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Cooperative Development on Higher Education and Economic Development

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Abstract

Economy and education are two bases for the development of modern society; the higher education has transformed from elite education to mass education and received a good development. Reasonable planning and scientific development at all levels of high education is the only way for social progress and economic development. But it is not harmonious between higher education and economic development because of regional difference and imbalance of higher education's investment. So we use the methods of cluster analysis and the panel data

model to analyze their relationship. At last, this paper puts forward the improvement ideas and measures.

Key words: COOPERATIVE DEVELOPMENT, HIGHER EDUCATION

1. Introduction

Education is the continuation of human civilization, and the indispensable important power of economic development. Higher education connects with economic development closely, it provides human resources directly and transmits knowledge, and it is also the foundation of knowledge creation and update in social development. Structure of higher education means the proportion structure and all kinds of the interaction relationship between the elements in higher education system. Maohongtao has analyzed empirically the relationship between higher education and economic development, the results have proved that they are a one-way causal and long-term equilibrium relationship, and suggested that economic growth is the cause of the development of higher education; they needed to match each other. Zhengming & Zhu-huaizhen have analyzed the relationship between higher education structure and economical growth according the relevant regional data from 1999 to 2005[1, 2]. Chijingming has analyzed empirically the relationship among the higher education level, scale and economic development by gathering the relevant data of structure change of China's higher education and economic development. Wangxiahui has introduced the ideas of higher education structure differentiation from Clark Kerr, even looked forward to the development of china's higher education. Zhuyan has focused on the development of China's higher education, and analyzed on the process of institutional change about the main body, methods and performance [3]. Zanhongyi has forecasted the enrolment number of every educational level on the basis of analysis of the situation in next year. Hanmengjie has analyzed the relations among the changing structures of higher education, market demand, competition and income in America by the economics theory of sup-

ply and demand [4, 5].

Predecessors' researches have reflected the importance of higher education structure to economic development from different sides. There are some questions in their research, for example, the research object more focus on the overall higher education, and ignore the regional difference and imbalance of higher education's investment. With the development of higher education and economic, they have changed largely about national policy, education environment, education concept, economic development level. So, they have been difficult to reflect the features of the present stage of higher education structure, and the relationship between the higher education and economic. In my research, I focus on a region's economic structure and imbalance, and study the matching degree of higher education structure and economic development importantly. I also compare crosswise of different regions. In conclusion, some suggestions are put forward.

2. The General Situation of Higher Education in Hebei Province

Since the expansion policy of our country's higher education in 1999, the investment in higher education increased year by year in Hebei province. As shown in table 1, during 2002 to 2009, the number of institutions of higher learning, the number of higher students per million populations and the number of graduates have increased significantly. During 2002 to 2009, there have been significant increases in the number of higher-education institutions, the number of higher education students per million populations and the number of the graduates. The higher-education institutions have grown up from 75 to 109; the number of higher students has increased from 70 to 151 in every 1 million people; and the number of graduates has increased from 62910 to 272247.

Table 1. The educational background in Hebei province

Year	The number of institutions of higher education	The number of higher students per 1 million people	The total number of graduates of institutions of higher education
2002	75	70	62910
2003	83	82	107652
2004	87	102	134148
2005	86	115	183213
2006	88	119	207566
2007	88	130	228193
2008	87	143	271335
2009	109	151	272247

(Data source: the statistical yearbook of Hebei province, 2009)

Education is closely connected with economic. On the one hand, education is restricted and influenced by the level of economic; the educational scale and the improvement of the quality need financial support; On the other hand, a high level of education will promote the development of economy. Different

levels of higher education and the human resources influence the development of society and economy differently. As an important measure of social supply and demand, how the number of graduates contributes to the development of economy is the key point of this paper.

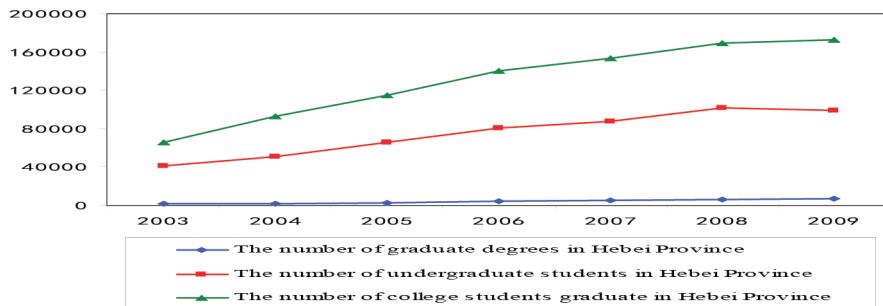


Figure 1. All levels of the number of graduates in Hebei province

Figure 1 describes the changing number of different levels of graduates in higher education in Hebei province from 2003 to 2009. As can be seen from the graph, the most obvious increasing is the number of specialist college graduates which is greater than the number of undergraduates.

The higher education attaches great importance to the cultivation of college graduates in Hebei province. Comparing with the number of college graduates and undergraduates, the change in number of graduate students is not very obvious. In 2009, the number of college graduates is 172747, undergraduate students are 99500, and graduate students are 7317 in Hebei province.

3. Higher Education Hierarchy of Hebei Province Across The Country

3.1 The method of clustering analysis

To analyze the position of the higher education hierarchical of Hebei province in the whole country, this paper will analyze those higher education hierarchical structures in 15 developed regions from 2003 to 2009 by clustering analysis which is a method from statistics. Clustering analysis, the idea of "birds of a feather flock together", is to measure the similarity between the sample or index, and make them as the statistics to classify the statistics similarity sample into one group by clustering, the other one into another kind, and to express by the spectrum diagram. The method to measure the similarity in clustering analysis is to measure the distance between the two indexes. This paper will divide two indexes of the higher education hierarchical structure: the number of graduate students including the doctor and master, the number of college graduate students including the undergraduate and the specialized graduate, and the GDP which measures the level of econom-

ic development in various provinces and cities. This paper applies the Euclidean distance square to express the distance between the samples, and the Ward minimum deviation square method is to measure the distance between the classes. The Euclidean distance square is defined as:

$$d_{ij} = \left[\sum_{k=1}^p (x_{ik} - x_{jk})^2 \right]^{1/2} \quad (1)$$

It means the square sum before prescribing of the difference between the indexes from x_i 's No.1 to No.k and x_j 's No.1 to No.k. The Ward minimum deviation square method is used widely to calculate the sum, which the difference that each class subtracts average class squares. The sum of squared residuals method is the definition as below:

$$D_\omega^2(p, q) = D_{p+q} - D_p - D_q \quad (2)$$

Lead a minimum of two kinds into one class of the (2).

3.2 The empirical research on clustering analysis

This paper searches the number of postgraduates, undergraduates and the GDP from 2003 to 2009 in the statistical yearbook of provinces and cities, such as Beijing, Tianjin, Shanghai, Liaoning, Shandong, Jiangsu, Guangdong, Fujian, Zhejiang, Hubei, Hunan, Anhui, Henan and Jiangxi. Calculate the mean and standard deviation of the above three indicators in six years; measure the average level and the degree of the change in both the undergraduate and graduate in these provinces and cities by the mean and standard deviation. It can cause the error if choosing just one year's sectional data. So this paper chooses the average data to measure the graduate number and the average level of economic development in these provinces and cities by clustering analysis, and meas-

ure the fluctuations by standard deviation. By data's clustering analysis to the Euclidean distance square and Ward minimum deviation squares, this paper gets the pedigree cluster diagram as shown in figure 2.

As can be seen from the figure 2, under the condition of the significance level of 0.05, it is suitable to gather four kinds for the 15 provinces and regions. As shown in table 2:

Table 2. Classification figure

Class	region
1st	Beijing
2nd	Guangdong Jiangsu Shandong
3rd	Tianjin Fujian Shanghai Liaoning
4th	Hebei, Henan, Hubei, Hunan, Jiangxi, Anhui, Zhejiang

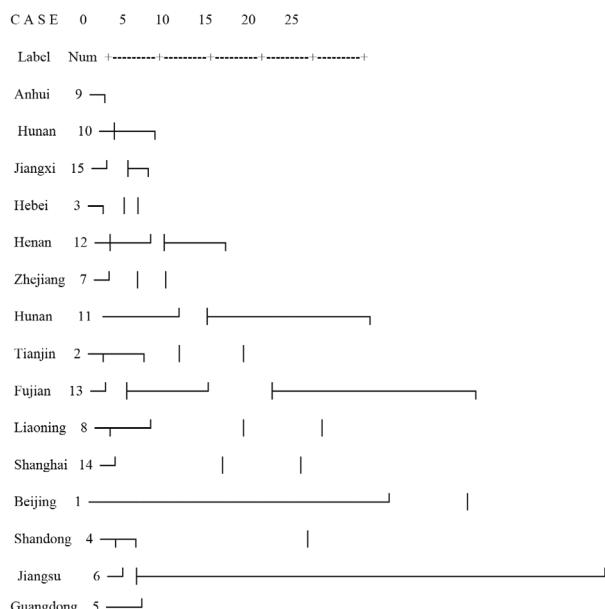


Figure 2. Hierarchical clustering figures Rescaled Distance Cluster Combine

4. The Economic Benefits Analysis of Education Quality--Panel Data Model

This paper has measured Hebei's higher education development from the time changing, and located properly the level of Hebei's higher education hierarchy in the country by comprising with 14 high education level provinces. Besides, this paper will further analysis the different influences of all the higher educational graduates in the different provinces by the panel data model.

By establishing the 15 provinces' panel data model from 2003 to 2009, this paper will analyze the higher education gap between Hebei province and the other 14 provinces. $\ln m_{it}$ means the logarithm of the number of graduates in the t-year in the i-region, $\ln b_{it}$ means the logarithm of the number of specialized graduates in the t-year in the i-region, $\ln gdp_{it}$ means

the logarithm of GDP in the t-year in the i-region. The Panel data model is:

$$\ln gdp_{ot} = \alpha_i + \beta_{1i} \ln m_{it} + \beta_{2i} \ln b_{it} + \lambda_t + \mu_{it} \quad (3)$$

4.1 The unit root test for panel data

It is same to time series, and it is necessary to test unit root of panel data before the panel data regression model established. Only if the panel data is smooth to establish, spurious regression problem can be avoided. The test of unit root of the panel data is below:

$$y_{it} = \rho y_{it-1} + x_{it} \delta_i + \varepsilon_{it} \quad (4)$$

If $\rho = 1$, it shows the panel data unit root exist in the type of (4). The unit root test of panel data is divided into homogeneous unit root test and heterogeneity unit root test. Homogeneous unit root test is mainly LLC inspection and BREITUNG, heterogeneity unit root test is mainly included IPS, Fisher - ADF and Fisher - pp inspection. In order to ensure the robustness of data, this paper will take LLC inspection and ADF-Fisher inspection respectively to test the results between homogeneous unit root and heterogeneity unit root. The results to $\ln gdp_{it}$, $\ln m_{it}$ and $\ln b_{it}$ can be seen in table 3.

The original sequence for $\ln gdp_{it}$, $\ln m_{it}$ and $\ln b_{it}$ all accept the original assumption that there are unit root; the sequence for $\Delta \ln gdp_{it}$, $\Delta \ln m_{it}$ and $\Delta \ln b_{it}$ that the first order difference sequence for $\ln gdp_{it}$, $\ln m_{it}$ and $\ln b_{it}$ reject the null hypothesis under the significance level of 5%, and thinking the first order difference sequence is considered smooth, so the original sequence are in process(1).

Table 3. Panel data unit root test

	LLC inspection	P values	ADF - Fisher test	P values
$\ln gdp_{it}$	-0.31455	0.376	6.892	0.96
$\ln m_{it}$	-0.259	0.398	2.96	0.99
$\ln b_{it}$	-3.37	0.00	11.36	0.98
$\Delta \ln gdp_{it}$	-4.0357	0.00	36.9984	0.02
$\Delta \ln m_{it}$	-4.3975	0.00	44.394	0.003
$\Delta \ln b_{it}$	-6.36	0.00	56.706	0.001

4.2 Co-integration test for panel data

There are two kinds of the co-integration test for panel data. The first is two-step method based on Engle Granger, i.e. Kao inspection which is to test the residual of regression model, and the deficiency of this test method is the strict requirements of the panel

data from its homogeneity, i.e. the time sequence on the longitudinal coefficient is same. Another co-integration test is Pedroni inspection which permits heterogeneity. Pedroni inspection structures different fixed effects model:

$$y_{it} = \alpha_i + \beta_i x_{it} + \varepsilon_{it} \quad (5)$$

Pedroni inspection structures seven statistics to test co-integration relationship of panel data. According to the residual structure, the null hypothesis of the 7 test assumed not exist co-integration relationship. These seven statistics are divided into inside estimation and group estimation, and according to the results of pedroni inspection, group estimation is more

flexible than inside estimation which is suitable for small sample co-integration test of panel data. Due to the small sample size, this paper will take group estimation as the inspection standards.

This paper will test the three sequences for $\ln gdp_{kt}$, $\ln ma_{it}$ and $\ln ba_{it}$ to determine whether co-integration relationship through Pedroni heterogeneity test is exist. The inspection results show the statistics pass the test, which is under 5% significance level as table4, so it rejects the null hypothesis. There is a co-integration relationship for the three sequences for $\ln gdp_{kt}$, $\ln ma_{it}$ and $\ln ba_{it}$, regression model can be established to estimate.

Table 4. Co-integration test

Inspection methods	Statistical quantity	P values
Panel v-statistic	27.63760	0.00
Panel rho- statistic	3.476145	0.00
Panel pp- statistic	-8.1866	0.00
Panel ADF- statistic	-11.94580	0.00
Group rho- statistic	4.880971	0.00
Group PP- statistic	-11.49758	0.00
Group ADF- statistic	-16.65640	0.00

4.3 The determination of panel data model

For the data of time series are short; the cross section data belongs to the small sample; this paper establishes the panel data model is to analyze the different effects of higher education on GDP in Hebei and other provinces which are influenced by some fixed factors, such as education funds, population, and economic development level and so on. So it needs to build individual fixed effects model:

$$y_{it} = \alpha_i + \beta_i x_{it} + \varepsilon_{it} \quad (6)$$

After the individual fixed effect model is set up, the following is to establish whether a variable coefficient model or a variable intercept model. To solve above problems, the panel data model are usually resolved through the following methods: First put forward the null hypothesis $H_1: \beta_1 = \beta_2 = \dots = \beta_n$ and $H_2: \alpha_1 = \alpha_2 = \dots = \alpha_n, \beta_1 = \beta_2 = \dots = \beta_n$. If the inspection accepts H_2 , it needn't to inspect H_1 ; if the inspection refuses H_2 , and it needs to continue to inspect H_1 .

Based on the below type to inspect H_2 :

$$F_2 = \frac{(S_3 - S_1) / [(N-1)(K+1)]}{S_1 / [NT - N(K+1)]} \sim F[(N-1)(K+1), N(T-K-1)] \quad (7)$$

Based on the below type to inspect H_1 :

$$F_1 = \frac{(S_2 - S_1) / [(N-1)K]}{S_1 / [NT - N(K+1)]} \sim F[(N-1)K, N(T-K-1)] \quad (8)$$

In above formula, S_3 means the residual sum of squares of the mixed model; S_2 means the residual sum of squares of variable intercept model; S_1 means the residual sum of squares of variable coefficient model; k expresses the number of variables. Based on the above inspection method, the calculation results are obtained as follows: $F_2 = 77.5 > F_{0.95}(42,60) = 1.58$. H_2 is refused, continue to test and get the result: $F_1 = 2.2148 > F_{0.95}(28,60) = 1.66$. H_1 is refused. Upon

the examination, the panel data model in this paper should establish variable coefficient model.

4.4 The results analysis

According to above analysis, we can set up individual fixed effect variable coefficient model, and get a coefficient table of provinces and cities, such as in table 5.

Economy

Table 5. Coefficient of panel data model

region	lnma	t-statistic	lnba	t-statistic
Beijing	1.067	1.4267	-0.303	-0.246
Guangdong	0.35	0.4795	0.806	10.85
Jiangsu	0.49	2.28	0.406	1.635
Shandong	0.31	0.8417	0.446	1.147
Shanghai	1.24	9.81	-0.847	-3.629
Zhejiang	0.26	1.29	1.072	5.71
Hebei	0.45	3.75	0.238	1.246
Henan	-0.17	-0.401	1.149	1.872
Hubei	1.92	0.03	-0.35	0.44
Hunan	1.25	0.00	-0.69	0.19
Liaoning	0.663	0.16	-0.046	0.961
Tianjin	-0.42	-0.87	1.57	0.0154
Fujian	0.39	1.456	0.278	0.871
Jiangxi	0.61	13.52	-0.06	0.86
Anhui	1.2	1.58	-0.706	-0.76

As can be seen from the table, most of the variables do not pass the test, even the significance level is under 10%. It shows that the graduates, who are in our country's higher education at all levels of the structure, do not make much significant contribution

to GDP at present and it will increase spending. The graduates need a certain adjustment period and need to improve professional skills in specific retraining.

Based on the above-mentioned, the panel data model of Hebei province is as follows:

$$\ln gdp = 0.4525 \ln ma + 0.238 \ln ba + 1.132 \lambda + 1.59 \quad (9)$$

As to graduate and other high-level personnel training effect, which you can see from above and in figure 3, the coefficient of graduates is greater than 1 in Beijing and Shanghai, and it can be took the test, so it means the master's graduate students and doctoral students in Beijing and Shanghai play a significant role to the economic development. In the second region, such as Shandong, Jiangsu and Guangdong, the contribution coefficients of graduates and specialized subject graduates to GDP are balanced; and basically the specialized subject graduate contribution to GDP

is more obvious. Compared with the three areas, graduate students contribute to GDP is more obvious in Hebei province. Figure 3 depicts the development of graduate students in Hebei province and Beijing, Shanghai, Shandong, Jiangsu and Guangdong province from 2003 to 2009; and it can be seen from the diagram while graduate students contribute to the economic development in Hebei province is very significant, the number of the graduate students exists a great gap between Hebei province and other first or second type areas.

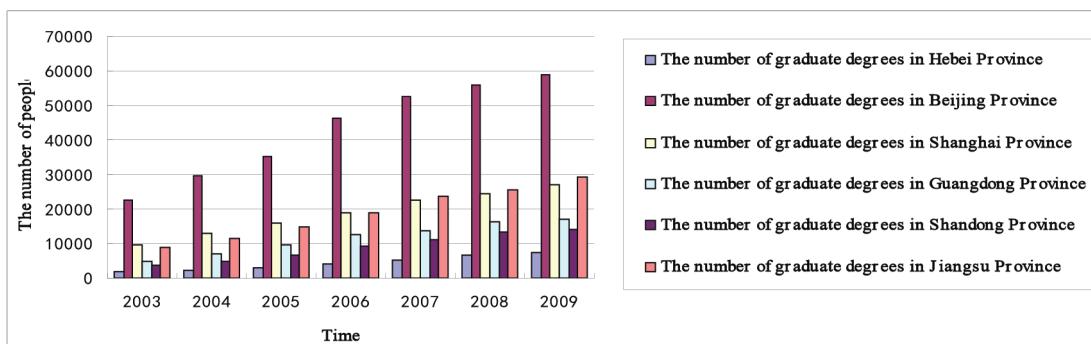


Figure 3. The comparison with the number of the graduate students in each province

On the other hand, as to the effect of the number of the specialized subject graduates to GDP, the coefficient is 0.238 in Hebei province which exists a great gap comparing with Henan, Tianjin and Zhejiang province. In the coastal areas of Zhejiang, Guangdong and Jiangsu province, it owns better advantage in the aspect of student's self-employment and ability

training and so on. Henan province does also very excellent in the specialized subject education. It can be seen from the figure 4, the number of the specialized subject graduates in Hebei province has transcended it in Tianjin, Henan, Zhejiang since 2007, but it still has gap for the contribution to the economic development. It shows the quantity and quality of the spe-

cialized subject graduates in Hebei province are not synchronous improve.

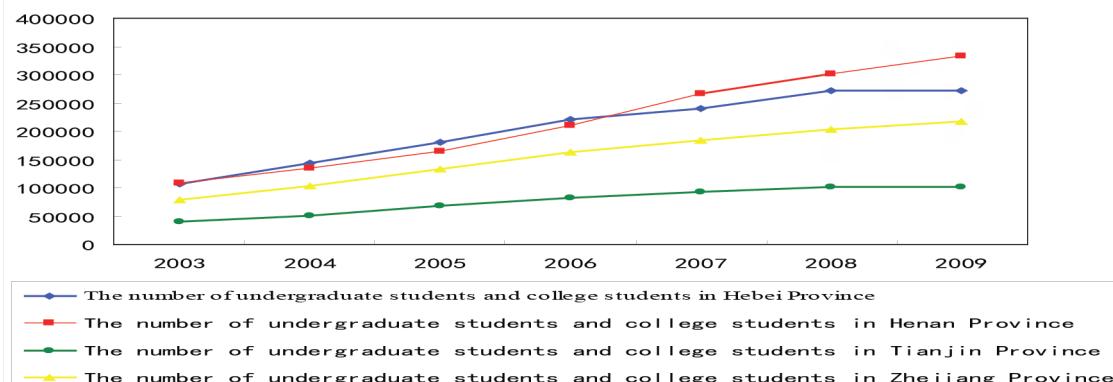


Figure 4. The number of the specialized subject graduates in each province

5. The development ideas and suggestions

From the related data as well as the analysis, it can clearly show that the development of the degree and postgraduate education is closely related to the local economic and social development. At present, the degree and postgraduate education are in the period of the adjustment and transformation in our country. According to China's education planning and related professionals, the proportion of the degree graduate scale of graduate students in the total scale will increase year by year, and the scale of the master's degree graduate student in the total scale of postgraduate will reach to 60%. According to the target, it needs to further increase the education expenditure to degree and postgraduate education in Hebei province; increase the recruit and training of professional degree education; maintain appropriate the growth rate of the professional degree graduate students. In order to reach the corresponding adjustment target, the growth rate needs to maintain at least 20%. On this basis, the department in charge of education and related research institutions of higher education need to evaluate the relationship between the input and output scientifically; plan and adjust the graduates' structure and quantity of different degree type, level and major according to the economic development of the overall plan, the structure condition of the graduate student enrollment, and the social demand for relevant professional talents, etc.

The adaptation of postgraduate training units is not only the adjustment of policy; it can also adjust by education funds. When the goal for the digital level has reached, the further improvement should be structure adjustment and the transformation of the related links in training stage, including training objectives, training plan, the evaluation of training quality, and so on. On one hand, it needs to rely on the professional degree committee to strengthen the guidance of the professional degree education; on the other hand,

the units who cultivate graduates should pay great attention to the professional master graduate students' training work.

According to the characteristics of the professional master graduate students, the postgraduate training units, who should take the initiative to adjust and change its curing academic graduate student training mode; hire more teachers and well-known social mentor, should embody the characteristics of specialization, professionalization to realize the mutual development between the professional master of postgraduates and academic students.

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