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AN AHP ANALYSIS METHOD FOR THE INVESTMENT STRUCTURE OF HIGHER EDUCATION

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Introduction

At present, the operation and flow direction of the social, group and household funds in many countries are not reasonable, for instance, these funds flow less into education and talent training than into living consumption. This situation is not beneficial to social progress and human being development. The overall fund flow direction and operation structure should be studied so that it can guarantee the rational operation of the funds, form a scientific guidance and control measure for fund flow, and make the limited funds obtain great benefit for the society. The establishment of a rational education investment structure is a good way to overcome the irrational situation. In order to provide scientific and sufficient information for the establishment of a rational higher education investment structure, the authors of this paper use an AHP method, which integrates quantitative method and qualitative method into one, to evaluate the technical coefficient matrix in the input-output model.

1. The Input-output Model for Higher Education Fund Resources

Higher education is a precious resource of a country and a society, and the establishment of the input-output analysis model should be based on the principle that the user of the talent resource should invest for the training of the talent. Based on the interdependent relationship in the input-output model, research on the education investment structure can be carried out through the integration of qualitative method and quantitative ones. In talent resource, there is an interdependent relationship among the country, the society, the locality, the enterprises and the universities.

(1) Universities train the talent and need investment in funds and materials.

(2) Every area and profession needs talent resource, hence needs to invest funds to the universities.

(3) The revitalization of an enterprise and a company relies on talent resource, and needs manpower replenishment of graduates who have a

master of scientific and technical knowledge (expertise) and are a source of productivity.

(4) The country possesses the talent resource and is a main investment for universities.

(5) The educated talent obtains knowledge and capability, and uses his or her knowledge and capability as a capital to obtain earnings in the society. From this point of view, the educated talent improves his or her value, and satisfies his or her needs in personal quality and spirit, therefore, he or she needs to assume some of the expenditure of education received by him or her.

The five sectors mentioned above is all oriented to the society and become final products, therefore, the input-output model is based on the interdependent relationship among these sectors. The five sectors are the country, the locality, the enterprises, the universities and the individuals who receive higher education, and all of the five sectors have an absolute definition. The input-output relation is shown in following table:

output / input	country	locality	enterprise	university	individual	society
country	X_{11}	X_{12}	X_{13}	X_{14}	X_{15}	Y_1
locality	X_{21}	X_{22}	X_{23}	X_{24}	X_{25}	Y_2
enterprise	X_{31}	X_{32}	X_{33}	X_{34}	X_{35}	Y_3
university	X_{41}	X_{42}	X_{43}	X_{44}	X_{45}	Y_4
individual	X_{51}	X_{52}	X_{53}	X_{54}	X_{55}	Y_5

In the table, X_{ij} indicates the number of intermediate products which sector i invests to sector j, and this number is expressed as a value.

There is not any object flow among the five sectors, and the aim of this table is to study the interdependent relationship among them, therefore, only the relative importance of the interdependent relationship needs considering. This is a very complicated relation among these sectors in the use of talent, therefore, there is not an accurate quantitative method. The authors apply the Analytic Hierarchy Process (AHP) method and obtain a valuable solution. X_{ij} in the table reflect the degree of closeness in the flow of talent resource between sectors i and j. Y_i indicates the contribution value of sector i to the society.

$$\sum_{j=1}^{n} Xij=Xi, \quad \sum_{i=1}^{n} Xij=X^j, \quad \Sigma\,\Sigma\,Xij=\Sigma\,Xi=\Sigma\,X^j=T$$

for sector i there is relation $X_i+Y_i=Q_i$.

Q_i indicates the total value of sector i in the procession of talent resource.

2. The Application of AHP to the Evaluation of Input-output Table

X_{ij} in the above-mentioned table can be estimated by AHP method.

Assuming that $X_{ij} / T = X'_{ij}$, then, $X'_{ij} = X_{ij} / X\dot{j} \cdot X\dot{j} / T$,

For the row vector $\{X^1/T, X^2/T, ..., X^n/T\}$, it is used to evaluate the ratio of the intermediate products consumed by every sectors, and to establish a judge matrix. The question needed answering is which sector consumes more intermediate products in sector j, therefore, $X\dot{j}/T$, j=1, 2, ..., n.

For $\{X_{ij}/X\dot{j}\}$, it is used to evaluate which sectors have provided the intermediate products consumed by sector j, and to evaluate what is the ratio of intermediate products provided by the sectors. From every judge matrix, a column vector $\{X_{ij}/X\dot{j}\}$, j=1, 2, ..., n, can be obtained, therefore

$X' = \{X_{ij} / X\dot{j} \cdot X\dot{j} / T\}$, i,j=1, 2, ... n.

Furthermore, the number of the final products for the relative importance F can be estimated, and the technical coefficient matrix can also be evaluated.

Let's cite an example to illustrate the aforementioned method. The interdependent relationship among Liaoning area, the country, the locality, the enterprises and the individuals in a University in Shanyang forms an input-output table, and based on AHP method, the relative estimated value of X_{ij} can be obtained as follows:

output / input	country	locality	enterprise	university	individual	society	sum
country	0.0312	0.020	0.025	0.0198	0.091	0.34	0.1880
locality	0.009	0.0298	0.01	0.025	0.008	0.08	0.0818
enterprise	0.004	0.0117	0.023	0.015	0.005	0.07	0.0587
university	0.0398	0.0387	0.053	0.049	0.051	0.39	0.2315
individual	0.0001	0.003	0.005	0.008	0.008	0.41	0.0961
total value	0.0841	0.1042	0.116	0.1178	0.235		

Based on this table, the technical coefficient matrix can be calculated. This table is a basis for input-output strategy and can provide sufficient information for education investment structure.

3. The Calculation of Technical Coefficient Matrix and Complete Consumption Coefficient Matrix

In the table mentioned above, $\alpha_{ij} = X'_{ij}/X_j$, i,j=1,2,...,n, can be calculated by using X_{ij}, and in this formula,

$$X_i=\sum_{j=1}^{n} X'_{ij}+Y_i,\ i=1, 2, ..., n$$

Therefore, α_{ij} forms matrix $A=(\alpha_{ij})$, $i,j=1,2,...,n$, and we call this matrix the technical coefficient matrix.

$C=(I-A)^{-1}-I$ is called complete consumption coefficient matrix. In this formula, I is the unit matrix. The definition of the factors in matrix C is apparent. It is the sum of direct consumption, first-level indirect consumption, second-level indirect consumption ..., and consumption in every level.

It is shown that the factors in the fourth row of matrix C is : 0.0387, 0.0149, 0.0153, 0.0141, 0.0230.

The factors indicate respectively the higher education investment, and the quantitative relationship of talent resource needed by the five sectors. The ratios of the needed talent resource by considered that the country, the locality, the enterprises, the universities and the individuals are respectively 40%, 15%, 15%, 15% and 25%, i.e., for every 100 yuan used in universities, the country assumes 40 yuan respectively; the local government and area, the organizations which need talent, and the university assumes 15 yuan; and the individual assumes 25 yuan.

4. Conclusion

The importance of this method is that it can provide a ratio relationship for higher education investment and can also make the society understand its responsibility to higher education investment. This method is reliable. It has mobilized many educators and the public to participate in, and has been understood and accepted by the public.

Reference

1 Xu Shubo. The Analytic Hierarchy Process. Tianjin University Press, 1988