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The Impact of China's Higher Vocational Education Financial Expenditures on the Upgrading of Industrial Structure

-- Analysis Based on the SDM Model

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Abstract: In the stage of high-quality development, higher vocational education is an important force to promote the optimization and upgrading of China's industrial structure. This paper selects provincial panel data and uses spatial Dubin model to explore the spatial effect of fiscal expenditure on Higher Vocational Education on the upgrading of industrial structure. The results show that: first, the fiscal expenditure of higher vocational education and the upgrading of industrial structure have spatial autocorrelation, mainly manifested in the phenomenon of high agglomeration and low agglomeration; Secondly, the fiscal expenditure of higher vocational education has an inhibitory effect on the upgrading of industrial structure and a negative spatial spillover effect on the surrounding areas; Thirdly, regionally, the fiscal expenditure on Higher Vocational Education in the eastern region has no obvious impact on the upgrading of industrial structure in the region, but it will hinder the upgrading of industrial structure in the surrounding areas; Fiscal expenditure on Higher Vocational Education in the central region can neither promote the upgrading of local industrial structure nor promote the upgrading of industrial structure in neighboring regions; Increasing fiscal expenditure on Higher Vocational Education in the western region has no obvious impact on the upgrading of industrial structure in the region, and can promote the upgrading of industrial structure in the surrounding areas. Finally, some suggestions are put forward: pay attention to the investment in connotation construction and speed up the training of high-level skilled talents; Strengthen the integration of industry and education to ensure the docking of talent supply and industrial demand; Pay attention to regional differences, promote the coordinated development of higher vocational education, and help upgrade the industrial structure.

Keywords: Fiscal Expenditure; Industrial Structure Upgrading; Spatial Effect; Vocational Education.

1. Introduction

At present, China's economy has entered a stage of high-quality development. The direction of industrial development has shifted from resource intensive and labor-intensive industries to technology intensive industries. The adjustment of industrial structure is accelerating, and the requirements for the skill level of practitioners are also increasing. As the main force of cultivating technical talents, higher vocational education plays an important role in the transformation of economic development mode, the optimization and upgrading of industrial structure and the adjustment of talent supply and demand structure [1]. After the 2018 national education conference, the State Council issued the implementation plan for national vocational education reform, which pointed out that "vocational education and general education are two different types of education and have the same important status", and then issued the implementation plan for the special work of Higher Vocational enrollment expansion to guide the reform of higher vocational colleges. In April 2021, the National Vocational Education Conference creatively put forward the concept and strategy of building a skilled society. Then in October, the general office of the CPC Central Committee and the general office of the State Council issued the opinions on promoting the high-quality development of modern vocational education, and put forward the goal of basically completing the modern vocational education system by 2025 and the skilled society by 2035. In 2022, the Ministry of education and the Ministry of Finance jointly issued the measures for the management of funds for the quality improvement plan of modern vocational education to increase the investment in vocational education and effectively improve the quality and adaptability of vocational education. It can be seen that the state has paid more attention to higher vocational education, and higher vocational education is entering a new stage of development. In this context, it is particularly necessary to explore the impact of higher vocational education fiscal expenditure on the upgrading of industrial structure.

2. Mechanism Analysis and Research Hypothesis

The relationship between education and industrial structure is very close. Public education investment is an important source of human capital. It can affect the industrial structure by affecting the development level of human capital, and promote the upgrading of industrial structure by promoting the spillover of knowledge, technology and talents [2-3]. The nature of higher vocational education makes the connection between public higher vocational education investment and industrial development closer. First, increasing public higher vocational education investment can enhance the effect of human capital agglomeration and promote the upgrading of industrial structure. Higher vocational education has a strong employment orientation. Based on people's employment demand, the higher the financial expenditure of higher vocational education, the easier it is to attract human capital

agglomeration. High level of human capital agglomeration can improve productivity and innovation ability, promote the exchange of knowledge and technology between economic subjects, increase the opportunities of enterprise product innovation and technological innovation [4], so as to improve the regional industrial structure and promote the upgrading of industrial structure [5-8]. Secondly, increasing the investment in public higher vocational education can improve the quality of human capital and promote the upgrading of industrial structure. Higher vocational education can improve the comprehensive quality of workers, enhance the ability of workers to use resources, help workers acquire, utilize and innovate new knowledge and skills, and enable workers to better adapt to the new working environment and new development mode. At the same time, high-quality workers are more likely to transfer to the secondary and tertiary industries [9], or enter more technologically advanced subdivisions within the industry, so as to promote the upgrading of industrial structure [2]. Based on the characteristics of higher vocational education to cultivate vocational and technical talents, increasing the financial expenditure of higher vocational education can improve the professional and technical ability and practical operation ability of workers [10], enable workers to quickly adapt to the work requirements of enterprises, increase income, and promote the upgrading of consumption structure. The training mode oriented by industrial demand can also enable workers to better meet the needs of industrial development, which is conducive to the upgrading of industrial structure.

Furthermore, increasing the investment in public higher vocational education can optimize the human capital structure and promote the upgrading of industrial structure. Increasing the investment in higher vocational education is conducive to increasing the proportion of high-level human capital among practitioners, meeting the objective demand of technological progress and production mode reform for the continuous improvement of talent demand level, thus promoting the continuous optimization and upgrading of industrial structure and promoting high-quality economic development [4]. Higher vocational education has the characteristics of industry demand-oriented development. According to the market signals and national policy guidance, higher vocational colleges adjust the professional layout, optimize the professional structure, improve the matching degree of human capital structure and industrial structure, and form a coordinated development mode of mutual coordination and promotion among the government, enterprises and schools, so as to promote the optimization and upgrading of industrial structure and promote high-quality economic development [11]. Increasing the financial expenditure of higher vocational education can help higher vocational colleges make better adjustments and improve its role in promoting the optimization and upgrading of industrial structure. However, if higher vocational colleges do not timely adjust the professional structure and training mode according to the industrial development direction and the development needs of local enterprises, it will cause the mismatch between the human capital structure and the industrial structure, a large number of structural unemployment, reduce the labor employment rate [12-14], and hinder Industrial Development and structural optimization and upgrading.

Hypothesis 1: Increasing financial expenditure on higher vocational education can promote the optimization and upgrading of industrial structure.

Finally, increasing investment in public higher vocational education can affect the upgrading of industrial structure through spatial spillover effect. Higher education has spatial spillover effect [15]. The upgrading of industrial structure in a region is not only affected by the level of financial expenditure on Higher Vocational Education in the region, but also affected by the surrounding areas. On the one hand, increasing education investment causes human capital agglomeration, which has a "siphon effect" on the adjacent areas and inhibits the upgrading of the industrial structure of the surrounding areas. On the other hand, knowledge and technology spillovers, human resource flows, competitive learning and other behaviors between regions have a spillover effect on the surrounding areas [3], improving the industrial development level of the surrounding areas and promoting the upgrading of the industrial structure of the surrounding areas.

Hypothesis 2: The financial expenditure on higher vocational education has a positive spillover effect on the optimization and upgrading of industrial structure.

Hypothesis 3: The fiscal expenditure on higher vocational education has a negative spillover effect on the optimization and upgrading of industrial structure.

3. Research Design

3.1. The Design of Spatial Autocorrelation Test

Before the formal regression of the spatial model, it is necessary to test whether the observation unit has spatial autocorrelation. In this paper, Moran's I is used to test the spatial autocorrelation. The specific formula is as follows:

$$Moran'sI = \frac{\sum_{i=1}^{n}\sum_{i\neq j}^{n} w_{ij}(x_i-\bar{x})(x_j-\bar{x})}{s^2\sum_{i=1}^{n}\sum_{i\neq j}^{n} w_{ij}} \quad (1)$$

Among them, s^2 is the variance of x, $\bar{x}$ is the sample mean of x, n is the total number of spatial units, w_{ij} is the spatial weight matrix, x_i and x_j represent the observed values of region i and region j.

The value of Moran index is [-1, 1], which reflects the spatial correlation between observation regions. The greater the absolute value of Moran index, the stronger the spatial correlation between regions; The smaller the absolute value of Moran index, the weaker the spatial correlation between regions. Taking the upgrading of industrial structure as an example, when the Moran index is less than 0, it shows that there is a negative spatial correlation effect in the upgrading of industrial structure in each province, that is, the upgrading of industrial structure presents the phenomenon of low level surrounded by high level and high level surrounded by low level; When the value of Moran index is greater than 0, it shows that there is a positive spatial correlation effect in the upgrading of industrial structure in each province, that is, the upgrading of industrial structure presents high agglomeration effect and low agglomeration effect; When the value of Moran index is close to 0, it means that there is no obvious spatial autocorrelation between the upgrading of industrial structure in each province [16-17].

3.2. The Construction of Spatial Weight Matrix

The spatial matrix represents the degree of correlation between observation units, and common weight matrices include adjacency matrix, geographic distance matrix, economic distance matrix, etc. This article constructs an

economic geography nested matrix wed_{ij} for spatial econometric analysis based on the spatial geography matrix wd_{ij} and spatial economic matrix we_{ij}. The formula is as follows:

$$wd_{ij} = \begin{cases} 0 & i = j \\ \frac{1}{d_{ij}^2} & i \neq j \end{cases} \quad (2)$$

d_{ij}represents the geographical distance between Province i and Province j.

$$we_{ij} = \begin{cases} 0 & i = j \\ \frac{1}{|\overline{y_i} - \overline{y_j}|} & i \neq j \end{cases} \quad (3)$$

$\overline{y_i}$ and $\overline{y_j}$ respectively represent the average per capita GDP of Province i and Province j during the sample period.

$$wed_{ij} = wd_{ij} \times we_{ij} \quad (4)$$

3.3. Model Specification

Common spatial econometric models include Spatial Auto Regressive Model (SAR), Spatial Error Model (SEM), and Spatial Durbin Model (SDM). Among them, the SDM model is a more common form of SAR model and SEM model. The SDM model not only observes the influence of lagged factors of the dependent variable on the dependent variable, but also considers the spatial spillover effects of different influencing factors on the dependent variable. Therefore, this article adopts the Spatial Durbin Model (SDM model) for empirical analysis. The basic formula is as follows:

$$Upis_{it} = \beta_0 + \delta W_{ij} Upis_{jt} + \beta_1 Hvfin_{it} + \beta_2 X_{it} + \theta_1 W_{ij} Hvfin_{jt} + \theta_2 W_{ij} X_{jt} + \mu_i + \lambda_t + \varepsilon_{it} \quad (5)$$

Among them, t is the year, i and j are regions, $Upis_{it}$ represents the industrial structure upgrading index of i provinces in the year t, $Hvfin_{it}$ represents the level of higher vocational education fiscal expenditure of i provinces in the year t. X_{it} is the relevant control variable affecting the industrial structure, β_1 and β_2 are the corresponding estimated parameters, W_{ij} is the spatial weight matrix, $W_{ij}Upis_{jt}$, $W_{ij}Hvfin_{jt}$, and $W_{ij}X_{jt}$ respectively represent the spatial lag terms of industrial structure upgrading, higher vocational education fiscal expenditure, and related control variables. δ, θ_1, and θ_2 are the corresponding spatial regression coefficients, β_0 is a constant term, μ_i, λ_t, and ε_{it} respectively represent spatial effects, time effects, and random error terms.

3.4. Index Selection and Statistical Description

3.4.1. The Explained Variable

Industrial Structure Upgrading Index (Upis): Researchers use various measurement methods to measure the upgrading of industrial structure, such as the ratio of the output value of the tertiary industry to that of the secondary industry, and the proportion of the added value of the tertiary industry to GDP. Some scholars proposed that industrial structure upgrading includes both static and dynamic transfer processes, and should not only reflect one aspect, but also reflect the mutual influence relationship between the three industries. Therefore, drawing on the practices of scholars such as Wang Wei, and et al. [18-19], a comprehensive weighted approach is adopted to measure the upgrading of industrial structure. The comprehensive weighted value is obtained by multiplying the proportion of the added value of the three industries to GDP by the corresponding weights assigned. The specific formula is as follows:

$$Upis = \sum_{i=1}^{3} i \times q_i = 1 \times q_1 + 1 \times q_2 + 3 \times q_3 \quad (6)$$

Among them, q_1, q_2, and q_3 respectively represent the ratio of the added value of the first, second, and third industries to GDP. The maximum value of the industrial structure upgrading index is 3 and the minimum value is 1. The closer its value is to 3, the higher the level of industrial structure upgrading.

3.4.2. Explaining Variable

Financial expenditure on higher vocational education (Hvfin): According to the division of the Ministry of Education, financial expenditures related to education include multiple parts such as research grants, education surcharges, etc. Among them, general public budget education expenses and basic construction expenditures are more representative and have been adopted by many scholars. Therefore, this article refers to the practices of scholars such as Shi Laibin [20], and uses the proportion of general public budget education expenses and basic construction expenditures of ordinary vocational colleges to GDP as a representative of higher vocational education financial expenditures.

3.4.3. Control Variables

There are many factors that affect industrial upgrading. In order to alleviate the endogeneity problem caused by omitted variables and obtain more accurate regression results, based on existing research, control variables are introduced for analysis [14,17,21-22], including:

Infrastructure level (Inst): A well-developed regional infrastructure is conducive to the flow of factor resources, reducing misallocation, promoting effective resource allocation, and thus promoting industrial structure upgrading. This article expresses it in kilometers per unit administrative area.

Urbanization level (Urb): The level of urbanization can promote the rapid development of emerging industries, especially modern service industries. The higher the level of urbanization, the faster and more diverse the development of modern service industries, thereby promoting the upgrading of industrial structure. This study uses the proportion of urban population to total population to measure the level of urbanization.

Informatization level (Infor): The level of informatization can accelerate technological exchanges between regions, enhance imitation and competition effects, promote technological innovation, and thus promote industrial structure upgrading. This article uses the ratio of mobile phone users to permanent residents as a representative of informatization level.

Degree of openness to the outside world (Open): Opening up to the outside world can introduce advanced technology and high-quality resources from abroad, which is beneficial for China's technological innovation. It can also promote the rational allocation of resource elements by optimizing the import and export structure, thereby promoting the upgrading of industrial structure. This study measures the degree of opening up to the outside world by using the ratio of the total import and export volume converted by exchange rates to GDP.

Government intervention intensity (Gov): Reasonable

government regulation can provide a favorable business environment for enterprises, promote healthy competition among enterprises, and thus promote industrial structure upgrading. This study expresses it as the ratio of general public budget expenditure to general public budget revenue.

Level of economic development (Eco): Regions with higher levels of economic development generally invest relatively more in technological research and development, which enhances their innovation capabilities and promotes industrial structure upgrading. This article uses per capita GDP to measure the level of economic development.

3.5. Statistical Description

Based on the availability and continuity of data, this paper selects the panel data of 30 provinces in China (excluding Xizang, Hong Kong, Macao and Taiwan) from 2009 to 2021 for research. The original data comes from resources such as EPS database, China Statistical Yearbook, China Statistical Yearbook of Education Expenditure, and the National Bureau of Statistics. The data description results are shown in Table 1.

Table 1. Descriptive Statistics

Var.	N	Mean	Std. Dev.	Max	Min
Upis	390	2.39	0.13	2.83	2.13
Hvfin	390	0.14	0.06	0.44	0.02
Inst	390	9336.00	5032.00	22343.00	832.60
Urb	390	58.27	12.79	89.60	29.89
Infor	390	9492.00	2708.00	18777.00	3493.00
Open	390	0.28	0.30	1.46	0.01
Gov	390	2.36	1.03	6.75	1.07
Eco	390	52156.00	29039.00	187526.00	10814.00

4. Empirical Analysis and Test

4.1. Spatial Autocorrelation Test

Before conducting spatial econometric analysis, test whether there is spatial autocorrelation between the explanatory variable and the dependent variable. According to the nested matrix of economic distance, the global Moran index of higher vocational education fiscal expenditure and industrial structure upgrading from 2009 to 2021 is calculated. The calculation results are shown in Table 2. Among them, the Moran index of industrial structure upgrading is positive and the P-value is significant, indicating that industrial structure upgrading has positive spatial autocorrelation. The Moran index of higher vocational education fiscal expenditure was not significant from 2009 to 2015, but significant from 2016 to 2021, indicating that the spatial autocorrelation has become stronger from weak to strong. Zhao Lei et al. pointed out that this can indicate that there is a certain spatial autocorrelation in higher vocational education fiscal expenditure, and the phenomenon of spatial agglomeration has objectively existed [23]. The insignificant Moran's index does not indicate that the level of financial expenditure on higher vocational education is not related to neighboring regions, and its statistical performance is not significant. This may be due to the offsetting of positive and negative factors or the existence of correlation in some regions. The Moran's index averages regional differences and cannot specifically reflect the spatial dependence between provinces. Local Moran's index scatter plots should be used to examine the spatial autocorrelation and corresponding spatial agglomeration characteristics of local regions [23].

This article selects the partial Moran scatter plot of China's higher vocational education fiscal expenditure in 2013 and 2018 for analysis, and the calculation results are shown in Figure 1. Figure 1 shows that most provinces are located in the first and third quadrants, indicating that higher vocational education fiscal expenditures mainly exhibit spatial agglomeration characteristics of high agglomeration and low agglomeration, further demonstrating that there is a certain spatial autocorrelation in higher vocational education fiscal expenditures. Analyzing the spatial distribution of higher vocational education fiscal expenditure in 2021, the provinces located in the first quadrant are Qinghai, Gansu, Xinjiang, Ningxia, Jiangxi, Hunan, and Guangxi. It can be seen that high and high concentration areas are mainly distributed in the central and western regions; The provinces located in the second quadrant are: Yunnan, Hainan, Hubei, Shaanxi, and Hebei; The provinces located in the third quadrant include Shanghai, Zhejiang, Fujian, Liaoning, Tianjin, Beijing, Jilin, Shandong, Guangdong, Jiangsu, Sichuan, Heilongjiang, and Chongqing. It can be seen that low and low concentration areas are mainly distributed in the eastern region; The provinces located in the fourth quadrant are Henan, Shanxi, Inner Mongolia, Anhui, and Guizhou.

Table 2. Moran' s I Index

Year	Hvfin		Upis	
	Moran's I	P Value	Moran's I	P Value
2009	-0.059	0.894	0.369	0.013
2010	-0.051	0.927	0.385	0.010
2011	0.200	0.170	0.431	0.004
2012	0.088	0.503	0.436	0.004
2013	0.182	0.230	0.426	0.005
2014	0.153	0.307	0.432	0.004
2015	0.037	0.665	0.435	0.004
2016	0.590	0.000	0.444	0.004
2017	0.442	0.002	0.458	0.003
2018	0.871	0.000	0.471	0.002
2019	0.643	0.000	0.511	0.001
2020	0.754	0.000	0.554	0.000
2021	0.741	0.000	0.543	0.001

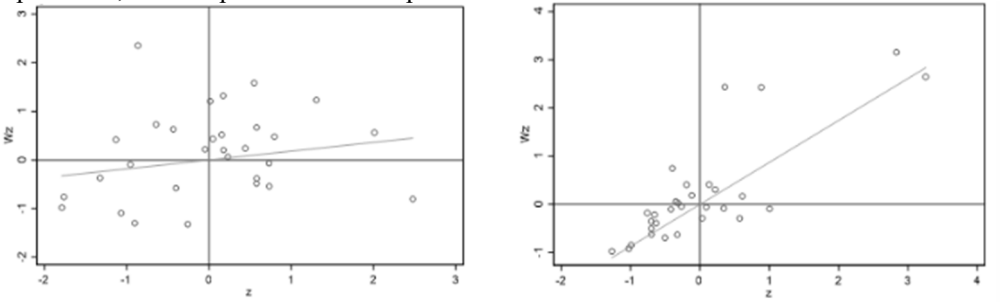


Figure 1. Moran's Scatter Plot
(Left Figure: 2013, Right Figure: 2018)

4.2. Selection of the Spatial Metrology Model

To mitigate the impact of heteroscedasticity, logarithmic processing is applied to the data used for infrastructure level, information technology level, and economic development level. When conducting spatial regression analysis, Lagrange Multiplier (LM) and Robust LM are generally used to analyze whether the sample data is suitable for the spatial Durbin model. Wald test and likelihood ratio test (LR test) are used to test whether the SDM model can be simplified into SAR model and SEM model. The test results are shown in Table 3. For LM test, two of the three tests for spatial error rejected the null hypothesis of "no spatial autocorrelation", while for the two tests for spatial lag, one rejected the null hypothesis of "no spatial autocorrelation". Some scholars pointed out that these results indicate that we should conduct spatial econometric analysis. The results of LR test and Wald test both passed the significance test, indicating that the sample data is suitable for the spatial Durbin model and will not degrade. Therefore, selecting the SDM model as the research model is appropriate, and once again demonstrates the spatial autocorrelation between vocational education investment and industrial structure upgrading. Meanwhile, using the Hausman test, a fixed effects model was chosen.

Table 3. Test Results

Inspection Type	Statistical Indicators	Statistic	P Value
LM Test	Moran's I	4.235	0.000
	LM-Spatial Error	16.013	0.000
	Robust LM-Spatial Error	1.933	0.164
	LM-Spatial Lag	16.246	0.000
	Robust LM-Spatial Lag	2.167	0.141
LR Test	LR-error	77.100	0.000
	LR-lag	54.260	0.000
Wald Test	Wald-error	52.170	0.000
	Wald-lag	36.100	0.000

4.3. Results and Discussion

By comprehensively comparing the coefficient of determination R-sq, Akaike information AIC, and Bayesian information metric BIC, it is found that the individual fixed effects spatial Durbin model has a better regression fitting effect than other models, indicating that the individual fixed effects spatial Durbin model can better reflect the impact of higher vocational education fiscal expenditure on industrial structure upgrading. Therefore, the individual fixed effects spatial Durbin model will be used for regression analysis in the following steps.

The regression results of the model of higher vocational education fiscal expenditure on industrial structure upgrading are shown in Table 4. The spatial autocorrelation coefficient Rho of the individual fixed effects spatial Durbin model is 0.281 and passed the 1% significance test, indicating that the upgrading of industrial structure in the local area has a positive spatial spillover effect on the upgrading of industrial structure in neighboring areas, further confirming the results of the spatial autocorrelation test.

The regression coefficient of the core explanatory variable, higher vocational education fiscal expenditure, on industrial structure upgrading is negative and passes the 5% significance test. The regression coefficient of the spatial lag term of higher vocational education fiscal expenditure is negative and passes the 1% significance test, indicating that industrial structure upgrading is not only affected by local higher vocational education fiscal expenditure, but also by the level of higher vocational education fiscal expenditure in neighboring regions.

Due to the fact that the regression results of the SDM model include the coefficients of the independent variables and spatial lag terms, which cannot truly reflect the degree of influence between variables, partial differentiation is generally used to decompose the impact effects and calculate the direct and indirect effects. The coefficients of the direct and indirect effects are used to explain the regression size and direction of each variable. Among them, the direct effect represents the impact of various explanatory variables in the local area on the upgrading of the local industrial structure, and also includes the impact of various explanatory variables in the local area on the upgrading of industrial structure in other areas, which is feedback to the local area through spatial mechanisms. This impact is also known as feedback effect; Indirect effects refer to the impact of various explanatory variables in the local area on the upgrading of industrial structure in neighboring areas, also known as spatial spillover effects; The total effect represents the average effect of higher vocational education fiscal expenditure on the upgrading of industrial structure in all regions [3].

Table 4. Spatial Durbin Model Regression Results

Variable	OLS	Individual Fixed Effects SDM Model	
		X	WX
Hvfin	0.095	-0.073**	-0.105***
	(0.78)	(-1.99)	(-2.75)
Inst	0.040***	0.018	-0.010
	(5.32)	(0.76)	(-0.28)
Urb	0.003	0.003**	0.006***
	(1.23)	(2.56)	(4.33)
Infor	0.076	0.062***	-0.004
	(1.53)	(3.40)	(-0.19)
Open	0.149**	-0.033	-0.097***
	(2.41)	(-1.62)	(-4.03)
Gov	0.036***	-0.011*	0.020***
	(4.54)	(-1.65)	(2.97)
Eco	0.048	-0.203***	0.139***
	(0.80)	(-7.71)	(4.96)
Rho		0.281***	
		(6.26)	
Observations	390	390	
Number of Id	30	30	
R-sq	0.753	0.278	
AIC	-1040.330	-1804.8110	
BIC	-1008.601	-1741.3530	

Note: () represents the t-statistic, * * *, * *, * respectively indicate p<0.01 p<0.05, p<0.1, Same below.

The decomposition results of the effect of higher vocational education fiscal expenditure on industrial structure upgrading are shown in Table 5. From the perspective of direct effects, the coefficient is -0.090 and passes the 5% significance test, indicating that continuing to increase financial expenditure on higher vocational education is not conducive to industrial structure upgrading. If the financial expenditure on higher vocational education in a certain province increases by one unit, the industrial structure upgrading index in the local area will decrease by 0.090. The reason behind this may be that the

current development of higher vocational education cannot match the industrial development and talent demand structure, and has not yet formed a positive interactive development mechanism with the three major industries. In the list of major construction in various vocational colleges, majors related to the secondary industry occupy half of the country, such as modern agricultural equipment application technology, mechatronics integration, mechanical equipment technology [24]. The high-level development of these related majors has provided a large number of excellent skilled talents for the secondary industry, promoting its continuous development during the period of rapid expansion. But currently, the secondary industry is in a period of transformation. On the one hand, modern and automated production models have led to relatively saturated demand for personnel in enterprises. On the other hand, innovation is the primary driving force for enterprise transformation and upgrading, and high-end technology is the cornerstone of industrial development and growth. This has raised higher requirements for skilled talents in enterprises, requiring more innovative high-end skilled talents that match their needs to support their development. Higher vocational education is slightly lacking in this regard. The vigorous development of the tertiary industry has expanded the scale of related majors, but there are problems of blind expansion, emphasis on quantity over quality, and the quality of talent cultivation needs to be improved, which cannot meet the needs of industrial structure upgrading [25]. So, blindly increasing funding for higher vocational education does not promote industrial structure upgrading, but rather has a restraining effect.

Table 5. Spatial Effect Decomposition

Variable	Effect Decomposition		
	Direct Effect	Indirect Effect	Total Effect
Hvfin	-0.090**	-0.159***	-0.248***
	(-2.38)	(-3.68)	(-4.32)
Inst	0.017	-0.004	0.013
	(0.68)	(-0.08)	(0.22)
Urb	0.004***	0.008***	0.012***
	(3.81)	(5.30)	(6.90)
Infor	0.063***	0.016	0.079***
	(3.69)	(0.62)	(2.79)
Open	-0.048***	-0.132***	-0.180***
	(-2.63)	(-4.54)	(-5.48)
Gov	-0.009	0.021***	0.012
	(-1.34)	(2.83)	(1.37)
Eco	-0.192***	0.103***	-0.089***
	(-7.59)	(3.68)	(-2.86)

From the perspective of indirect effects, the coefficient is -0.159 and passes the 1% significance test, indicating a negative correlation between higher vocational education fiscal expenditure and the industrial structure upgrading of surrounding areas. An increase of one unit in higher vocational education fiscal expenditure in a certain province leads to a decrease of 0.159 in the industrial structure upgrading index of neighboring areas. Regions with higher financial expenditures on higher vocational education attract talents and resources from neighboring areas to gather in the local area. The high-level agglomeration produces a "polarization effect", improving the human capital level and labor productivity of the region, and creating a "siphon effect" on talents and resources in surrounding areas, resulting in a decrease in labor output in neighboring areas and thus suppressing the upgrading of industrial structure in neighboring areas. In order to mitigate the negative impact of this negative spillover, surrounding areas will learn from their own practices and increase public investment in higher vocational education. Therefore, the development level of higher vocational education in neighboring areas will also be relatively high, leading to a phenomenon of high concentration.

4.4. Heterogeneity Analysis

Considering the significant regional differences in China, this article refers to the classification of the National Bureau of Statistics and compares 30 provinces in China according to the eastern, central, and western regions (Beijing, Tianjin, Shanghai, Shandong, Guangdong, Jiangsu, Hebei, Zhejiang, Hainan, Fujian, and Liaoning are provinces in the eastern region; Jilin, Anhui, Shanxi, Jiangxi, Henan, Hubei, Hunan, and Heilongjiang are provinces in the central region of China), further analyzing the relationship between higher vocational education fiscal expenditure and industrial structure upgrading. The regression results are shown in Table 6, Table 7, and Table 8.

From a regional perspective, the direct effect in the eastern region is not significant, and the role of higher vocational education investment in industrial structure upgrading is not obvious. This may be because the eastern region has a higher level of economic development, better industrial development, abundant factor resources, and numerous knowledge and technology intensive industries. Industrial upgrading relies more on talents with innovative and research abilities, and higher vocational education mainly cultivates skilled talents, with little effect on industrial structure upgrading. In addition, the further development of the industry requires the support of high-end skilled talents. In this regard, the current higher vocational education talent training system has certain shortcomings, which are not conducive to the further development and upgrading of the industry structure. The indirect effect in the eastern region is significantly negative, and its higher vocational education fiscal expenditure has a negative spatial spillover effect on the upgrading of industrial structure in surrounding areas, which suppresses the upgrading of industrial structure in neighboring areas through the "siphon effect".

The direct and indirect effects in the central region are significantly negative, indicating that increasing financial expenditure on higher vocational education in the central region is not only detrimental to the upgrading of the local industrial structure, but also has a restraining effect on the upgrading of the industrial structure in neighboring regions. The direct effect in the central region is significantly negative, which may be due to the important position of traditional industries in the economic development of the central region. The central region is still dominated by an extensive economic development model, and its labor market cannot provide sufficient and suitable employment opportunities for high-level talents [16]. Even if increasing investment in higher vocational education attracts talent aggregation, the mismatch of human capital weakens this positive impact and even inhibits industrial structure upgrading. The financial expenditure on higher vocational education in the central region has a negative spatial spillover effect on the upgrading of industrial structure in surrounding areas. This may be due to the uneven distribution of resources and significant development differences within the central region [26]. The financial expenditure on higher vocational education is

implemented in universities. Due to the uneven distribution of universities and economic development differences, human capital is concentrated in individual provinces, forming a "siphon effect" and inhibiting the upgrading of industrial structure in neighboring areas.

The direct effect in the western region is not significant, which may be due to the insufficient human resources in the western region. Increasing investment in higher vocational education can attract talent to gather and promote industrial structure upgrading. However, at the same time, there is also a serious phenomenon of talent loss in the western region [27-28]. Increasing education investment does not produce output, and even inhibits industrial structure upgrading. The promoting and inhibiting effects cancel each other out, resulting in weak significance. The indirect effect is significantly positive, indicating that the financial expenditure on higher vocational education has a positive spatial spillover effect on the upgrading of industrial structure in surrounding areas. The western region generally lacks high-level talents, advanced technology, and experience. Increasing investment in higher vocational education can attract talent to gather and spread advanced technology and experience to surrounding areas through knowledge exchange, regional cooperation, and other channels, thereby promoting the upgrading of industrial structure in surrounding areas [29].

Table 6. Heterogeneity Analysis Results (Eastern Region)

Variable	Eastern Region	
	Direct Effect	Indirect Effect
Hvfin	-0.011	-0.167***
	(-0.32)	(-4.29)
Inst	0.067***	-0.149***
	(2.96)	(-3.68)
Urb	0.003***	-0.002
	(3.49)	(-1.56)
Infor	-0.075***	0.089***
	(-4.68)	(3.85)
Open	-0.151***	-0.051**
	(-8.77)	(-1.97)
Gov	-0.011*	0.020***
	(-1.84)	(2.97)
Eco	-0.133***	0.178***
	(-5.64)	(6.98)
Rho	0.240***	
	(4.87)	
Observations	390	
Number of Id	30	
R-sq	0.156	

To further verify the reliability of the model, the following methods are used for robustness testing: (1) Replace the weight matrix and use the economic distance weight matrix to replace the nested economic geographic weight matrix of the original model; (2) Replace the core explanatory variable and measure the financial expenditure on higher vocational education using the proportion of national fiscal education funds to GDP for ordinary vocational colleges. The recalculated results are shown in Table 9. The results show that under the economic distance weight matrix, higher vocational education fiscal expenditure still significantly inhibits industrial structure upgrading. Whether changing the weight matrix or core explanatory variables, the sign directions of spatial autocorrelation coefficient, core explanatory variable regression coefficient, and spatial lag coefficient are consistent with the regression results of the previous model, indicating that the research results are robust.

Table 7. Heterogeneity Analysis Results (Central Region)

Variable	Central Region	
	Direct Effect	Indirect Effect
Hvfin	-0.068*	-0.100**
	(-1.72)	(-2.10)
Inst	-0.065**	-0.068
	(-2.50)	(-1.34)
Urb	0.001	0.006***
	(1.32)	(3.58)
Infor	0.103***	-0.007
	(5.79)	(-0.27)
Open	0.054***	-0.041
	(2.87)	(-1.31)
Gov	-0.004	0.016*
	(-0.57)	(1.95)
Eco	0.005	-0.086***
	(0.20)	(-2.86)
Rho	0.342***	
	(8.28)	
Observations	390	
Number of Id	30	
R-sq	0.110	

Table 8. Heterogeneity Analysis Results (Western Region)

Variable	Western Region	
	Direct Effect	Indirect Effect
Hvfin	-0.011	0.116***
	(-0.34)	(3.40)
Inst	0.018	0.218***
	(0.91)	(6.34)
Urb	-0.001	0.004***
	(-1.06)	(3.34)
Infor	0.034**	-0.065***
	(2.34)	(-3.21)
Open	0.046***	-0.037
	(3.04)	(-1.59)
Gov	0.005	-0.015**
	(0.98)	(-2.51)
Eco	-0.062***	0.011
	(-2.88)	(0.48)
Rho	0.208***	
	(4.33)	
Observations	390	
Number of Id	30	
R-sq	0.243	

4.5. Robustness Test

Table 9. Robustness Test Results

Variable	Replace Matrix		Replace the Core Explanatory Variable	
	X	WX	X	WX
Hvfin	-0.080**	-0.093**	-0.117***	-0.077**
	(-2.24)	(-2.12)	(-3.98)	(-2.41)
Inst	0.012	0.012	0.020	0.001
	(0.50)	(0.28)	(0.87)	(0.03)
Urb	0.002*	0.007***	0.003***	0.006***
	(1.83)	(4.83)	(2.92)	(4.50)
Infor	0.052***	0.016	0.067***	-0.010
	(2.74)	(0.63)	(3.71)	(-0.44)
Open	-0.022	-0.100***	-0.032	-0.101***
	(-1.08)	(-3.18)	(-1.60)	(-4.25)
Gov	-0.011	0.017**	-0.009	0.020***
	(-1.63)	(2.43)	(-1.40)	(2.89)
Eco	-0.212***	0.127***	-0.198***	0.129***
	(-8.40)	(4.36)	(-7.68)	(4.65)
Rho	0.306***		0.264***	
	(6.33)		(5.81)	
R-sq	0.212		0.336	

5. Conclusion and Recommendations

5.1. Conclusion

This paper uses the panel data of 30 provinces in China (excluding Xizang, Hong Kong, Macao and Taiwan) from 2009 to 2021 to analyze the impact of higher vocational education fiscal expenditure on industrial structure upgrading through the individual fixed effect spatial Durbin model, and draws the following conclusions:

Firstly, the Moran's I index for industrial structure upgrading is significantly positive, indicating a positive spatial autocorrelation relationship. From the Moran scatter plot, it can be seen that the financial expenditure on higher vocational education also has a certain spatial autocorrelation relationship, with spatial distribution mainly manifested as high agglomeration and low agglomeration phenomena. High agglomeration is mainly concentrated in the central and western regions, while low agglomeration is mainly distributed in the eastern regions.

Secondly, overall, the financial expenditure on higher vocational education has a restraining effect on industrial structure upgrading and a negative spatial spillover effect on surrounding areas. An increase of one unit in the financial expenditure on higher vocational education in a certain region leads to a decrease of 0.090 in the local industrial structure upgrading index and a decrease of 0.159 in the surrounding industrial structure upgrading index. The current development of higher vocational education cannot match the industrial development and talent demand structure, and has not yet formed a positive interactive development mechanism with the three major industries. Simply increasing public investment in higher vocational education cannot promote the upgrading of industrial structure, but will instead have a negative impact on production.

Thirdly, there are regional differences in the role of the current level of financial expenditure on higher vocational education in upgrading the industrial structure in China. The financial expenditure on higher vocational education in the eastern region does not have a significant impact on the upgrading of the local industrial structure, but it will hinder the upgrading of the industrial structure in surrounding areas; The financial expenditure on higher vocational education in the central region cannot promote the upgrading of local industrial structure, nor can it promote the upgrading of industrial structure in neighboring regions; Increasing financial expenditure on higher vocational education in the western region has no significant impact on the upgrading of the local industrial structure, but can promote the upgrading of the industrial structure in surrounding areas.

5.2. Recommendations

Based on the above analysis and conclusions, the following suggestions are proposed:

Firstly, pay attention to investment in connotation construction and accelerate the cultivation of high-level skilled talents. The investment in public higher vocational education should shift from large-scale expansion to internal improvement, and should not overly focus on external expansion while neglecting internal construction, resulting in a situation where the level of human capital cannot be improved and cannot meet the needs of enterprises. Therefore, it is necessary to leverage the support role of fiscal funds, increase investment in teaching equipment and other resources, ensure that equipment updates are synchronized with industrial development, strengthen the connotation construction of courses, laboratories, textbooks, etc., attach importance to the construction of teaching staff, improve the overall education level of vocational colleges, and cultivate skilled talents with real technological advantages. Vocational and technical colleges mainly focus on cultivating applied talents. Therefore, it is necessary to encourage universities to carry out diversified practical projects, so that students have more opportunities to participate in practical activities. Special bonuses can be set up to select practical examples, give full play to the exemplary role of outstanding students and universities, encourage healthy competition, and cultivate truly skilled talents with practical abilities. We can also carry out university exchange programs to exchange advanced teaching experience, learn advanced teaching models, continuously optimize talent training models, enrich talent training systems, and promote industrial structure upgrading with high-quality talents.

Secondly, strengthen the integration of industry and education, and ensure that the supply of talents matches the demand of the industry. The mismatch between human resources and industrial demand seriously affects the role of higher vocational education in upgrading industrial structure. Therefore, it is necessary to give full play to the guiding role of fiscal funds, combine the characteristics of regional industrial development, establish special funds for industry education integration projects, build bridges between schools and enterprises, guide schools to establish and improve talent training systems that are in line with the direction of industrial development, achieve effective connection between education, talent, and industry, and improve the matching degree of talent structure, employment structure, and industrial structure. On this basis, we should further promote the collaborative development model of industry university research, strengthen the connection between technological research and industrial development, and develop more applicable technologies based on the actual needs of enterprises, so that the scientific and technological

achievements of universities can be put into practice, rather than floating high and detached from reality. This is conducive to cultivating high-quality talents who can truly serve industrial development. At the same time, this can also help students and universities gain a deeper understanding of the current needs of industrial development, adjust their training direction in a timely manner, optimize their employment structure, thereby improving the coupling degree between employment structure and industrial structure, and promoting the upgrading of industrial structure.

Thirdly, we should attach importance to regional differences, promote coordinated development of higher vocational education, and assist in upgrading the industrial structure. Not only should we pay attention to the differences in development levels between regions, but we should also attach importance to the differences in development advantages and development difficulties, give full play to each other's strengths, and form a regional integrated development pattern. Therefore, it is necessary to leverage the coordinating role of fiscal funds, establish specific support funds, and assist the needy. For the eastern region, the booming development of emerging industries not only brings a large number of employment opportunities, but also puts forward higher requirements for the quality of employed personnel. Therefore, it is necessary to focus on cultivating innovative skilled talents and talents who master high-end manufacturing technology, establish special talent training plans, prioritize the cultivation of a group of high-tech skilled talents, and promote further upgrading of the industrial structure. There are significant internal differences in the central region, and fiscal funds should be appropriately tilted towards difficult provinces to vigorously support characteristic majors, alleviate the impact of siphon effects, optimize resource allocation, and promote regional coordinated development. Higher vocational colleges should vigorously develop characteristic majors based on regional industrial characteristics to help upgrade the local industrial structure. The development of higher vocational education in the western region is relatively backward. To achieve the overall improvement of skilled talents in the western region, it is necessary to establish a support mechanism between the eastern and western regions, fully utilize spatial spillover effects, and play a driving and radiating role. At the same time, it is necessary to improve the subsidy policies for senior talents and reduce talent loss. Only by retaining talents and high-quality talents can we better promote the upgrading of the industrial structure in the western region.

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