University Teachers’ Performance Appraisals Model Based on DEA and AHP

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ABSTRACT: The university teachers’ performance appraisals model decides the development of scientific research. And a set of scientific, reasonable and comprehensive model is the premise and foundation to evaluate it. First, this article analyses the domestic and foreign university teachers’ performance appraisals model. Second, it combines the current teachers’ performance appraisals theory and practice research, and discusses the questionnaire suitable for the university teachers’ performance appraisals model in our country. Third, through the questionnaire data analysis, the paper uses factor-analysis-method to screen indexes. Fourth, the paper uses AHP method and calculates the index weights for all levels. Finally, the paper establishes the university teachers’ performance appraisals index model based on DEA.

Categories and Subject Descriptors: K.3.1 [Computer Uses in Education]; Collaborative learning

General Terms: Learning index, Collaborative learning

Keywords: Performance Appraisals, Index System, AHP, Quantization.

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1. Introduction

Since the late 1990s, market economic structure in our country has gradually established and perfected, and the management of university and other education institutions have also became scientific and normative. The core content of the university personnel reform is employing and distribution reform. It is deepened, explored and advanced step by step. Therefore, a scientific, fair, objective and accurate performance appraisals model is urgently needed as the premise and basis of the personnel system reform.

In 1986, Committee Of Vice Chancellors And Principals and the University Grants Commission (CVCP/UGC) divided the performance appraisals index into three classes: first are input indexes, these indexes mainly reflect the available resources, manpower and funds; second are process indexes, these indexes mainly reflect the utilization rate of resources, management and organization behavior in the course of running; third are output indexes, mainly reflect the educational effectiveness and output [1]. In December 1998, the British government put forward the performance and salary (Performance Related Pay) teacher evaluation system [2]. The scholars in our country widely did research on universities and teachers’ performance appraisals since the late 1990s [3]. Jia et al emphasized that the research first ought to make scientific, systematic evaluation index model. Second, different evaluation content and index system should be developed based on the function of work respectively. Third, the research should further improve the appraisal methods, extend the scope, strengthen the three-dimensional evaluation and carry out the dynamic...
assessments through the truth. Finally, the research should enhance transparency in the work and fully implement people’s right to know, to participate, to choose and to supervise [4]. Liao discussed the performance appraisals procedures, the standard, the content, the method and the use of the results. Besides, he analyzed the relationship between performance appraisals and appointment [5]. Fang put forward the overall train of thought to strengthen quantitative assessment on the basis of qualitative assessment and to combine with the annual assessment on the basis of regular assessment [6].

Chinese university teachers’ performance appraisals model is in an exploration stage, it only pays attention to process and ignores the results as same as pay attention to the quantity and ignores the quality. Besides, it lacks a clear purpose so that it couldn’t play expected incentive effect. On the other hand, evaluation indexes should be formulated combining with the domestic universities features. However, some universities index system are too simple and it can’t fully investigate teachers’ comprehensive performance; some are too complex, too harsh, and they make teachers only pay attention to complete the task and can’t take innovation and upgrade aspects in account. This resulted in the lack of comprehensive and maneuverability.

The university teachers’ research performance appraisals system decides the development of university scientific research ability. Constructing a set of scientific, reasonable and comprehensive model of university teachers’ performance appraisals model is the premise and foundation to evaluate it. How to correctly assess and evaluate university teachers’ academic performance is very important, it has directly practical significance to our country’s development of colleges and universities and promotion to scientific research. It is not only the methods to understand the academic quality, but also the guarantee to improve the academic quality. This paper aims to analyze the situation and characteristics of university teachers’ performance appraisals, discuss the index system and scientific method of university teachers’ performance appraisals domestic and abroad, develop and optimize foreign university teachers’ performance appraisals model and eventually construct a system suitable for Chinese national conditions based on AHP.

2. University teachers’ performance appraisals index system framework design

The design of appraisal index is a very important basic work in university teachers’ performance appraisals. The index design includes appraisal standard, appraisal index, appraisal index quantification, weight, appraisal main body choice etc.

Firstly, this paper discusses the establishment of performance appraisals model and the establishment of the weight; it should combine with the current theory and practice research about teachers’ performance appraisals. Secondly, through the design of the questionnaire and the analysis of the questionnaire data, this paper adopts factor-analysis-method to screen and confirm indexes. Thirdly, the paper uses AHP method to calculate the index weights for all levels. Ultimately, it establishes the university teachers’ performance appraisals index model based on DEA.

Based on the input-output analysis of teachers’ performance and the basic principles of constructing DEA evaluation index system, the following chapter respectively analyzes the input and output indexes.

2.1 The establishment of input index evaluation

Teachers’ performance input is from manpower, financial resources and material resources and the corresponding evaluation index should also be determined based on these three aspects [7]. The investment in school is mainly administrative personnel, crew and other personnel investment. It maintains the normal teaching and scientific research, and living environment. So, these aspects are considered as environmental factors, and they have the consistent influence on each teacher. Therefore, these factors are not considered in the input index. In the view above, the input models of teachers’ performance can be divided into two categories.

(1) Manpower input index. This is mainly the teachers’ personal intellectual labor. From requirements of Chinese current title accreditation, teachers’ positional title is the reflection on teachers’ academic ability, professional quality and working level in some degree. So we have the title indicators as one of input indexes.

(2) Finance input index. From the current situation of university teachers, the finance input for teacher is relatively clear. One part is the salary every teacher has, and another part is the kinds of benefits some teachers enjoy(not including bonus, because bonus assign is according to the performance appraisals).

2.2 The determination of output index

2.2.1 The collection of output index

In educational assessment, the methods of assessment index establishment contain content-analysis-method, factor-group-method and so on. Content-analysis-method starts from the essence attributes analysis, and determines the appearance of nature for the basis for index selection. Factor-group-method refers to screen the indexes related to assessment object. The factors related to the assessment object are searched through the related data. The research has connotation analysis on university teachers and obtains the indexes through factor-group-method. The indexes to be analyzed through factor-group-method are the ones used in domestic and foreign research and practice.

According to chapter one about the summary of home and abroad research status, the paper combines the index
system determined by KPI theory and our university operation management features, then goes through expert consultation, and ultimately determines the one-grade indicators in the university teachers’ performance appraisals [8]. The one-grade indicators include 3 dimensions, namely teaching ability indicator, scientific research ability indicator and negative indicator. Through literature collection and questionnaire collection, this paper gets 14 two-grade assessment index.

2.2.2 Analytic hierarchy process to determine the output index weight
1. Regularizing each column of the matrix, there is
\[
\bar{b}_{ij} = \frac{a_{ij}}{\sum_{i=1}^{n} a_{ij}}, \quad i, j = 1, 2, ..., n.
\]
2. Summing up each column after regularization of the matrix by row
\[
\bar{W}_i = \sum_{j=1}^{n} \bar{b}_{ij}, \quad i = 1, 2, ..., n.
\]
3. Normalizing the vector \( W = [\bar{W}_1, \bar{W}_2, ..., \bar{W}_n]^T \), and get
\[
\overline{W}_i = \frac{W_i}{\sum_{i=1}^{n} W_i}, \quad i = 1, 2, ..., n.
\]
4. Calculating the largest eigenvalue \( \lambda_{\text{max}} \) in the matrix, there is
\[
\lambda_{\text{max}} = \sum_{i=1}^{n} (AW)_i / nW_i.
\]
Then, introduce the consistency ratio parameter
\[
CR = \frac{CI}{RI}.
\]
The consistency index of the matrix is
\[
CI = \frac{\lambda_{\text{max}} - n}{n-1}.
\]
Finally, introduce disposable random index \( RI \).

If CR is less than 0.1, \( W \) can be used as a weight vector; or else adjust the matrix. Using the above method, we can get the index weight vector.

This paper calculates the feature vector of the matrix by AHP [9]. Results are in the following table.

2.3 Output index quantification

2.3.1 Teaching ability indicator quantification
(1) Class teaching performance score \( (F_i) \)
\[
F_i = (K_1 + K_2 + K_3 + N * K_4) * J
\]
\( K_1 \) means class teaching coefficient; \( K_2 \) means teaching quality coefficient; \( K_3 \) means professional technology post coefficient; \( K_4 \) means adding class coefficient; \( N \) means adding class number; \( J \) means planning class hour(experimental class hour not include).

(2) Practice teaching performance score \( (F_2) \)
\[
F_2 = R * J * K_1 * K_2 * K_3
\]
\( R \) means students number; \( J \) means planning week number; \( K_1 \) means practice type; \( K_2 \) means teaching quality coefficient; \( K_3 \) means professional technology post coefficient.

2.3.2 Scientific research ability indicator quantification
(1) Scientific research task performance scores \( (C_i) \)
Scientific research task indicator includes approving projects and not approving projects. The calculation formula is:
\[
C_i = \frac{E_i}{R_i} P_i + \frac{F_i}{R_i} P_i.
\]
In the formula, \( E_i \) means the level score that the \( i^{th} \) scientific research project is formally approved (basic score + funds score), the basic score partition according to undertook project and subordinate task; the funds score is calculated according to the actual gained scientific research funds multiplied by 0.8 cent per million. \( F_i \) means the level score that the the \( i^{th} \) scientific research project does not approved by the election; \( R_i \) means the unit participation coefficient of the \( i^{th} \) scientific research project; \( P_i \) means the personal participation coefficient of the \( i^{th} \) scientific research project.

(2) Science and technology achievement indicator performance score \( (C_2) \)
Science and technology achievement indicator include reward, achievement appraisal and accepted project. The calculation formula is:
\[
C_2 = \frac{E_i}{R_i} P_i + \frac{F_i}{R_i} P_i + \frac{G_i}{R_i} P_i,
\]
In the formula, \( E_i \) means the \( i^{th} \) reward score; \( F_i \) means achievement appraisal score; \( G_i \) means the accepted project score; \( R_i \) means the unit participation coefficient of the \( i^{th} \) scientific and technological achievements -ents; \( P_i \) means the personal participation coefficient of the \( i^{th} \) scientific and technological achievements.

(3) Intellectual property rights indicator performance score \( (C_3) \)
Intellectual property rights indicator includes patent, the new variety right and copyright. The calculation formula is:
\[
C_3 = \frac{E_i}{R_i} P_i + \frac{F_i}{R_i} P_i.
\]
In the formula, \( E_i \) means the patent score that the \( i^{th} \) authorizes or awards; \( F_i \) means the copyright score of the \( i^{th} \) item; \( R_i \) means the unit participation coefficient of the \( i^{th} \) intellectual property rights; \( P_i \)

<table>
<thead>
<tr>
<th>Dimension</th>
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<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
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</thead>
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<td>RI</td>
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<td>0.00</td>
<td>0.58</td>
<td>0.90</td>
<td>1.12</td>
<td>1.24</td>
<td>1.32</td>
<td>1.41</td>
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</table>

Table 1. Average value of random disposable index.
<table>
<thead>
<tr>
<th>One-grade indicator</th>
<th>Two-grade indicator</th>
<th>Three-grade indicator</th>
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</thead>
<tbody>
<tr>
<td>Teaching ability indicator (0.37)</td>
<td>Two-grade indicator</td>
<td>Three-grade indicator</td>
</tr>
<tr>
<td>Class teaching (0.34)</td>
<td>Basic Knowledge, professional theory</td>
<td></td>
</tr>
<tr>
<td>Practice Teaching (0.11)</td>
<td>Course design, graduation practice, graduation design</td>
<td></td>
</tr>
<tr>
<td>Teaching-reform ability (0.19)</td>
<td>Combining students’ actual situation to make the corresponding reform in teaching</td>
<td></td>
</tr>
<tr>
<td>Postgraduate Guidance (0.12)</td>
<td>Performance of Guiding graduate</td>
<td></td>
</tr>
<tr>
<td>Teaching achievement (0.24)</td>
<td>Publication of teaching achievement</td>
<td></td>
</tr>
<tr>
<td>Scientific research ability indicator (0.50)</td>
<td>Scientific research task (0.24)</td>
<td>Approving projects, not approving projects</td>
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<td>Science and technology</td>
<td>Reward, achievement appraisal, accepted project, the</td>
<td></td>
</tr>
<tr>
<td>Achievement (0.16)</td>
<td>promulgated standards</td>
<td></td>
</tr>
<tr>
<td>Intellectual property rights (0.10)</td>
<td>Patent, new variety right, copyright</td>
<td></td>
</tr>
<tr>
<td>Thesis writing (0.19)</td>
<td>Journal papers, conference papers, books, reports</td>
<td></td>
</tr>
<tr>
<td>Achievement transformation (0.07)</td>
<td>Tangible product and intangible product</td>
<td></td>
</tr>
<tr>
<td>Personnel training (0.04)</td>
<td>Undergraduate instruction and innovative team cultivation</td>
<td></td>
</tr>
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<td>Science and technology communication (0.09)</td>
<td>Academic conference, science and technology cooperation, science and technology activities</td>
<td></td>
</tr>
<tr>
<td>Science and technology management (0.11)</td>
<td>Administrative position, academic position, individual honor</td>
<td></td>
</tr>
<tr>
<td>Negative indicator (0.13)</td>
<td>Project responsibility matters (0.35)</td>
<td>Scientific research task lag, scientific research accidents, and audit issues</td>
</tr>
<tr>
<td>Individual illegal behavior (0.65)</td>
<td>Academic cheating behavior, academic corruption</td>
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</tr>
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</table>

Table 2. Weight of college teachers’ performance appraisals index

<table>
<thead>
<tr>
<th>Semester</th>
<th>1st Semester</th>
<th>2nd Semester</th>
<th>3rd Semester</th>
<th>4th Semester</th>
<th>5th Semester</th>
<th>6th Semester</th>
<th>7th Semester</th>
</tr>
</thead>
<tbody>
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<td>Master</td>
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<td>35</td>
<td>35</td>
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<td>——</td>
<td>——</td>
</tr>
<tr>
<td>Doctor</td>
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<td>45</td>
<td>45</td>
<td>45</td>
<td>45</td>
<td>45</td>
</tr>
</tbody>
</table>

Table 3. Postgraduate guidance performance score standard

<table>
<thead>
<tr>
<th>National level</th>
<th>Provincial and ministerial level</th>
<th>Municipal level</th>
<th>School level</th>
</tr>
</thead>
<tbody>
<tr>
<td>400</td>
<td>200</td>
<td>100</td>
<td>20</td>
</tr>
</tbody>
</table>

Table 4. Teaching-reform project performance score standard

means the personal participation coefficient of the $i^{th}$ intellectual property rights.

(4) Thesis writing indicator performance score ($C_4$)

Thesis writing indicator includes journal papers, conference papers, books and reports. The calculation formula is:  
$$ C_4 = \Sigma E_i + \Sigma F_i + \Sigma G_i + \Sigma H_i $$  
In the formula, $E_i$ means the $i^{th}$ journal papers score; $F_i$ means the $i^{th}$ conference papers score; $G_i$ means the $i^{th}$ published book score (basic score and words count score), basic score is the published books, words count score is calculated by 2 to 1.5 cent per million words; $H_i$ means the reports score of the $i^{th}$ item; $R_i$ means the unit participation coefficient of the $i^{th}$ thesis writing; $P_i$ means the personal participation coefficient of the $i^{th}$ thesis writing.

(5) Achievement transformation indicator performance score ($C_5$)

Achievement transformation indicator includes tangible product and intangible product. The calculation formula
is: $C_i = \Sigma E_i R P_i + \Sigma F_i R P_i$. In the formula, $E_i$ means the $i^{th}$ tangible product score (basic score and income score); $F_i$ means the $i^{th}$ intangible product score (basic score and income score); $R_i$ means the unit participation coefficient of the $i^{th}$ achievement transformation; $P_i$ means the personal participation coefficient of the $i^{th}$ achievement transformation.

(6) Personnel training indicator performance score ($C_6$)

Personnel training indicator includes undergraduate instruction and innovative team cultivation. The calculation formula is: $C_6 = \Sigma E_i P_i + \Sigma F_i P_i$. In the formula, $E_i$ means the $i^{th}$ undergraduate instruction score; $F_i$ means the $i^{th}$ innovative team cultivation score (basic score and excellent score); $P_i$ means the personal participation coefficient of the $i^{th}$ personnel training.

(7) Science and technology communication indicator performance score ($C_7$)

Science and technology communication indicator includes academic conference, science and technology cooperation and science and technology activities. The calculation formula is: $C_7 = \Sigma E_i P_i + \Sigma F_i P_i + \Sigma G_i R P_i$. In the formula, $E_i$ means the $i^{th}$ academic conference score; $F_i$ means the $i^{th}$ science and technology cooperation score; $G_i$ means the $i^{th}$ science and technology activities score; $R_i$ means the unit participation coefficient of the $i^{th}$ science and technology communication; $P_i$ means the personal participation coefficient of the $i^{th}$ science and technology communication.

(8) Science and technology management indicator performance score ($C_8$)

Science and technology management indicator includes administrative position, academic position and individual honor. The calculation formula is: $C_8 = \Sigma E_i P_i + \Sigma F_i P_i + \Sigma G_i P_i$. In the formula, $E_i$ means the $i^{th}$ administrative position score; $F_i$ means the $i^{th}$ academic position score; $G_i$ means the $i^{th}$ individual honor score; $P_i$ means the personal participation coefficient of the $i^{th}$ science and technology management.

### 2.3.3 Negative indicators indicator quantification

(1) Project responsibility matters indicator performance score ($D_1$)

Project responsibility matters indicator includes scientific research task lag, scientific research accidents and audit issues. The calculation formula is: $D_1 = \Sigma E_i R P_i N_i + \Sigma F_i C_i S_i + \Sigma G_i C_i S_i$. In the formula, $E_i$ means the deducted score that the $i^{th}$ project task don’t finished before specified period; $R_i$ means the unit participation coefficient of the $i^{th}$ scientific research task; $P_i$ means the personal participation coefficient of the $i^{th}$ scientific research task; $F_i$ means the deducted score that $i^{th}$ project task safe liability accident happen in implementation and application process; $G_i$ means the deducted score that the $i^{th}$ project and achievement has serious audit issues; $C_i$ means the eight indicator performance score accumulation; $S_i$ means the ratio deducted by severity degree of the $i^{th}$ project.

(2) Individual illegal behavior indicator performance score ($D_2$)

Individual illegal behavior indicator includes academic cheating behavior, academic corruption and technical disclosure. The calculation formula is: $D_2 = \Sigma E_i C_i S_i + \Sigma F_i C_i S_i + \Sigma G_i C_i S_i$. In the formula, $E_i$ means the deducted score of academic cheating behavior of the $i^{th}$ project; $F_i$ means the deducted score of the academic corruption of the $i^{th}$ project; $G_i$ means the deducted score of the $i^{th}$ technical disclosure; $C_i$ means the eight indicator performance score accumulation; $S_i$ means the ratio deducted by severity degree of the $i^{th}$ project.

### 2.4 Establishment of the performance appraisals index system calculation method

This chapter analyzes teachers’ input and output. On the basis of this chapter, the paper establishes university teachers’ performance appraisals model based on DEA and AHP. The model is shown as figure 1.

### 3. Experimental analysis of university teachers’ performance appraisals based on DEA

The evaluated object is 15 teachers from a college. The
paper demands annual performance evaluation of the 15 teachers. Besides, this paper aims to have DEA appraisal system analysis on the evaluation results and proposes the corresponding improvement [10].

3.1 The evaluation index system and the index data
According to the established evaluation index system, this chapter combines with the data collection on the basis of the evaluation purpose and the evaluated teachers’ characteristics, and finally evaluation index system includes 2 input indexes and 3 output indexes:

2 input indexes are $X_1$ (Title coefficient) and $X_2$ (Income coefficient); 3 output indexes are $Y_1$ (Teaching ability indicator score), $Y_2$ (Scientific research ability indicator score) and $Y_3$ (Negative indicator score).

After the original data conversion, the indicators are all dimensionless. The original data (omitted) and the final conversion plan of data calculation adopt the college's calculation methods.

The title coefficient of professor is 1.4, the title coefficient of associate professor is 1.2, the title coefficient of lecturer is 1.1, and the title coefficient of assistant is 1.0.

Input and output index data of the 15 teachers are shown in the following table, wherein all the teachers are signed as order number.

According to the purpose of evaluation, this paper selects two DEA models to evaluate the model. The models can reflect technology efficiency of the decision unit, scale efficiency and technology scale comprehensive efficiency. The models are C²-R-D form and C²GS²-D form [11].

It supposes there are n decision making units $DMU_j$ ($j = 1, 2, ..., n$). Every decision-making-unit has $k$ kinds inputs and $s$ kinds outputs. The input and output vector of $j^{th}$ decision-making-unit $DMU_j$ are $X_j = (x_{ij}, ..., x_{mj})^T > 0$, $Y_j = (y_{ij}, ..., y_{sj})^T > 0$, $j = 1, ..., n$. $x_{ij}$ shows the $i^{th}$ input data of the $j^{th}$ decision-making-unit, $y_{ij}$ shows the $r^{th}$ output data of the $j^{th}$ decision-making-unit. $DMU_0$ is the evaluated decision-making-unit, and the input and output vector are namely $X_0$ and $Y_0$. The model is the antithetical model to the original model. The optimum solution is $\lambda^*, S^-, S^+, \theta^*$. The DEA model of C²-R-D form is shown. The min è means the minimum, the four following linear inequality are the constraint conditions of it.

\[
\begin{align*}
\min & \quad \theta \\
\text{s.t.} & \quad \sum_{j=1}^{n} \lambda_j X_j + S^- = \theta X_0 \\
& \quad \sum_{j=1}^{n} \lambda_j Y_j - S^+ = Y_0 \\
& \quad \lambda_j \geq 0, j = 1, ..., n \\
& \quad S^- \geq 0, S^+ \geq 0
\end{align*}
\]

The DEA model of C²GS²-D form is similar to the C²-R-D form, but the optimum solution is $\lambda^*, S^*, S^+, \theta^*$. The DEA model of C²GS²-D form is shown. The min $\sigma$
means the minimum, the four following linear inequality is the constraint conditions of it.

\[
\begin{align*}
\min & \quad \sigma \\
\text{s.t.} & \quad \sum_{j=1}^{n} \lambda_j X_j + S^- = \sigma X_0 \\
& \quad \sum_{j=1}^{n} \lambda_j Y_j - S^+ = Y_0 \\
& \quad \lambda_j \geq 0, j = 1, ..., n \\
& \quad S^- \geq 0, S^+ \geq 0
\end{align*}
\]

(1)

The first model and the second are ordinary linear programming; they can be solved through some business mathematics software programming. This paper uses mathematical programming software ILOG OPL Studio developed by ILOG Company. The solving process is: first, substitute the evaluated teachers' data into the two models; second, programming; third, obtain the calculation results. According to the technology and scale efficiency nature of C2-R-D model and C2GS2-D model as well as the calculation results, relative validity of the evaluated teachers' performance is shown in the table below.

From the appraisal examples, in this 15 teachers, 8 are technology effective, 7 are not effective, and the minimum value is 0.7888; 6 are scale effective, 9 are not effective, and the minimum value is 0.5091, besides, 8 teachers' benefit of scale increase progressively. The result shows that teachers' performance remains to be improved in large quantities, and scale non-effective problem is prominent.

From table 7 and table 8, it is found that the reason caused teachers non-effective is the scientific research gaps, namely the low score of scientific research ability indicator is the mainly reason of teachers' performance non-effective. Another version is that teachers' scientific research ability is different from each other largely. The deep-seated reason of this situation is what we called “Matthew effect” in sociology. To scientific worker, “Matthew effect” shows that a higher reputation scholar is easier to apply scientific research funds, publish at a high level in the academic journals and get research award. On the contrary, one's academic reputation is not significant, he would strive for the funds of scientific research and publication more difficultly. This evaluated teachers' practical situation is conform to the analysis. Therefore, it is important to establish a more fair competitive mechanism of scientific research, because the mechanism is an important content in the reform of scientific research management system, and it should offer more opportunities to the young teachers. At the same time, teachers who are weaker in research should be more active to apply scientific research task.

4. Conclusions

First, this article analyzes the domestic and foreign university teachers' performance appraisals model. Second, it combines with the current teacher performance appraisals theory and practice research, and discusses the questionnaire suitable for the university teachers' performance appraisals model in our country. Third, through the questionnaire data analysis, the paper uses factor-analysis-method to screen indexes and form index system. Fourth, the paper uses AHP method and

<table>
<thead>
<tr>
<th>Teacher</th>
<th>Title coefficient</th>
<th>Income coefficient</th>
<th>Teaching ability Indicator score</th>
<th>Scientific research ability indicator score</th>
<th>Negative indicator score</th>
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Table 6. Input and output index data of the evaluated teachers
calculates the index weights for all levels. Finally, it establishes university teachers’ performance appraisals index system based on DEA.

However, as a young professional field, university teachers’ performance appraisals is a very complex and challenging work, several problems remain to be further studied.

University teachers’ work is quite different from the material production sectors; the long-term and delayed effect is the main pattern of manifestation. In the short term, it is difficult to find its effect. How to deal with the long-term and delayed effect needs to be further in-depth study.

DEA method has much advantages to deal with the relative efficiency evaluation in multiple input and output system, but there are also shortcomings. First, it should study the DEA method itself. Second, it depends on the combination of DEA method and other method. Besides, what methods, how to combine are all need further study.

5. Acknowledgment

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Table 7. Relative validity of 15 evaluated teachers

<table>
<thead>
<tr>
<th>Teacher</th>
<th>$\theta^*$</th>
<th>$\sigma^*$</th>
<th>$P^* = \theta^<em>/\sigma^</em>$</th>
<th>$K^* = \Sigma \lambda_j$</th>
<th>Technology efficiency</th>
<th>Scale efficiency</th>
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<tr>
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<td>1.0000</td>
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<td>1</td>
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<td>Effective</td>
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<tr>
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<td>Non-effective, decrease progressively</td>
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<tr>
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<td>1.0000</td>
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<td>Effective</td>
</tr>
<tr>
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<tr>
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<td>1.0000</td>
<td>1</td>
<td>1</td>
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<td>Effective</td>
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<tr>
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<tr>
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<td>0.5091</td>
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<td>Non-effective, increase progressively</td>
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<tr>
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<td>1.0000</td>
<td>1</td>
<td>1</td>
<td>Effective</td>
<td>Effective</td>
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<td>0.9792</td>
<td>0.9550</td>
<td>Non-effective</td>
<td>Non-effective, increase progressively</td>
</tr>
</tbody>
</table>

References


Author Biographies

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