Analysis on Spatial Distribution and Spillover Effect of Higher Education Resources in China

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Keywords: Higher education; Regional economy; Geographically weighted

Abstract: Higher education resources is the important basis in determining the quality of regional higher education, is the powerful guarantee of building innovative country and enhance international influence, is the important way of "talent is the first resource". This article analyzed the resources of higher education in China from 2010 to 2014 the space distribution characteristics and the regional economic development situation, using stata software analysis found that the scale of higher education and regional economic development has a positive relationship, because of the higher education scale since the correlation, in the space, its effect on economic growth may be different, with GER method is an effective approach to solve such problems. Then USES the method of GWR analysis of higher education scale effects on regional economic growth, found that higher education scale developed economic regions is negatively related to regional economic development, and the economic scale of higher education in regional economic development in less developed areas is positively related to the influence of, therefore, increase the recruitment of students scale in less developed areas has a positive impact to the economy of less developed areas.

1. Introduction

Our country has a long history and culture. The initial university education can be traced back to Xia and Shang Dynasty. The first modern higher education system in China was formed in the late Qing Dynasty in Guangxu. The Beijing Normal University Hall, founded in 1898, was the beginning of the comprehensive university in modern China. Since then, higher education in the Qing Dynasty has been greatly developed. By 1909, there were 123 government-run colleges and universities in China. Comrade Deng Xiaoping presided over the work in 1977. With the opening of the reform, higher education ushered in two small peaks of recovery and growth. In 1978, the National College Entrance Examination was resumed, and students all over the country had expectations.

In today's era of rapid development of knowledge economy, the level of science and technology has become the key to measure national strength, and the strength of science and technology level is closely related to the development of higher education. Therefore, all regions have now formulated a talent war to promote the innovative development of the region by absorbing talents. In the competition for regional talents, the competition for higher education talents is the most fierce, so the development of higher education has always been the focus of attention in regional economic development. However, the development level of higher education in different regions is different, and the distribution of higher education resources is also affected by various factors (politics, economy, geography, environment, etc.). Since higher education is a vital aspect of promoting regional economic growth, it naturally requires higher education resources to develop in a balanced way in all regions.

This paper first analyses the overall development status of higher education resources in China from the national level, then from the inter-provincial level, it analyses the scale of higher education and the current situation of regional economic development in 31 provinces and municipalities in China from 2010 to 2014, and finds that the development of higher education scale promotes the development of regional economy by using Stata software. It provides feasible suggestions for the

  DOI: 10.25236/icem.2019.105

development of regional economy.

2. Literature Review

The spatial pattern of higher education resources allocation has been concerned by scholars at home and abroad. Some domestic scholars have conducted in-depth research on it, involving the structure, efficiency, scale, system and quality of higher education resources. The main points of view are divided into two groups. The first group thinks that the problem of balanced or unbalanced distribution of higher education resources is not serious. For example, Yan Chengbu et al. (2009)[2] By analyzing the number of college students per 10,000 people and the number of college students per 100,000 yuan of gross national product, the paper draws a conclusion that the scale of higher education in eastern coastal areas is relative to the economic development ratio. It is concluded that the scale of higher education in most provinces in central China is lagging behind that of economic development, and that the scale of higher education and economic level in the old industrial areas in Western and northeastern China are well balanced. Mao Jianjun, Peng Manru (2012) [3] Empirically analyzed the balance of higher education resources allocation in China from three aspects of teacher-student ratio, average student building area and average student allotment income by using range ratio, coefficient of variation, Gini coefficient and Verstegen index, based on the cross-sectional data of universities directly under the Ministry of Education from 2006 to 2010. The balance of human resources and material resources allocation in Colleges and universities directly under the Ministry is in a relatively ideal state among provinces, cities and regions.

Many scholars believe that there is a serious imbalance in the spatial allocation of higher education resources in China. Yan Libing (2005) [4] Using the two indicators of enrollment and the number of colleges and universities, Lorentz curve method and cluster analysis method, thinks that there is a great inequity in the regional distribution of high-quality higher education resources. Baowei and Liu Yanhui (2009)[5] calculated Gini coefficient and Theil coefficient of the per capita education funds of provincial students from 1993 to 2005, and analyzed the regional differences of higher education resources allocation before and after the enrollment expansion. The conclusion is that the regional gap of higher education funds allocation in China has not decreased after the enrollment expansion, but has increased to a certain extent. Trends. Liu Huajun, Zhang Quan (2013) [6] and other provincial data in China are used to make an empirical study on the non-equilibrium and polarization of the spatial distribution of higher education resources in China by using five indicators: the number of universities, the number of students, the investment of education funds, the ratio of teachers to students and the average cost of students.

3. Analysis of the Present Situation of Higher Education Resources in China

3.1 National Level Analysis

3.1.1 Analysis of Higher Education Investment

Firstly, this paper analyses the input of higher education resources in China from 2000 to 2015 at the national level. Fig. 1 shows the number of full-time teachers in general colleges and universities (10,000 people) and the number of staff in general colleges and universities (10,000 people). Both investment trends are increasing, but the growth trend slows down from 2012 to 2015.

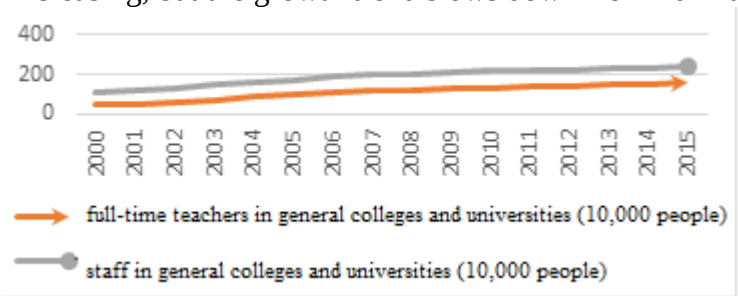

Figure 1 Investment of Full-time Teachers and Staff in Universities and Colleges from 2000 to 2015

In terms of the area occupied by teachers, libraries, laboratories and practice sites, the overall growth trend is the same, but the area of teachers gathered in 2002-2006, and then attributed to a steady growth trend, while the library has been growing slowly. The growth trend of laboratories and practice sites is similar to that of teachers.

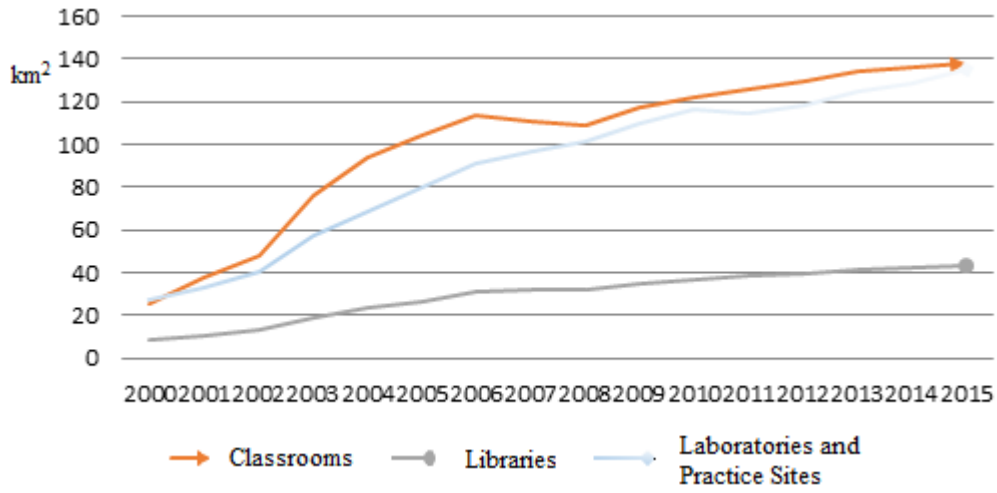

Figure 2 Coverage of Classrooms, Libraries, Laboratories and Practice Sites in Colleges and Universities from 2000 to 2015

3.1.2 Output Analysis of Higher Education

The most intuitive output indicator is the number of College graduates. The number of college graduates in China grew rapidly from 2004 to 2008. During this period, there was a general problem of difficult employment for college graduates, and the growth trend slowed down after 2009.

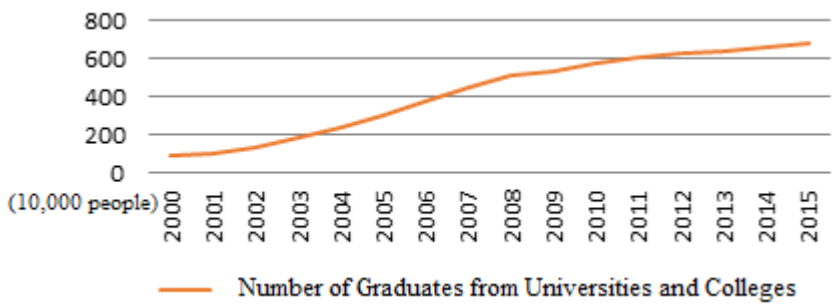

Figure 3 Number of Graduates from Universities and Colleges between 2000 and 2015

3.2 Interprovincial Level Analysis

At the inter-provincial level, the distribution of higher education resources in 31 provinces and cities in China is analyzed by Geoda software. The following figure shows the specific situation of the number of students in 31 provinces and cities (excluding Hong Kong, Macao and Taiwan) in 2014. The number of students is divided into three groups: 0-632785 students in the first group, 737797-1391079 students in the second group and 1536609-5482550 students in the third group. The darker the color in the picture, the more students there are. From the picture, we can see that the first group is Beijing, Guangdong, Jiangsu, Sichuan, Shandong, Shaanxi and other provinces, with the largest number of students; the second group is Heilongjiang, Jiangxi, Yunnan, Chongqing, Shaanxi, Jilin, and other provinces; the third group is Xinjiang, Tibet, Qinghai and Nei. Mongolia, Gansu and other provinces. From the grouping, because the number of students in provinces with better economic development level is also larger, we can not help wondering whether the scale of universities is related to the level of regional economic development. So the next step is to observe the level of regional economic development.

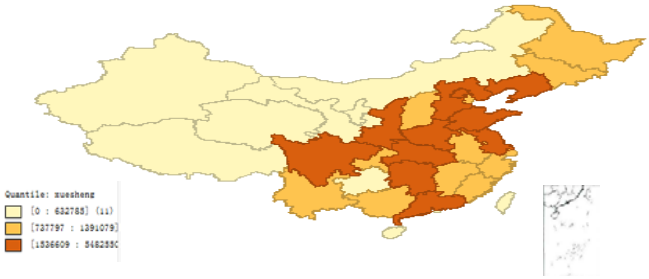

Figure 4 The Number of Students in Colleges and Universities in China in 2014

The number of students in Figure 4 is grouped into tables 1

Table 1 Number of students enrolled in school in 2014 by provincial grouping

group	Province
first group	Beijing, Guangdong, Jiangsu, Sichuan, Shandong, Shaanxi, Liaoning, Hebei, Henan, Hunan
Second group	Heilongjiang, Jilin, Tianjin, Shanxi, Anhui, Jiangxi, Zhejiang, Fujian, Chongqing, Guangxi and Yunnan
Third group	Xinjiang, Tibet, Qinghai, Gansu, Ningxia, Inner Mongolia and Guizhou

Figure 5 shows China's GDP in 2014. Similarly, China's GDP is divided into three groups. The deeper the color, the greater the value, the better the level of economic development. From the following picture, we can see the first group: Guangdong, Sichuan, Jiangsu, Zhejiang, Shandong and other provinces; the second group: Jilin, Jiangxi, Yunnan, Anhui, Chongqing, and other provinces; the third group: Qinghai, Tibet, Xinjiang, Gansu, Heilongjiang, Ningxia and other provinces. Comparing the figure below with the figure above, we find that there are many provinces where the grouping of GDP coincides with the grouping of the number of students. We further verify our guess. Then we use empirical evidence to verify our hypothesis: the impact of the scale of higher education on regional economic growth.

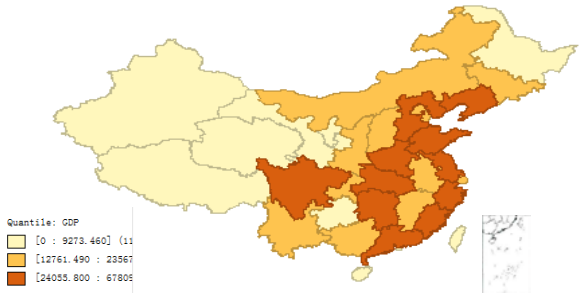

Figure 5 China's GDP in 2014

4. Spatial Spillover Effect Analysis-Based on Panel Data Regression Model

The theoretical model of education and economic growth can be based on the theory of production function. In the neoclassical growth model, Cobb-Douglas production function is used to measure this problem. Y (GDP) is expressed as economic output. Then input can be divided into material capital input, labor force, human capital and technological progress. K (total investment in fixed assets of the whole society) is used to measure material capital, L (total employment) is used to measure labor force, H (scale of Higher Education - number of students in school) is used to measure human capital. Here, the number of college students is used as an index to measure the scale of higher education. The reason is: the number of college students in school. The more, the larger the scale of higher education will be, which shows a very positive correlation. Therefore, the

number of college students is chosen as a variable to measure the scale of higher education schools. Thus the model is established.

$$Y = AK^{\alpha} L^{\beta} H^{\gamma} \mu$$

Among them, A stands for technical level, a, b, r stands for elasticity coefficient of material capital, labor force and human capital, u is the immediate interference term, and the value is less than or equal to 1. Here we take the number of students in school as a variable to measure the scale of higher education. We collected panel data of 31 provinces in China from 2010 to 2014 and made a panel regression. Because both sides are quantity. So we can take logarithms on both sides of the model and logarithms on both sides of the formula to get:

$$\ln Y_t = \ln A + \alpha \ln K_t + \beta \ln L_t + \gamma \ln H_t + u$$

The collected panel data are used to do panel regression with Stata software:

Table 2 Descriptive statistics of variables

Variable	Obs	Mean	Std. Dev.	Min	Max
Ln(GDP)	155	9.440	1.0035	6.2294	11.1245
Ln(zaixiaosheng)	155	13.635	1.023	10.5927	15.5171
Ln(gudingzichan)		9.1069	0.8917	6.1371	10.6571
Ln(jiuye)	155	5.9225	0.9109	3.1001	7.5874

Then use Stata software to analyze model regression:

Table 3 Panel regression analysis results

Variable	Regression Coefficients	Standard Deviation
Ln(zaixiaosheng)	0.3039	0.0737
Ln(gudingzichan)	0.5096	0.06219
Ln(jiuye)	0.2403	0.07601
_cons	-0.7687	0.6255
R^2	0.95	

From the regression results, we can see that the number of school students has a positive correlation with the regional economy. Although the positive effect is not as strong as the whole society's fixed assets, it still contributes to the development of regional economy. In the regression coefficients of these three variables, we find that the whole society's fixed assets have a positive impact on the regional economy. Economic development plays the strongest role, followed by the number of school students, and finally the employment population of the whole society. The above results confirm the previous speculation that the scale of higher education is positively related to the development of regional economy.

5. Model Improvement

5.1 Spatial Autocorrelation Test

Geoda software is used for analysis. First, a rock weight matrix is established, and then Moran index is analyzed. The following figure is the size of Moran index. The results show that the number of students in Colleges and universities in different regions has spatial autocorrelation, and this autocorrelation is negative. The number of students in a region is very large. More, then the number of students in the neighbourhood may be reduced. Through the study of Moran index, we find that the number of students does have spatial correlation. In order to test the model well, we use the geographic weighted model to transform the panel data regression model to reduce this spatial heterogeneity.

5.2 Geographically Weighted Regression Model (GWR)

The regression principle is used to study the quantitative relationship between two or more variables with spatial distribution characteristics. Local features are considered as weights in data processing. Geographically weighted regression can reduce spatial heterogeneity. In this paper, since the data are from 31 provinces and there are spatial correlations among the data, the analysis of spatial autocorrelation illustrates this point, so the following is the setting of GWR model.

$$Y_{\mathrm{i}} = \beta_0(u_i, v_i) + \sum_{k=1}^{p} (u_i, v_i) x_{ik} + \varepsilon_i$$

In the above formula, Yi is the observation value, (ui, vi) is the coordinate of sample i, the first coefficient represents the regression constant of point i, while the latter coefficient represents the K regression parameter of point i, which is a function of geographical location, P represents the number of independent variables, and X represents independent variables. These are the explanations of the general geo-weighted model, so the model in this paper can be written as follows:

$$Y_{\mathrm{i}} = \beta_0(u_i, v_i) + \beta_1(u_i, v_i) x_{1i} + \beta_2(u_i, v_i) x_{2i} + \beta_3(u_i, v_i) x_{3i} + \varepsilon_i$$

Where I represents the region I and K represents the number of explanatory variables. In the provinces represented in this paper, the K explanatory variable regression coefficient, which represents the first region, is related to geographical location (ui, vi). In this formula, the three X explanatory variables represent the number of students in school, the amount of investment in fixed assets and the number of employment in the whole society, and Y represents the total GDP of provinces.

Next, we use ArcGIS software to carry out geographically weighted regression. The results of geographically weighted regression analysis for each province in 2014 are as follows:

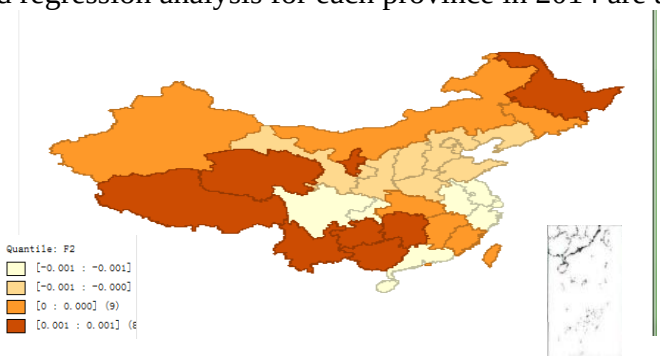

Figure 6 Distribution of GWR Model Check Coefficient

Fig. 6 Using geographically weighted regression method, the coefficients of the number of students in each province in 2014 are obtained. ArcGIS software calculates the coefficients of each observation value in each province, so as to manage the different effects of each province. Several conclusions can be drawn from the above figure:

1) The figure divides the coefficients into four groups. The lightest color represents the negative correlation between the size of higher education and the regional economy, mainly concentrated in Sichuan, Guangdong, Shanghai, Zhejiang, Anhui, Jiangsu and these provinces.

2) The coefficients of the second group with middle color also show that the scale of higher education has a negative correlation with regional economic development, but this degree is smaller than that of the first group. They are mainly concentrated in Beijing, Tianjin, Shandong, Shaanxi, Shanxi, Gansu, Liaoning, Jilin, Hebei and Henan provinces.

3) The impact of the third group on the regional economy is positively correlated with the scale of higher education, but the intensity of this positive correlation is less than that of the fourth group.

They are mainly concentrated in Xinjiang, Fujian, Jiangxi, Hubei, Jilin and Inner Mongolia provinces.

Generally speaking, in areas where higher education resources are relatively scarce, increasing enrollment scale has a driving effect on regional economy, while in economically developed areas, increasing enrollment scale has a weak driving effect on regional economy, even in chivalrous areas, there is a negative correlation. The level of educational resources in economically developed areas is already adequate. And the less developed regions can increase educational resources and enrollment scale.

Table 4 Coefficient Value of Higher Education Scale to Regional Economic Development (GWR Method)

Province	Coefficient value
Beijing	-0.000424
Tianjin	-0.000462
Hebei	-0.00046
Shanxi	-0.000576
Neinenggu	0.000212
Liaoning	-0.000265
Jilin	0.000054
Heilongjiang	0.000721
Shanghai	-0.000763
Jiangsu	-0.000714
Zhejiang	-0.000825
Anhui	-0.000759
Fujian	0.000112
Jiangxi	0.000134
Sahngdong	-0.000594
Hebei	-0.000708
Hubei	0.000207
Hunan	0.000906
Guangdong	-0.001004
Guangxi	0.001026
Hainanqing	-0.0011256
Chong	-0.000863
Sichuan	-0.000891
Guizhou	0.000963
Yunnan	0.001057
Xizang	0.000599
Shanxi	-0.000688
Gansu	-0.000642
Qinghai	0.000744
Ningxia	0.000627
Xinjiang	0.000361

6. Current Political Conclusions and Policy Recommendations

This paper analyses the development of higher education resources at the national and provincial levels in recent years, and finds that the scale of higher education has a close relationship with the regional economic development at the provincial level. In order to verify the conjecture, we first collect panel data of 31 provinces (excluding Taiwan, Hong Kong and Macao) in 2010-2014, and then use Stata software to do simple panel regression. The regression results show that the size of higher education is indeed related to the level of regional economic development, and the

relationship between China has become obviously positive. Directional relationship. Here we will inevitably wonder whether the scale of higher education has the same impact on every region. Will panel regression not eliminate the impact of spatial heterogeneity, and then we use Geoda software to analyze the scale of higher education, found that there is indeed spatial autocorrelation, in order to solve this problem, we use the spatial econometrics method - GWR method, to eliminate this impact, through the GWR model analysis. The influence of higher education scale on regional economy in 2014. GWR gives the coefficients of the observed values for each region and 31 coefficients for male dogs. Geoda software is used to group the coefficients. It is found that not every region's higher education scale has a positive correlation with the regional economy, and enrollment increases in economically underdeveloped regions. The impact of scale on regional economy is positively correlated. In regions where the scale of higher education is relatively scarce, the increase of higher education resources has a significantly higher promoting effect on regional economic growth than in regions where the resources of higher education are relatively sufficient.

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