Prediction Model of Investment Scale for Electricity Transmission and Distribution Companies Under New Round of Power System Reform

Zhengjia Zhu and Zhixiong Liu

ABSTRACT

To improve the accuracy of the investment scale prediction of electricity transmission and distribution companies in comprehensive plan management, and improve the efficiency of resource allocation for investment income improvement. This paper constructs an improved investment scale indicator system for electricity transmission and distribution companies, and uses the combination of subjective and objective weights and the gray cluster trigonometric evaluation model for weight assignment and comprehensive evaluation. The comprehensive evaluation value and investment are calculated. The scale correlation analysis and the investment scale measurement model are used to test the model by using the estimated standard error test method. Finally, a transmission and distribution company located in a city of northern China is selected as the research subject. The results show that the investment scale index system of electricity transmission and distribution companies constructed in this paper can comprehensively reflect the investment ability of electricity transmission and distribution companies; the investment scale prediction model can directly reflect the total investment of these companies, and predict the investment scale, which provides complete calculation for these companies.¹

INTRODUCTION

With the implementation of the new round of power system reform, the distribution and sale side of the power supply gradually opened, and new ETDCs appeared on a large scale. Investment scale prediction is one of the important

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components in the comprehensive plan management. The investment scale of the company is related to the vital interests of its own and end users, which affects the efficiency of the company's resource allocation. Under the new round of power system reform, changes in the state's regulatory methods and regulatory scope have put enormous pressure on enterprises in large-scale investment. Therefore, it is of great practical significance to study how to formulate a scientific and reasonable investment scale prediction model to avoid waste of investment resources and to make a better investment plan for ETDCs.

The existing researches are carried out from many aspects such as investment theory and investment model research [1-5], which provide reference for the investment scale prediction of ETDCs. However, there are few related researches on ETDCs as research subjects. Based on the theory of regression analysis, this paper constructs a comprehensive investment scale evaluation index system and a relatively intuitive investment scale prediction, and then quantitatively analyzes the investment scale of new ETDCs, enabling ETDCs identify their own investment capabilities to efficiently allocate resources.

CONSTRUCTION OF INVESTMENT SCALE EVALUATION INDICATORS FOR ETDCS

We first analyze the investment scale evaluation indicator system from existing indicators and other types of indicators. Secondly, based on the existing investment scale evaluation indicators of ETDCs, we build a comprehensive transmission and distribution company investment scale evaluation index system according to comprehensive policy, development, sociality and other indicators (as shown in Figure 1).

Figure 1. Construction of investment scale evaluation indicators for ETDCs.
Analysis of the Existing Indicators

ANALYSIS OF THE EXISTING INDICATORS ON ETDCS

According to different angles of investment scale evaluation, we divide the investment scale evaluation system into Class 1, 2 and 3 indicators to sort out the scale of investment evaluation indicators.

(1) Analysis of Class 1 indicators
Class 1 indicators focus on the economic indicators from the capital expenditure, fixed assets investment, total assets and business income to determine the scale of investment.

(2) Analysis of Class 2 indicators
Class 2 indicators focus on the capital indicators (including asset liability ratio, depreciation, total assets and rate of return on common stockholders' equity (ROE)) and the cost indicators (including business income, gross profit and line loss rate).

(3) Analysis of Class 3 indicators
Class 3 indicators focus on development indicators, capital indicators, and operation indicators. The development indicators include the ten major investment items of development levels of enterprises. The capital indicators include asset liability ratio, electricity sales and average electricity price. The operation indicators include cost, income and profit.

ANALYSIS OF OTHER INDICATORS

We divide other indicators into policy assessment indicators, modern company development indicators and ETDCs’ responsibility indicators to sort the indicators out from three perspectives of policy, development and responsibility.

(1) Policy assessment indicators
Under the new electricity reform, power regulation is facing new requirements and challenges. Therefore, policy assessment indicators should be included in the confirmation of its investment scale. In the economic aspect, total profit, economic value added (EVA), asset liability ratio and ROE have become one of the key aspects of the regulation of ETDCs by relevant government departments. In terms of social benefits, government satisfaction and the ability to promote economic and social development are also the focuses of policy assessment under the new situation. Therefore, to ensure the maximization of investment returns, it is necessary to take EVA and government satisfaction as key evaluation indicators.

(2) Modern company development indicators
As ETDCs emerge, the modern company development indicators are introduced to ensure their sustainable development and the rationality of investment, improve the speed and quality of development and reflect social value and significance. Modern company development should consider both economic indicators and social indicators. The economic indicators include EVA, profits, management costs, market share. The social indicators include satisfaction level and service efficiency.
(3) ETDCs’ responsibility indicators

As a force to promote social harmony and stability, power companies should perform fully duties of the power system and achieve the safety, economy and environmental protection of social power supply. Therefore, the social responsibility assessment indicators should be included when confirming the scale of their investment. The premise of safety and high-quality power supply is that the power supply is reliable and the power supply voltage is qualified. The increase of the household power supply rate reflects the satisfaction of end users’ power demand to a certain extent, which is a concentrated expression of social benefits.

Based on the above analysis, we comprehensively constructed an indicator system of influencing the investment scale.

**Construction of Improved Evaluation Indicator System**

According to the analysis of the existing indicators, we found that most of the evaluation indicators of investment scale of ETDCs only include economic indicators, lack of evaluation indicators such as policy and social categories, by which ETDCs cannot make comprehensive decisions. Therefore, we will synthesize various indicators to build an improved evaluation indicator system of investment scale for ETDCs.

The various indicators can be classified as four categories: asset quality, company development, business performance and social services of ETDCs. The asset quality of ETDCs is used to evaluate the economic development quality of the company; the company development is used to evaluate the company's future development potential; business performance is used to evaluate the company's investment ability from the perspective of company's profit; and the social service is used to evaluate the necessity of investment.

Therefore, considering the coordination between the future development of ETDC and the economy and society, and following the principles of scientificalness,
systematicness, comprehensiveness and hierarchy [6], an evaluation indicator system for investment scale of ETDCs is constructed (as shown in Figure 3).

Combined with Figure 3, we summarize every indicator’s computational formula and its target orientation in Table 1.

**Figure 3. Investment scale evaluation indicator system for ETDCs.**

**TABLE I. INVESTMENT SCALE INFLUENCING INDICATOR LIBRARY OF ETDCS.**

<table>
<thead>
<tr>
<th>Second level indicator</th>
<th>Third level indicator</th>
<th>Computational formula</th>
<th>Target orientation</th>
</tr>
</thead>
<tbody>
<tr>
<td>D^1</td>
<td>Total liabilities / Total assets</td>
<td>Moderate indicator</td>
<td></td>
</tr>
<tr>
<td>D^2</td>
<td>Net profit / Average net assets</td>
<td>Forward indicator</td>
<td></td>
</tr>
<tr>
<td>D^3</td>
<td>Unit income growth / Unit investment growth</td>
<td>Forward indicator</td>
<td></td>
</tr>
<tr>
<td>Z^1</td>
<td>Year-end load growth / Total load at the beginning of the year</td>
<td>Moderate indicator</td>
<td></td>
</tr>
<tr>
<td>Z^2</td>
<td>Total capacity of substation equipment / Maximum load in power supply area</td>
<td>Moderate indicator</td>
<td></td>
</tr>
<tr>
<td>Z^3</td>
<td>Year-end total assets growth / Total assets at the beginning of the year</td>
<td>Moderate indicator</td>
<td></td>
</tr>
<tr>
<td>Z^4</td>
<td>Year-end electricity sales / Total electricity sales at the beginning of the year</td>
<td>Moderate indicator</td>
<td></td>
</tr>
<tr>
<td>Y^1</td>
<td>EVA / Net assets</td>
<td>Forward indicator</td>
<td></td>
</tr>
<tr>
<td>Y^2</td>
<td>Business income / Net assets</td>
<td>Forward indicator</td>
<td></td>
</tr>
<tr>
<td>Y^3</td>
<td>(Electricity supply – Electricity sales) / Electricity supply</td>
<td>Reverse indicator</td>
<td></td>
</tr>
<tr>
<td>F^1</td>
<td>0.5Y^1 + 0.5Y^2</td>
<td>Forward indicator</td>
<td></td>
</tr>
<tr>
<td>F^2</td>
<td>Total number of electrified households / Total number of households</td>
<td>Forward indicator</td>
<td></td>
</tr>
<tr>
<td>F^3</td>
<td>1- Average power interruption duration / Statistics time</td>
<td>Forward indicator</td>
<td></td>
</tr>
</tbody>
</table>
Note: $V_a$, $V_b$, $V_c$, and $V_d$ indicate the qualified rate of power supply voltage of detection points of class A, B, C, and D, respectively.

**COMPREHENSIVE EVALUATION AND PREDICTION MODELS OF INVESTMENT SCALE FOR ETDCS**

In the section, we build comprehensive evaluation and prediction models of investment scale. Firstly, the comprehensive evaluation model of investment scale includes: the comprehensive weight model combining the subjective and objective methods of the entropy weight method (EWM) and the network analysis method (NAM), and the indicator standardization processing model and the gray clustering trigonometric function evaluation model for determining the evaluation results. Secondly, the investment scale prediction model includes: the correlation evaluation model of comprehensive evaluation value and investment scale, the investment scale measurement model and the investment scale examining model (As shown in Figure 4).

**The Weight Determination of Investment Scale Indicators**

To fully reflect the objectivity of weight determination and reduce the influence of human factors, we adopt a comprehensive weight determination method [7-8], which combines EWM and NAM to ensure the rationality of weight to the greatest extent.

![Figure 4. Correlation between models.](image-url)
OBJECTIVE WEIGHTING MODEL OF EWM

Step 1: collect and process raw data, then standardized indicator vector $Y_{ij}$ is obtained.

$$Y_{ij} = \begin{bmatrix} y_{i1} & y_{i2} & \cdots & y_{im} \\ y_{21} & y_{22} & \cdots & y_{2m} \\ \vdots & \vdots & \cdots & \vdots \\ y_{n1} & y_{n2} & \cdots & y_{nm} \end{bmatrix}$$

(1)

where $y_{ij}$ is standardized value of $i$ indicator at the $j$-th level.

Step 2: calculate the uncertainty of the indicator $H(y_i)$. The formula is

$$H(y_i) = -\sum_{j=1}^{n} \left( \frac{1+y_{ij}}{y_{i}} \ln \frac{1+y_{ij}}{y_{i}} \right)$$

(2)

where $y_i = \sum_{j=1}^{n} (1+y_{ij})$.

Step 3: calculate the information entropy of the indicator $e(y_i)$. The formula is

$$e(y_i) = \frac{H(y_i)}{\ln n}$$

(3)

where $0 \leq e(y_i) \leq 1$.

Step 4: calculate the objective weight of the indicator $\xi_i$. The formula is

$$\xi_i = \frac{1 - e(y_i)}{m - \sum_{i=1}^{m} e(y_i)}$$

(4)

where $0 \leq \xi_i \leq 1$, $\sum_{i=1}^{m} \xi_i = 1$

SUBJECTIVE WEIGHTING MODEL OF NAM

In NAM, the ranking vectors are obtained by the eigenvalue method. If the consistency test is satisfied, the above eigenvectors will be the ranking vectors.
(weights) of network elements. The ranking vectors of all network elements are combined and constructed as 

$$W_{ij} = \begin{bmatrix} w_{i1}^{j1} & w_{i1}^{j2} & \cdots & w_{i1}^{nj} \\ w_{i2}^{j1} & w_{i2}^{j2} & \cdots & w_{i2}^{nj} \\ \vdots & \vdots & \ddots & \vdots \\ w_{in}^{j1} & w_{in}^{j2} & \cdots & w_{in}^{nj} \end{bmatrix}$$

(5)

Where the column vector of $W_{ij}$ is the importance of ranking vector of $C_i$ elements to $C_j$ elements. Combining the ranking vectors of all elements, we can get a hypermatrix under the control elements as

$$W = \begin{bmatrix} w_{11} & w_{12} & \cdots & w_{1N} \\ w_{21} & w_{22} & \cdots & w_{2N} \\ \vdots & \vdots & \ddots & \vdots \\ w_{n1} & w_{n2} & \cdots & w_{nN} \end{bmatrix}$$

(6)

Each element of a matrix is a matrix and its sum are 1, but it is not a normalized matrix. To calculate conveniently, it is necessary to normalize the hypermatrix, which is weighting the elements of the hypermatrix to get the weighted hypermatrix $\bar{W} = (\bar{W})_{1\times N}$, $\bar{W} = a_{ij}W_{ij}$,  where $a_{ij}$ is weighting factor, $i, j = 1, 2, \cdots, N$.

COMBINED WEIGHTING

For the combination of single evaluation methods, the weights of single evaluation method can be combined, and the ranking results of single evaluation method can also be combined. The combined weighting method generally adopts the linear weighted combination method. The formula is

$$\gamma_i = \alpha \omega_i + (1-\alpha) \xi_i$$

(7)

where $\omega_i$ is subjective weight vector, and $\sum \omega_i = 1$; $\xi_i$ is objective weight vector, and $\sum \xi_i = 1$; $\gamma_i$ is combined weight vector, and $\sum \gamma_i = 1$; $\alpha$ is the degree of importance of subjective weighting method.
Comprehensive Evaluation Model of Investment Scale for ETDCs

INDICATOR PROCESSING MODEL

The decision-making indicators can be roughly divided into three categories: forward indicators, reverse indicators and moderate indicators [9].

(1) Forward indicator

The indicator-standardizing model is

\[
y = \frac{x - x_{\text{min}}}{x_{\text{max}} - x_{\text{min}}}
\]  

(8)

Where \(x_{\text{max}}\) is the maximum of expectation, and \(x_{\text{min}}\) is the minimum of history.

(2) Reverse indicator

The indicator-standardizing model is

\[
y = \frac{x_{\text{max}} - x}{x_{\text{max}} - x_{\text{min}}}
\]  

(9)

Where \(x_{\text{max}}\) is the maximum of history, and \(x_{\text{min}}\) is the minimum of expectation.

(3) Moderate indicator

For moderate indicators, according to model (10), the indicator is converted into a reverse indicator, and then process it as a reverse indicator.

\[
x' = |x - x_{\text{mid}}|
\]  

(10)

Where \(x_{\text{mid}}\) is the moderate value of expectation.

GRAY CLUSTERING TRIGONOMETRIC FUNCTION EVALUATION MODEL

(1) Calculation of gray triangle whitening weight function

Based on the evaluation of the number of gray classes, the value of the evaluation indicator is divided into \([k_1, k_2], [k_2, k_3], ..., [k_s, k_{s+1}]\). Let \(\varepsilon_k = (k_s + k_{s+1})/2\), the grey clustering trigonometric function belonging to the \(K\) grey class is 1, the range of indicator \(j\) can be extended to the left and right to \(k_0, k_{s+2}\) respectively, and Grey clustering trigonometric function for indicator \(i\) is [10]
Where $k_1, k_2, \ldots, k_m$ are dividing boundaries of evaluation indicators, $\varepsilon^k$ is the grey trigonometric value of $K$ grey class, and $\zeta^i(x)$ is grey clustering trigonometric function of indicator $i$.

The grey category (namely, the investment capacity of ETDCs) is divided into five grades: very high, high, medium, low and very low. According to the value range of the basic value of the indicator after the standardization of the evaluation indicator, the grey category range is set between 0 and 1, and the corresponding relationship is shown in Table 2 below.

According to $\varepsilon^k = (k_i + k_{i+1})/2$, the values $\varepsilon$ corresponding to the five levels of gray are respectively obtained as $\varepsilon_1 = (k_1 + k_2)/2 = 0.1$, $\varepsilon_2 = (k_2 + k_3)/2 = 0.3$, $\varepsilon_3 = (k_3 + k_4)/2 = 0.5$, $\varepsilon_4 = (k_4 + k_5)/2 = 0.7$, and $\varepsilon_5 = (k_5 + k_6)/2 = 0.9$. Simultaneously, the field of value is extended to the left and right, after which we can obtain that $k_0 = -0.2$ and $k_7 = 1.2$.

The grey clustering trigonometric function and the standardized value of the evaluation indicator are used to obtain the clustering trigonometric function of each gray level corresponding to the evaluation indicator $x$ respectively.

**TABLE II. CLASSIFICATION OF INVESTMENT CAPABILITY OF ETDCS.**

<table>
<thead>
<tr>
<th>Benefit level</th>
<th>Very low</th>
<th>Low</th>
<th>Medium</th>
<th>High</th>
<th>Very high</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hierarchical defined value</td>
<td>[0,0.2]</td>
<td>[0.2,0.4]</td>
<td>[0.4,0.6]</td>
<td>[0.6,0.8]</td>
<td>[0.8,1]</td>
</tr>
</tbody>
</table>
(2) Calculation of grey triangulation vector

Regarding indicator \( x_i \), the grey evaluation coefficients of m evaluation grey classes are marked as \( b_{im} \), and the total evaluation numbers of different evaluation grey classes are marked as \( b_i \), then

\[
\mathbf{b}_m = \sum_{j=1}^{m} g_m(x_j), \quad \mathbf{b}_i = \sum_{m=1}^{m} b_{im}
\]
According to the above formula, the m-th triangular evaluation weight of indicator \( x_i \) is marked as \( a_{im} = b_{im} / b_i \), \( a_{im} \) is the m-th triangular evaluation weight of indicator \( x_i \), and then the grey triangular weight vector of indicator is obtained.

(3) Calculation and classification of comprehensive evaluation results

The grey triangular weight vector corresponding to each indicator is multiplied with the corresponding gray value \( \varepsilon \), and the clustering gray value \( B \) of the indicator is obtained. According to the product of the weighting result of the evaluation indicator and the clustering gray value, the comprehensive evaluation result of the triangular function can be obtained as

\[
y_n = \theta_i B
\]

To facilitate calculation, we processed the evaluation results and converted them into

\[
Y_n = y_n \cdot 100
\]

**Prediction Model of Investment Scale for ETDCs**

**CORRELATION ANALYSIS BETWEEN COMPREHENSIVE EVALUATION VALUE AND INVESTMENT SCALE**

Suppose the comprehensive evaluation value is \( x \), the investment scale of ETDC is \( y \). The relationship between the comprehensive evaluation value and the amount of investment can be determined by the correlation coefficient. The formula is

\[
r = \frac{\sum_{i=1}^{n} (x_i - \bar{x})(y_i - \bar{y})}{\sqrt{\sum_{i=1}^{n} (x_i - \bar{x})^2 \sum_{i=1}^{n} (y_i - \bar{y})^2}}
\]

The value of \( r \) determines the degree of the relationship between the two variables. The closer the value is to 1, the better the linear relationship between the comprehensive evaluation of investment and the amount of investment is; the closer the value is to 0, the worse the linear relationship between the comprehensive evaluation of investment and the amount of investment is.
INVESTMENT SCALE MEASUREMENT

According to the relationship between the comprehensive evaluation value of investment scale and total investment over the years, a formula for calculating the investment scale of ETDCs [11] is established by regression theory.

The formula is

\[ y = a + bx + \epsilon \]  \hspace{1cm} (21)

where \( a \) is regression constant, \( b \) is regression coefficient, \( \epsilon \) is random variable of error which is not affected by \( x \) and \( y \). To facilitate calculation, we don’t take the error \( \epsilon \) into consideration here. \( x \) and \( y \) are known variables. The key problem is to determine the coefficients \( a \) and \( b \). According to the least square method can be used to solve the problem.

\[
b = \frac{\sum_{i=1}^{n} x_i y_i - \bar{x} \sum_{i=1}^{n} y_i}{\sum_{i=1}^{n} x_i^2 - \bar{x}^2 \sum_{i=1}^{n} x_i}
\]

\[ a = \bar{y} - b \bar{x} \]  \hspace{1cm} (23)

where \( \bar{x}, \bar{y} \) are the average values of \( x \) and \( y \).

\[
\bar{x} = \frac{\sum_{i=1}^{n} x_i}{n}
\]

\[
\bar{y} = \frac{\sum_{i=1}^{n} y_i}{n}
\]  \hspace{1cm} (24) \hspace{1cm} (25)

INVESTMENT SCALE EXAMINING MODEL

To verify the accuracy of the model, we use the method of estimating standard error to test the regression mathematical model established.

\[
S = \sqrt{\frac{\sum_{i=1}^{n} y_i^2 - a \sum_{i=1}^{n} y_i - b \sum_{i=1}^{n} x_i y_i}{n-2}}
\]  \hspace{1cm} (26)
EXAMPLE ANALYSIS

Standardization Results of Investment Scale of the ETDC

We select an ETDC in a certain city of northern China as the research object. Based on the actual development data of this company in the region and the determination of the target orientation of each evaluation indicator, the dimensionless processing results of each indicator data of the ETDC from 2015 to 2017 are obtained based on the model (8) - (10). As shown in Table 3.


<table>
<thead>
<tr>
<th></th>
<th>D1</th>
<th>D2</th>
<th>D3</th>
<th>Z1</th>
<th>Z2</th>
<th>Z3</th>
<th>Z4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Year</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2015</td>
<td>0.655</td>
<td>0.353</td>
<td>0.731</td>
<td>0.078</td>
<td>0.493</td>
<td>0.4</td>
<td>0.3211</td>
</tr>
<tr>
<td>2016</td>
<td>0.673</td>
<td>0.331</td>
<td>0.745</td>
<td>0.084</td>
<td>0.873</td>
<td>0.6</td>
<td>0.3742</td>
</tr>
<tr>
<td>2017</td>
<td>0.655</td>
<td>0.347</td>
<td>0.737</td>
<td>0.023</td>
<td>0.495</td>
<td>0.6</td>
<td>0.4021</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Year</th>
<th>Y1</th>
<th>Y2</th>
<th>Y3</th>
<th>F1</th>
<th>F2</th>
<th>F3</th>
</tr>
</thead>
<tbody>
<tr>
<td>2015</td>
<td>0.966</td>
<td>0.958</td>
<td>0.361</td>
<td>0.5</td>
<td>0.823</td>
<td>0.929</td>
</tr>
<tr>
<td>2016</td>
<td>0.954</td>
<td>1</td>
<td>0.429</td>
<td>0.571</td>
<td>0.901</td>
<td>0.929</td>
</tr>
<tr>
<td>2017</td>
<td>0.963</td>
<td>0.744</td>
<td>0.792</td>
<td>0.643</td>
<td>0.911</td>
<td>0.971</td>
</tr>
</tbody>
</table>

TABLE IV. WEIGHT OF INVESTMENT SCALE OF THE ETDC.

<table>
<thead>
<tr>
<th>Second level indicator</th>
<th>Weight</th>
<th>Third level indicator</th>
<th>Weight</th>
<th>Combined weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>D</td>
<td>0.2665</td>
<td>D1</td>
<td>0.4731</td>
<td>0.126</td>
</tr>
<tr>
<td></td>
<td></td>
<td>D2</td>
<td>0.3472</td>
<td>0.093</td>
</tr>
<tr>
<td></td>
<td></td>
<td>D3</td>
<td>0.1797</td>
<td>0.048</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Z1</td>
<td>0.2716</td>
<td>0.087</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Z2</td>
<td>0.1347</td>
<td>0.043</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Z3</td>
<td>0.3589</td>
<td>0.115</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Z4</td>
<td>0.2348</td>
<td>0.075</td>
</tr>
<tr>
<td>Z</td>
<td>0.3201</td>
<td>Y1</td>
<td>0.5396</td>
<td>0.138</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Y2</td>
<td>0.297</td>
<td>0.076</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Y3</td>
<td>0.1634</td>
<td>0.042</td>
</tr>
<tr>
<td></td>
<td></td>
<td>F1</td>
<td>0.4732</td>
<td>0.075</td>
</tr>
<tr>
<td></td>
<td></td>
<td>F2</td>
<td>0.2451</td>
<td>0.039</td>
</tr>
<tr>
<td></td>
<td></td>
<td>F3</td>
<td>0.2817</td>
<td>0.044</td>
</tr>
</tbody>
</table>
Weight Design of Investment Scale Indicator System for the ETDC

Based on the model (1) - (7), using MATLAB software, the indicator is objectively assigned by the EWM, and then subjectively assigned by the NAM. Finally, combining the two methods, the final weight of each indicator is determined by the method of comprehensive weighting. The results are shown in Table 4.

**Comprehensive Evaluation Results and Correlation Analysis of Investment Scale of the ETDC**

The results of comprehensive evaluation of investment scale and the actual data of the company in this area are shown in Table 5.

To determine the correlation between the total investment and the evaluation results, we use model (20) to discriminate with the actual data in Table 5. The correlation between the two is

\[
 r = \frac{1433.424}{1566.261} = 0.915
\]  

(27)

The result reflects the degree of correlation between investment scale and comprehensive evaluation value. It is found that there is a high correlation between investment scale and comprehensive evaluation value, which is between 0.8 and 1. The next step is to estimate the scale of investment.

**Measurement and Examination of Investment Scale**

Based on the comprehensive evaluation value and actual investment scale data of the company from 2016 to 2017, combined with the model (21) - (25), the results are

\[
a = 569.577; b = 88.082
\]

(28)

Let the original investment scale be \( Y^* \), we can obtain that
\[ Y^* = 569.577 + 88.082X \] (29)

To further discriminate the rationality and applicability of the investment scale model based on regression model, we use the estimation standard error examining method to examine the model. Based on the model (26), the results are

\[ S = \sqrt{\frac{106824675.3 - 10189253.04 - 96610936.97}{3-2}} = 156.478 \] (30)

The results show that the error of the investment model is very small. The investment scale model established in this paper has passed the examination and is suitable for the investment planning of the ETDC. The model accords with the actual economic significance of investment planning of ETDC, and has certain practicability and feasibility.

**CONCLUSIONS**

In this paper, firstly, we constructed a comprehensive evaluation system of investment scale, and evaluated the investment scale capability of ETDCs by using grey clustering trigonometric function evaluation model, which lays a foundation for investment scale prediction. Secondly, we analyzed the correlation between comprehensive evaluation value and investment scale, and constructed a regression model of investment capacity of ETDCs. This model is easy to operate and calculate, and can directly reflect the investment capacity of ETDCs. It also provides a complete calculation way for the prediction of investment scale.

Investment scale prediction is an important part of the comprehensive planning management of ETDCs. Strengthening the prediction of investment scale can make the company better allocate assets, improve the level of investment management, then better improve the investment efficiency of the company. Therefore, in the development process of ETDCs, it is necessary to continuously improve investment prediction technology, achieve accurate investment, and maximize the economic and social benefits as the company develops.

**REFERENCES**