Volume 7, Issue 1, pp. 47-52, 2023.
International Journal of Scientific Engineering and Science
ISSN (Online): 2456-7361

Analysis on Technology Catch-Up of Advanced Manufacturing Cluster in Jiangsu Province from the Perspective of "Dual Circulation" Development Pattern

Jiang Huanshu[1], Lu Wenxi[2]
[1]Jiangsu University, No.301, Xuefu Road, Jingkou District, Zhenjiang, Jiangsu, 212013, China
[2]Jiangsu University, No.301, Xuefu Road, Jingkou District, Zhenjiang, Jiangsu, 212013, China

Abstract— *At present, the domestic and international economic situation presents an unprecedented complex pattern, in this context, President Xi Jinping put forward the concept of "domestic and international double cycle", which emphasizes the need to give full play to the advantages of China's super large-scale market and internal potential. As a large manufacturing country, China still has a certain degree of technological gap compared with some developed countries, despite the current momentum of the development of relevant industrial clusters. Therefore, as the most remarkable manufacturing industry in China, it is more necessary for Jiangsu Province to follow the premise of the new pattern of "domestic and international double-loop", and firmly take reform and innovation as the fundamental driving force to promote the technological catch-up of China's manufacturing clusters with developed countries, so as to narrow the technological gap with developed countries and finally achieve the goal of surpassing them. Based on the new development pattern of "double cycle", this paper discusses the development trend and catch-up target of the relevant industries from the perspective of the technological catch-up evolution of advanced manufacturing clusters in Jiangsu Province, and selects 10 key industries from which to measure the TFP of these 10 industries using DEAP2.1 software. At the same time, the findings of this paper are of some significance to China's exploration of the path and mechanism of upgrading the advanced level of manufacturing clusters under the perspective of "double cycle".*

Keywords— *"Dual Circulation"Development Pattern, Advanced Manufacturing Cluster, Technological Catch-up, Total Factor Productivity.*

I. INTRODUCTION

At present, the domestic and international economic situation presents a complex pattern, and because of this, President Xi Jinping has proposed the concept of "domestic and international double cycle", emphasizing the need to give full play to China's advantage of a large market and internal potential. In the process of technological catch-up under this pattern, manufacturing clusters are formed through the cooperation and symbiosis of enterprises and institutions closely linked around the field of advanced manufacturing in a region, forming a networked industrial organisation to promote the prosperous development of the industry. The issue of building a social and cultural environment for innovation needs to be given high priority (Wang et al., 2019) . At the same time, Yang et al. argue that the agglomeration of manufacturing industries can effectively contribute to their innovation productivity in the national context (Yang et al., 2020). In addition, Liu et al. found that Chinese manufacturing exports significantly increased the innovation output of US manufacturing firms in the long run (Liu et al., 2021),which shows that China's advanced manufacturing clusters have achieved further development, and the technological level and industrial scale of related industries have been improved to a certain extent. However, compared with developed markets such as the United States, Europe and South Korea, the relevant advanced manufacturing clusters in China still have a passive situation of a weak foundation. The reasons for this are, on the one hand, that the domestic advanced manufacturing clusters are not yet as mature as foreign markets, the industrial environment needs to be further improved, and some industries are easily restricted by foreign enterprises in terms of basic arts; on the other hand, the domestic relevant advanced manufacturing industries are weak in terms of independent innovation strength, and the lack of technology in the research and development of new technologies and new products also happens from time to time. In addition, in the current context, the act of maintaining the production line equipment, instruments and materials of some advanced manufacturing industries still by way of importing also restricts the technological upgrading of enterprises and the renewal of products to a certain extent. Therefore, in the process of technological catch-up, China's advanced manufacturing clusters should pay sufficient attention to the improvement of their internal environment and the enhancement of their independent innovation capabilities. In view of this, Feng Genfu et al. argue that the size of enterprises is the key internal factor that determines the technological autonomous innovation of relevant enterprises in China, while the level of regional financial development, industrial structure and the level of property rights protection are the key external factors that determine the technological autonomous innovation of relevant enterprises in China (Feng Genfu et al., 2021),while Yang Haocheng et al. argue that the improvement of technical efficiency rather than technological progress is the main way for manufacturing clusters to promote innovative productivity (Yang Haocheng et al., Yang Haochang et al.,2020),it can be seen that the breakthrough point for technological catch-up in China's manufacturing clusters lies not only in the improvement

IJSES

International Journal of Scientific Engineering and Science
Volume 7, Issue 1, pp. 47-52, 2023. ISSN (Online): 2456-7361

of the external environment of enterprises, but also in seizing the series of breakthroughs in the expansion of the internal scale of the relevant enterprises, the strengthening of their technological level and innovation capability, and the enhancement of the efficiency of technological R&D.

To address the issue of independent innovation and R&D efficiency progress, conducting TFP measurement is the most direct way to study the issue. Up to now, there are many methods to estimate TFP, and through a comparative study of several domestic and foreign articles measuring China's TFP growth and its contribution to China's economic growth, Yang Rudai found that using different methods, variable settings, and data types can lead to large differences in the measurement results (Yang Rudai. 2015), while Lu and Lian Yujun argue that before choosing the right measurement method, the method needs to be differentiated into macro and micro dimensions to induce a faster and more efficient measurement of the required TFP estimates (Lu et al., 2012). In view of Shang Chuanlei's use of the DEA model and Malmquist index, a "dynamic and static" approach is used in the study to conduct a comprehensive analysis of TFP in China's logistics industry (Shang Chuanlei et al.,2019), combined with Cao Ze et al.'s comprehensive measurement of TFP in the construction industry in the Yangtze River Delta region based on the DEA model and Malmquist index. Malmquist index to elucidate the spatial spillover effect of TFP in the construction industry in the Yangtze River Delta region (Cao Ze, 2020), and given that this paper wishes to use provincial panel data from 2007 to 2016 to measure TFP in 10 key industries in the advanced manufacturing industry in Jiangsu Province, the DEA model and Malmquist index method are mainly used for estimation in this paper.

Based on the previous research, this paper continues to explore the development trend and technological catch-up process of the enterprises involved in the technological catch-up evolution of advanced manufacturing clusters in Jiangsu Province. Meanwhile, the remaining structure of this paper is arranged as follows: the second part conducts the theoretical analysis and establishes the research foundation of technology catch-up in advanced manufacturing clusters, the third part details the relevant model setting and variable selection, the fourth part further understands the technology catch-up process of advanced manufacturing clusters in Jiangsu Province through empirical analysis, and the last part concludes.

II. THEORETICAL ANALYSIS AND RESEARCH BASIS

In the process of exploring the technological catch-up evolution of advanced manufacturing clusters in Jiangsu Province, it can be found that, whether through the way of improving the scale and structure within the clusters or through the way of promoting key factors outside the clusters, the aim is to promote the high-quality development of advanced manufacturing clusters in Jiangsu Province with technological progress, so as to achieve the ultimate goal of catching up and surpassing developed countries. As one of the pillar industries of China's national economy, it is important to strengthen the outward expansion of the manufacturing industry in terms of scale, while focusing on the internal growth of the industry in terms of total factor productivity. Therefore, by studying the total factor productivity of advanced manufacturing clusters in Jiangsu Province, we can have a more intuitive understanding of the evolution of the technology catch-up process of advanced manufacturing clusters in Jiangsu Province, so as to further explore the influence and driving force of the new "double-loop" pattern on the relevant industries, and thus correctly lead the development of the relevant industries to a This will lead to a qualitative breakthrough in the development of related industries.

Total Factor Productivity is a measure that plays a large role in the study of efficiency issues in the economy, and is an important tool for analysing the sources of economic growth and an important basis for governments to use in the process of formulating long-term sustainable growth policies. In addition, there are various methods for calculating TFP, among which the most common ones are the growth accounting method based on the Solow model, the index method based on the definition of productivity, the data envelopment analysis method based on the Malmquist index and the stochastic frontier production function method. Of these, it is worth noting that in 1978, Charnes et al introduced the Data Envelopment Analysis method for evaluating the efficiency of decision units, and the measurement of Total Factor Productivity is an application of this method. In this paper, that is, based on the DEA model and Malmquist index method, the total factor productivity of 10 key industries in advanced manufacturing clusters in Jiangsu province is measured using the relevant provincial panel data from Jiangsu Statistical Yearbook and China Economic Census Yearbook for the 10 years from 2007 to 2016, where the 10 industries are electrical machinery and equipment manufacturing, chemical raw materials and chemical products manufacturing, computer communication and other electronic equipment man, general equipment manufacturing, ferrous metal smelting and rolling processing industry, special equipment manufacturing, automobile manufacturing, metal products industry, textile industry, non-metallic mineral products industry. In addition, this paper selects three types of variable indicators, namely output, labour and capital, for detailed measurement of the above 10 industries, so as to understand the detailed process of technological catch-up evolution of advanced manufacturing clusters in Jiangsu Province.

III. MODEL SETTING AND VARIABLE SELECTION

In this paper, Data Envelopment Approach and Malmquist Index method are used to study the TFP of advanced manufacturing related industries in Jiangsu Province.

A. DEA method based on the BCC model

This method is also one of the most effective methods to study panel data at the provincial level. The core of this method is to treat individuals of the same type as an independent decision unit, and each unit has multiple inputs and outputs. In addition, due to the existence of the payoff of scale, the input and output of the decision unit can be determined as follows. In addition, due to the existence of returns to scale, DEA models include the CCR model with constant returns to scale and the BCC model with variable returns to scale, while the BCC model

IJSES

International Journal of Scientific Engineering and Science

Volume 7, Issue 1, pp. 47-52, 2023. ISSN (Online): 2456-7361

is chosen for further analysis of the 10 key industries in the advanced manufacturing sector in Jiangsu Province covered in this study.

First, assume that there are n related industries in the advanced manufacturing industry, then these n related industries belong to n decision making units, where the j industry can be expressed as $DMU_j(0 < j < n, n \in N)$, and the input and output vectors of DMU_j can be expressed as$x_j = (x_{1j}, x_{2j}, \cdots x_{nj})^Tandy_j = (y_{1j}, y_{2j}, \cdots y_{nj})^T$.On this basis, assuming m inputs and$s$outputs, the input-oriented BCC-based model can then be derived,with the specific linear programming shown below.

$$\theta^* = min\theta$$
$$s.t. \begin{cases} \sum_{j=1}^{n} \lambda_j x_{ij} \leq \theta x_{ij}, i = 1,2,\cdots,m \\ \sum_{j=1}^{n} \lambda_j y_{ij} \leq x_{ij}, r = 1,2,\cdots,s \\ \sum_{j=1}^{n} \lambda_j = 1, \lambda_j \geq 0, j = 1,2,\cdots,n \end{cases} \quad (1)$$

Above all, j is the decision variable and θ^* is the optimal solution of the model.

B. DEA-Malmquist productivity index model

The BCC-DEA model described above is only capable of estimating efficiency values per unit for each year of measurement and lacks dynamic analysis, so to analyse the dynamic trends in efficiency and specific trends in Effch (technical efficiency), Techch (technological progress) and Pech (pure technical efficiency) and Sech (scale efficiency) for each decision unit over n years, we need to use the DEA-Malmquist index is used to measure this. The Malmquist index model, named after Malmquist, was introduced in 1953 and has since been applied by many scholars to the measurement of TFP. The use of the distance function is one of the highlights of the Malmquist index and has become one of the best ways to facilitate understanding of the dynamics of the efficiency of a decision unit. the Malmquist index model is generally based on the assumption that the input factors do not change, and the best frontier is used as a template to compare each decision unit to in order to understand productivity from the perspective of output maximisation, a dynamic process.

It is known that the DEA-Malmquist index model is defined through the distance function $D(x, y)$ and that this function is capable of defining not only inputs but also outputs, from period t to period $t + 1$ the index is specified as

$$M(x^{t+1}, y^{t+1}, x^t, y^t) = \left[\frac{D^t(x^{t+1}, y^{t+1}|C) D^{t+1}(x^{t+1}, y^{t+1}|C)}{D^t(x^t, y^t|C) D^{t+1}(x^t, y^t|C)}\right]^{\frac{1}{2}} = \frac{D^t(x^{t+1}, y^{t+1})|C}{D^t(x^t, y^t|C)} \left[\frac{D^t(x^{t+1}, y^{t+1})|C}{D^{t+1}(x^t, y^t|C)} \frac{D^t(x^t, y^t)|C}{D^{t+1}(x^{t+1}, y^{t+1}|C)}\right]^{\frac{1}{2}} \quad (2)$$

And D^t denotes the distance function and is the reciprocal of the optimal solution obtained from equation (1).

In addition, when the payoff of scale is constant, Effch can be decomposed into Pech along with Sech, and there are Tfpch= Effch x Techch and Effch= Pech x Sech.

C. Data sources and processing

This paper focuses on data processing and analysis in accordance with the above-mentioned DEA-Malmquist index model. The data were obtained from the Jiangsu Statistical Yearbook and the China Economic Census Yearbook for the 10-year period from 2007 to 2016,and based on the results of Feng Delian et al.'s selection of world-class advanced manufacturing clusters in the Yangtze River Delta region (Feng Delian et al., 2020),the ten key industries in the advanced manufacturing industry in Jiangsu province were selected as electrical machinery and equipment manufacturing, chemical raw materials and chemical products manufacturing, computer communication and other electronic equipment manufacturing, general equipment manufacturing, ferrous metal smelting and rolling processing industry, special equipment manufacturing, automobile manufacturing, metal products industry, textile industry, non-metallic mineral products industry. These industries, as the key industries in Jiangsu Province, are extremely representative. By studying the TFP of these ten industries, it is extremely important to understand the evolution of the technology catch-up process of advanced manufacturing clusters in Jiangsu Province.

For the model required in this paper, the calculation of total factor productivity mainly uses three types of variable indicators: output, labour and capital.2007-2016 data of the 10 industries in the advanced manufacturing cluster in Jiangsu Province are mainly selected as follows, capital output, which means the data selected is the total industrial output value of these 10 industries for each year as the value indicator of output level, labour input, which means a quantitative indicator to measure labour input, Labour input, which means a quantitative indicator to measure labour input, expressed as the annual average number of employees in the 10 key industries, Capital input, which means in order to simplify the operation, the annual amount of fixed asset investment in the 10 key industries is selected as an economic indicator to measure input. It should be noted that as the automotive manufacturing industry was part of the transport equipment manufacturing industry in 2010 and before, it is not listed separately and the value is large, therefore it tends to have a slight impact on the final results.

IV. EMPIRICAL ANALYSIS

It is known that the DEA-Malmquist index model is used for the measurement of TFP, and this paper uses DEAP 2.1 software to perform detailed calculations on the aggregated data to gain further insight into the efficiency of the 10 key industries in the advanced manufacturing clusters in Jiangsu Province.

With regard to the Malmquist index calculated in TABLE I—TABLE III, in general, the total factor growth rates in Jiangsu province are all above 1, basically maintaining growth. From the average value of 5.4% of the change index of technical efficiency, it can be seen that the technical efficiency of the 10 key industries in the advanced manufacturing cluster in Jiangsu province is high, in addition, from the scale efficiency index

IJSES

International Journal of Scientific Engineering and Science
Volume 7, Issue 1, pp. 47-52, 2023. ISSN (Online): 2456-7361

basically greater than 1, it can be seen that the overall situation of these 10 industries is preferred, although The average value of change in technical efficiency is 5.4%, but combined with the average value of change in technical progress index of -3%, plus the small change in pure technical efficiency, it can be seen that the independent innovation and technical improvement ability of these 10 industries in Jiangsu Province's advanced manufacturing industry needs to be further strengthened.

TABLE I. Effch and Techch index decomposed by different periods from 2007 to 2016.

Year	Effch	Techch
2007~2008	1.054	1.115
2008~2009	1.176	0.795
2009~2010	1.241	0.836
2010~2011	0.935	1.024
2011~2012	1.002	0.889
2012~2013	1.002	1.085
2013~2014	1.011	1.035
2014~2015	1.063	0.979
2015~2016	1.029	1.025
Mean	1.054	0.970
Base period	1.054	1.115

TABLE II. Pech and Sech index decomposed by different periods from 2007 to 2016.

Year	Pech	Sech
2007~2008	0.995	1.060
2008~2009	1.052	1.118
2009~2010	1.137	1.092
2010~2011	0.987	0.948
2011~2012	1.030	0.972
2012~2013	0.989	1.013
2013~2014	0.987	1.025
2014~2015	0.949	1.120
2015~2016	0.965	1.066
Mean	1.009	1.044
Base period	0.995	1.060

TABLE III. Tfpch and TFP growth rate index decomposed by different periods from 2007 to 2016.

Year	Tfpch	TFP growth rate
2007~2008	1.176	17.6%
2008~2009	0.935	-6.5%
2009~2010	1.037	3.7%
2010~2011	0.958	4.2%
2011~2012	0.890	-11%
2012~2013	1.087	8.7%
2013~2014	1.047	4.7%
2014~2015	1.040	4%
2015~2016	1.054	5.4%
Mean	1.022	2.2%
Base period	1.176	17.6%

Combining the pure technical efficiency index and the scale efficiency index, the average value of change in the pure technical efficiency index is 0.9%, while the average value of change in the scale efficiency is 4.4%, which shows that the change in the pure technical efficiency index is not significant, while the progress in the scale efficiency is more obvious and has a greater promotion effect on the increase of the total factor growth rate. In addition, the mean value of the change in pure technical efficiency index is lower than that of the change in scale efficiency, which also indicates that the 10 key industries in Jiangsu's advanced manufacturing clusters have not been able to learn and improve advanced technology, and they have not been able to make good use of the existing resources to promote the renewal and development of the industry, which also reflects that the new pattern of "double cycle" has a great effect on the development of China's advanced manufacturing industry and even the overall manufacturing industry. The "double-cycle" new pattern is also a useful way to respond to the development of the times and promote social progress. The TFP index and scale efficiency index from 2010 to 2012 are lower than one, considering that it may be due to the global financial crisis in 2008, which caused a certain degree of impact on China, making the scale efficiency and TFP growth rate lower. Combining the technical efficiency and TFP indices after 2012, the overall trend of the development of advanced manufacturing industry in Jiangsu Province is good, and combined with the small change in the pure technical efficiency index, it can be seen that there is still some room for the improvement of technical efficiency. At the same time, it is necessary to make good use of the background of the new "double-cycle" pattern to further promote the development and progress of the industry.

TABLE IV. Technical efficiency change index and Technological Progress Index decomposed by 10 key industries.

Industry Classification	Technical efficiency change index	Technological progress index
Electrical machinery and equipment manufacturing	1.057	0.950
Chemical raw material and chemical product manufacturing	1.061	1.017
Computer communications and other electronic equipment manufacturing	1.052	0.935
General equipment manufacturing	1.066	0.959
Ferrous metal smelting and rolling processing industry	1.000	0.977
Specialised equipment manufacturing	1.081	0.990
Automotive manufacturing	1.084	0.995
Metal products industry	1.062	0.979
Textile industry	0.989	0.932
Non-metallic mineral products industry	1.089	0.968
Average value	1.054	0.970

TABLE V. Pure technical efficiency index and Scale efficiency index decomposed by 10 key industries.

Industry Classification	Pure technical efficiency index	Scale efficiency index
Electrical machinery and equipment manufacturing	1.047	1.010
Chemical raw material and chemical product manufacturing	1.060	1.001
Computer communications and other electronic equipment manufacturing	1.000	1.052
General equipment manufacturing	1.015	1.050
Ferrous metal smelting and rolling processing industry	1.000	1.000
Specialised equipment manufacturing	0.973	1.111
Automotive manufacturing	1.013	1.069
Metal products industry	0.993	1.070
Textile industry	0.994	0.995
Non-metallic mineral products industry	0.995	1.094
Average value	1.009	1.044

Volume 7, Issue 1, pp. 47-52, 2023.
ISSN (Online): 2456-7361

TABLE VI. TFP index and TFP growth rate decomposed by 10 key industries.

Industry Classification	TFP index	TFP growth rate
Electrical machinery and equipment manufacturing	1.005	0.5%
Chemical raw material and chemical product manufacturing	1.079	7.9%
Computer communications and other electronic equipment manufacturing	0.984	-1.6%
General equipment manufacturing	1.022	2.2%
Ferrous metal smelting and rolling processing industry	0.977	-2.3%
Specialised equipment manufacturing	1.070	7%
Automotive manufacturing	1.078	7.8%
Metal products industry	1.040	4%
Textile industry	0.921	7.9%
Non-metallic mineral products industry	1.054	5.4%
Average value	1.022	2.2%

Based on the indices of the 10 key industries in Jiangsu's advanced manufacturing sector in TABLE IV—TABLE VI, it can also be seen how much importance Jiangsu's advanced manufacturing sector places on improving technological efficiency in the process of technological catch-up. Compared to TABLE I—TABLE Ⅲ, the increase in the indices in Table TABLE IV—TABLE VI are higher, which also indicate to a certain extent that the development status of some enterprises is not stable. Specifically, firstly, the change index of technical efficiency is 5.4% on average. It can be seen that the advanced manufacturing industry in Jiangsu Province has always persistently promoted the rapid development of the industry with efficiency improvement as the driving force in the process of improving the technical efficiency of the industry to promote independent innovation. In addition, from the viewpoint of the technical progress index, although the efficiency has improved, the overall technical progress is still poor, and combined with the changes in the pure technical efficiency index and scale efficiency, it can be seen that there is still a certain gap from the optimal state, and at the same time, the 10 key industries' unsatisfactory ability to learn and improve on advanced technologies and their failure to make good use of existing resources to efficiently promote the renewal and development of industries are consistent with the results in TABLE IV—TABLE VI. This shows that Jiangsu Province still has a long way to go in the process of catching up with technology, and therefore needs to take advantage of the favourable conditions brought about by the new "double-cycle" pattern to further promote the adjustment of industrial structure and the upgrading of industrial technology. From the change of scale efficiency index, the average value of scale efficiency change is 4.4%, which shows that the 10 key enterprises in Jiangsu Province's advanced manufacturing industry are performing well, and the development trend is good, and the technology can catch up soon. Finally, the change of TFP index shows that among the 10 industries, the best development status is in chemical raw materials and chemical products manufacturing, textile industry and automobile manufacturing, while the ferrous metal smelting and rolling processing industry and computer communication and other electronic equipment manufacturing industry are generally in poor condition, and there is still much room for improvement in the process of enhancing technical efficiency and improving the main innovation ability.

After analyzing the above table of index changes in different periods and different industries, we can understand that these 10 industries in the advanced manufacturing clusters in Jiangsu Province have developed relatively well, and Jiangsu Province is capable of playing a leading role in the process of promoting the technological catch-up of the advanced manufacturing clusters, which shows that from the perspective of prerequisites, Jiangsu Province has the basic conditions to comply with the "double cycle From the perspective of the prerequisites, Jiangsu Province has the basic conditions to comply with the background of the new pattern of "double cycle". However, in terms of the above-mentioned data, the technical efficiency and the degree of change in technological progress of the industries related to the advanced manufacturing cluster in Jiangsu Province have not yet reached the ideal state, which shows that there is still a lot of room for progress in the development of the related industries, and at the same time, technological catch-up is a long process, which requires not only increasing the investment in R&D of the related industries in China, but also encouraging the related enterprises to improve the level of independent innovation, taking into account the current domestic and international Combined with the current domestic and international double cycle background, give full play to China's super large-scale market advantages and internal potential is the key task of China's advanced manufacturing industry in the process of technological catch-up.

V. CONCLUSIONS AND RECOMMENDATIONS

Based on the new pattern of "double-loop", this study has measured the total factor productivity of advanced manufacturing industries in Jiangsu Province, explored the technological catch-up process of advanced manufacturing clusters in Jiangsu Province in recent years, and combined with the DEA-Malmquist index model, further studied the 10 key industries in advanced manufacturing clusters in Jiangsu Province to measure their total factor productivity. The study further investigates the total factor productivity of 10 key industries in the advanced manufacturing clusters in Jiangsu Province, and understands the importance of the efficiency of technological progress to the task of technological catch-up of advanced manufacturing clusters in China and the key role of the new development pattern of "double cycle" to the development of advanced manufacturing industries in China. The results of the study show that the growth of total factor productivity of advanced manufacturing clusters in Jiangsu Province mainly comes from the contribution of technical efficiency and scale efficiency, while it is worth noting that the improvement of technical progress efficiency is a major breakthrough in the task of technological catch-up. Therefore, in the process of technological catch-up of advanced manufacturing industries, it is necessary to further unite internally and externally to strengthen the level of technological innovation and R&D of advanced manufacturing clusters in Jiangsu Province and even in the whole country, so as to lead the whole country with a point, thus playing a positive role in promoting the process of technological catch-up of China's advanced manufacturing clusters to those of developed countries. In addition, it is necessary to take full advantage of the super large-scale market and the potential of domestic demand, and conform to the new development pattern with the main domestic circulation and the dual domestic and international circulation promoting each other. This development pattern will more strongly protect the market players of China's advanced manufacturing industry and activate the vitality of market players, whether in the process of "external circulation" to further connect China's advanced manufacturing industry with the international value chain, or in the process of "internal circulation" to continuously meet the needs of the domestic market, all of which will contribute to the development of China's advanced manufacturing industry. In the process of "external circulation", China's advanced manufacturing industry will further connect with the international value chain, and in the process of "internal circulation", China will continue to meet the needs of the domestic market. Based on the above research findings, and taking into account the current situation of the development of advanced manufacturing clusters in Jiangsu Province, the following suggestions are made.

First, increase the cooperation between government, industry, academia and research in advanced manufacturing industries, build a reasonable pattern that is more conducive to the improvement of industrial structure, and actively respond to the call for structural reform on the supply side to promote the flexibility of supply to demand. Second, increase the investment in scientific and technological progress, combine with the background of "double cycle", and appropriately introduce foreign advanced technology. Last but not least, we should adhere to the key breakthroughs, focusing on energy saving and environmental protection, clean production and clean energy, and take the lead in making breakthroughs to drive the integration of advanced manufacturing clusters with other industrial clusters, so as to achieve the integration of "two chemical and three industries", and comprehensively drive the green and efficient upgrading of various industries.

REFERENCES

[1] Wang Jici. “The Space of Innovation -- Industrial Cluster and Regional Development,” Science Press,2019.
[2] Zhao Yanfei,Wang Xiaojiong and Wang Li. “Research on Innovation Efficiency measurement of Chinese manufacturing industry based on input-process-output-environment perspective,” Contemporary Economic Research,2021(10):102-112.
[3] Yang Haochang, Li Lianshui and Zhang Faming. “The impact of manufacturing agglomeration on innovation productivity and regional comparison,” Studies in Science of Science,2020,38(01):63-75.
[4] Liu Zhidong and Gao Hongwei. “The impact of China's manufacturing exports on American enterprise innovation,” China Industrial Economics,2019(08):174-192.
[5] Ma Shuang and Guo Jingjing. “Study on the countermeasures of high quality development of China's advanced manufacturing industry during the fourteenth Five-year Plan period,” Innovation of Science and Technology,2021,21(05):40-47.
[6] Zhao Lu and Lv Lina. “From rust to Advanced Manufacturing Cluster: The path of resource-based economic transformation and high quality development,” World Regional Studies,2021,30(04):802-812.
[7] Feng Genfu, Zheng Mingbo, Wen Jun and Zhang Cunbin. “What factors determine the technological innovation of Chinese enterprises—A reempirical study based on the data of nine authoritative Chinese economic journals and a share listed companies,” China Industrial Economics,2021(01):17-35.
[8] Yang Rudai. “Research on Total factor Productivity of Chinese manufacturing enterprises,” Economic Research Journal,2015,50(02):61-74.
[9] Lu Xiaodong and Lian Yujun. “Total factor Productivity estimation of Chinese industrial Enterprises: 1999-2007,” China Economic Quarterly,2012,11(02):541-558.
[10] Shang Chuanlei, Zhang Wuyi and Chen Junying.“Total factor energy efficiency evaluation of Chinese logistics industry based on DEA and Malmquist index,” Ecological Economy,2019,35(03):51-56.
[11] Cao Ze,Yin Tianci and Chen Xingxing.“Spatial spillover effect of total factor productivity in construction industry in Yangtze River Delta region,” Construction Economy,2020,41(12):26-30.
[12] Qian Xuefeng and Gao Wan.“Import competition and Dynamic total factor productivity in China's manufacturing industry: From the perspective of resource allocation,” International Economics and Trade Research,2021,37(10):4-21.
[13] Li Lianshui, Bao Yifa and Liu Jun. “Research on the impact of intelligence on Total factor productivity of Chinese manufacturing industry,” Studies in Science of Science,2020,38(04):609-618+722.
[14] Yu Gang and Zhang Zhiqing. “Study on efficiency of Chinese Commercial Banks based on DEA-Malmquist Index,” Journal of Dongbei University of Finance and Economics,2019(01):79-86.
[15] Li Lin, Yang Chengchua and He Jianhong. “Research on the periodical Transition of technological capability in China's advanced Manufacturing Enterprises' technological catch-up,” Chinese Journal of Management,2021,18(01):79-90.
[16] Feng Delian and Wang Weijie. “Research on selection and cultivation of world-class advanced manufacturing cluster in Yangtze River Delta region,” Journal of Tongling University,2020,19(02):3-8.
[17] Maria, Liao Guanmin and Yu Xiaoyun. “The Brain Gain of Corporate Boards: Evidence from China,” The Journal of Finance,2015,70(4).
[18] Liu Zhibiao and Ling Yonghui. “Structural transformation, total factor Productivity and high quality development.,” Management World,2020,36(07):15-29.
[19] Ren Lu, Min Ruan and Torger Reve. “Cluster and co-located cluster effects: An empirical study of six Chinese city regions,” Research Policy,2016,45(10):1984-1995.
[20] Sun Hongjun, Chen Min, Wang Shengguang amd Chen Yu.“Spatial imbalance and influencing factors of total factor productivity growth in China's high-tech zones,” Soft Science,2020,34(01):1-6.
[21] Hiroyuki Okamuro and Junichi Nishimura.“ Local Management of National Cluster Policies: Comparative Case Studies of Japanese, German, and French Biotechnology Clusters,” Administrative Sciences, 2015,5(4):213-239.
[22] Andreas, Eisingerich, Simon and Paul Tracey. “How can clusters sustain performance? The role of network strength, network openness, and environmental uncertainty,” Research Policy,2009,39(2):239-253.