Frontiers in Business, Economics and Management
ISSN: 2766-824X | Vol. 7, No. 3, 2023

Research on Promoting Effect of Coordinated Development of Two-Way FDI on Integration of Two Industries

Shanting Yi[1, *]

[1]School of Business, Hunan University of Science and Technology, Xiangtan, Hunan, 411201, China

[*]**Corresponding author**: Shanting Yi (Email: yishanting@163.com)

Abstract: This paper takes 30 provinces and cities in China as the research object, andanalyzes the influence and mechanism of two-way FDI coordinated development on the integration of the two industries based on two-way fixed effects. The study found that: The coordinated development of two-way FDI in provinces and cities has significantly promoted the convergence of two industries in our country, and the promotion is mainly realized by improving the level of technological innovation and optimizing the structure of human capital. Further analysis shows that the coordinated development of two-way FDI plays a more significant role in promoting the integration of the two industries and capital-intensive service and manufacturing industries in the eastern and central regions. Therefore, it is recommended that all regions should adhere to the two-way open strategy, enhance the level of technological innovation and increasing talent introduction plan, further optimize the structure of regional human capital, establishing reasonable industrial policy, promote the depth of the two fusion.

Keywords: Two-way FDI coordinated development, Integration of the two industries, Technological innovation, Human capital optimization.

1. Introduction

The integration of manufacturing industry and service industry is an important way to enhance the core competitiveness of manufacturing industry and achieve high quality development of manufacturing industry [1]. Continuously improving the deep integration of the two industries is of great significance to stabilize China's industrial chain and supply chain, enhance the competitiveness of manufacturing industry, and drive China's manufacturing industry to upgrade to the high-end of the global value chain.

The integration of manufacturing and service industry means that the boundary between the two is constantly being broken. The manufacturing industry is integrating more and more service elements, while the service industry is integrating manufacturing elements and extending to the manufacturing link under the premise of not changing the main function of its service, that is, the serserization of manufacturing industry and the extension and development of service industry to manufacturing [2]. Although, with the continuous improvement of the social productivity, Chinese manufacturing industry and service industry integration phenomenon continuously emerges, but because of the late development of Chinese service industry, the degree of service industry and manufacturing integration is not deep, the level is not high, there is still a big gap with the developed countries. Scholars explored the factors affecting the integration of the two industries from different perspectives and sought ways to promote the further integration of manufacturing and service industries. The research found that the level of technological innovation, the ability of enterprises to design and develop new products; Healthy competition between industries and market-oriented demand; The government's policy support and deregulation for the deep integration of the two industries; High level consumer demand; Factors such as talent training and investment in scientific and technological research and development have obviously promoted the deep integration of the two industries[4-8], The low level of per capita income and the lack of enterprise management ability will become an obstacle to the deep integration of the two industries[9]. Although the above research analyzed the important factors that promote the deep integration of the two industries from different perspectives, it ignored the possible influence of the further improvement of the level of collaborative development of two-way FDI, which is the main way to connect the two markets at home and abroad, on the integration of the two industries in the future under the background of "double cycle" and adhering to the two-way opening strategy.

As the world's largest recipient of foreign investment and the second largest outbound investor, China has been continuously pursuing the quality of two-way investment while ensuring the quantity of two-way investment. The level of coordinated development of two-way FDI in China is also constantly improving, which has played a great role in promoting China's industrial development. Scholars generally believe that IFDI and OFDI both contribute to the development of industries in their home countries and have a long-term and stable relationship [10,11]. Meanwhile, with the improvement of the coordinated development level of IFDI and OFDI in various regions, market competition will be further intensified, regional technological innovation level will be improved, and human capital structure will be optimized [12,13], Market competition, technological innovation level and human capital structure are important factors affecting the integration of the two industries. Therefore, the improvement of the coordinated development level of two-way FDI may promote the further integration of the two industries. May have the following questions, two-way FDI regional coordinated development level of ascension

to promote industry amalgamation? If so, what is the path for the coordinated development of two-way FDI to improve the integration degree of the two industries? Solving these problems is of great significance for scientific analysis of the motivation to promote the deep integration of the two industries, improving the core competitiveness of the manufacturing industry, promoting the transformation and upgrading of the manufacturing industry, and achieving high-quality economic development.

Based on the above background and the lack of research literature, this paper takes the provincial level data from 2008 to 2019 as research samples, and adopts the two-way fixed model to systematically investigate the impact of the coordinated development of two-way FDI on the integration of manufacturing and modern service industries. The study found that coordinated development significant two-way FDI promotes the regional depth fusion, two industry mainly through technology innovation effect and optimize the effect of human capital, the two ways the coordinated development of industry amalgamation two-way FDI promoting effect to regional differences and industry differences. The possible marginal contributions of this paper are as follows. First, this paper discusses the relationship between the coordinated development of two-way FDI and the integration of the two industries in a unified analytical framework, expands and deepens the theoretical research on the deep integration of the two industries in the region, and enrichis the relevant literature on the integration of the two industries. Second, from the two aspects of technological innovation and human capital optimization, this paper reveals the internal mechanism of two-way FDI coordinated development to promote the integration of the two industries, and provides new empirical evidence for promoting the integration of the two industries in China.

2. Theoretical Analysis and Research Hypothesis

The integration of manufacturing industry and modern service industry is affected by many factors, and the degree of integration is closely related to technological innovation and human capital optimization. IFDI can promote industrial technological innovation through technology spillover effect) [14], competition effect [15] and correlation effect [16] and foster local emerging industries at the same time. OFDI can optimize industrial structure and human capital structure to drive industrial development through reverse technology spillover effect [17], export creation effect, access to natural resources, human capital and production capacity transfer [18] and other paths. The coordinated development of IFDI and OFDI is to form a positive interaction between the two, exert the positive effect of IFDI and OFDI to the maximum, further improve the regional technological innovation level and optimize the human capital structure, so as to have an impact on the integration of the two industries. Therefore, the coordinated development of two-way FDI is likely to be an important factor affecting the deep integration of the two industries. Through the review and summary of the existing literature, it is found that the coordinated development of two-way FDI can promote the deep integration of industries by improving the level of technological innovation and optimizing the structure of human capital.

The role of the coordinated development of two-way FDI in improving the level of technological innovation may promote the deep integration of the two industries in the region[19]. The reason why the coordinated development of two-way FDI can promote the deep integration of industries is that it is an important way of communication to promote technological innovation) [20]. Gradually break the industrial boundary of the two and promote the further integration of the two industries [21]. The role of coordinated development of two-way FDI in improving the level of technological innovation is mainly reflected in the following two aspects: On the one hand, the inflow of IFDI not only brings capital to the host country, but also brings advanced technology, production process and management process. In addition, IFDI can also improve the quality and technical content of upstream and downstream products through industrial linkage; At the same time, the local marketization of foreign-funded enterprises will intensify the original market competition in the host country, which poses a certain threat to the survival of enterprises in the host country. On the other hand, in the process of OFDI, enterprises in the home country can quickly acquire strategic assets such as advanced technology, advanced management experience and high-tech talents through mergers and acquisitions and cooperation with foreign advanced enterprises, so as to improve their own technological level. In addition, in order to stand firm and compete with foreign enterprises when conducting OFDI, enterprises in the home country need to constantly improve their own technical level. Based on this, Chinese enterprises promote OFDI by absorbing IFDI and giving full play to the advantages of the domestic market and the role of the domestic circulation, and the domestic circulation promotes the international circulation.

The coordinated development of two-way FDI may also promote the deep integration of the two industries by optimizing the regional human capital structure. The high coordination level of regional two-way FDI means that the benign interaction between high-quality IFDI and OFDI will bring a large number of high-quality talents to the region and promote the improvement of the quality of regional human capital, which determines the level of industrial development and is the soft power spring to ensure the integrated development of industries [22]. Therefore, the coordinated development of two-way FDI can promote the deep integration of the two industries by optimizing the regional human capital structure. The optimization effect of the coordinated development of two-way FDI on regional human capital is mainly reflected in two aspects. In addition, the inflow of IFDI brings a large number of technical and management talents to the host country, which increases the stock of human capital in the region [23]. On the other hand, in order to integrate into the international environment and carry out investment activities more quickly, enterprises will absorb and utilize a large number of high-quality talents from the host country, improve knowledge spillover effect through transnational labor mobility, and optimize domestic employment structure and human capital structure [24]. Next, in order to further form competitive advantages, they will first increase the education and training of internal employees to improve the quality of employees. Therefore, in the process of coordinated development, two-way FDI will promote the optimization of regional human capital through education investment, knowledge spillover effect, competition effect and other ways.

To sum up, with the continuous improvement of the coordinated development level of two-way FDI, its

promotion effect on the integration of the two industries will also continue to improve, and the coordinated development of two-way FDI will promote the deep integration of the two industries through the technological innovation effect and the human capital optimization effect. Accordingly, this paper puts forward the following hypothesis:

Hypothesis 1: The higher the coordinated development level of regional two-way FDI is, the more it can promote the integration of the two industries.

Hypothesis 2: The coordinated development level of regional two-way FDI promotes the deep integration of the two industries mainly by improving the level of technological innovation and optimizing the structure of human capital.Acknowledgment

3. Model, Variables and Data Description

3.1. Measurement model setting

In order to explore the impact of China's coordinated development of two-way FDI on the integration of manufacturing and modern service industry, the following two-way fixed effect model is set.

$$IA_{it} = \alpha + \beta TFDI_{it} + \gamma Control_{it} + \lambda_i + \tau_t + \varepsilon_{it} \quad (1)$$

Among them, the explained variable IA_{it} is the integration level of manufacturing and modern service industry in each region, the explanatory variable $TFDI_{it}$ is the coordinated development level of two-way FDI, Controlit is the control variable, λ_i represents the regional fixed effect, τ_t represents the time fixed effect, and ε_{it} is the random disturbance term.

3.2. Selection of variables

1.Explained variable.

Integration of the two industries. Regarding the accurate measurement of the integration level of the "two industries," the academic community has not yet formed a unified standard and method. Through the analysis of the integration process of manufacturing industry and modern service industry, this paper finds that the integration between the two industries is a dynamic evolution process of mutual dependence and interaction, which conforms to the characteristics of the physical coupling model used to measure the degree of dependence and interaction between different systems. Therefore, this paper adopts the physical coupling model to measure the integration level of the "two industries," so that the measurement results have both reliability, accuracy and timeliness. When constructing the evaluation index of the integration of "two industries," considering the adaptation of industrial structure, the synergy of industrial scale, the coordination of location development and the matching of economic effect and future development potential brought by the manufacturing industry and modern service industry, and referring to Tang et al. [25], Li and Zhao [26], Xia Lun [27] constructed an evaluation index system from the five aspects of economic effect, development potential, industrial scale, industrial structure and location advantage, and calculated the integration level of "two industries" in 30 provinces in China from 2008 to 2019. The calculation steps are as follows: firstly, the standardization is carried out according to Formula (2). The formula is as follows:

$$\begin{aligned} u_{zj}^{\ t} &= (x_{zj}^{\ t} - m_{zj}^{\ t}) / (M_{zj}^{\ t} - m_{zj}^{\ t}) \\ u_{sj}^{\ t} &= (x_{sj}^{\ t} - m_{sj}^{\ t}) / (M_{sj}^{\ t} - m_{sj}^{\ t}) \end{aligned} \quad (2)$$

x_{zj}^{t}, M_{zj}^{t} and m_{z}^{jt} represent the value, maximum value and minimum value of the JTH indicator of the manufacturing industry in year t, respectively; x_{sj}^{t}, M_{sj}^{t} and m_{sj}^{t} represent the value, maximum value and minimum value of the JTH indicator of the modern service industry in year t.

$$\begin{aligned} u_z^{\ t} &= \sum_{j=1}^{j=n} \lambda_{zj} u_{zj}^{\ t}, \sum_{j=1}^{j=n} \lambda_{zj} = 1 \\ u_s^{\ t} &= \sum_{j=1}^{j=n} \lambda_{sj} u_{sj}^{\ t}, \sum_{j=1}^{j=n} \lambda_{sj} = 1 \end{aligned} \quad (3)$$

Then, the comprehensive development level is calculated according to Formula (3). Where λ_{zj} and λ_{sj} are the weights of each index calculated using the entropy method, u_{zt} and u_{st} are the comprehensive development levels of manufacturing and modern service industries obtained using the linear weighting method.

$$\begin{aligned} C^t &= 2\sqrt{\left(u_z^{\ t} * u_s^{\ t} / (u_z^{\ t} + u_s^{\ t})\right)} \\ T^t &= \alpha u_z^{\ t} + \beta u_s^{\ t} \\ D^t &= \sqrt{(C^t * T^t)} \end{aligned} \quad (4)$$

Finally, the integration level of manufacturing and service industry is calculated according to Formula (4). Where *Ct*, *Dt* and Tt are the coupling degree value, coupling coordination degree and comprehensive evaluation index reflecting the synergistic effect of manufacturing and producer service in year t, respectively. α and β represent the contribution degree of manufacturing and modern service industry in calculating the synergistic evaluation index. According to the practice of existing research, α=β=1/2 (α+β=1), In the process of calculating the coupling degree *Ct*, there will be a high coupling degree when the comprehensive development level of the two industries is not high. Therefore, in order to more accurately calculate the integration level of the "two industries", the synergy evaluation index Tt is introduced, and the coupling coordination degree *Dt* is obtained by combining the coupling degree *Ct* and the synergy evaluation index *Tt*, which is the integration level of the "two industries". The larger the *Dt* value is, the better the integration level of the two industries is.

2. Core explanatory variables

Coordinated development of two-way FDI. For the calculation of the coordinated development level of two-way FDI, it is necessary to judge whether two-way FDI affects and promotes each other, and then use the physical coupling model for measurement. Referring to the method of Huang Lingyunet al. [28], this paper first uses Fisher, LLC and IPS to judge the stationarity of IFDI and OFDI data, then uses IRF function to preliminarily analyze whether there is an interaction effect, and finally uses PVAR model to retest the interaction effect of IFDI and OFDI data. The calculation formula of the coordinated development level of two-way FDI is as follows:

Table 1. Measurement indicators of the integration level of the two industries

Industry	Primaryindex	Secondary index
Manufacturing industry	Scale of industry	Total number of manufacturing enterprises
		Total fixed asset investment in manufacturing
		The total output value of manufacturing industry
	Structure of industry	Employment in manufacturing/employment in the secondary industry
		Fixed asset investment in manufacturing/fixed asset investment in secondary industry
	Advantages of location	Location entropy of manufacturing industry
		Tax revenue/total industrial output value
	The economic effect	Manufacturing tax revenue
		Total wages/number of manufacturing employees
		Total output value/number of employed persons
	Potential for growth	(Total output value of the current year/total output value of the previous year) -1
		Investment in fixed assets/national investment in fixed assets
Service industry	Scale of industry	Total number of producer service enterprises
		Total fixed asset investment in producer services
		Total output value of manufacturing industry and service industry
	Structure of industry	Employment in producer services/employment in the tertiary industry
		Producer service fixed investment investment/tertiary industry fixed asset investment
	Advantages of location	Producer service location entropy
		Tax revenue/total output value of producer services
	The economic effect	Producer service tax revenue
		Total wages/number of employed persons in producer services
		Total output value/number of employed persons
	Potential for growth	(Total output value of the current year/total output value of the previous year) -1
		Investment in fixed assets/national investment in fixed assets

$$
\begin{aligned}
C_{it} &= 2\sqrt{\left(IFDI_{it} * OFDI_{it} / (IFDI_{it} + OFDI_{it})\right)} \\
T_{it} &= \alpha IFDI_{it} + \beta OFDI_{it} \\
D_{it} &= \sqrt{(C_{it} * D_{it})}
\end{aligned} \tag{5}
$$

α and β represent the weights of IFDI and OFDI, respectively.In order to avoid the characteristic differences of the data in the calculation process, the data are standardized, and the formula is as follows:

$$
\begin{aligned}
u_{ij} &= \frac{x_{ij} - m_{ij}}{M_{ij} - m_{ij}} (\text{Positive indicator}) \\
u_{ij} &= \frac{M_{ij} - x_{ij}}{M_{ij} - m_{ij}} (\text{Negative indicator})
\end{aligned} \tag{6}
$$

i denotes the province, j denotes IFDI and OFDI, and Mij and mij denote the maximum and minimum values of the corresponding years of IFDI and OFDI, respectively.

3.Control variables

Drawing on the existing research, in order to control the factors affecting industrial integration as much as possible, the following variables are controlled. (1) The degree of government intervention is expressed by dividing government fiscal expenditure by regional GDP; (2) the level of human capital is expressed by the average years of education in each region; (3) the degree of trade openness is expressed by dividing the total amount of imports and exports in each region by regional GDP; (4) the level of economic development is expressed by the logarithmic form of regional GDP; (5) investment in science and technology, The financial input of industrial enterprises above designated size for new product development is used to represent, and the logarithm is processed in the empirical analysis.

4. Mediating variable

(1) Technological innovation level: principal component analysis is used to synthesize the three indicators of R&D expenditure of industrial enterprises above designated size, the amount of domestic patent application and technology market turnover [29].

(2) The level of human capital optimization is represented by the number of people engaged in scientific research and technical services in the region, and is calculated by taking the logarithm.

3.3. Source of data

This paper selects the data of 30 provinces from 2008 to 2019 for analysis. The original data in China Industrial Statistical Yearbook, China Tertiary Industry Statistical Yearbook and China Tax Yearbook are used to calculate the integration level of the "two industries" in each province. The original data are from the Statistical Bulletin of China's Outward Foreign Direct Investment and the China Statistical Yearbook. Missing data present in individual regions were filled in with linear interpolation.

4. Analysis of Empirical Results

4.1. Benchmark regression results

This paper first conducts regression on the whole sample data with only regional and time fixed effects controlled without control variables, and then adds control variables for regression again. The regression results show that no matter whether control variables are added or not, the regression coefficient of the coordinated development level of two-way FDI on the integration of the two industries is always positive

at the significance level of 1%, which indicates that the higher the coordination degree of two-way FDI is, the more it can promote the integration of manufacturing and modern service industry. The possible reason why the coordinated development level of two-way FDI can promote the deep integration of the two industries is that IFDI and OFDI form a benign interaction in the process of development, which not only drives China's industrial development, but also brings advanced technology, production management experience and high-quality talents to China. Through market competition and demand orientation, we should accelerate the improvement of regional technological innovation level and the optimization of human capital structure, and guarantee and promote the further integration of manufacturing and modern service industry from the inside. Its specific action pathway needs further analysis.

Table 2. Benchmark regression results

	（1）	（2）
TFDI	0.0186*** (6.4571)	0.0164*** (5.2859)
DGI		0.0071 (1.1569)
LHC		-0.0027 (-1.2602)
TO		0.0270* (1.8406)
LED		0.0968*** (6.8631)
IST		0.0236*** (3.9759)
Effect of region	YES	YES
Effect of time	YES	YES
Variable of control	NO	YES
Constant term	0.4181*** (38.8510)	-0.9688*** (-6.1280)
Value of observation	360	360
R^2	0.9657	0.9783

Note: *, ** and *** indicate that the statistical values are significant at the significance levels of 10%, 5% and 1%, and the following tables are the same

4.2. Robustness test

In order to verify the basic conclusion that the higher the degree of coordinated development of two-way FDI is, the better the integration level of the "two industries," this paper conducts a series of robustness tests.

(1) Substitution of variables. Some scholars believe that the input-output method can better reflect the cross and penetration relationship between the two industries. The data used to calculate the replacement variables come from the input-output tables of China's regions (2007, 2012 and 2017). The regression results are shown in Column (1) of Table 3, and the coefficient of the coordinated development of two-way FDI is consistent with the benchmark regression results, which is still significantly positive.

(2) Changing samples. As municipalities are directly led by the central government, they are more likely to be favored by political welfare and industrial policies, causing interference in the process of coordinated industrial development. Therefore, the regression is carried out after removing the samples of municipalities. It can be seen from Column (2) of Table 3 that the signs of the coefficients of the core explanatory variables do not change after the sample elimination, indicating that the regression results are still valid after the sample elimination.

(3)Heteroscedasticity and autocorrelation. For the heteroscedasticity and autocorrelation of panel data, this paper uses the xtscc model to conduct regression again . As shown in Column (3) of Table 3, the regression results are still significantly positive, supporting Hypothesis 1

(4) Endogeneity problem. Referring to the practice of most studies, to solve the endogeneity problem, we consider the one-period lag of the coordinated development of two-way FDI, the core explanatory variable, as the instrumental variable, and choose the IV-2SLS model for estimation. The coefficient of the core explanatory variable in Column (4) of Table 3 does not change, indicating that after the endogeneity problem is solved, the coordinated development level of two-way FDI still has a significant role in promoting industrial integration. To sum up, the research results of this paper have certain robustness, and Hypothesis 1 is established, that is, under certain conditions, the higher the level of coordinated development of two-way FDI is, the more it can promote the integration of the two industries.

Table 3. Estimation results of robustness test

	(1)	(2)	(3)	(4)
TFDI	0.0065*** (3.4114)	0.0184*** (4.8510)	0.0164*** (5.0544)	0.0147** (4.7944)
Effect of region	YES	YES	YES	YES
Effect of time	YES	YES	YES	YES
Variable of control	YES	YES	YES	YES
Constant term	0.3690** (2.4502)	-1.0643*** (-5.8225)	-0.9521*** (-11.0418)	-1.0003*** (-13.3685)
Value of observation	300	312	360	330
R^2	0.9595	0.9785	0.9130	0.8700

4.3. Test of mechanism

Through the theoretical analysis of this paper, it is believed that the coordinated development of two-way FDI can promote the integration of the two industries through technological innovation and human capital optimization. From the perspective of technological innovation effect, the benign interaction between IFDI and OFDI drives Chinese enterprises to continue technological innovation, constantly update the old production means and processes in the production process of manufacturing and modern service industries, build the common technological foundation of the two, gradually break the industrial boundary of the two, and further promote the deep integration of the two industries. From the perspective of the optimization effect of human capital, in the process of coordinated development, two-way FDI will promote the optimization of regional human capital through education investment, knowledge spillover effect, competition effect and other ways, bring high-quality talents needed for the development of manufacturing and modern service industry, and ensure the further integration of the two industries. Based on this, regression model (7) is constructed

on the benchmark regression model, as follows:

$$IV_{it} = b_1 + b_2 TFDI_{it} + b_3 control_{it} + \lambda_i + \tau_t + \varepsilon_{it}$$
$$IA_{it} = c_1 + c_2 TFDI_{it} + c_3 IV_{it} + c_4 control_{it} + \lambda_i + \tau_t + \varepsilon_{it} \quad (7)$$

In Equation (7) above, IVit is the mediating variable, representing human capital optimization (HCOit) and technological innovation (TIit) respectively; b2 represents the influence effect of the coordinated development of two-way FDI on technological innovation and human capital optimization; c2 represents the direct effect of the coordinated development of two-way FDI on the integration of the two industries after controlling the mediating variable. c3 represents the impact of technological innovation and human capital optimization on the integration of the two industries after controlling the impact of the coordinated development of two-way FDI.

It can be seen from columns (1) and (3) in Table 4 that the coefficient b2 is significantly positive, indicating that the coordinated development of two-way FDI helps to improve the level of technological innovation and promote the optimization of human capital. It can be seen from (2) and (4) that c2 and c3 are significantly positive at the level of 1%, and the estimated values of the core explanatory variable coefficient c2 are 0.0119 and 0.0137 respectively, which are both smaller than the estimated value of the core explanatory variable coefficient in the benchmark regression model, which is 0.0164. This shows that the level of technological innovation and human capital optimization play an intermediary role in the process of the coordinated development of two-way FDI promoting the integration of the two industries, that is, the coordinated development of two-way FDI can promote the integration of the two industries through the two ways of "technological innovation level" and "human capital optimization." After Sobel Z test, it can be found that the two mediating effects of technological innovation level and human capital optimization account for 27.35% and 16.45% of the total effect respectively, indicating that the coordinated development of two-way FDI is the most effective in promoting industrial integration by improving the level of technological innovation, while the effect of human capital optimization is the second.

Table 4. Estimation results of mediating effect

	(1)	(2)	(3)	(4)
	TI	IA	HCO	IA
TFDI	1.6535*** (3.6976)	0.0119*** (2.9917)	0.0585** (2.3724)	0.0137*** (3.5788)
TI		0.0027*** (4.5903)		
HCO				0.0460*** (3.1082)
Sobel Z		4.176		3.207
(p)		(0.011)		(0.0013)
Variable of control	YES	YES	YES	YES
Effect of region	YES	YES	YES	YES
Effect of time	YES	YES	YES	YES
Value of observation	360	360	360	360
Proportion of intermediaries	27.35%		16.45%	
R^2	0.8807	0.9819	0.9807	0.9805

5. Further Discussion

The coordinated development of two-way FDI has significantly promoted the deep integration of manufacturing and modern service industry. However, due to the great differences in economic development level, industrial development foundation and industrial development characteristics in different regions of China, the coordinated development of two-way FDI may have different effects on the integration of modern service industry and manufacturing industry in different regions and with different industrial characteristics. In order to explore the differences of effects, This paper examines the heterogeneity of the coordinated development of two-way FDI on the deep integration of the two industries from the perspectives of economic development level and industry characteristics.

5.1. Regional differences

Due to economic development and preferential policies, the eastern region has a stronger ability to attract foreign investment and foreign investment, and has more advantages in industrial development. Its coordinated development level of two-way FDI is relatively high, while the central and western regions have a low coordinated development level of two-way FDI due to relatively backward economic development and industrial development. Such regional differences may have an impact on the effect of the coordinated development of two-way FDI on promoting the integration of the two industries.

Table 5. The estimated results are grouped by region

	East	Central	West
TFDI	0.0174*** (3.5361)	0.0101* (1.8988)	-0.0006 (-0.1296)
Constant term	-1.3844*** (-2.9103)	-1.7458*** (-7.1447)	-0.6508*** (-3.4028)
Variable of control	YES YES	YES YES	YES YES
Effect of region	YES 132	YES 120	YES 108
R^2	0.9684	0.9785	0.9869

It can be seen from Table 4 that the coefficient of the

coordinated development level of two-way FDI in the eastern and central regions is consistent with the regression results of the whole sample, which is significantly positive. The possible reason why the estimated results of the western region are not significant is that the eastern region, as the pilot area of opening up, can attract higher quality FDI inflow and promote large-scale OFDI of enterprises, form a more comprehensive pattern of opening up to the outside world, improve the coordinated development level of regional two-way FDI, and thus accelerate the improvement of the integration degree of manufacturing and modern service industry. Due to the advantages of production cost and resource endowment, the ability of central region to attract foreign capital has been continuously enhanced in recent years, and the level of industrial development has been continuously improved, so the central region also has a good foundation for industrial integration. However, due to backward economic development, the western region has disadvantages in attracting talents and technological innovation, which hinders the promotion effect of the coordinated development level of two-way FDI on the integration of manufacturing and modern service industry.

5.2. Differences by industry

In the process of integration of modern service industry with manufacturing industry, due to the different production factors on which its development depends, it may also be affected differently by the coordinated development of two-way FDI. Therefore, modern service industry can be divided into capital-intensive service industry and knowledge-intensive service industry according to the differences in required production factors. Capital-intensive service industry refers to the industry that needs more capital input such as logistics, capital and commerce, including transportation, storage and postal industry, finance industry, leasing and business service industry. Kibs refer to industries that require a large amount of input in information technology, R&D and design factors, including information transmission, software and information technology services, scientific research and technology services.

Table 6. Grouping the results by industry characteristics

	(1)	(2)
TFDI	0.019*(1.8710)	0.036(0.5630)
Constant term	0.2498(1.9603)	0.1043(0.4822)
Variable of control	YES	YES
Effect of region	YES	YES
Effect of time	YES	YES
Value of observation	360	360
$\mathbf{R^2}$	0.9330	0.6504

Columns (1) and (2) of Table 6 respectively show the regression results of the integration of capital-intensive services and KIBs with manufacturing affected by the coordinated development of two-way FDI. The results show that the regression coefficients of both groups of samples are positive, but the results of the integration of KIBS and manufacturing did not pass the significance test. The above results show that the coordinated development of two-way FDI has promoted the integration of capital-intensive service industry and manufacturing industry more significantly. The possible reason is that China has greater market advantages and logistics advantages at present, and capital-intensive service industry can provide more production factors such as logistics, capital and commerce for manufacturing industry. Thus, the coordinated development of two-way FDI can improve the promotion effect of industrial convergence, while the integration process of KIBS and manufacturing requires more input of factors such as R&D services and information technology services. At present, problems such as insufficient R&D investment and low technology transfer rate in China affect the promotion effect of coordinated development of two-way FDI on the integration of KIBs and manufacturing industry.

6. Conclusions and Implications

Under the background that China adheres to the strategy of two-way opening-up and modern service industry should serve the high-quality development of manufacturing industry, this paper explores the impact and mechanism of the coordinated development of two-way FDI on the integration of the two industries. There are three main conclusions. First, the empirical study shows that the coordinated development of two-way FDI plays a significant role in promoting the integration of the two industries, and the results are still significant after a series of robustness tests and solving the endogenous problems. Secondly, the impact of the coordinated development of two-way FDI in all provinces and cities on the integration of the two industries can be realized through technological innovation and human capital optimization, that is, technological innovation and human capital optimization play an intermediary role between the coordinated development of two-way FDI and industrial integration. Third, after further analysis, it is found that there are regional and industrial differences in the impact of the coordinated development of two-way FDI on the integration of the two industries. That is, due to the great differences in the degree of coordinated development of two-way FDI and industrial development in different regions, the effect of the coordinated development of two-way FDI on the integration of the two industries is also quite heterogeneous.

The above empirical tests and research results have certain policy significance for China's provinces and cities to formulate foreign policies and industrial policies according to their own economic development conditions, build a domestic and international double-cycle development pattern, improve the core competitiveness of the manufacturing industry, and promote high-quality economic development. First, the government should adhere to the two-way opening strategy, rationally arrange the introduction of foreign capital and foreign direct investment, achieve two-way harmony in the quantity and quality of IFDI and OFDI, form a benign interaction situation of two-way FDI, strengthen the positive effect brought by IFDI and OFDI, and constantly improve the promotion effect of the coordinated development of two-way FDI on the integration of the two industries. Secondly, due to the mediating effect of technological innovation and human capital optimization between the coordinated development of two-way FDI and the integration of the two industries, on the one hand, local enterprises can continuously improve their innovation level by relying on the advanced technology obtained from high-quality FDI, and on the other hand, they can actively acquire foreign high-tech and other strategic

assets through OFDI to improve the level of technological autonomy. At the same time, the government needs to formulate relevant preferential policies to encourage relevant units to increase investment in technological innovation and talent introduction, further improve the level of technological innovation of enterprises and regions and optimize the talent structure of enterprises and regions, and actively expand the positive effect of the coordinated development of two-way FDI. Third, due to the great differences in resource endowment, economic development level and industrial development status among different regions in China, when different regions make industrial layout, they should fully consider their own conditions and formulate industrial policies based on the resource advantages of surrounding areas. At the same time, they should strengthen the close connection among various regions and break through the factor barriers through similar geographical advantages. It drives the high-speed flow of factors between regions, improves the ability of each region to use factors, achieves coordinated development and common progress, and gives full play to the radiation effect of adjacent regions while strengthening the promotion effect of local two-way FDI coordinated development on industrial integration. Fourthly, on the basis of consolidating our country's original market advantages and logistics advantages, the government shall formulate and introduce relevant policies, establish a reasonable R&D transformation mechanism, promote enterprises and scientific research institutions to strengthen communication, increase R&D investment costs, improve R&D transformation channels, and improve the rate of return on investment and technology transformation. In the process of promoting the integration of the two industries through the coordinated development of two-way FDI, We will accelerate the flow of production factors such as R&D services and information technology services, promote the rapid and efficient development of knowledge-intensive services, and achieve deep integration with the manufacturing industry.

References

[1] B. Jiang, S.L. Ma, X.H. Tang. The impact of industrial convergence on the innovation efficiency of equipment manufacturing industry in China: the moderating effect of structural embeddedness . Science and Technology Progress and Policy,Vol.36(2019)No.9, p.77-86.

[2] J.C.Xia, Y.Xiao. Developing and strengthening the real economy with the integration of manufacturing and service industry . China Circulation Economy,(2022)No.3, p.3-13.

[3] J.Xu: Research on the Integration development level, difference and influencing factors of modern service industry and advanced manufacturing industry(MS.,Shandong: Shandong University of Finance and Economics, China 2022).

[4] C.D.Wang, L.Qi, Y.CAI. Research on the influencing factors of equipment manufacturing industry and producer service industry integration . Industrial Technical Economics, Vol.34(2015)No .2, p.134-142.

[5] N.D.Wen, L.Q.Qi. Research on the Interactive Integration process and influencing factors between Knowledge intensive service industry and equipment Manufacturing Industry . Technology and Management,Vol.18(2016)No.2, p.7-14.

[6] R.F.Yang, C.B.Liu. Industrial upgrading under the background of producer service and manufacturing Integration . Reform,(2011)No.1, p.40-46.

[7] H.F. Wang, J.Y.LI, Y.M.Fu, et al. Dynamic mechanism and model of integration of advanced Manufacturing and modern service industry . Journal of Hunan University of Technology (Social Science Edition),Vol27(2022)No.1, p.52-60.

[8] L.Q.Ji, Q.XLi. Research on the Interactive and integrated development of equipment manufacturing industry and producer service industry. Learning and Exploration, (2016) No.11, p.99-103.

[9] L. Lu ,Y. Chen. Research on the measurement and influencing factors of the synergy level between manufacturing and producer service industry in our country . Journal of Industrial Technical Economics,Vol.40(2021)No.5, p.155-160.

[10] James R Markusren,Anthony J.Venables.Foreign direct investment as a catalyst for industrial development [J]. European Economic Review, (1999)No.2, p.335-356 .

[11] J.Y.Chen, Y.Y.Sheng. An Empirical Study on Foreign Direct Investment and Industrial Structure Adjustment of Our Country: Based on the perspective of Capital Supply and Knowledge Spillover . Journal of International Trade,(2009)No.1, P.94-100.

[12] M.X. Li, Zhu, Y. & Yu, D. The impact of China's foreign direct investment on industrial structure adjustment. Asia-pacific Economics,(2020)No.3, p.85-94+151.

[13] J.Yao. Research on the effect mechanism of Foreign direct Investment on industrial structure upgrading. Economics and Management,(2005)No.11, p.42-44.

[14] Aitken B J,Harrison A E.Do domestic firms benefit from direct foreign investment? Evidence from Venezuela. American Economic Review,Vol.89(1999)No.3, p.605-618.

[15] Kugler M. Lovers from foreign direct investment: within or between industries. Journal of Development Economics, Vol.80 (2006) No.2), p.444-477.

[16] Eslavam,FleleracC,Xudy.(Indirect) input linkages.American Economic Review,Vol.105(2015)No.5, p.662 -666.

[17] X.Huo.Research on the impact of China's OFDI reverse technology spillovers on domestic technological progress: from the perspective of absorptive capacity. Economic Journal, Vol.33(2016)No.3, p.60-65.

[18] D.X.Yang, F.Zhou. Foreign direct investment and China's industrial structure upgrading: a study based on the dual perspectives of capacity transfer and technological progress . Exploration of Economic Issues, (2020)No.10, p.124-134.

[19] Y.M.Huang, Y.N.Zhang. Two-way FDI synergy and the ascent of China's industrial global value Chain. Asia-pacific Economy, (2022)No.2, p.91-103.

[20] Y.Wu, Y.L.Zhao. Research progress on some theoretical issues of foreign industrial convergence. Economic Review, (2012) No.5, p.152-160.

[21] X. Zhang, J.Zhong, Wang Huanfang. Research on the Integration level of advanced manufacturing industry and modern service industry in China and its influencing factors. The Theory and Practice of Finance and Economics, Vol.43 (2012) No.3, p.135-141.

[22] G.B.Cheng, C.Yang. Evaluation of regional industrial integration level and its influencing factors: A case study of the Yangtze River Economic Belt. East China Economic Management, Vol(2020)No.4, p.100-107.

[23] J.L. Zhu, H.J.Liu. Research on the impact of FDI on Human Capital accumulation: An empirical analysis based on Some provincial panel data in China. Journal of International Trade,(2013)No.11, p.136-144.

[24] J.Y. Li, J.Xue, F.Feng, et al. Two-way FDI and regional innovation in China . Research on Economics and Management, Vol.42(2021)No.9, p.14-27.

[25] X.H.Tang, X.J.Zhang, Li Yang. An empirical study on the dynamic and coordinated development of manufacturing and

producer services in China. Economic Research Journal, Vol.53 (2018) No.3, p.79-93.

[26] L.Li, H.Zhao. "two industry" fusion and study on the relationship between the carbon efficiency. Journal of economic frame, Vol.42(2021),No.5, p. 71-79.

[27] L.Xia. Does industrial convergence promote the transformation and upgrading of manufacturing industry? Journal of Harbin University of Commerce (Social Science Edition),(2021)No.5, p.68-85.

[28] L.Y.Huang Ling, D.D.Liu, H.Q.Xie. Research on the two-way coordinated development of foreign investment and foreign investment introduction. China Industrial Economics, (2018)No.3, p.80-97.

[29] J.J. QIAN, Y.ZHONG, H.F.Zhang. Financial agglomeration and economic high-quality development: an analysis of the mediating effect based on technological innovation . Journal of Financial Economics,Vol36(2021)N0.6, p.130-141.