The impact of digital inclusive finance and technological innovation on the upgrading of industrial structure -- Analysis of spatial Durbin model based on the perspective of unbalanced regional development

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Abstract

Digital inclusive finance can break the spatial distance limit, and the new financial model led by it can better promote the micro-enterprise management and even the high-level development of macro industrial structure. Based on the panel data of prefecture-level cities in China from 2013 to 2020, this paper uses the spatial Durbin model to explore the cross-regional impact of digital inclusive finance and technological innovation on industrial upgrading under the new financial model, and finds that current technological innovation has a significant promoting effect on industrial upgrading. However, the promotion effect of digital inclusive finance on industrial upgrading is not as obvious as we think, and even has a negative effect. Further analysis shows that due to the differences in regional history, geography and institutional policies, the uneven development of digital inclusive finance and scientific and technological level across the country has gradually formed, and the regions with relatively backward development of digital inclusive finance have promoted industrial upgrading at an extremely slow speed under the influence of the digital divide. However, in the regions with rapid development of digital inclusive finance, due to excessive competition, it has a serious negative effect on industrial upgrading. In addition, digital inclusive finance, as a new driving force for industrial advanced development, cannot play its role without a good scientific and technological innovation environment. Under the condition of continuous development of scientific and technological innovation level, the promotion effect of the development of digital inclusive finance on regional industrial advanced experience a trend of decline and then increase.

Keywords

digital inclusive finance; Scientific and technological innovation; Industrial upgrading; Spatial Durbin model; Digital divide.

1. Introduction

The upgrading of industrial structure is an important part of the optimization of industrial structure, and it is also the key to understanding the different economic development modes between developing countries and developed countries, and a necessary condition for the sustained and healthy economic development of developing countries. There are many ways for digital inclusive finance to affect industrial structure. Tang Wenjin, Li Shuang, and Tao Yunqing (2019) used the threshold effect model and took the development of digital inclusive finance's impact on industrial structure, and found that the effect of digital inclusive finance on industrial structure would experience a process from weak to strong, from insignificant to very significant. Du Jinmin, Weschway and Wu Wenyang (2020) take income gap and capital accumulation as intermediary variables and use the intermediary effect model to prove that digital inclusive

finance indirectly affects the optimization of industrial structure by reducing income gap and promoting capital accumulation. Wang Kai (2021) takes resource allocation as an intermediary variable and uses the intermediary effect model to prove that the development of digital inclusive finance can promote the optimization and upgrading of industrial structure by improving the allocation efficiency of labor and capital. And the impact of digital inclusive finance on industrial structure is also different in different regions. Sun liguo and Hou Feifan (2021) adopted a fixed-effect model to prove that digital inclusive finance can promote industrial upgrading in rural areas to improve the opportunities for rural non-agricultural activities, so digital inclusive finance can effectively overcome the 80-to-20 rule of traditional finance and enable financial services to better reach the long-tail group. Aiming at the wealth gap in different counties, Sun Qian and Xu Zhangyong (2021) used the threshold effect model to prove that digital inclusive finance can promote the optimization of industrial structure in non-poor counties with good county endowments, while the effect is not obvious in relatively poor counties. For each province, Wang Jingjing and Liu Xihua (2020) used a spatial error model to prove that the optimization and upgrading of industrial structure among provinces has spatial correlation, and digital inclusive finance has a significant role in promoting the optimization of industrial structure. Aiming at different regions, Ge Heping and Zhang Li (2021) adopted a dynamic digital panel threshold model to conduct a subregional study on the development of digital inclusive finance and the upgrading of industrial structure in China, and found that three indicators related to digital inclusive finance all have threshold effects. The heterogeneity analysis of digital inclusive finance on industrial structure optimization in each region shows that it has the greatest effect on industrial structure optimization in the eastern region. Zhang Qingjun and Huang Ling (2021) found that due to regional endowment differences, digital inclusive finance in the central region can better promote the transformation and upgrading of industrial structure and promote the high-quality development of industrial structure. But the development of digital financial inclusion also raises new questions, Dong Zhiyong, Li Chengming and Cheng Sheng (2021) found from the theoretical level that the current development of digital inclusive finance in China is uneven and insufficient, that digital infrastructure in some backward regions needs to be improved, that local financial supervision capabilities with high development of digital inclusive finance also need to be improved, that some residents have relatively low financial literacy, and that risk control costs of financial institutions need to be reduced. Liu Xiaoxin and Bi Wenxiang (2021) also found from the theoretical level that with the rapid development of digital inclusive finance, the higher the digitalization, the ability of data to reflect information of things will decline, and there may be distortion, low data quality, and coordination difficulty.

In addition, most scholars believe that scientific and technological innovation is also an important source of vitality in the process of continuous optimization of industrial structure. Cheng Qiang and Wu Di (2015) believe from the theoretical level that scientific and technological innovation can improve the technical gold content of industries and expand the development direction of various industries to promote the transformation and upgrading of industries. Wang Min, Zhang Xinglong and Duan Jiameng (2022) proved that the comprehensive innovation reform pilot zone can promote the optimization of industrial structure by improving the innovation level by using the difference-difference method. However, the investment of scientific and technological funds has no obvious influence on it. Tao Changqi and Peng Yongzhang (2017) measured the industrialization of industrial structure based on the Hamming approximation degree of structural deviation and the cosine of the included Angle, and used the SDM model to regression the rest of the scientific and technological innovation. The research results found that the scientific and technological innovation level has a more significant effect on the optimization of industrial structure in areas with high economic agglomeration.

Existing literature has made in-depth discussion on the impact of digital inclusive finance development, scientific and technological innovation, and industrial structure, but most of the literature mainly focuses on the rationalization of industrial structure in the optimization of industrial structure, ignoring the emphasis on the upgrading of industrial structure. In addition, the background of the unbalanced development of digital inclusive finance is not combined. Therefore, this paper uses a spatial econometric model to analyze the impact of the two on industrial upgrading from the perspective of current regional unbalanced development from both national and subregional perspectives, and studies the impact of digital inclusive finance on industrial upgrading on the basis of scientific and technological innovation as the threshold variable.

2. Analysis on the mechanism of digital inclusive finance and technological innovation affecting the upgrading of industrial structure

2.1. Theoretical analysis of the influence of digital inclusive finance on the upgrading of industrial structure

For the region, first of all, digital financial inclusion can improve the coverage of financial services in the region, lower the threshold for enterprises to obtain financial services, and give more financial support to industries that were previously excluded by traditional finance. Secondly, digital inclusive finance in the region improves the convenience of commodity circulation, promotes residents' consumption, stimulates investment and ultimately promotes industrial optimization. In addition to the above positive effects, the development of digital inclusive finance in the surrounding regions will also have some negative impacts. For example, digital inclusive finance needs to be applied to information technologies such as big data and cloud computing, which will inevitably lead to the unbalanced development of digital inclusive finance in the context of the uneven development of digital technology across the country. As a result, the developed areas of digital financial inclusion have crowded out the capital resources originally available in the underdeveloped areas, and this phenomenon of digital divide makes the industrial structure with a poor digital financial inclusion environment develop more slowly. Secondly, in areas with better development of digital inclusive finance, there may be artificial interference in the direction of information flow due to excessive competition. As a result, the more developed the information technology, the more blocked the flow of information.

Therefore, hypothesis H1 is proposed:

From the perspective of direct effects, digital inclusive finance can reduce the cost of obtaining financial services for micro enterprises by improving the coverage of financial services, promote consumer consumption and expand investment, and promote industrial upgrading. From the perspective of indirect effects, the development of digital inclusive finance in surrounding areas has positive and negative effects on industrial upgrading, so the size of indirect effects cannot be determined.

2.2. Theoretical analysis of the influence of technological innovation on industrial upgrading

In terms of the impact of technological innovation on industrial structure, although the improvement of technological innovation level leads to the replacement of enterprise technology, the overall technology of the industry is improved; With the improvement of technology, the production efficiency of enterprises has been improved, and the backward enterprises in the market have been gradually eliminated, thus promoting the advanced industrial structure. However, not all levels of scientific and technological innovation are

conducive to industrial restructuring. The short-term improvement in industrial efficiency brought about by a low degree of scientific and technological innovation may not necessarily lead to creative destruction of jobs, but may also create new jobs in primary and secondary industries. Moreover, capital owners may also invest more means of production due to the reduction of manufacturing costs due to technological improvement. Slow down the development of advanced industries. However, with the continuous improvement of the level of scientific and technological improvement, from a long-term perspective, people's limited material needs are met by the growing material production, and it will inevitably develop towards the service industry. From a regional perspective, this paper holds that the improvement of the overall scientific and technological innovation level in the surrounding areas represents the significant improvement of the overall scientific and technological level, while the improvement of local scientific and technological innovation represents the change of the scientific and technological level with relatively low influence.

Therefore, hypothesis H2 is proposed:

From the perspective of the local region, the improvement of scientific and technological innovation has a positive and negative effect on industrial upgrading due to the negative short-term production expansion effect of material production, job creation effect and positive elimination effect of inefficient enterprises, so the direct effect is uncertain, while the improvement of scientific and technological innovation in surrounding areas has a positive indirect effect on industrial upgrading in the region.

2.3. Theoretical analysis of the influence of digital inclusive finance on the upgrading of industrial structure under different technological innovation environments

Finance is an important tool for the operation of micro-enterprises, and it is also a necessary resource for enterprises to use science and technology to serve production. In essence, scientific and technological innovation can expand the direction of production and operation of enterprises, while digital inclusive finance can better correct the problem of capital mismatch in traditional finance by means of big data, cloud computing and other technologies. In theory, the higher the level of scientific and technological innovation, the wider the scope of use of digital inclusive finance. In addition, compared with traditional finance, digital inclusive finance can better solve problems such as market information asymmetry, and it can also more clearly identify projects with market potential. Therefore, the higher the level of scientific and technological innovation, and the more obvious the promotion effect on the upgrading of industrial structure.

Therefore, hypothesis H3 is proposed:

The level of scientific and technological innovation has a positive moderating effect on the process of digital inclusive finance affecting industrial optimization and upgrading.

3. An empirical analysis of the impact of digital inclusive finance and technological innovation on the upgrading of industrial structure

3.1. Variable selection

3.1.1. Explained variables

OIS is a process in which the focus of economic development shifts from the primary industry to the secondary industry and finally to the tertiary industry. Based on the practice of Li Linhan and Tian Weimin et al. (2021), this paper takes the proportion of the output value of the tertiary industry in the total output value as a measure.

3.2. Core explanatory variables

The Digital Financial Inclusion Index (DF) is measured by the digital financial inclusion index prepared by Guo Feng, Wang Jingyi, Wang Fang et al. (2020), and the digital financial inclusion level in the region and surrounding areas is represented by (LDF) and (SDF) respectively. Scientific and technological innovation (TI) is expressed as the logarithm of the number of three types of patent applications granted in the city in the current year, and the level of scientific and technological innovation in the local and surrounding areas is also expressed as (LTI) and (STI).

3.3. Control variables

3.3.1 Level of opening up to the outside world (OPE): the ratio of total foreign investment and import and export to GDP is used to measure, the higher the ratio, the greater the degree of opening up.

3.3.2 Government expenditure level (GEL): Used to reflect the impact of regional government expenditure on industrial upgrading, this paper uses the measurement method proposed by Zhu Yaling (2020) for reference, and adopts the ratio of regional government fiscal expenditure to nominal GDP to measure.

3.3.3 Population education level (EL): This paper refers to the practice of Li Zhongqiao, Liu Yaoyang, Chen Hanzhen et al. (2022), and uses the number of students with different education levels multiplied by the weight assigned to it to measure.

3.35Environmental pollution Level (EPL): This paper selects the most widely used annual sulfur dioxide emissions of each city to measure the pollution level of each province and city.

3.4. Data sources

The research object of this paper is the process of industrial advanced development in China's provinces. Based on the availability and research necessity of data, the sample research span is 2013-2020, and the panel data set of 31 provinces in China is constructed. The data mainly come from National Bureau of Statistics, China Economic Net, Digital Financial Inclusion Research Center of Peking University, and statistical yearbooks of various regions. The descriptive statistics of each variable are shown in Table 1.

Table 1 Descriptive statistics of variables					
variable	Obs	Mean	Std.Dey.	Min	Max
OIS	248	0.5056	0.0896	0.1244	0.8387
DF	248	252.8329	68.7599	115.1	431.93
TI	248	10.6922	1.4618	5.3132	13.4863
GEL	248	0.2982	0.2100	0.0082	1.3538
EL	248	1.2348	0.1954	0.7526	1.7166
EPL	248	34.8177	34.2827	0.1800	164.5000
OPE	248	0.1045	0.1462	0.0001	0.7702

3.5. Model selection

3.5.1. Spatial autocorrelation analysis

In this paper, Moran's I index is first used to analyze the spatial correlation of industrial upgrading in various provinces in China from 2013 to 2020. As shown in Table 2, it can be seen that the global Moran's I index of industrial upgrading basically passes the significance level test of 0.05, and the Moran's I index keeps increasing with the growth of time. However, the P-value continues to shrink, indicating that the industrial upgrading at the national scale has shown increasing spatial correlation characteristics during this period.

Year	Moran index	Z value	P value
2013	0.133*	1.595	0.055
2014	0.137**	1.661	0.048
2015	0.108	1.458	0.072
2016	0.137**	1.678	0.047
2017	0.152**	1.846	0.032
2018	0.152**	1.878	0.030
2019	0.182**	2.172	0.015
2020	0.219***	2.547	0.005

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Table 2 Moran's I Index	x of industrial up	grading in 31 p	provinces from	n 2013 to 2020

Note: ***, ** and * correspond to 1%, 5% and 10% significance levels respectively, as shown in the following tables.

3.5.2. Selection of dynamic spatial metrology model

Due to the above results, the development of the surface industry upgrading shows a certain spatial dependence, so it is reasonable to analyze the industry upgrading based on the spatial model, we need to choose a suitable one from the three common spatial panel models. Based on the practice of Li Linhan, Tian Weimin et al. (2021), this paper adopts LM and robust LM test method to test the model as follows. both tests of spatial autoregressive effect passed the significance test of 0.05, while the LM test of spatial hysteresis effect passed the significance test while the robust LM did not pass, indicating that the spatial hysteresis of the two models should be considered in this paper at the same time. Therefore, the spatial Durbin model was first selected for regression. Then the LR test was carried out to test the rationality of the spatial Durbin model. The results showed that Irtest sdm_a sar_a and Irtest sdm_a sem_a both passed the 1% significance level test, which once again proved that the selection of spatial Durbin model was reasonable. The Hausmann index of SDM model is 82.82, which passes the fixed effect test at the significance level of 1%. To sum up, this paper selects the fixed-effect spatial Durbin model to analyze the influence of the development of digital inclusive finance and technological innovation on industrial upgrading.

3.5.3. Construction of spatial Durbin model

According to the above test results, we choose the spatial Durbin model to construct the impact of digital inclusive finance and technological innovation on the upgrading of industrial structure. The model design is as follows:

 $OISit = \alpha W \times OISit + \beta 1 LDFit + \beta 2 LTIit + \theta 1 W \times SDFit + \theta 2 W \times STIit + \lambda 1 Xit + \lambda 2 W \times Xit + \mu it$ (1)

4. Empirical analysis

4.1. Spatial effect analysis of digital inclusive finance and technological innovation affecting industrial upgrading

Considering that the economic development level of regions with better industrial upgrading is usually superior, however, in reality, the mutual influence of different provinces is mainly based on the proximity relationship. In order to avoid excessive repetition and highlighting the impact of economic disparity, this paper selects the spatial adjacency 01 matrix as the weight matrix for regression of the model. According to the regression analysis results of the nationwide industrial structure upgrading (OIS), the direct effect of the digital financial inclusion development index (DF) on the industrial upgrading is significantly positive, indicating that the development of digital financial inclusion does help to improve the industrial upgrading in the region. However, the spatial spillover effect and total effect of the rapid development of digital inclusive finance on industrial upgrading are negative, indicating that the current development of digital inclusive finance may indeed have structural problems, and the negative effect brought

by the unbalanced development of digital inclusive finance in the country even exceeds the positive effect, which confirms the hypothesis H1. On the contrary, the direct effect of scientific and technological innovation (TI) on the regression result of industrial upgrading, as we believe, does not promote the development of industrial structure upgrading well, on the contrary, it even has a certain inhibitory effect, while the spatial spillover effect and total effect of scientific and technological innovation (TI) are positive. Therefore, it also confirms the hypothesis that the improvement of the overall level of scientific and technological innovation from H2's long-term perspective is conducive to industrial upgrading.

industrial upgrading				
Variable	direct effect	indirect effect	total effect	
 DF	0.0024036***	-0.003657***	-0.0012535*	
GEL	0.0903286***	0.1561241**	0.2464528***	
EPL	-0.0004433***	0.0006814	0.0002381	
EL	-0.0338689	-0.0692882	-0.1031571	
TI	-0.0116949***	0.0393366***	0.0276417*	
 OPE	0.0991826***	0.3080344***	0.4072169***	

Table 5 Spatial regression results of digital financial inclusion and technological innovation on industrial ungrading

4.2. Robustness test of the model

This paper tries to make a robust analysis by looking for the main explanatory variable capital efficiency and some control variables foreign investment and pollution level. The regression results of the new SDM model are shown in Table 6 below. The robustness test results show that the positive and negative signs of the effects of most variables on industrial upgrading are roughly the same as above and basically significant, which indicates that the above regression results are robust and reliable.

Table 6 Results of robust regression				
Variable	direct effect	indirect effect	total effect	
DF	0.001544***	-0.0053196***	-0.0037756***	
GEL	0.4965601***	0.5871421**	1.083702***	
EPL	-0.0007305***	-0.0001541	-0.0008846**	
EL	-0.1987764***	-0.3679587***	-0.5667351***	
TI	-0.0146309*	0.03679587***	0.0215713**	
OPE	0.0321718	0, 045078***	0.2520679***	

5. The impact of digital financial inclusion on industrial upgrading from the perspective of unbalanced regional distribution

In the above study, we found that digital financial inclusion has a positive direct effect on industrial upgrading in the region and a negative trans-regional spatial spillover effect, as we assumed. However, it is worth asking whether it is caused by the digital divide formed by the uneven development level of regional digital inclusive finance or the vicious competition among industries caused by the excessive development of digital inclusive finance in some regions. In order to answer the above questions, In this paper, 31 provinces are divided into three regions

according to the development level of digital inclusive finance: the eastern region with fast development of digital inclusive finance, the central region with middle development level, and the western region with poor development level. As shown in Figure 7, 8, and 9, the regression structure shows that the overall benefits show that the promotion effect of digital inclusive finance on industrial upgrading is the best in the central region, the western region is weak, and the eastern region even has a inhibitory effect. Comparing the eastern region and the central and western regions, the eastern region, as a highly developed region of digital inclusive finance, is not so optimistic in the effect of industrial upgrading. Even when the overall effect of the central and western regions is positive, it drags down the national industrial upgrading development process. To sum up, it can be concluded that the eastern region with the highest development of digital inclusive finance may indeed have artificial intervention in the direction of financial asset flow due to excessive industrial competition. The higher development of digital inclusive finance will lead to a more closed financial environment, thus greatly inhibiting the industrial advancement. Compared with the central and western regions, the western region with digital divide has a weak effect on the promotion of industrial upgrading. This proves that the digital divide formed by the uneven development level of digital inclusive finance restricts the positive effect of digital inclusive finance on industrial upgrading. According to other regression results, the direct effect of digital financial inclusion in the western region is negative. The reason may be that although digital financial inclusion enables financing activities to be carried out regardless of geographical distance, the unequal development of digital financial inclusion in various regions has been formed due to the impact of production environment infrastructure. In order to develop digital inclusive finance in the western region where the environment is poor and the foundation is weak, a lot of human and material resources must be invested, which may inhibit the industrial structure in the western region in a short time. According to the regression results of scientific and technological innovation level on industrial upgrading, the direct effect of the eastern region is negative, the direct effect of the central region and the western region is positive but not significant, and the spatial spillover effect of the three regions on industrial upgrading is positive. Once again, it is confirmed that the improvement of the overall level of science and technology in the surrounding areas is more effective in promoting the advanced development of industrial structure than the local scientific and technological innovation

innovation on industrial upgrading in eastern				
Variable	direct effect	indirect effect	total effect	
DF	0.0013639***	0.0033323***	0.0046962***	
GEL	1.257777***	0.0793875	1.337164***	
EPL	0.0003288	0.000694**	0.0010228***	
EL	-0.3995768***	-0.0507469	-0.4503236***	
TI	0.0144407	-0.0929036***	-0.078463***	
OPE	1.008657***	-1.194103***	-0.1854461	

Table 7 Regression results of the effects of digital inclusive finance and technological

 Table 8 Regression results of the effects of digital financial inclusion and technological innovation on industrial upgrading in central

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Variable	direct effect	indirect effect	total effect
DF	-0.0008109*	0.0013753*	0.0005644
GEL	0.064572***	0.0520087	0.1165807**
EPL	-0.0004505***	-0.0002478*	-0.0006984**
EL	-0.0345716***	0.1190282	0.0844566***

TI	0.0018818	0.0043637***	0.0062454***
OPE	0.076259***	-0.0893801***	-0.0131211

Table 9 Regression results of the effects of digital inclusive finance and technological innovation on industrial upgrading in western

Variable	direct effect	indirect effect	total effect
DF	-0.0008109*	0.0013753*	0.0005644
GEL	0.064572***	0.0520087	0.1165807**
EPL	-0.0004505***	-0.0002478*	-0.0006984**
EL	-0.0345716***	0.1190282	0.0844566***
TI	0.0018818	0.0043637***	0.0062454***
OPE	0.076259***	-0.0893801***	-0.0131211

6. Further analysis: the difference of the impact of digital inclusive finance on industrial structure under different technological innovation environments

This section considers whether digital inclusive finance and scientific and technological innovation have regulatory effects in the process of affecting the upgrading of industrial structure. Therefore, based on the spatial model, the interaction term DF×TI of digital inclusive finance and scientific and technological innovation for centralized processing and their spatial lag term W×DF×TI are added. The model design is as follows:

 $OIS_{it} = \alpha W \times OISit + \beta_1 LDF_{it} + \beta_2 LTI_{it} + \theta_1 W \times SDF_{it} + \theta_2 W \times STI_{it} + \lambda_1 X_{it} + \lambda_2 W \times X_{it} + \eta_1 DF \times TI + \eta_2 W \times DF \times TI + \mu_{it}$

Table 10 shows the model regression results after adding the interaction items between digital inclusive finance and technological innovation. According to the regression results of industrial upgrading (UI), the direct effect of interaction term does not pass the significance test, but its spatial spillover effect does. Therefore, it is proved that with the continuous improvement of the development level of scientific and technological innovation and digital inclusive finance, it will have a more significant positive regulatory effect on the industrial upgrading of the other side. The reason is that under the environment of rising scientific and technological innovation rate, the use direction of digital inclusive finance can be expanded, so that financial assets can flow to more potential financing projects and optimize the industrial structure. Second, in the short term, the transformation of scientific and technological innovation into investment in technological upgrading will require all kinds of large, small and medium-sized enterprises to invest a large amount of capital, which is unfavorable to the production activities of the primary and secondary industries. Some enterprises even go bankrupt due to high initial investment capital and slow income acquisition, which will have a negative impact on the advanced development of industrial structure. Digital inclusive finance can provide a lot of financial support to reduce the cost of capital seeking, so as to ease the capital constraints of enterprises, promote scientific and technological innovation and industrial optimization and upgrading.

Table 10 considers the spatial effect decomposition of interaction terms
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Variable	direct effect	indirect effect	total effect
DF	0.0021221***	-0.0051564***	-0.0030343***
GEL	0.0934451***	0.1610802**	0.2545252***

EPL	-0.000434***	0.0010861*	0.000652
EL	-0.0272355	-0.059261	-0.0864965
UE	-0.0075932	0.0535631***	0.0459699***
OPE	0.1409551***	0.4715659***	0.612521***
DF×UE	0.000041	0.0002417***	0.0002827***

7. Conclusions and Recommendations

7.1. Research conclusions

Based on the relevant data of 31 provinces and cities in China from 2013 to 2020, this paper constructs a spatial panel model to study the impact of digital inclusive finance and technological innovation on industrial upgrading. Based on the empirical results, the conclusions are as follows: First, from a national perspective, digital inclusive finance does not play a good role in promoting industrial upgrading. Regional studies have found that human intervention in the direction of financial asset flow caused by excessive competition in the highly developed process of digital inclusive finance in the eastern region is the key reason for this. The digital divide is also the key reason why digital inclusive finance in the western region does not play an obvious role in promoting industrial upgrading. Second, the overall effect of scientific and technological innovation on industrial upgrading is basically significantly positive from both a national perspective and a regional perspective, which proves that scientific and technological innovation is indeed an important driving force for optimizing industrial structure. From the point of view of the direct effect of scientific and technological innovation on industrial upgrading, the direct effect in the eastern region is negative, while the direct effect in the central and western regions is positive but not significant, which confirms that scientific and technological innovation in this region cannot be an effective driving force for the upgrading of its industrial structure at present, and only the overall improvement of regional scientific and technological development is the key to the continuous improvement of industrial upgrading. Third, scientific and technological innovation plays an important regulating role in the process of digital inclusive finance affecting the upgrading of industrial structure. A higher scientific and technological innovation environment will have a more significant positive regulating and catalytic role in the process of digital inclusive finance affecting the upgrading of industrial structure in this region and other regions, because scientific and technological innovation determines the direction of the use of digital inclusive finance funds. Looking further at the impact of digital inclusive finance on industrial upgrading, there is a significant threshold effect of technological development level. Digital inclusive finance has the greatest impact on industrial upgrading when the rate of scientific and technological innovation is low, and when the rate of scientific and technological innovation exceeds a certain threshold, the promotion effect of digital inclusive finance on industrial upgrading will be reduced. However, with the continuous rise of scientific and technological innovation rate, the promotion effect of digital inclusive finance on industrial upgrading will be more obvious when it crosses another threshold.

7.2. Relevant suggestions

Based on the above conclusions, this paper puts forward the following suggestions: First, the eastern region of China is a demonstration area for reform in many fields, and takes the developed human resources and high level of science and innovation as the leading force of China's economic development to drive the national economic development. Under the current environment of increasing downward economic pressure, various industries are facing more stringent living conditions. On this basis, the highly developed digital inclusive finance in the

eastern region may cause excessive competition in the industry and have a negative impact on the industrial upgrading. Relevant regional governments should consult with each other to establish policies to alleviate local excessive competition, improve the system for the integrated development of digital inclusive finance in different regions, accelerate the research and development of digital technology innovation, and strengthen cooperation and exchanges with neighboring regions. Form healthy competition and achieve win-win cooperation. Second, due to historical reasons, geographical and environmental reasons, the current development level of digital inclusive finance is low in the western region. In order to give full play to the advantages of digital inclusive finance as soon as possible, so that it can better serve the real economy. It is necessary for the local government to increase the construction of digital inclusive financial infrastructure and create a healthy digital inclusive financial development market mechanism, so that digital inclusive finance can meet the needs of advanced industrial development faster and more efficiently. Third, the development of scientific and technological innovation rate has a positive spatial spillover effect. Therefore, all regions should strengthen regional cooperation, jointly explore and improve, and give full play to the spillover effect of the improvement of scientific and technological innovation rate, so as to promote the industrial transformation and upgrading of surrounding areas, strengthen the exchange of high and new technologies, and finally realize the positive role of industrial structure optimization in promoting high-quality economic development. Fourth, since the rate of scientific and technological innovation is the threshold variable that affects the industrial upgrading of digital inclusive finance, and the promotion mode is first slowing down and then increasing, on the one hand, more attention should be paid to the central region with the middle level of scientific and technological development, encourage scientific and technological innovation in the central region and introduce new and high technologies in the eastern region, so as to realize the technological development level crossing the threshold value as soon as possible. To accelerate the promotion effect of digital inclusive finance on industrial upgrading at a higher level, on the other hand, it is necessary to avoid the excessive competition for digital inclusive financial resources formed by the development of high technology of digital inclusive finance in the eastern region.

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