Study on the Regional Postgraduate Education Performances in China

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Abstract
The postgraduate education in China is gradually shifting to a new stage of 'Connotative Development', to study the efficiency and effectiveness of education resource utilization from the perspective of performance has more important significance. This paper applies the Factor Analysis Method to integrate 12 groups of variables which represent the present situation of postgraduate education into 2 major factors: input and output, and to evaluate and compare the postgraduate education resource utilization of 31 provinces (or autonomous regions) in China.
Key words: *education performance; postgraduate education; resource utilization*

1 Introduction

Under the background of the great development of higher education in China, the main problem facing the country at the present stage is how to improve the quality, optimize the structure and increase efficiency of the education, and to cultivate high-level talents to meet the needs of economic and social development. Promoting regional educational development is a major trend at present. Through rational planning, innovation and reform, it is possible to achieve sustainable development of both regional economy and regional education. Due to the influence of local policies, culture and economic development level and other factors, the difference of educational development between regions has always been a research focus of concern. The existing research results mainly focused on the evaluation of regional education level, or on the interaction between regional education and economy etc.[1-4]

However, as the postgraduate education in China is now gradually shifting into a new stage of 'Connotative Development', future research will focus on the improvement of education quality and resource allocation, rather than resource possession and consumption. Therefore it is necessary to explore efficiency and effectiveness of regional postgraduate education resource utilization from the perspective of performance, namely evaluating and analysing postgraduate education performance of different regions according to resources such as human, financial, material and output of the talent, scientific research and other status data. In general, the output of postgraduate education should match the investment, which means the more resources invested, the more results outputted, and more resources would be re-invested in the future. But in fact, there may be cases of high-input with low-output or low-input with high-output. So, it is a new attempt to analyse and compare the postgraduate education development of various provinces (or autonomous regions) in China from the perspective of performance, and it will not only help to enrich regional higher education evaluation methodology system, but also provide decision-making reference for promoting the efficiency

and effectiveness of the resources allocation, further improving the postgraduate education quality.

2 Factor Analysis of Postgraduate Education Status Quo

This paper takes the Factor Analysis Method to analyse the current situation of postgraduate education in 31 provinces or autonomous regions in China. Factor Analysis Method will be able to combine many of the original variables into a relatively small number of indicators (factors) with minimal loss of information, of which the advantages including high information retention, easy to name and explain, etc.[5] By adopting the factor analysis method, it will facilitate in-depth study of the regional status quo of Chines postgraduate education and dig its internal characteristics.

Considering the reliability and the availability of the data, this paper selects the following 12 groups of variables in 31 provinces or autonomous in China: Educational expenditure of public finances (￥100 million), Number of full-time teachers with associate professors and above title (person), Number of classrooms (rooms), Number of Books (10 thousand copies), Number of computers (sets), Floor space (10 thousand square meter), Number of awarded postgraduate degrees (person), Number of R&D projects (items), Number of formed national or industry standards (items), Number of published scientific papers (items), Number of published scientific books (species), Number of patent applications (cases). Data of these 12 groups of variables are gathered from "China Statistical Yearbook on science and technology 2015" published by National Bureau of statistics and Department of science and technology in November 2015, ‘2014 national education funds perform statistical bulletin (Education Finance [2015] No. 9)’ issued by the Ministry of education, National Bureau of statistics and Ministry of Finance in October 2015,and ‘statistical data in 2014’ released by Education Planning Division of Ministry of education in September 2015. Due to the different units of measurement and magnitude of each selected variables, the data need to be standardized (dimensionless). Next we will begin a detailed analysis by using SPSS17.0.

2.1 Factors Extraction

Before factor extraction, a KMO test was conducted and its results showed that there are common factors between the 12 groups of variables, so the data are suitable for factor analysis. Correlation test is also conducted and the results showed that there were highly significant correlation between any two sets of variables at the condition of ‘$p < 0.05$’, therefore right angle (orthogonal) method cannot be used to force the two factors unrelated. In this study, we choose the optimal oblique rotation (Promax) to carry out the oblique rotation of the factor loading matrix. Results are shown in Table 1, and it is reasonable to extract 2 factors from the original 12 groups of variables, the overall effect of factor extraction is also ideal.

2.2 Factors Naming

As shown in Table 2, after being rotated, the meanings of the 2 factors become much clearer. In order to name the 2 factors and make them explanatory, we can name the 2 factors respectively according to the correlation between the 2 factors and original 12 groups of variables.

Table 1 – Total Variance Explained

Component	Initial Eigenvalues			Extraction Sum of Squared Loading			Rotation Sum of Squared Loading
	Total	% of variance	accumulation %	Total	% of variance	accumulation %	Total
1	9.206	76.713	76.713	9.206	76.713	76.713	7.974
2	1.664	13.864	90.577	1.664	13.864	90.577	7.940
3	0.513	4.271	94.848				
4	0.266	2.221	97.068				
5	0.187	1.561	98.629				
6	0.049	0.409	99.038				
7	0.040	0.337	99.376				
8	0.031	0.255	99.631				
9	0.024	0.196	99.827				
10	0.011	0.089	99.916				
11	0.007	0.055	99.971				
12	0.003	0.029	100.000				

Table 2 – Rotated Component Matrixes

	Component	
	1	2
Zscore(Expenditure)	0.577	0.922
Zscore(Full-time teachers)	0.832	0.946
Zscore(Classrooms)	0.538	0.951
Zscore(Books)	0.719	0.991
Zscore(Computers)	0.875	0.934
Zscore(Area)	0.565	0.978
Zscore(Degrees)	0.957	0.553
Zscore(Topics)	0.939	0.714
Zscore(Standards)	0.819	0.402
Zscore(Papers)	0.973	0.764
Zscore(Works)	0.960	0.645
Zscore(Patents)	0.849	0.708

Factor 1 mainly explains 6 variables, the original variables explained by factor 1 are basically the outputs of postgraduate education, thus factor 1 can be named as Postgraduate Education 'Output Factor'. Factor 2 mainly explains 6 variables, the original variables explained by factor 2 are basically the input of postgraduate education, thus factor 2 can be named as Postgraduate Education 'Input Factor'.

In Table 2, the values of Zscore(Full-time teachers) variable and Zscore(Computers) variable loading on both factor 2 and factor 1 are able to meet the standard of 0.8. However, this study takes these two variables as Postgraduate Education Input Factor for the following considerations: on one hand, these two variables are biased in favour of factor 2 from the data.

Zscore(Full-time teachers) variable' value loading on the factor 2 is 0.946, bigger than the value loading on factor 1 which is 0.832. And Zscore(Computers) variable' value loading on factor 2 is 0.934, is bigger than the value loading on factor 1, which is 0.875. On the other hand, based on our general understanding of educational activities, these two variables represent parts of the human resource and material resource of postgraduate education input. Therefore, to classified these two variables as Postgraduate Education Input Factor is more reasonable.

Table 3 – Scores and rankings of 31 provinces or autonomous regions

Region	Factor1（Output）		Factor 2（Input）	
	Score	Ranking	Score	Ranking
Beijing	3.42	1	0.45	10
Tianjin	-0.27	16	-0.56	24
Hebei	-0.32	18	0.46	9
Shanxi	-0.67	24	-0.47	21
Inner Mongolia	-0.80	26	-0.80	26
Liaoning	0.48	6	0.40	11
Jilin	-0.29	17	-0.47	22
Heilongjiang	-0.01	12	0.01	15
Shanghai	0.99	3	-0.13	16
Jiangsu	2.69	2	2.12	1
Zhejiang	0.41	7	0.59	7
Anhui	-0.11	14	0.33	12
Fujian	-0.34	19	-0.28	17
Jiangxi	-0.55	21	0.24	14
Shandong	0.41	8	2.05	2
Henan	-0.03	13	1.48	4
Hubei	0.84	4	0.91	6
Hunan	0.19	11	0.52	8
Guangdong	0.74	5	1.53	3
Guangxi	-0.48	20	-0.40	19
Hainan	-0.95	29	-1.44	28
Chongqing	-0.14	15	-0.38	18
Sichuan	0.30	10	1.01	5
Guizhou	-0.78	25	-0.55	23
Yunnan	-0.56	22	-0.46	20
Tibet	-1.07	31	-1.65	31
Shaanxi	0.35	9	0.31	13
Gansu	-0.61	23	-0.93	27
Qinghai	-0.95	28	-1.64	30
Ningxia	-0.98	30	-1.50	29
Xinjiang	-0.89	27	-0.76	25

2.3 Factors Score

Next, the regression method is used to calculate the factor scores of each sample on the Output Factor and Input Factor. For the data which ware standardized, factor score is a relative value, the meaning of which is the degree of the sample deviating from the mean of all samples. If the score of one sample is positive, it indicates that the sample exceeds average level, and higher score means much more exceed than average level. If the score is negative, it

indicates that the sample is below average level, and the lower the score, the more lower than the average level. Therefore, factor scores can be used as a basis for comparative rankings. So we rank the 31 provinces (autonomous regions) in the two aspects of the postgraduate education input and output according to the factor scores. Results are shown in Table 3.

2.4 Performance Analyses

It can be seen from Table 3 that in most parts of China, the scores and the rankings between the Postgraduate Education Input and Output Factor have little difference. But in some areas, the input is much larger than the output, and in some other areas, the input is far less than the output. To help further analysis, the ranking of Postgraduate Education Input is taken as the vertical coordinate, and Postgraduate Education Output is taken as the horizontal coordinate, to build a coordinate axis graph based on them. The horizontal coordinates and vertical coordinates are divided separately into trisections, including high-level region (1st to 10th), middle-level region (11st to 21st) and low-level region (22nd to 31st). Then we draw two auxiliary lines L1 and L2 as shown in Fig. 1, with the help of coordinate axis graph and the auxiliary lines, the postgraduate education performance all over the country can be divided into three different situations: input-output equilibrium, output over input and input over output.

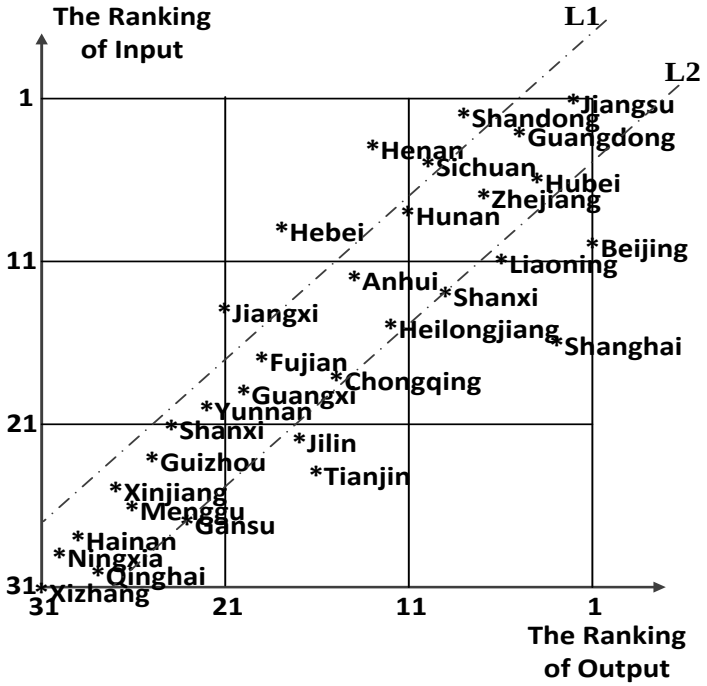

Fig. 1 – The coordinate axis in Postgraduate Education Input and Output

Fig. 1 can be divided into 3 parts:

- Part 1 is between L1 and L2, shows that the postgraduate education input and output the in most parts of China is approach parity, the postgraduate education performance in these regions is doing well.
- Part 2 is the regions of 'Output over Input', which are on the right side of L2, includes Beijing, Liaoning, Shanghai, Jilin and Tianjin. Compared with other

regions, the development trend of postgraduate education these 5 provinces (or autonomous regions) is very efficient.

- Part 3, there are regions of 'Input over Output', which are on the left of L1, including Shandong, Sichuan, Henan, Hebei, Jiangxi, These 5 provinces (or autonomous regions) have great space for improvement in postgraduate education resource allocation and utilization.

3 Conclusion

This paper applies Factor Analysis Method to analyses the inputs and outputs of postgraduate education of 31 provinces (or autonomous) in China, on this basis, evaluates and compares the postgraduate education performance of different regions from the perspective of resource utilization efficiency. Finally, reaches the following conclusions: (1) there is roughly balance between Postgraduate Education Input and Output in most parts of the country. Among them, six regions including Jiangsu, Guangdong, Hubei, Zhejiang, Hunan and Shaanxi are in the country's leading level both in terms of postgraduate education input or output;(2) Beijing, Liaoning, Shanghai, Jilin, Tianjin and other regions' postgraduate education outputs are greater than postgraduate education input , and their postgraduate education resource utilization efficiency and performance are at a higher level;(3) Shandong, Sichuan, Henan, Hebei, Jiangxi and other regions' postgraduate education performance are relatively low, urgent need to improve the efficiency of postgraduate education resources through system reform and innovation.

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