326.9           | 0.1556            |
| 2011                      | 74807.88       | 0.1884            | 4359.02             | 0.0582            | 45349.2           | 0.6062            | 11005.6           | 0.1471            |
| 2012                      | 74423.36       | 0.1852            | 4016.1              | 0.0539            | 45671.9           | 0.6136            | 10945.1           | 0.1470            |
| 2013                      | 84798.28       | 0.1842            | 4760.94             | 0.0561            | 51806.5           | 0.6109            | 12610.6           | 0.1487            |
| 2014                      | 91392.81       | 0.1807            | 4749.7              | 0.0519            | 56928.7           | 0.6229            | 13194.8           | 0.1443            |
| 2015                      | 95122.57       | 0.1748            | 4624.57             | 0.0486            | 60744.9           | 0.6385            | 13121.7           | 0.1379            |
| (data source: Guangdong statistical yearbook 2010-2019 [10])

Since the third revision of the national standard of industrial classification of national economy in 2011, the classification of manufacturing industry in China has changed. The transportation equipment manufacturing industry is the sum of automobile manufacturing industry, railway, ship, aerospace and other transportation equipment manufacturing industries. The rubber products industry and plastic products industry are combined into rubber & plastic products industry, and metal products, machinery and equipment are repaired Science and technology is a new industry after 2011, which is deleted due...
to lack of data. There are other manufacturing industries that are difficult to classify, and finally 28 manufacturing industries are integrated. This paper makes statistics on the total output value of four types of manufacturing industries in the PRD region from 2009 to 2018. See Table 1 for details.

It can be seen from Table 2 that the technology intensive manufacturing industry in the PRD developed rapidly in 2009-2018, with the proportion in the total output value and output value being the highest among the four types of manufacturing industry, and kept rising; the proportion in the total output value and output value of labor-intensive manufacturing industry ranked the second among the four types of manufacturing industry, with a relatively rapid growth in 2009-2011, and a decline in output value in 2011-2012, and then The development is slow, and the gap with technology intensive manufacturing industry is widening year by year; the total output value and output value proportion of resource intensive manufacturing industry rank the third among the four types of manufacturing industry; the total output value basically shows an upward trend in ten years, and the gap with labor-intensive manufacturing industry is narrowing year by year; the total output value of capital intensive manufacturing industry is the lowest and the growth is slow, and the proportion in the total output value of the four types of manufacturing industry is the highest Low.

4. Manufacturing Competitiveness in the Pearl River Delta

Ming Juan [8] thinks that there are generally two methods to evaluate the industrial competitiveness: one is the single index evaluation method, which divides the industrial competitiveness into four levels: industrial environment, productivity, market share and profit rate according to the source, essence, performance and result of competitiveness, and selects one or more indexes to evaluate the industrial competitiveness at one or more levels; The other is the index system evaluation method. Firstly, select several indexes according to certain principles to build the index system, and then determine the weight of each index through mathematical methods to comprehensively evaluate the industrial competitiveness. This paper uses a single index evaluation method, productivity is the essence of competitiveness, so choose labor productivity as the index to evaluate the competitiveness level of manufacturing industry in the PRD.

In this paper, the total output value of manufacturing industry in the PRD (RMB 1000) and the average number of employees (person) in 2012-2016 are selected from the 2013-2017 Guangdong industry statistical yearbook. By dividing the total output value of manufacturing industry and the average number of employees, the labor productivity of four types of manufacturing industry in the Pearl River Delta (RMB / person) in 2012-2016 is calculated. See Table 2 for specific calculation results.

| Table 2. Labor productivity by industry type (unit: yuan / person) |
|---|---|---|---|---|
| year | Overall manufacturing | labor-intensive | capital intensive | technology intensive | resource intensive |
| 2012 | 620355.0287 | 704778.7765 | 2311082.443 | 758508.0836 | 364857.353 |
| 2013 | 714864.4393 | 784929.7223 | 2651237.593 | 866334.451 | 4039044.333 |
| 2014 | 773555.4584 | 835638.7411 | 2805305.021 | 943062.7323 | 3305510.2 |
| 2015 | 819628.957 | 862553.6201 | 2844538.06 | 992813.2871 | 2685025.886 |
| 2016 | 898932.8024 | 932000.002 | 2845233.848 | 1071185.873 | 2701678.432 |

(data source: Guangdong Industrial Statistics Yearbook, 2013-2017)

From the perspective of labor productivity changes in sub sectors and four types of industries, the characteristics of manufacturing industry competitiveness in the Pearl River Delta can be summarized as follows:

First, the labor productivity of capital intensive and technology intensive industries is high and competitive. Among the top ten industries in terms of average labor productivity in 2012-2016, three

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1 The labor productivity of the four types of industries is the average of the labor productivity of the subdivided industries belonging to this type.
of the capital intensive manufacturing industries ranked second, fifth and sixth respectively, and three of the technology intensive manufacturing industries ranked the top ten in terms of average labor productivity. Although the ranking is relatively low, the output value of the technology intensive manufacturing industry is relatively high. According to the output value in 2016, the total output value of capital intensive manufacturing industry and technology intensive manufacturing industry accounts for 78.69% of the total output value of the top ten manufacturing industries with average labor productivity, while the output value of labor intensive manufacturing industry accounts for 12.68%, and the output value of resource intensive manufacturing industry only accounts for 8.63%.

Second, the labor productivity of labor-intensive industries is growing slowly, and the competitive disadvantage is gradually revealed. Among them, the average labor productivity of agricultural and sideline food processing industry and wine, beverage and refined tea manufacturing industry ranked fourth and ninth respectively, which still has a certain competitive advantage; however, in the labor-intensive manufacturing industry, the traditional manufacturing industry with higher output value, such as textile industry, textile clothing and clothing industry, the average labor productivity ranked 21st and 30th respectively, which shows that the labor-intensive manufacturing industry has poor competition Potential.

Third, the competitiveness of high-tech industries has gradually increased. For example, the average labor productivity of chemical raw materials and chemical products manufacturing, automobile manufacturing and pharmaceutical manufacturing ranked 7th, 8th and 10th respectively, gradually forming a competitive advantage, indicating that the development of high-tech industry is the source to enhance the future competitiveness of manufacturing industry. The Pearl River Delta should focus on the development of high-tech industry, and promote the optimization and upgrading of the industrial structure of manufacturing industry.

5. An Empirical Analysis of the Factors Influencing the Competitiveness of Manufacturing Industry in the Pearl River Delta

5.1. Data Source and Variable Selection
Based on Porter diamond model, this paper analyzes the panel data of 31 sub sectors of manufacturing industry in the Pearl River Delta from 2013-2017 in Guangdong Industrial statistical yearbook, and divides the four basic factors influencing industrial competitiveness into two aspects: input level and production efficiency. In terms of investment level, the equipment rate per capita and the average industrial scale can respectively reflect the hardware level of production technology and the average income level of manufacturing enterprises; in terms of production efficiency, the turnover rate of current assets and the industrial added value rate can respectively reflect the asset utilization efficiency of manufacturing enterprises and the economic benefits of industrial intermediate consumption reduction. Productivity is the essence of industrial competitiveness. In the empirical analysis, we choose total labor productivity as the dependent variable to express the competitiveness of manufacturing industry. Total labor productivity is the comprehensive performance of industrial production technology level, management level and employee contribution, so it can reflect the competitive strength of the industry. The dependent variable (LD) is the total labor productivity, which is equal to the added value of manufacturing industry / annual average number of employees. Explanatory variables: Industrial per capita equipment rate (ZB), equal to the original price of fixed assets / number of employees; industrial average scale (GM), equal to industrial sales revenue / number of enterprise units; turnover rate of current assets (ZZL), equal to main business income / average current assets; industrial added value rate (ZJZ), equal to industrial added value / total industrial output value.

5.2. Model Checking and Setting
In order to determine the specific form of panel data model, the individual random effect model and time random effect model were respectively tested by Hausman test, and the test results are as follows:
Table 3. Hausman test results

| Test Summary        | Chi-Sq. Statistic | Chi-Sq. d.f. | Prob.   |
|---------------------|-------------------|--------------|---------|
| Cross-section random| 5.730172          | 4            | 0.2202  |
| Period random       | 22.17893          | 4            | 0.0002  |

It can be seen from the Hausman test results in Table 3 that the p value of the statistics of the individual random effect model is 0.2202, and the p value of the statistics of the time random effect model is 0.0002, indicating that under the level of 5% significance, the original hypothesis established by the time random effect model should be rejected, but the original hypothesis established by the individual random effect model should not be rejected, that is, the individual fixed effect model should not be adopted, and the original hypothesis established by the individual random effect model should be adopted. Using the individual random effect model.

According to the previous test results, the panel data model set in this paper is:

$$
\ln L_D_{it} = \alpha + \beta_1 \ln ZB_{it} + \beta_2 \ln GM_{it} + \beta_3 \ln ZZL_{it} + \beta_4 \ln ZJZ_{it} + \mu_i + \epsilon_{it}
$$

In them, the variable subscripts $i$ and $t$ represent the industry and time of manufacturing industry respectively, $\mu_i$ and $\epsilon_{it}$ are random interference items; $L_D_{it}$, $ZB_{it}$, $GM_{it}$, $ZZL_{it}$ and $ZJZ_{it}$ indicate the labor productivity, per capita equipment rate, average industrial scale, turnover rate of current assets and industrial added value rate of manufacturing industry $I$ in the Pearl River Delta in year $t$ respectively.

5.3. Analysis of Model Regression Results

According to the model test and setting in the previous section, this section establishes a regression model of individual random effects, and estimates the model by using Eviews software. Because the number of cross sections is greater than the number of time series, the weight is selected by section weighting, and PCSE estimation method is used, and the regression results are as follows:

Table 4. Model regression results

| Variable   | random effect model | fixed effect model |
|------------|---------------------|--------------------|
| Intercept item | -1.12388**          | -2.85339           |
| LNZB       | 0.473731***         | 0.510215***        |
| LNGM       | 0.424203***         | 0.495519***        |
| LNZZL      | 0.174434**          | 0.083727           |
| LNZJZ      | 0.664248***         | 0.701221***        |
| $R^2$      | 0.915825            | 0.997297           |
| F-statistic| 210.4393            | 1126.379           |
| Prob(F-statistic) | 0.0000          | 0.0000             |

According to the regression results, the following estimation models can be obtained:

$$
\ln L_D_{it} = -1.1239 + 0.47371 \ln ZB_{it} + 0.42424 \ln GM_{it} + 0.17444 \ln ZZL_{it} + 0.66424 \ln ZJZ_{it}
$$

From the regression equation, we can see that the four variables of industrial per capita equipment rate, industrial average scale, turnover rate of current assets and industrial added value rate all have a positive impact on the competitiveness of manufacturing industry in the Pearl River Delta, that is to say, increasing these four variables can enhance the competitiveness of manufacturing industry in the Pearl River Delta. Among them, the industrial added value rate has the greatest impact on the overall labor productivity, followed by the industrial per capita equipment rate and industrial average scale, and the impact of the turnover rate of current assets is relatively small.

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6. Conclusion
First, improve the ability of independent innovation and accelerate the development of technology intensive manufacturing industry. The advantageous industries of manufacturing industry in the Pearl River Delta have been transferred from labor-intensive manufacturing to capital intensive and technology intensive manufacturing. The Pearl River Delta should vigorously develop technology intensive manufacturing industry, encourage enterprises to increase investment in research and development, improve their technological development ability and independent innovation ability; introduce and cultivate high-quality talents, formulate relevant policies to encourage all kinds of talents to innovate and start businesses; promote the development of technology intensive manufacturing industry, and further enhance the overall industrial competitiveness of the manufacturing industry in the Pearl River Delta.

The second is to give full play to the advantages of the whole industrial chain and create an advantageous industrial cluster. The Pearl River Delta has the advantage of the whole production chain in some manufacturing industries. The government should actively provide the whole industry chain services to ensure the competitiveness of the industry chain. The leading manufacturing enterprises in Guangdong Province are mainly concentrated in the Pearl River Delta. Industrial agglomeration is an effective way to enhance the competitiveness of the industry. Through the construction of industrial parks, we can build industrial clusters with certain competitive advantages.

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Reference
[1] Mingjuan, zizicheng. Measurement of manufacturing industry competitiveness in the Pearl River Delta [J]. Statistics and decision making, 2007, 6: 70-72
[2] Chen Limin, Wang Xuan, Rao Siyuan. Comparison of international competitiveness of manufacturing industry between China and the United States: An Empirical Analysis Based on the level of industrial competitiveness [J]. China's industrial economy, 2009, 6: 57-66
[3] Wang Peng. Comparative study on manufacturing competitiveness between Anhui Province and Jiangsu, Zhejiang and Shanghai [D]. East China University of political science and law, 2018
[4] Liu Jie. Analysis of factors influencing the competitiveness of equipment manufacturing industry in Liaoning Province [J]. Business economy, 2008, 14: 9-11
[5] He Feng. Guangdong manufacturing industry competitiveness measurement and its influencing factors -- Empirical Research Based on enterprise panel data [D]. Jinan University, 2012
[6] Zhu Hongen. Competitiveness evaluation and influencing factors analysis of manufacturing industry in Jiangsu Province [D]. Nanjing University of Aeronautics and Astronautics, 2015
[7] Cao Zongping, Zhu Qinfeng. Agglomeration and transfer of manufacturing industry in Guangdong Province and its influencing factors [J]. Economic geography, 2017, 9: 111-117
[8] Ming Juan. An Empirical Study on the competitiveness of manufacturing industry in the Pearl River Delta [D]. South China Normal University, 2007
[9] Daniela Livia Trascajméno, Mirela Aceleanu. Assessing the Competitiveness of Romanian Manufacturing Industry [J]. Procedia Economics and Finance, 2015, 30: 885-889.
[10] Guangdong Bureau of statistics, compiled by Guangdong survey team of National Bureau of statistics. Guangdong Statistical Yearbook (2019) [R]. China Statistics Press, 2019