Re-screening of the Influencing Factors of Advanced Structure of the Manufacturing Industry in the Yangtze River Delta Based on Grey Correlation

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Abstract: In the context of the “Yangtze River Delta Integration Strategy” being upgraded to a national strategy, it is important to examine the influencing factors of advanced structure of the manufacturing industry in the Yangtze River Delta region. This paper intends to select provincial panel data from 2005 to 2018 in the Yangtze River Delta region, screens out 11 influencing factors through literature review, and uses grey correlation and dynamic equation models to analyze the major influencing factors on advanced structure of the manufacturing industry. The results show that: (1) Among the 11 influencing factors, fixed asset investment has the highest correlation with advanced structure of the manufacturing industry, followed by opening up and human capital level. (2) The level of human capital significantly promotes the advanced industrial structure, and the impact of both fixed asset investment and opening up on the advanced structure of the manufacturing industry presents “inverted U-shaped”. According to the research results, it is suggested that the development of manufacturing structure in the Yangtze River Delta must optimize capital investment structure, and obtain high-quality labor force and high-end opening-up.

Keywords: Yangtze River Delta region; Advanced structure of the manufacturing industry; Grey correlation model; Dynamic equation model; Fixed asset investment; Opening up

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1. Introduction

China’s manufacturing industry has developed rapidly in terms of both volume and structure, and is now in a major historical convergence period between the third industrial revolution and the upgrading of industrial structure. The proposal of “Industry 4.0” and “Made in China 2025” is an urgent need to improve industrial competitiveness and an important thrust for high-quality economic development. As one of the important engines of development in China, the Yangtze River Delta region plays a pivotal role in promoting high-quality economic development. From the perspective of economic development, the GDP of the Yangtze River Delta was about 17.8 trillion yuan in 2018, with a GDP growth rate of 7.14% compared with that of 2017, higher than the national average growth rate of 6.6%. From the perspective of population agglomeration, the population increment in the Yangtze River Delta in recent three years has been ahead of the country, with an average annual growth of 1.009 million. In terms of manufacturing development, manufacturing industry is the traditional advantage and pillar industry in the economic

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development of the Yangtze River Delta region. With the progress of science and technology, the development of the advanced structure of the manufacturing industry in the Yangtze River Delta region has become the focus.

It is quite important for the integrated development of the Yangtze River Delta to promote the advanced structure of the manufacturing industry and realize the high-quality development of the manufacturing industry. In view of this, this paper intends to clarify the following questions: which are the main influencing factors of the advanced structure of the manufacturing industry in the Yangtze River Delta? And how? In order to solve these problems, this paper uses grey correlation model to analyze the main influencing factors of the advanced structure of manufacturing industry, establishes dynamic equation models to further analyze the influence effect, and puts forward related policy recommendations for promoting the advanced structure of manufacturing industry in Yangtze River Delta.

2. Literature Review

Industrial upgrading has always been the focus and hotspot of academic research. Scholars at home and abroad have done a lot of research on promoting the transformation and upgrading of traditional industries and accelerating the optimization of industrial structure. Clark and other research showed that the essence of industrial structure transformation is to optimize the allocation of material, labor force and human capital. Kuznets pointed out that the key to the change of industrial structure is the flow of production factors from sectors with low productivity to higher sectors to improve the efficiency of resource allocation, that is, industrial upgrading refers to the transfer of industries from low sectors to high sectors (Wang Baulin, 2009) [1]. The core of industrial evolution from low sector to high sector is about industrial upgrading innovation and production capacity (Li Linmu and Wang Chong, 2017) [2]. In terms of production capacity, it refers to the expansion of manufacturing scale, which is manifested by the increase of industrial gross output value and industrial added value (Arash Azadegan and Stephan M, 2011) [3]. These will help enterprises to maximize profits, maintain competitive advantages in the fierce market competition, and promote industrial upgrading (Zhang Hui, 2007) [4]. In terms of independent innovation, innovation is the most important factor affecting China’s industrial transformation and upgrading (Jin Bei, 2011) [5]. The optimal allocation of enterprise labor force is the driving force for innovation and development and an important factor for improving total factor productivity (Cai Fang, 2017) [6]. In developed countries, the contribution rate of labor allocation among industrial enterprises to productivity increase is as high as 1/3–1/2 (Fosteret al., 2008) [7]. China has a large population base, the rational allocation of labor has great development potential (Cai,2016) [8], and human capital and knowledge capital are the key factors affecting innovation (Su Hang et al, 2017) [9]. Although the above literatures have different perspectives, the basic connotation of industrial structure upgrading is obtained: the industry evolves from a state of low added value and low technology level to a state of high added value and high technology level.

As for the influencing factors of the advanced structure of the manufacturing industry, domestic scholars have conducted researches from the perspectives of enterprises, industry, government and society. Guo Weifeng et al. (2012) have found from the perspective of collaboration that for affecting the advanced structure of the manufacturing industry, enterprises are the main body, industrial chain and industrial collaboration are the key factors [10]. Yang Shuqing et al. (2014), from the perspectives of government, enterprises and social organizations, believe that enterprises lead, governments guide and social organizations assist are the key factors
Other scholars have study the advanced structure of manufacturing industry from different directions, such as environmental regulation (Nie Guoqing et al., 2018) \[12\], human capital (Yang Xingao, 2018) \[13\], population agglomeration (Zhou Yulong et al., 2015) \[14\], population aging (Zhao Chengfeng and Deng Feng, 2018) \[15\], labor quality (Li Lei et al., 2019) \[16\] and technological innovation (Zhao Yulin and Pei Chengchen, 2019; Yu Donghua and Zhang Weiguo, 2018) \[17,18\], Labor Cost (Feng Ping et al., 2019) \[19\], Labor Supply (Yu Donghua and Li Jie, 2019) \[20\], Opening up (Li Wei and He Canfei, 2017; Zhang Zhinan, 2018; Yang Li Gao, 2017) \[21-23\], fiscal expenditure (Abdallah, 2014; He Tao and Zha Zhigang, 2015) \[24-25\], etc. In view of the advanced structure of the manufacturing industry in the Yangtze River Delta, scholars have conducted research from factor price (Yu Donghua and Zhang Weiguo, 2018) \[18\], technological progress (Yu Donghua and Cui Yan, 2019) \[26\], talent quality (Wang Zhihua et al., 2016) \[27\], etc. By studying the causes of “smile curve”, Qin Yue et al. (2014) \[28\] conclude that the key to the advanced structure of the manufacturing industry is to treat different types of manufacturing industry differently.

Through literature review, it is found that there are many factors affecting the advanced structure of manufacturing industry. The existing studies on the advanced structure of manufacturing industry are limited to some known aspects, while the factors affecting the advanced structure of manufacturing industry also include some aspects that are difficult to be quantified or unknown. As a typical area of manufacturing industry development, the research of Yangtze River Delta is limited to one or two aspects. Therefore, this paper divides the manufacturing industry into labor-intensive, capital-intensive and technology-intensive manufacturing industries, considers 11 factors affecting the advanced structure of the manufacturing industry in the Yangtze River Delta comprehensively through literature review, uses the gray correlation model to screen out the main factors, and uses the static and dynamic equation models to further examine the influence effects.

3. Data Source and Explanation

1. Data sources

In this paper, panel data of four provinces and cities in the Yangtze River Delta (Shanghai, Jiangsu, Zhejiang and Anhui) from 2005 to 2018 are collected, and the data comes from Shanghai Statistical Yearbook, Jiangsu Statistical Yearbook, Zhejiang Statistical Yearbook and Anhui Statistical Yearbook. When processing manufacturing data, three major categories of manufacturing industry are extracted, namely, labor-intensive, technology-intensive and capital-intensive manufacturing, as shown in Table 1.

<table>
<thead>
<tr>
<th>Industry type</th>
<th>Specific industries</th>
</tr>
</thead>
<tbody>
<tr>
<td>Labor-intensive manufacturing</td>
<td>Food manufacturing; Textile; Clothing and other fiber products; Leather, fur, down and their products; Wood processing and bamboo, rattan, brown and grass products; Furniture; Printing and Reproduction of recording medium; Cultural and educational sports goods; Rubber; Plastic; Nonmetallic minerals; Metal products</td>
</tr>
<tr>
<td>Capital-intensive manufacturing</td>
<td>Drinks; Tobacco; Paper and paper products; Petroleum processing and coking; Chemical raw materials and chemical products; Chemical fiber; Ferrous metal smelting and rolling processing; Mechanical equipment</td>
</tr>
<tr>
<td>Technology-intensive manufacturing</td>
<td>Medicine; Communication equipment, computers and other electronic equipment; Transportation equipment; Electrical machinery and equipment; Instrumentation and cultural, office machinery manufacturing</td>
</tr>
</tbody>
</table>
(2) Variable description

Based on Li Xiaoyang et al. ‘s classification of the influencing factors of total factor productivity, the influencing factors of the advanced structure of the manufacturing industry are divided into eight aspects: the number of labor force, labor cost, market environment, economic development, opening up, human capital development, fixed asset investment, and government fiscal expenditure. See Table 2 for the definition of specific variables.

Table 2 Variable name and its measure index table

<table>
<thead>
<tr>
<th>Factor</th>
<th>Variable name</th>
<th>Measure index</th>
</tr>
</thead>
<tbody>
<tr>
<td>Advanced structure of manufacturing industry</td>
<td>Y1: Output value of labor-intensive manufacturing</td>
<td>GDP of technology-intensive manufacturing industry (100 million yuan)</td>
</tr>
<tr>
<td></td>
<td>Y2: Output value of capital-intensive manufacturing</td>
<td>GDP of capital-intensive manufacturing (100 million yuan)</td>
</tr>
<tr>
<td></td>
<td>Y3: Output value of technology-intensive manufacturing</td>
<td>GDP of technology-intensive manufacturing industry (100 million yuan)</td>
</tr>
<tr>
<td></td>
<td>UPG: Index for the advanced structure of manufacturing industry</td>
<td>The measurement method of Fu Linghui (2010) is adopted</td>
</tr>
<tr>
<td>Labor force</td>
<td>X1: Agricultural migrants</td>
<td>Difference between practitioners in rural areas and those in primary industry (10,000)</td>
</tr>
<tr>
<td></td>
<td>X2: Practitioners</td>
<td>Practitioners in manufacturing industry (ten thousand)</td>
</tr>
<tr>
<td>Labor cost</td>
<td>X3: Labor cost</td>
<td>Average real wage of employed staff and workers in urban units (Yuan)</td>
</tr>
<tr>
<td></td>
<td>X4: PMI</td>
<td>China Manufacturing PMI: Current</td>
</tr>
<tr>
<td></td>
<td>X5: GDP</td>
<td>GDP (100 million yuan)</td>
</tr>
<tr>
<td>Market environment in manufacturing industry</td>
<td>Opening up</td>
<td>X6: Real utilization of foreign direct investment</td>
</tr>
<tr>
<td>Level of economic development</td>
<td></td>
<td>Real utilized foreign direct investment (100 million dollars)</td>
</tr>
<tr>
<td></td>
<td>X7: Total value of imports and exports</td>
<td>Total value of imports and exports (100 million dollars)</td>
</tr>
<tr>
<td>Human capital development</td>
<td>X8: Education level</td>
<td>Number of enrolled students of regular higher education (10 thousand persons)</td>
</tr>
<tr>
<td></td>
<td>X9: Expenditure on Education</td>
<td>General budgetary expenditure on education (100 million yuan)</td>
</tr>
<tr>
<td>Fixed asset investment</td>
<td>X10: Fixed investment</td>
<td>Fixed investment in manufacturing industry (100 million yuan)</td>
</tr>
<tr>
<td>Government fiscal expenditure</td>
<td>X11: Expenditure on science and technology</td>
<td>General budgetary expenditure science and technology (100 million yuan)</td>
</tr>
</tbody>
</table>

1) Advanced industrial structure

The UPG measurement index adopts the method of Fu Linghui (2010). Firstly, the GDP of each part is calculated according to the classification of manufacturing industry, and the proportion of each part in the GDP of manufacturing is taken as a component in the spatial vector. A set of 3-dimensional vectors is formed as $X_0 = (x_1,0, x_2,0, x_3,0)$; and then the included angles $\theta_1$, $\theta_2$, $\theta_3$ between $X_0$ and the vectors $X_1=(1,0,0)$, $X_2=(0,1,0)$, $X_3=(0,0,1)$ arranged from low to high levels of manufacturing are calculated respectively.
Secondly, the calculation formula of UPG is as follows:

\[
\theta_j = \arccos \left( \frac{\sum_{i=1}^{3} (x_{i,j} \times x_{i,0})}{\sqrt{\sum_{i=1}^{3} (x_{i,j} \wedge 2) \times \sqrt{\sum_{i=1}^{3} (x_{i,0} \wedge 2)}}} \right)
\]

\begin{equation}
UPG = \sum_{k=1}^{3} \sum_{j=1}^{k} \theta_j
\end{equation}

The higher the UPG, the higher the level of industrial structure.

2) Number of labor force

The number of labor force is divided into agricultural migrants and manufacturing practitioners. Labor force is the foundation of the development of manufacturing industry. In the context of Lewis turning point, the employment structure of agricultural migrant changes with the change of industrial structure (Ge Xiaowei and Ye Juntao, 2014). The agricultural migrants are measured by the difference between those employed in rural areas and those employed in primary industries. Labor costs are measured in terms of the average wage of an employee in a manufacturing town.

3) Market environment

The manufacturing PMI (Purchasing Manager Index) reflects overall growth or decline in the manufacturing sector and is used to measure market conditions in the manufacturing sector. The PMI is based on official data from China’s National Bureau of Statistics.

4) Economic development

The level of economic development affects the distribution and development of industries, and then affects the structural development of manufacturing industry, which is measured by gross regional product (GDP).

5) Opening up

Opening up brings capital to enterprises and indirectly brings advanced ideas, talents and technologies from abroad, which affects the development of manufacturing industry. Opening up is measured by real utilized foreign direct investment and total value of imports and exports.

6) Human capital development

Human capital development affects local industry and economic development, and human capital leads to innovation and higher productivity. In view of the availability of data, referring the human capital measured by Li Bin et al. (2019) the number of students in ordinary higher education is adopted to measure that. General education expenditure measures the importance to human capital, which indirectly represents the development of human capital and is represented by general education expenditure.
7) Fixed asset investment
   Capital is the guarantee of project construction and development, and fixed asset investment
   affects the development of manufacturing industry to a certain extent. With reference to the
   research of Yang Zhian et al. (2019) [33], the fixed asset investment in manufacturing industry is
   selected as the representation.

8) Government fiscal expenditure
   The government fiscal expenditure affects the local market, education level and infrastructure
   construction, which is measured by general expenditure on science and technology.

4. Grey Correlation Analysis of Advanced Structure of the Manufacturing Industry

(1) Research methods
   Grey relational analysis mainly analyzes the factors in the grey system, in which only part
   of information is known, and the relationship between the factors is uncertain. The advanced
   structure of manufacturing industry is affected by many factors. After sorting out the literature,
   11 influencing factors are obtained, and there are still some factors that cannot be grasped
   and measured. The grey correlation model requires less information and has high modeling
   accuracy. Therefore, the grey correlation model is used to analyze the 11 influencing factors of
   the advanced structure of the manufacturing industry in the Yangtze River Delta. The main steps
   of grey correlation analysis are: determining reference sequence and comparison sequence; Find
   correlation coefficient and correlation degree; Determine the order of association.

(2) Determine reference sequence and comparison sequence
   The panel data sequence is $Y_1, Y_2, Y_3, UPG; X_1, X_2, \ldots, X_{11}$, among which, $Y_1, Y_2, Y_3, UPG$
   is reference sequence and $X_1, X_2, \ldots, X_{11}$ is comparison sequence. The above three groups of
   panel data are initialized. These three groups of multidimensional data sequences have different
   dimensions, so the initial value operator is selected to conduct dimensionless processing on the
   original data, and 14 groups of dimensionless panel data are obtained. $D_1$ is the zero operator
   at the starting point of the panel data. $Xi$ represents the influencing factors, $Yj$ represents three
   different types of manufacturing, $S$ represents the region, and $t$ represents the time.

   \[
   X_iD_1 = \begin{bmatrix}
   x_i(1,1)d_1 & x_i(1,2)d_1 & \cdots & x_i(1,n)d_1 \\
   x_i(2,1)d_1 & x_i(2,2)d_1 & \cdots & x_i(2,n)d_1 \\
   \vdots & \vdots & \ddots & \vdots \\
   x_i(n,1)d_1 & x_i(n,2)d_1 & \cdots & x_i(n,n)d_1
   \end{bmatrix}
   \]

(3) Calculate correlation coefficient and correlation degree
   The correlation coefficient $r_{ij}(s, t)$ is calculated from equations (5) to (8), and the resolution
   coefficient is 0.5. The calculation of correlation degree $Y_{ij}$ is the comparison sequence and
   reference sequence of all the moments of the sample period, and the most common method is
   to take the average value to measure the correlation degree. $D_j$ is a sequence operator, $m$ and $M$
   represent the difference between two ends, $r_{ij}(s, t)$ is the distance correlation coefficient between
   $Y_j$ and $X_i$, and $Y_{ij}$ is the gray correlation degree of panel data.
The comprehensive correlation degree between UPG and 11 influencing factors is calculated by Excel programming, and the results are shown in Table 3. The comprehensive correlation degree is a comprehensive representation of the closeness between sequences, and the value is between 0 and 1. The closer to 1, the closeness between sequences is higher.

Table 3  Correlation Degree Influencing Factors Ranking

<table>
<thead>
<tr>
<th></th>
<th>Y1</th>
<th>Y2</th>
<th>Y1</th>
<th>Y1</th>
</tr>
</thead>
<tbody>
<tr>
<td>X10</td>
<td>0.7801</td>
<td>0.7653</td>
<td>0.7907</td>
<td>X10 0.7769</td>
</tr>
<tr>
<td>X4</td>
<td>0.6806</td>
<td>0.7633</td>
<td>0.7774</td>
<td>X6 0.7647</td>
</tr>
<tr>
<td>X2</td>
<td>0.6723</td>
<td>0.7567</td>
<td>0.7642</td>
<td>X3 0.7336</td>
</tr>
<tr>
<td>X6</td>
<td>0.6717</td>
<td>0.7493</td>
<td>0.7641</td>
<td>X5 0.7177</td>
</tr>
<tr>
<td>X11</td>
<td>0.6682</td>
<td>0.7371</td>
<td>0.7455</td>
<td>X9 0.7124</td>
</tr>
<tr>
<td>X3</td>
<td>0.6674</td>
<td>0.7257</td>
<td>0.7451</td>
<td>X2 0.6745</td>
</tr>
<tr>
<td>X8</td>
<td>0.6530</td>
<td>0.7250</td>
<td>0.7433</td>
<td>X11 0.6514</td>
</tr>
<tr>
<td>X9</td>
<td>0.6414</td>
<td>0.7225</td>
<td>0.7402</td>
<td>X8 0.6501</td>
</tr>
<tr>
<td>X7</td>
<td>0.6407</td>
<td>0.7141</td>
<td>0.7376</td>
<td>X4 0.6222</td>
</tr>
<tr>
<td>X5</td>
<td>0.5991</td>
<td>0.6640</td>
<td>0.6432</td>
<td>X7 0.5940</td>
</tr>
<tr>
<td>X1</td>
<td>0.5575</td>
<td>0.5086</td>
<td>0.5066</td>
<td>X1 0.5643</td>
</tr>
</tbody>
</table>

According to the sequence correlation ranking in Table 3, it can be seen that:

1) Between the development of labor-intensive manufacturing industry, the maximum correlation is between X_{10} and Y_1, above 0.78, that is, the fixed asset investment has a maximum comprehensive correlation with labor-intensive manufacturing industry; (2) Between the development of capital-intensive manufacturing industry, the maximum correlation is between X_{10}, X_8, X_3 and Y_2, which is above 0.75, that is, the fixed asset investment, education level, labor and power cost have a maximum comprehensive correlation with capital-intensive manufacturing industry; (3) Between the development of technology-intensive manufacturing industry, the maximum correlation is between X_3, X_7, X_6, X_9 and Y_2, up to more than 0.75, that is, the labor cost, import and export, real utilized foreign direct investment, education expenditure have a large correlation with technology-intensive manufacturing industry; (4) Between the advanced development of manufacturing industry, the maximum correlation is between X_{10} and Y_3, reaching...
above 0.77, that is, the fixed asset investment has a maximum comprehensive correlation with technology-intensive manufacturing; \( X_6, X_3, X_5, X_{9}, \) and \( Y_3 \) have a large correlation, that is, the real utilized foreign direct investment, labor cost, GDP and education expenditure have a large correlation with the advanced structure of the manufacturing industry, reaching 0.71–0.76.

According to the grey correlation model, the investment in fixed asset investment has the greatest correlation with the advanced structure of manufacturing industry, followed by opening up, economic development level and human capital development. The concrete analysis is: capital is the foundation of industrial development, sufficient capital can guarantee the project investment and construction; Opening up enables enterprises to face the international market, and the increasing intensity of competition affects the development of manufacturing industry. Human capital development is the core of enterprise and regional development. The development of manufacturing industry in the Yangtze River Delta is undergoing transformation and upgrading and has achieved some results. It has changed from highly relying on the number of labor force to relying on the level of foreign investment and human capital.

5. Influencing Effect Analysis of Advanced Structure of Manufacturing Industry

(1) Model construction

The above analysis shows that fixed asset investment \((X_{10})\), human capital development \((X_{9})\), opening up \((X_6)\), labor cost \((X_3)\) and economic development \((X_5)\) are the main influencing factors of UPG. A regression model is further built to examine the influencing effect. Considering the differences in the development of advanced structure of the manufacturing industry under the conditions of wage rigidity and different levels of economic development, UPG is taken as the cause variable, and \( \ln X_{10}, \ln X_9, \) and \( \ln X_6 \) are taken as the independent variable respectively. The static equation model (9) ~ (11) and dynamic equation model (12) ~ (14) are established as follows:

\[
\begin{align*}
UPG_{it} &= \ln x_{10it} + \ln x_{3it} + \ln x_{5it} + \varepsilon_{it} \quad (9) \\
UPG_{it} &= \ln x_{9it} + \ln x_{3it} + \ln x_{5it} + \varepsilon_{it} \quad (10) \\
UPG_{it} &= \ln x_{6it} + \ln x_{3it} + \ln x_{5it} + \varepsilon_{it} \quad (11) \\
UPG_{it} &= \ln x_{10lt}^2 + \ln x_{10it} + \ln x_{3it} + \ln x_{5it} + \varepsilon_{it} \quad (12) \\
UPG_{it} &= \ln x_{9lt}^2 + \ln x_{9it} + \ln x_{3it} + \ln x_{5it} + \varepsilon_{it} \quad (13) \\
UPG_{it} &= \ln x_{6lt}^2 + \ln x_{6it} + \ln x_{3it} + \ln x_{5it} + \varepsilon_{it} \quad (14)
\end{align*}
\]

Where \( i \) represent the region, \( t \) represents the time, and \( \varepsilon_{it} \) represents the error term. In order to ensure the stationarity of the data, the natural logarithm of the above data is taken for processing.

(2) Analysis of regression results

The regression results are shown in Table 4. Fixed asset investment \((X_{10})\), human capital development \((X_9)\), opening up \((X_6)\) have a significant impact on the upgrading of manufacturing structure. \( X_9 \) has significantly promoted the upgrading of the manufacturing structure, and \( X_{10}, X_6 \) have influenced marginal decreases, showing a significant “inverted U-shaped”.
The results of models (9) and (12) show that fixed asset investment ($X_{10}$) has an obvious correlation of “inverted U-shaped” with the advanced structure of the manufacturing industry. When fixed asset investment is on the left side of the “inverted U-shaped”, it significantly promotes the advanced structure of the manufacturing industry. Capital is the foundation for the construction of enterprises and projects. The more the fixed asset investments, the more capital will be invested in project facilities and research and development to promote the advanced structure of manufacturing industry. With rising levels of the fixed asset investments, the promoting effect will decrease progressively. When fixed asset investment is on the left side of the “inverted U-shaped”, it hinders the advanced structure of the manufacturing industry. Due to the fiscal expenditure exist bias in Yangtze River Delta region, high technology manufacturing investment scale is small and proportion is low, resulting in fixed asset investments mainly promote the advanced structure of labor-intensive, and capital-intensive manufacturing.

The regression results of models (10) and (13) show that human capital development ($X_{9}$) has a significant promoting effect on the advanced structure of manufacturing industry. As human capital increases, education expenditure increases, labor productivity and human resource utilization efficiency improves, enterprises fully tap the potential of employees and cultivate a large number of highly skilled talents who master core technologies. The development level of human capital is high, the ability of scientific and technological innovation is improved, and the high-quality labor force is inclined to the manufacturing industry with high technology and high capital, which significantly promotes the upgrading of the manufacturing structure.
The results of models (11) and (14) show that the level of opening up (X₆) has an “inverted U-shaped” influence on the structure of manufacturing industry. When the level of opening up is on the left side of the “inverted U-shaped”, it significantly promotes the advanced structure of the manufacturing industry. With the improvement of the level of opening up, enterprises face the international market and bring in advanced technology and talents while attracting foreign investment. When the level of opening up is on the right side of the “inverted U-shaped”, it hinders the advanced structure of the manufacturing industry. China’s manufacturing industry is big but not strong. In some high-end or key industries, the core of science and technology still rely on imports, so the level of opening up to the manufacturing industry structure upgrade has limitations. The higher the level of opening up, a stronger dependence on import may produce.

6. Conclusions and Policy Recommendations

(1) Research conclusions
In this paper, the grey correlation model is used to screen the 11 influencing factors of the advanced structure of the manufacturing industry, and it is found that the fixed asset investments, opening up and the development of human capital are the most important influencing factors. By further establishing static and dynamic equation models, it is found that the development of human capital significantly promotes the upgrading of industrial structure, while the fixed asset investments and opening up have an “inverted U-shaped” influence on the advanced of manufacturing structure.

(2) Policy recommendations
In view of the above research conclusions, this paper believes that the advanced development of the manufacturing structure in the Yangtze River Delta needs to optimize the capital investment structure, obtain high-quality labor force and develop a high-end opening platform. The specific suggestions are as follows:

1) Optimize capital investment to enable the advanced manufacturing industry. Expand financing channels and optimize the investment environment of manufacturing industry, such as introducing preferential policies to attract investment from enterprises, banks and entrepreneurs. Optimize the investment structure, introduce appropriate policies to support the development of capital-intensive and technology-intensive manufacturing industries, encourage enterprises to introduce high-end machinery, equipment and production technologies, raise the level of technological innovation in manufacturing, and raise production efficiency.

2) Improve the level of education and accelerate talent agglomeration. Increase education investment, strengthen vocational training, and promote the “Demographic dividend” in the manufacturing industry to the “Talent Profit”. Pay attention to the matching of talent structure and manufacturing structure, establish and improve the supply and demand mechanism for talents in universities and manufacturing industry, establish a complete employment information database, track and feedback the flow of talents, so as to effectively match the supply and demand.

3) Build a “high-end” and “proactive” mode of opening-up. Master core science and technology and take the road of innovative development. The government would increase investment in capital-intensive and technology-intensive manufacturing industry, with the focus on supporting the development of technology and scientific research. Actively build industrial chains, promote the integrated development of upstream and downstream industries, and make
efforts to promote the manufacturing industry to the overseas market. The government would provide information consultation, market development, investment rights and interests protection, capital and other support.

Note:

(1) Since the caliber of statistical yearbook has changed, food processing and food manufacturing have been combined into food manufacturing.

(2) Due to the large proportion of general equipment, special equipment and general equipment are merged into mechanical equipment and put into capital-intensive manufacturing.

Works Cited


