

# The Application of DEA Method in University Employment Service System

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## Abstract

This paper established C<sup>2</sup>R model and the corresponding projection model and evaluation index system using data envelopment analysis (DEA) method. In recent years, the application of DEA method in management of university employment service system has increasing, which produces various effects since efficiency evaluation of data envelopment analysis (DEA) for multiple input multiple output system has unique advantages. Analysis showed that, college students' public employment service system had efficiency loss in dealing with the problem of college students' employment after 2009, in which indicators of the number of teachers in colleges and universities, the number of public employment service agencies and financial subsidies for college graduates entrepreneurship had bigger influence on the effectiveness of college public employment service system, at the same time there is room for improvement.

*Keywords:* DEA method, projection model, employment service system, financial subsidies

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## 1 Introduction

Difficult employment in college students has become the key point of economists' research and attention. From the factors influencing college students' employment, Clune believed that the reason why unemployment rate of received good educators in developing countries is rising was that jobs were not enough by using new technology. The increasing demand for education was better than increasing jobs for the solution of employment [1]. However, Chapman thought the main factor influencing the employment was graduates' expectation for the future; in terms of income, students generally overestimated their expected income; the expectation will be influenced by family background, school, gender, profession, job information, etc [2]. The study on university students' employment problem in international scholars is established on the basis of mature labor market, while employment market for international college graduates is a part of the well-developed human resources market, which does not exist as a special human resources market. For this reason, most scholars study college students' employments are based on the modern human resources management thoughts and the labor market theory.

In recent years, the domestic also has many outstanding achievements on study of university students' employment service. Wang Chuan, et al. in Research on Establishment and Improvement of Multi-dimensional Three-dimensional Structure Employment Service System of Colleges and Universities [3] proposed the establishment and improvement of employment service system of multi-dimensional three-dimensional structure of colleges and universities can effectively relieve the huge pressure of employment. The "chain" structural model can effectively

support and improve the employment service system of colleges and universities. Zhuang Yingying in Innovation on the Construction of Substantive University Employment Service System referred that employment service system of colleges and universities can help job seekers to understand and grasp the current forms of employment and the employment situation, analyze the employment policies and regulations realize their professional interests, personal ideal, professional ability and the personalities and characteristics, and then to reach the high match between job seekers and occupations. Xiong Lihui, in The Analysis and Exploration on the Construction of Employment Service System of Colleges and Universities showed that the construction of universities employment service system was highly emphasized, including the enlightenment education on students' occupation, and the cultivation of professional quality, employment guidance, entrepreneurship instruction, etc. The modern university employment service system needed to think and improve problems including enrich the teaching contents, broaden the employment forms and offer the stable employment channels for students. This paper evaluated the influence of indicators DEA method for the numbers of teachers in colleges and universities and public employment service agencies and fiscal subsidies for college graduates entrepreneurship.

## 2 The Construction of DEA Analysis Model

The basic model of DEA method is the C<sup>2</sup>R model, which is a problem about fractional programming. It defines the efficiency of each decision making unit as the ratio of the weighted output and weighted inputs of decision making units, and solves the optimal weight coefficient and the efficiency value by establishing linear programming [6].

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DEA method has two kinds of models in the evaluation for decision making unit relative efficiency, namely the input angle efficiency measurement model and output angle efficiency measurement model. The checked out efficiency level of these two methods is completely equal under the hypothesis of constant returns to scale (CRS). We assume that the employment service system of colleges and universities with accepting evaluation have n decision making units (DMU) in total. For some selected decision making unit, dual program of C<sup>2</sup>R model for judging the effectiveness of that unit is as follows:

$$D_{C^2R}^I \begin{cases} \min = \theta \\ \sum_{j=1}^n Y_j \lambda_j + S^- = \theta X_0 \\ \sum_{j=1}^n Y_j \lambda_j - S^+ = Y_0 \\ \lambda_j \geq 0, j = 1, 2, \dots, n \\ S^- \geq 0, S^+ \geq 0 \end{cases}$$

In C<sup>2</sup>R model, input vector is  $X_j = (x_{1j}, x_{2j}, \dots, x_{mj})^T, j = 1, 2, \dots, n$ , output vector is  $Y_j = (y_{1j}, y_{2j}, \dots, y_{sj})^T, j = 1, 2, \dots, n$ ,  $X_{mj}$  expresses the input of the m kind of resource to the j decision-making unit;  $y_{sj}$  expresses the output of the j kind of resource to the s product.  $X_0$  and  $Y_0$  represent the input and the n output of the 0 decision-making unit  $DMU_0$ , respectively.  $\theta$  represents efficiency value of being criticized decision-making unit  $DMU_0$ .  $\lambda_j$  is a mix proportion of the j decision-making unit in reconstructing a valid DMU combination relative to  $DMU_0$ . Among them,  $S^- = (s_1^-, s_2^-, \dots, s_m^-)^T$ ,  $S^+ = (s_1^+, s_2^+, \dots, s_m^+)^T$  is relaxation value.

DEA efficient decision making units are distributed in a hyperplane  $\pi$ , which is called relatively effective surface of DEA, and the other points on the hyperplane  $\pi$  are also DEA efficient. Put a non DEA efficient decision making unit on the hyperplane  $\pi$  for "projection", how big the gap between it and the corresponding DEA validity is can be measured. Find out the index quantity needs to be improved in input and output aspects and the optimal quantity should be reached when we turn a non DEA efficient decision making unit into DEA validity.

### 3 The Application of DEA Method

In order to establish a reasonable index system, choose the right model and make objective analysis. We must first have a correct working procedure so as to maximize

the advantages of DEA method and provide more reasonable information. General steps of DEA method are as follows:

- (1) The confirmation of evaluation objectives. The most main function of DEA method is "relative advantages and disadvantages" evaluation for multiple similar unit. The confirmation of evaluation target is the primary problem of the application of DEA method since the determination of evaluation target directly affects a series of problems, such as the choice, the determination of input and output indicators of decision making units.
- (2) The selection of decision making units. The most basic requirement of choosing DMU is similar unit because the characteristic of DEA method itself is relative effectiveness evaluation between the similar types of DMU. The selection of DMU is essentially determining the reference set. Therefore, the selection of DMU should meet the following basic characteristics: with the same target, mission, external environment and input and output indicators. The selection of decision making units has certain representativeness [7].
- (3) The establishing of input/ output index system. The establishing of input/ output index system is a premise work of applying DEA method. This phase needs to do the following works: the input and output indexes are fully representative and with independence; the selection of input vector and output vector reflect the evaluation purpose as comprehensive as possible; the qualitative and quantitative relationship between the input vector and the output vector should be taken into account; the diversity of input/ output index system should be taken into consideration.
- (4) The evaluation and analysis of results. On the basis of the above work, the computed results are analyzed and compared, find out the cause of the invalid unit, and provide the way of further improvement; examine the rationality of the evaluation results according to qualitative analysis and forecasting results. The DEA model can be used to evaluate several schemes when necessary, and analyze the results comprehensively or combine with other assessment methods or information provided by other methods for comprehensive analysis.

## 4 Empirical Analysis

### A. SAMPLE SELECTION

The DEA method required that sample size must be larger than index number. Based on this, this article selected students' employment support policies in some city from 2005 to 2012 as sample indicator. There were eight samples in total with enough representativeness, which complied with the relevant requirements of DEA model. The input and output variables are shown in table 1:

Table 1 The input, output raw data of relative effectiveness evaluation on university student's public employment service system in some city

Year	Public employment service (pc)	For-profit employment service (pc)	The number of graduation (million)	Employment rate (%)	Initial wag (RMB)
2005	270	32	0.84	79.2	1550.3
2006	251	38	0.96	86.3	1603.2
2007	225	42	1.04	70.2	1689.7
2008	210	51	1.35	65.8	1723.6
2009	246	65	1.89	50.6	1792.0
2010	264	75	2.62	61.1	1895.6
2011	271	86	3.21	70.0	1963.2
2012	277	97	4.01	53.9	2053.9

## B. RELATIVE EFFECTIVENESS ANALYSIS

We substituted data after dimensionless processing in table 1 into the constructed C2R model, solve DEA model linear programming using LINGO8.0 software, obtain efficiency value of college students' the public employment service system from 2005 to 2012. Effective value  $\theta$  was 1 in 2005-2008, 2012 and the slack variable  $s$  was zero. According to the basic principle of the DEA method, we knew that university students' employment system was weak DEA effective in solving the college students' employment in 2005-2008 and 2012. Effective value  $\theta$  in 2009-2012 showed that college public employment service policy did not reach Pareto optimality in dealing with college students' employment in these 3 years. But the effectiveness was very close to 1, it was efficient in the labor market construction especially for labor services of college graduates employment and construction of information platform. Validity coefficient was less than 1, however, to some extent also illustrated its existence of efficiency loss in terms of system performance, and still there was a Pareto improvement space. Thus, even though the public employment service system improves the labor and the butt joint of the market and plays a huge role in

promoting employment, the current labor department adopts vulgar policy management way that enlarges the work cost.

## C. THE PROJECTION ANALYSIS OF NON DEA EFFECTIVE DECISION MAKING UNITS

According to the relative effectiveness analysis of college students public employment service system, we concluded that relative effectiveness of college students' public employment service system was insufficient in solving the employment problem of college students in 2009-2011. Therefore, the non DEA effective decision making units should be analyzed by projection. The principle of projection analysis explained that when the college students public employment service system of evaluation system achieved completely efficiency, the input index and output index should reach the level through the non DEA effective year projection analysis, thus to point out the improvement direction of non DEA efficient decision making units. Table 2 is shadow analysis results of college students' public employment service policy of non DEA efficient.

Table 2 shadow analysis results of college students' public employment service policy of non DEA efficient

Year	The target input quantity			The target output quantity	
	Public employment service agency (pc)	Employment agencies for profit (pc)	The number of graduates (million)	Employment rate (%)	Initial wage (RMB)
2009	237	63	1.84	70.8	1758.3
2010	236	71	2.19	68.0	1769.6
2011	251	85	2.96	69.2	1983.7

We can know from table 2 that, the increasing of the number of the public employment service agencies and employment agencies for profit was beneficial to the improvement of the college students' employment rate. Take 2009 as an example, under the condition of meeting the need of the college students' employment rate was 70.8% and the initial wage was 1758.3 RMB, the number of public employment service agency shall be reduced to 237, the number of employment agencies for profit should be decreased to 63, the number of graduates decreased to 18400 persons. As previously mentioned, the decreasing of the number of college graduates was lack of implementation conditions on the premise of popularization of higher education. However, under the background of the comprehensive construction and specification of the Labor market, we not only need to improve the public employment service system, increase the number of public employment service agencies, but

also need to improve the working efficiency of the public employment service agencies. Therefore, the public employment service agencies exist low efficiency problem in dealing with the problem of employment especially college students employment problem, also involve in loss problem of labor productivity in public sector.

## 5 Conclusion

College students' public employment service system is an important measure to promote university students' employment. Take public employment service agencies as an indicator of measuring the effectiveness of the public employment service system, the increase of the absolute quantity promote the university students' employment. But in execution efficiency, there are a lot of deficiencies in such aspects, for example, the

infrastructure construction, construction of information network and code of conduct, etc, which affect the commitment and implementation of the specific employment policy since China's employment agency is in its infancy. Therefore, we should improve the public employment service system from the solution, including further perfecting the function of the university students' employment agency, establish the status of university students' employment market intermediaries; maximize the role of market in resource configuration of college graduates, raise the service level of university students' employment market intermediary; regulate the market behavior of private college students' employment agency

to establish a transparent, open and scientific compensation system for the university students' employment, establish labor information system including the labor supply and demand information system and unemployed early-warning information system, develop the Internet employment service suited to the characteristics of the college graduates applying for a job, promote the employment information release and joint online recruitment activities of public employment service institution of labor and social security department combined with the education department, the personnel department.

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