Analysis of the Relevance Effects of Service Industry FDI and Industrial Structure Upgrading in Jiangsu Province

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Abstract— Based on the grey correlation theory research method, using the data and bulletin of Jiangsu Province from 2006 to 2017, the empirical analysis of the impact of service industry FDI on the structural upgrading of manufacturing industry in Jiangsu Province shows that Jiangsu Province's productive and life service industry utilization There is a significant positive correlation between the foreign investment's and the structural upgrading of the manufacturing industry. Among them, the FDI of the life service industry is greatly affected by the structural upgrading of the manufacturing industry. From the perspective of the service industry segmentation industry, the education structure upgrade has a greater impact on education. Industry FDI, residential services and other services FDI, leasing and business services FDI and cultural, sports and entertainment FDI.

Keywords— Service industry FDI, manufacturing structure upgrade, grey relational theory.

I. INTRODUCTION

The experience of 40 years of reform and opening up shows that the achievements of China's rapid economic development have benefited from opening up to the outside world. Foreign capital has become an important part of China's economy. To achieve high-quality development of manufacturing industry, it is even more necessary to expand opening up. Jiangsu Province is a large manufacturing province with a high concentration of manufacturing. Although Jiangsu has entered the middle and late stages of industrialization, the proportion of high-end manufacturing in manufacturing has increased year by year, but traditional manufacturing still accounts for a relatively high proportion, and industrial development is still at the low end of the value chain. At present, the added value of service industry in Jiangsu Province has exceeded 50% of GDP, and the industrial structure has achieved the iconic transformation from "23:1" to "32.1". The service economy has become an important support for optimizing investment structure and promoting transformation and upgrading. . As China's economic development enters the middle and late stages of industrialization, the introduction of foreign investment in the manufacturing and service industries and the expansion of the opening up pattern are of great significance to the high-quality development of China's economy.

Foreign scholars Blomstom & Kokko (2000) and Francois & Woerz (2007) found that service industry FDI significantly promoted the productivity of manufacturing industry through technology spillover effects. Domestic scholars Zhang Ruqing, Shi Yuan et al (2014) and Xu Hongyi, Huang Yujiang, etc. (2016) found that service industry FDI has a significant spillover effect on manufacturing productivity. Markusen (2005) found that the introduction of foreign investment in the service industry can lead to higher quality intermediate inputs, thereby increasing production efficiency. Wei Zuilei (2013) found that the service industry FDI can promote the professionalism of the division of labor in the

host country and enhance the innovation ability of the enterprise. On the other hand, it can also use the backward correlation effect to improve the production efficiency of the manufacturing industry. However, some scholars have proposed different views. For example, Hua Guangmin et al. (2014) believe that high-tech service industry FDI has curbed the improvement of China's domestic manufacturing efficiency. In addition, Sha Wenbing and Tang Lei (2016) found that the overall production service industry and the FDI of the six major sub-sectors have positively promoted the technological innovation capability of China's manufacturing industry. Nicolini et al. (2010) have shown through empirical research that FDI in service industry generates positive economic and technological spillovers, and works on the development of manufacturing industry through correlation effects to improve production efficiency. Meng Pingli and Dong Xiangcho (2017) conducted an empirical analysis using the method of grey correlation analysis. The study found that there is a close relationship between FDI and OFDI in the production service industry and the upgrading of the industrial structure of the manufacturing industry.

Research by scholars at home and abroad shows that the development of FDI in service industry can improve the technical level and export competitiveness of a country, and the industrial correlation effect between service industry and manufacturing industry will also promote the transformation and upgrading of manufacturing industry. Therefore, the scale expansion and structural adjustment of the use of foreign capital in Jiangsu's service industry is of great significance to the high-quality development of the manufacturing industry.

II. PRESENT SITUATION ANALYSIS

A. The Development Level of FDI in Service Industry in Jiangsu Province

Since China's accession to the WTO, China has rapidly developed into a world factory. In the rapid economic development of the Yangtze River Delta, Jiangsu Province has

developed rapidly. In 2005, the actual use of foreign investment in the service industry was only US$170.35 million. In 2007, the actual FDI of the service industry in Jiangsu Province exceeded the proportion. 20% and keep rising. By 2016, the actual FDI of the service industry reached 1,114.272 million US dollars, which was 102.233 million US dollars higher than the actual use of foreign capital of 146.439 million US dollars. In recent years, the openness of foreign investment in Jiangsu's service industry is shown in Table I. The actual utilization of foreign investment in the province's service industry increased from 229.457 billion Yuan in 2006 to 775.29 billion Yuan in 2016, an increase of about 6 times. As shown in Table I, the service industry's FDI openness value in 2006 was 29.0%, and reached the highest value of 37.2% in 2007. During the period of 2008-2010, due to the financial crisis, the growth rate decreased, and then the openness increased. The speed is rising. In short, the openness of FDI in Jiangsu's service industry is getting higher and higher, and more and more foreign direct investment into the service industry.

TABLE I. List of foreign investment in service industry in Jiangsu Province from 2006 to 2016

Year	Service industry FDI (100 million yuan)	Tertiary industry GDP (100 million yuan)	Service industry FDI openness (%)
2006	2294.57	7914.11	29
2007	3618.41	9730.91	37.2
2008	4078.4	11888.53	34.3
2009	4555.99	13629.07	33.4
2010	5316.64	17131.45	31
2011	7207.49	20842.21	34.6
2012	6884.82	23517.98	29.3
2013	8464.44	27197.43	31.1
2014	7236.48	30599.49	23.6
2015	7793.95	34085.88	22.9
2016	7752.9	38458.45	20.1

Note: 1. The data comes from the Jiangsu Statistical Yearbook;2. FDI openness of service industry = actual investment amount of FDI in service industry / GDP of tertiary industry

B. The Development of Manufacturing Industry in Jiangsu Province and the Status Quo of Industrial Structure

Jiangsu is a large manufacturing province. The rapid development of manufacturing in Jiangsu Province is a key driving force for the province's economic growth. In 2007-2016, Jiangsu Province's GDP and Jiangsu's manufacturing GDP grew at a faster rate. The decline, in which the growth rate of the manufacturing industry is lower than the growth rate of Jiangsu's GDP. The GDP of the manufacturing industry has always accounted for about 40% of the province's GDP, as shown in Table II.

Manufacturing can be divided into three major categories of technology, labor and capital-intensive industries. Since 2011, the number of units in the three intensive large-scale manufacturing industries in Jiangsu Province has gradually approached, and the state of labor-intensive manufacturing has been continuously improved. The structure of the manufacturing industry has been continuously adjusted. The specific data is shown in Table III.

TABLE III. Total GDP and Manufacturing Ratio of Jiangsu Province in 2007-2016   Unit: 100 million yuan

Year	Jiangsu Province GDP	Manufacturing gross production	Manufacturing industry's GDP as a percentage of the province's GDP
2007	26018.48	12246.85	47.07%
2008	30981.98	14318.3	46.21%
2009	34457.3	15430.81	44.78%
2010	41425.48	18101.33	43.70%
2011	49110.27	20978.51	42.72%
2012	54058.22	22393.82	41.43%
2013	59753.37	24124.67	40.37%
2014	65088.32	25484.27	39.15%
2015	70116.38	26434.83	37.70%
2016	76086.17	27813.27	36.55%

TABLE IIIII. Number of units with different factor-intensive manufacturing units above scale in Jiangsu Province from 2011 to 2016

Manufacturing classification	2011	2012	2013	2014	2015	2016
Labor-intensive manufacturing	14634	15665	16595	16373	16391	16138
Capital-intensive manufacturing	15096	15762	17039	17512	16915	16561
Technology-intensive manufacturing	13102	13864	14549	14557	14526	14509

In recent years, under the background of the rapid development of the national manufacturing industry, the manufacturing industry in Jiangsu seized the opportunity and quickly adjusted the internal structure. Among them, the high-tech industry and the heavy chemical industry are on the rise, and the high-tech industry is mainly based on capital and technology. Mainly; the downward trend is the traditional labor-intensive manufacturing industry; the large and medium-sized industrial enterprises in Jiangsu Province are gradually increasing their expenditure on science and technology research and development, the expenditure on talent cultivation is increasing year by year, and the innovation ability of enterprises is strengthening; Jiangsu Province is a large manufacturing industry. In the province, there are a large number of large, medium and small manufacturing enterprises, and the scale is large. The average annual industrial output value ranks high in the country. With the continuous extension of the industrial chain, the development of industrial clusters has formed a certain scale.

III. EMPIRICAL ANALYSIS

A. Gray Correlation Analysis Principle and Steps

Due to the related development between industries, the introduction of foreign capital in various industries has different effects on each industry, while FDI plays its role in different industries through industrial correlation effects. Among the methods for studying the correlation effects, there are regression statistics, variance statistics, principal component analysis and other mathematical statistics methods, coupling coordination methods and gray correlation analysis methods. However, regression model analysis is more suitable for linear analysis, and the correlation analysis between multiple factors in this paper uses gray correlation analysis. Grey correlation analysis is an analysis method belonging to the grey system theory. It provides a quantitative measure for

the development trend of a system, that is, the quantitative comparison analysis of the development situation, which is very suitable for the dynamic process analysis. It makes up for the shortcomings of the mathematical statistics method, and it is equally applicable to the sample size and the regularity, and the calculation amount is small, which is very convenient.

In the gray correlation analysis, if the two factors are consistent with the development of the system, that is, the degree of synchronization changes is high, it can be considered that the relationship between the two is relatively large; otherwise, the correlation between the two is small [11] . In the real world, because there can be positive correlations or negative correlations between actual things, when the gray correlation degree is regarded as a measure of the correlation between sequences, the correlation value should be closed. Between intervals [-1, 1]. Specific steps of the grey correlation analysis method:

(a). Determine the reference sequence and compare the series
Reference series:X_0, $X_0 = x_0^{(k)} = \{x_0^{(1)}, x_0^{(2)}, x_0^{(3)}, \ldots x_0^{(k)}\}$
Comparison series:X_i, $X_i = x_i^{(k)} = \{x_i^{(1)}, x_i^{(2)}, x_i^{(3)}, \ldots x_i^{(k)}\}$

(b). Dimensionless processing

In order to avoid the influence of various factors on the conclusion of the data dimension, non-dimensional data processing is performed. The covariance matrix formed by the data of each indicator processed by the averaging method can reflect the difference in the degree of variation of each indicator in the original data, and also the information on the difference in the degree of mutual influence of each indicator. So here we use the mean method, the formula is:

$$x_i^{'} = \frac{x_i}{\overline{x_i}} \tag{1}$$

(c).Grey correlation coefficient

$$\xi_i(k) = \frac{\min_i(\Delta_i(\min)) + 0.5\max_i(\Delta_i(\max))}{|x_0(k) - x_i(k)| + 0.5\max_i(\Delta_i(\max))} \tag{2}$$

$$\min_i(\Delta_i(\min)) = \min_i(\min_k|x_i(k) - x_i(k)|)$$

$$\max_i(\Delta_i(\max)) = \max_i(\max_k|x_0(k) - x_i(k)|)$$

(d).Correlation r_i

$$r_i = \frac{1}{N}\sum_{k=1}^{N}\xi_i(k) \tag{3}$$

(e).Relevance ranking

$0 \leq r_i \leq 0.4$, Relevance is weak ; $0.4 \leq r_i \leq 0.6$, Relevance is medium ; $0.6 \leq r_i \leq 0.8$, Relevance is relatively strong ; $0.8 \leq r_i \leq 1$, Relevance is extremely strong.

B. Data Selection and Source

(a). Combined with the specific situation of industrial structure adjustment and manufacturing development in Jiangsu Province, referring to the research theory of domestic scholar Nan Bojun (2013) on the upgrading of manufacturing structure, the structural upgrading is mainly divided into three parts: material capital structure, human capital structure and technical structure upgrading. aspect. Drawing on the domestic scholar Chen Caiqin's research on the structural

upgrading of manufacturing industry, the proportion of industrial output value of high-tech manufacturing industry to the total industrial output value of manufacturing industry represents the internal industrial structure index of Jiangsu manufacturing industry. This paper also refers to this proportion as a measure of technical structure upgrading. The sum of the fixed assets and current assets of the manufacturing industry in Jiangsu Province is expressed as capital investment, as a measure of the upgrading of the material capital structure; the proportion of the R&D personnel in the manufacturing industry in Jiangsu Province represents the upgrading index of the human capital structure of the manufacturing industry, as human capital. The measurement index of structural upgrading; the proportion of industrial output value of high-tech manufacturing industry in Jiangsu Province in 2006-2016, the proportion of industrial output value of manufacturing industry, the capital investment and the proportion of R&D personnel in manufacturing industry were selected as reference sequences, expressed as:X_0、Y_0、Z_0,k is the number of years, k=11,

Internal industrial structure index:$X_0 = x_0^{(k)} = \{x_0^{(1)}, x_0^{(2)}, x_0^{(3)}, \ldots x_0^{(k)}\}$

Capital investment:$Y_0 = y_0^{(k)} = \{y_0^{(1)}, y_0^{(2)}, y_0^{(3)}, \ldots y_0^{(k)}\}$

The proportion of R & D personnel:$Z_0 = z_0^{(k)} = \{z_0^{(1)}, z_0^{(2)}, z_0^{(3)}, \ldots z_0^{(k)}\}$

(b). In this paper, the service industry is mainly divided into two categories: production and life service industry. The actual FDI of Jiangsu Province's productive service industry and life service industry from 2006 to 2016 is selected as the comparison sequence X_i, i is the number of indicators, i=2 And also selected 13 segments of the service industry: transportation, warehousing and postal services, information transmission, computer services and software, wholesale and retail, accommodation and catering finance, real estate, leasing and business services, Scientific research, technical services and geological exploration, water conservancy, environmental and public facilities management, residential services and other services, education, health, social security and social welfare, culture, sports and entertainment, FDI for sub-sectors Compare the sequence, denote Y_i, i is the number of indicators, i=13, k is the number of years, k=11,

$X_i = x_i^{(k)} = \{x_1^{(1)}, x_2^{(2)}, x_3^{(3)}, \ldots x_i^{(k)}\}$
$Y_i = y_i^{(k)} = \{y_1^{(1)}, y_2^{(2)}, y_3^{(3)}, \ldots y_i^{(k)}\}$

C. Result Analysis

TABLE IV. Gray correlation degree of FDI to manufacturing structure upgrade in producer service industry and life service industry

Index	Producer service industry FDI	Life service industry FDI
X_0	0.5881	0.5319
Y_0	0.4742	0.6997
Z_0	0.5537	0.6928

It can be seen from Table III that there is a certain difference in the impact of FDI on the upgrading of manufacturing structure in the productive and life service industries. It can be seen from Table IV: (1) The degree of correlation between the FDI of the producer service industry and the structural upgrading index of the manufacturing

industry is, from large to small, the internal industrial structure, human capital and material capital structure, and the proportion of the internal industrial structure. The maximum is 0.5881; the relationship between FDI and life service industry from large to small is material capital structure, human capital structure and internal industrial structure, and the impact on material capital structure is 0.6997. (2) The continuous introduction of foreign capital in the development of the service industry has brought advanced technology to the development of the manufacturing industry through technology spillovers, promoting the development of high-tech manufacturing industry; the living service industry has brought foreign capital to the development of the manufacturing industry. Advanced technical talents have also boosted manufacturing employment and increased employment training, which has promoted the upgrading of the material capital structure of the manufacturing industry and the upgrading of the human capital structure.

TABLE V. Gray correlation degree of FDI to manufacturing structure upgrade in service industry segment

Segment industry FDI (Y_i)	X_0		Y_0		Z_0	
	r_i	Rank	r_i	Rank	r_i	Rank
Transportation, warehousing and postal services	0.6452	9	0.6238	11	0.6902	7
Information transmission, computer services and software industry	0.6503	8	0.6546	8	0.7236	6
Wholesale and retail trade	0.6816	5	0.6856	7	0.6061	12
Accommodation and catering industry	0.5987	12	0.6514	9	0.6280	11
Financial industry	0.6345	10	0.6125	12	0.6311	10
Real estate industry	0.6099	11	0.7238	4	0.6753	8
Leasing and business services	0.7025	3	0.7192	6	0.6017	13
Scientific research, technical services and geological exploration	0.5197	13	0.5997	13	0.6331	9
Water, environmental and public facilities management	0.6767	6	0.7266	3	0.7290	5
Resident services and other services	0.7347	2	0.7217	5	0.8073	1
education	0.8123	1	0.8451	1	0.7961	2
Health, social security and social welfare	0.6736	7	0.6379	10	0.7377	4
Culture, sports and entertainment	0.6963	4	0.7504	2	0.7855	3

As can be seen from Table V, it can be seen that the correlation between FDI in the service industry segment of Jiangsu Province and the three indicators for measuring the structural upgrading of manufacturing is obviously different. It also shows that the influence of different foreign exchanges in the service industry on manufacturing has different, and capital and labor. And the impact of technology is also different. It can be seen from Table 5: (1) Horizontal comparative analysis, the differences are more obvious in the wholesale and retail industry, real estate industry, leasing and

business services, which shows that the impact of wholesale and retail FDI on human capital is small, real estate The industry has a greater impact on physical capital. FDI in the leasing and business services industry has a greater impact on the introduction of technology, but less on capital and manpower; the smallest difference is in the education industry, and the association between FDI and the three major indicators in the education industry The degree is relatively large, indicating that the introduction of foreign investment in the education industry, including technology, knowledge and various intangible information, has a significant positive impact on the upgrading of the manufacturing structure. (2) Longitudinal comparative analysis, the most relevant to the industrial structure indicators of the manufacturing industry is the education industry FDI, the smallest is the scientific research, technical services and geological exploration industry FDI; the largest correlation with the manufacturing material capital structure indicators It is the education FDI, the smallest is the scientific research, technical services and geological exploration industry FDI; the most relevant to the manufacturing human capital structure indicators is the residential service and other service industry FDI, the smallest is the lease and business services FDI; this The correlation results are judged by empirical facts. Talents are the first resource for the development of advanced manufacturing industry. The development of modern science and technology service industry, on the one hand, cultivates talents, carries out scientific and technological innovation, on the other hand, introduces sophisticated talents and advanced management skills and advanced technical experience.

In short, from the results of the grey correlation model, it can be concluded that the actual use of foreign capital in the service industry and the expansion of scale have a high degree of correlation with the development and structural upgrading of the manufacturing industry in terms of technology, capital and labor. The industry FDI spillover effect theory can analyze that through the spillover effects of economic and technological aspects, the service industry attracts and utilizes foreign capital to effectively promote the development and structural upgrading of the manufacturing industry. In order to accelerate the pace of optimization and upgrading of the manufacturing structure, it is necessary to pay attention to services. The role of foreign investment in the industry in promoting the development of the manufacturing industry and the interaction between industries.

IV. SUGGESTIONS

A. *The Enlightenment of Introducing Foreign Capital into Service Industry in Jiangsu Province*

At present, in Jiangsu's productive service industry, some knowledge-intensive service industries such as information technology, computer service industry and financial industry have higher thresholds for attracting foreign investment. Therefore, relevant government departments should, on the basis of ensuring market economy autonomy, to a certain extent. Reduce the threshold for entry, attract more foreign investment, and effectively increase the technology spillover effect and driving effect. The use of FDI in the service

industry in Jiangsu Province has basically flowed to the real estate industry. This also suggests that the government can guide the rationalization of FDI flows through policy guidance, so that more foreign capital flows into knowledge- and technology-intensive industries, and the flow of FDI is made as uniform as possible to avoid. Focus on one of the departments. The labor-intensive service industry in Jiangsu's life service industry also belongs to the traditional service industry. It is necessary to maintain the proportion of FDI flow to it, so that the advantages of the traditional service industry can be exerted.

Second, we must attach great importance to the use of foreign capital in the service industry, encourage enterprises to open up to the outside world, attract and select better foreign capital, and further adjust the structure of foreign capital utilization. On the one hand, it is conducive to the introduction of advanced science and technology and equipment, on the other hand, it is conducive to the entry of emerging service industries, and it is also helpful to learn from foreign advanced technology and management experience. Based on the optimization and upgrading of industrial structure, it will help to promote the adjustment of the internal structure of the traditional service industry, enhance the level and level of foreign capital utilization, enhance the related development of modern service industry and high-tech manufacturing industry, promote the development of circular economy, and reduce the environment. Pollution and waste of resources.

In short, the step-by-step expansion of the proportion of foreign investment in the service industry in Jiangsu Province and the gradual optimization of its structure have promoted the development process and optimization and upgrading of the service industry itself. On the other hand, it can also be analyzed from the perspective of linkage, in the process of continuously introducing foreign capital. The development of the manufacturing industry has brought many opportunities to promote the optimization and upgrading of the manufacturing structure.

B. The Enlightenment of Jiangsu Province's Service Industry FDI Promoting the Upgrade of Manufacturing Structure

First, analyze from the perspective of technical structure upgrade. The key to the upgrading of the technological structure of manufacturing industry in Jiangsu Province lies in technology. The increase in investment in technology research and development is of great significance to the development of high-tech manufacturing. Empirical research shows that the productive service industry brings high-level R&D technology, rich management experience and technical talents while utilizing foreign capital, among which high-end service industries such as finance, computers and commercial leasing account for a large proportion. It also inspires Jiangsu to expand the scale of the introduction of foreign investment in the production service industry, adjust the structure, especially to encourage high-end service industries with high correlation with high-tech manufacturing industries to attract foreign investment, strengthen its relationship with the manufacturing industry, and play a productive service industry. FDI spillover effect accelerates the upgrading of manufacturing technology structure. Among the scale of FDI in the life service industry,

the largest is the real estate industry, and the development of the real estate industry is inseparable from the development of the manufacturing industry. Focusing on the development of high-tech manufacturing, combined with the implementation of modern real estate projects, the government needs to formulate relevant policies. To create a better environment, provide certain preferential policies and assistance for the emerging high-tech manufacturing industry, and promote the integration and development of the two.

Second, from the perspective of upgrading the material capital structure. The upgrading of the material capital structure of the manufacturing industry not only requires an increase in capital investment, but also a need to adjust the capital structure. This also inspires us to pay attention to the issue of upgrading the capital structure of the manufacturing industry and encourage foreign investment to enter the manufacturing industry. On the one hand, while attracting foreign investment, the service industry has introduced a large amount of capital investment. From a related perspective, it is necessary to expand the scale of utilization of foreign investment in service industries with higher correlation with manufacturing, and to solve some emerging technology industries and small and medium-sized manufacturing in manufacturing. The problem of insufficient capital investment in the industry has enabled the manufacturing enterprises that are closely related to the development of the service industry to obtain the introduced foreign capital, and promote the upgrading of the material capital structure of the manufacturing industry on the basis of the integration of the two.

Third, from the perspective of upgrading the human capital structure. In the life service industry, the traditional service industry, which mainly focuses on the real estate industry and the wholesale and retail industry, attracts foreign investment and also drives employment. It also adds more jobs to the development of the related manufacturing industry. The upgrading of the human capital structure indicates that the number of developers and technical personnel in the manufacturing staff is increasing, the per capita education level is improved, and the per capita wage is increasing. This also reveals that in the sub-sectors of the service industry, when attracting and utilizing foreign capital, it is necessary to pay attention to the high quality of the introduction of foreign capital, and encourage the manufacturing enterprises to innovate and improve the enterprises on the basis of learning and drawing on the introduced technical experience. Innovative ability, increase technical training courses for employees, improve the quality of employees, and promote the optimization and upgrading of manufacturing human capital structure.

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