The impact of FDI on industrial upgrading

Based on the spatial effect analysis of 34 prefecture-level cities in the HuaiHe River Basin

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ABSTRACT. Based on the panel data of 34 prefecture-level cities in the HuaiHe River Basin from 2010 to 2019, the impact of FDI on the industrial transformation and upgrading of the Huaihe River Basin was analyzed by using the spatial Dubin model. The study found that FDI can effectively promote the industrial transformation and upgrading of local cities in the HuaiHe River Basin, and has a significant positive spatial spillover effect, which can not only promote the development of local industries, but also promote the industrial transformation and upgrading of neighboring areas; Education investment and technological innovation inhibit industrial upgrading in the Huaihe River Basin; The impact of regional openness on industrial transformation and upgrading is not significant. Therefore, the formulation of FDI policies needs to fully consider regional interactions and their spillover impacts in geographical space, and steadily implement the strategy of the Huaihe River Ecological and Economic Belt.

1 Introduction

The Huaihe River Basin is located in the central and eastern part of China and flows through the five provinces of Anhui, Jiangsu, Shandong, Henan and Hubei. The region is rich in mineral resources and has a high density of population, which has laid a good foundation for economic development. However, most of the industries in the Huaihe River Basin are in the middle and low end of the value chain, the industrial layout is unreasonable, and the problem of industrial pollution is more prominent [1]. On October 18, 2018, the State Council officially issued the "Approval for the Development Plan of the Huaihe Ecological Economic Belt", which means that the development of the ecological economy in the Huaihe River Basin has officially risen to the height of the national strategy. While putting environmental protection and ecological governance as the core goals, carrying out economic and industrial construction has become the primary problem to be solved in the development of cities in the Huaihe River Basin.

Foreign direct investment plays an important role in the sustainable development of China's economy. It can be used to upgrade China's industrial structure through various mechanisms such as technology spillover and capital supply. At present, China's industrial development is in a new stage of upgrading and derailment. As a national strategic development area, the Huaihe River Basin must use FDI to promote its own industrial

transformation and upgrading. Promote regional economic and ecological development. Therefore, under the background of high-quality economic development and dual-cycle strategy, it is of great practical significance to explore the regional synergy effect of foreign direct investment on industrial transformation and upgrading from the regional level, which is of great practical significance for the realization of green development and transformation in the Huaihe River Basin.

2 Theoretical mechanisms and assumptions

2.1 The impact of FDI on industrial structure upgrading

This paper mainly analyzes the influencing mechanism of FDI on the upgrading of industrial structure in the Huaihe River Basin from the perspectives of capital supply effect and technology spillover effect.

From the perspective of the capital supply effect of FDI. At first, in the process of industrial development, a large amount of capital needs to be continuously invested. The internal economic development level of cities in Huaihe River Basin is relatively low, which cannot provide sufficient capital basis for industrial transformation and upgrading. The inflow of FDI can directly increase the available funds of urban agglomerations in the Huaihe River Basin in a short period

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of time, which provides a stable capital supply for their industrial development. Secondly, the industrial layout of cities in the Huaihe River Basin is mostly labor-intensive industries, so the industrial structure needs to be adjusted in the process of industrial development. FDI promotes the effective adjustment of factor proportion in cities of Huaihe River Basin through capital supply, thereby promoting industrial transformation and upgrading. Finally, the cultivation and accumulation of knowledge and technology needed by industrial transformation can't be separated from the support of funds. In the long run, the short-term inflow of FDI provides financial guarantee for the knowledge accumulation and technological upgrading of cities, and lays the foundation for the future technology-intensive and capital-intensive industrial transformation.

From the perspective of FDI's technology spillover effect, it can be divided into direct technology spillover effect and indirect technology spillover effect. After FDI flows into the Huaihe River Basin in the short term, its own advanced technology and efficient management concept will enhance the technical level of urban industry in the Huaihe River Basin. The indirect technology spillover effect plays a role in two aspects. On the one hand, the establishment of high-tech industries in host countries requires cooperation with local enterprises in the industrial chain. The technical level of related enterprises will also be affected by ' Technology spread ' in mutual cooperation, so as to achieve technical improvement in the whole industrial chain. On the other hand, enterprises established by FDI will compete with local industries to some extent, which will cause learning and imitation of local industries. By absorbing the technology and talent spillover of FDI, local enterprises in the Huaihe River Basin will further innovate on the basis of it, and the degree of urban industrial transformation and upgrading will gradually increase. Based on this, hypothesis 1: FDI can effectively promote the industrial transformation and upgrading of local cities in the Huaihe River Basin.

2.2 The spatial spillover effect of FDI

From the perspective of new economic geography, incorporating the impact of FDI on industries into the analysis framework, it can be found that FDI affects industrial transformation and upgrading in the region through agglomeration and diffusion effects. On the one hand, the inflow of FDI establishes related industries in the host country and provides a channel for technology spillover. With the imitation, competition and talent cultivation of local enterprises, it promotes the concentration of talents and industrial clusters in the region, thereby forming economies of scale and spatial effects. On the other hand, with the establishment of the industrial chain, the construction of upstream and downstream related industries will be gradually improved, and more and more similar industries will gather here because of production factors such as raw materials and technology. Through the "center-periphery" pattern, that is, the central city develops high-tech industries, and the peripheral cities undertake traditional industries and supporting industries, thereby forming industrial clusters

and synergies in a certain area. Based on this, this paper puts forward Hypothesis 2: FDI has a significant positive spatial spillover effect on the industrial transformation and upgrading of the Huaihe River Basin, which can not only promote the development of local industries, but also promote the industrial transformation and upgrading of neighboring areas.

3 Research Design

3.1 Spatial correlation test

To perform the spatial autocorrelation test, firstly, it is necessary to determine the spatial weight matrix. This paper refers to the method of Bao Mingqi[2]. Construct the geographic weight matrix W

$$W = \begin{cases} \dfrac{1}{d^2}, i \neq j \\ 0, i = j \end{cases} \qquad (1)$$

Among them, d is the distance between the geographic centers of the two regions.

The global Moran index test was carried out on the industrial transformation and upgrading and FDI of cities in the Huaihe River Basin, and the results all passed the 1% significant level, which indicates that both the industrial transformation and upgrading of the Huaihe River Basin and FDI have a positive spatial correlation, and a spatial model can be constructed.

3.2 Model setting

At present, the spatial econometric models are mainly divided into three types: spatial error model (SEM), spatial lag model (SAR) and spatial Durbin model (SDM). In terms of studying the spatial effect of watershed economy, the spatial Durbin model is more scientific[3]。

Therefore, without considering the spatial spillover of FDI, the direct relationship between FDI and industrial transformation and upgrading is investigated, and Model 1 is constructed.

$$\ln IS_{it} = \alpha_0 + \alpha_1 \ln FDI_{it} + \alpha_2 \ln TI_{it} + \alpha_3 \ln EDU_{it} + \alpha_4 \ln OPEN_{it} + \delta_t + \theta_i + \varepsilon_{it} \quad 。 \qquad (2)$$

Among them, $lnIS_{it}$ represents the industrial transformation and upgrading index of city i in the Huaihe River Basin in year t; $lnFDI$ represents the core variable foreign direct investment; $lnTI$、$lnEDU$、$lnOPEN$ are the control variables technological innovation, regional education level and regional openness; δ_t and θ_i Time fixed effects and individual fixed effects; ε_{it} is the error term.

At the same time, the spatial Durbin model (SDM) was introduced to quantify the spatial effect of FDI, and model 2 was constructed.

$$\ln IS_{it} = \rho W \ln IS_{it} + \beta_1 \ln FDI_{it} + \beta_2 \ln EDU_{it} + \beta_3 \ln TI_{it} + \beta_4 \ln OPEN_{it}$$
$$+ \gamma_1 W \ln FDI_{it} + \gamma_2 W \ln EDU_{it} + \gamma_3 W \ln TI_{it} + \gamma_4 W \ln OPEN_{it} + \mu_i + v_t + \varepsilon_{it} \quad 。 \qquad (3)$$

Among them, W is the geographic weight matrix; ρ is the spatial autoregressive coefficient, γ_i represents the spatial spillover effect of industrial transformation and upgrading; μ_i and v_t represent the spatial and temporal

fixed effects; ε_{it} is the error term.

3.3 Indicator selection and data sources

Explained variable The explained variable of this paper is the upgrading of industrial structure. Drawing on Kong Dandan's research, it is measured by the industrial structure upgrading index, and the calculation formula is

$$IS = \sum_{i}^{3} p_i \times i \, 。$$

(4)

Among them, IS is the industrial structure upgrading index, and p_i represents the proportion of the i industry in the urban GDP. The larger the value of IS, the higher the degree of industrial advanced transformation, and the smaller the value, the lower the industrial advanced transformation. The core explanatory variable of this paper is foreign direct investment (FDI). FDI can provide financial and technical support for industrial transformation, and can bring advanced industrial management models and experience. It is measured by the proportion of actual use of foreign direct investment in GDP[4]. The control variables selected in this paper are the level of technological innovation, the level of regional education and the degree of regional openness. Based on the availability of data and referring to previous literature research, this paper selects the ratio of internal R&D expenditure of industrial enterprises to industrial output value to measure the level of technological innovation (lnTI), the ratio of government education expenditure to GDP to measure the regional education level (lnEDU), The ratio of total imports and exports to GDP is used to measure the level of regional openness (lnOPEN).Data Description This paper selects the panel data of 34 prefecture-level cities in the Huaihe River Basin from 2010 to 2019. The data are mainly from the statistical yearbooks of various provinces and cities.

Variable	Average	Standard deviation	Minimum	Maximum
lnIS	5.448198	0.0432651	5.350056	5.560566
lnFDI	0.3127172	0.6719035	-1.44596	1.709711
lnTI	1.11909	0.3305645	0.5133864	1.924559
lnOPEN	1.817599	0.9627893	-0.5259758	4.036101
lnEDU	-0.1874421	0.6173275	-1.79275	1.188591

Fig. 1. Descriptive statistics

4 Result

This paper reports the direct, indirect and total effects of changes in explanatory variables on industrial upgrading based on the geographic distance weight matrix and the estimation results of model 2[5], as detailed in Table 2.

Variables	Spatial Durbin model effect		
	Direct effect	Indirect effect	Total effect
lnFDI	0.011*** （5.91）	0.102** （2.37）	0.113*** （2.54）
lnTI	-0.014*** （-2.79）	-0.353** （-2.82）	-0.367*** （-2.83）
lnOPEN	-0.001 （-0.56）	0.019 （0.36）	0.018 （0.32）
lnEDU	-0.033*** （-4.84）	-0.369** （-2.38）	-0.402** （-2.52）

Fig. 2. Spatial Durbin model effect decomposition

In Table2, the direct effect indicates the magnitude of the effect of the independent variable on the dependent variable in a region. The direct effect regression coefficient of foreign direct investment is 0.011, the direct effect coefficients of technological innovation and education level are -0.014 and -0.033 respectively and all three values pass the statistical test at 1% level of significance, while the degree of regional openness shows a non-significant negative effect. The reason for this is that the Huaihe River basin lacks sufficient capital and technology development in the early stage of industrial development due to its low level of economic development and large internal economic disparity. By introducing foreign investment, the local industry is promoted to upgrade gradually from the primary industry to the secondary and tertiary industries. In today's globalized economy, the flow of FDI is subordinated to the global strategy of multinational parent companies, which usually transfer low value-added and non-core industries outward. Multinational enterprises take advantage of the high population density and abundant resources in the Huaihe River Basin to establish and expand labor-intensive and resource-intensive industries, which also brings hidden dangers for the subsequent high-end industrial transformation.

In Table 2, the indirect effect indicates the average effect of the explanatory variables on industrial transformation in other regions. In terms of indirect effects, the indirect effect of FDI on industrial transformation passed the 1% significance level test, and for every 1% increase in FDI in local cities, the degree of industrial transformation in other regions increased by 0.102%. This implies that the inflow of FDI can well drive the industrial development of the whole region and strengthen the correlation between industrial chains. Meanwhile, the coefficient of spatial spillover effect of lnFDI is significantly larger than the direct effect, which can reflect that the additive effect brought by the interactive relationship between regions is much better than the separate development of regions. Technological innovation and regional education levels significantly inhibit industrial transformation and upgrading in other regions. The indirect effect of regional openness is different from the direct effect, showing an insignificant promoting effect. This shows that trade opening is conducive to industrial development, further proving the importance of promoting regional integration in the Huaihe River Basin.

The aggregate effect can be interpreted as the average effect of the change of an explanatory variable in a region on the explanatory variables in all regions. In general, the introduction of FDI can promote the upgrading of the overall industry in the Huaihe River Basin region; regional openness shows a non-significant promotion effect; while technological innovation and regional education level instead inhibit the transfer of primary industry to secondary and tertiary industries.

5 Policy Recommendations

Firstly, the development of the Huai River ecological

economy requires mutual coordination and cooperation among the five provinces of Jiangsu, Anhui, Shandong, Henan and Hubei, strengthening government organization and leadership, and mobilizing social forces to jointly realize the transformation and upgrading of industries in the whole basin. In the direction of industrial development, it is necessary to coordinate and give full play to the agglomeration and complementary effects of industries, combine local advantages with industrial transformation, and promote changes in the quality and efficiency of economic development.

Then, traditional investment promotion in the Huaihe River Basin uses land resources, mineral resources, low-cost labor and other economic resources in exchange for investment. However, this method is not scientific, and is prone to many problems such as imperfect assessment system, low work efficiency, and serious industrial pollution. With the implementation of a series of systems such as the dual-cycle strategy and high-quality development, the traditional investment attraction model has gradually become unsuitable for China's national conditions. The local government needs to establish a scientific investment promotion policy, strengthen the supervision of investment promotion, do a good job in investment promotion planning, and determine the key industries for investment promotion according to the actual local situation.

Finally, for the government, it is necessary to provide reasonable subsidies and guidance for technological innovation, strengthen supervision, and avoid zombie patents and abuse of subsidies; increase investment in infrastructure and education, and lay a good foundation for attracting foreign investment and promoting industrial upgrading. On the enterprise side, it is necessary to increase investment in research and development, promote technology application research, and make the application of new technologies closely related to the transformation and upgrading of the industry; summarize and innovate advanced management methods and industrial models, and cooperate with the government to deploy industrial clusters.

6 Conclusion

Based on the panel data of 34 prefecture-level cities in the Huaihe River Basin from 2010 to 2019, this paper uses the spatial Durbin model to empirically explore the impact of FDI on the industrial transformation and upgrading of the Huaihe River Basin. The main conclusions are: (1) There is a significant relationship between FDI and industrial structure upgrading in the Huaihe River Basin. (2) The spatial effect of FDI on industrial transformation and upgrading in the Huaihe River Basin occurs both within and between regions. It shows that FDI in a region can not only stimulate the structural upgrading of local industries, but also drive and improve the industrial structure level of adjacent regions; (3) Technological innovation, education level and regional opening all affect the industrial structure upgrading of the Huaihe River Basin to varying degrees. Among them, technological innovation and the improvement of education level cannot promote the

industrial transformation and upgrading of the Huaihe River Basin, and regional opening shows an insignificant role in promoting.

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