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The Comprehensive Evaluation Method of Supervision Risk in Electricity Transaction Based on Unascertained Rational Number

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Abstract. For the uncertain problems in the comprehensive evaluation of supervision risk in electricity transaction, this paper uses the unidentified rational numbers to evaluation the supervision risk, to obtain the possible result and corresponding credibility of evaluation and realize the quantification of risk indexes. The model can draw the risk degree of various indexes, which makes it easier for the electricity transaction supervisors to identify the transaction risk and determine the risk level, assisting the decision-making and realizing the effective supervision of the risk. The results of the case analysis verify the effectiveness of the model.

1. Introduction

With the establishment of the united and mutual power market[1-2], the objects and methods of electricity transaction are more complicated, and there is greater uncertainty in market behaviors, resulting in increasing supervision risk in electricity transaction. In order to avoid the deteriorating supervision risk in electricity transaction, affect the market order and bring more risk to the electricity transaction, it is urgent to research the supervision risk in electricity transaction.

At present, fuzzy comprehensive evaluation method [3-4]is widely used to evaluate the supervision risk in electricity transaction[5-6]. However, the evaluation objects of the method are most the power market operation efficiency, the power market operation rules and so on which are highly certainty. Relative to the supervision risk in electricity transaction with greater uncertainty, the fuzzy comprehensive evaluation method does not exactly reflect the uncertainty in the evaluation which is embodied in two aspects. Firstly, uncertainties in market behaviors lead to greater uncertainty in the comprehensive evaluation of supervision[7] risk in electricity transaction. Secondly, when determining

the true state of things and the number relation, policy makers are with uncertainty in purely subjective understanding due to insufficient information.

In fact, the information which is provided by any system has both state factors and behavioral factors is mainly all essentially unidentified information .For the information, we must consider its uncertainty and can not simplify it to the determining information to deal with it. Therefore, aiming at the uncertainty of supervision risk in electricity transaction, this paper constructs the comprehensive evaluation method of supervision risk in electricity transaction based on unascertained rational number[8].

2. The comprehensive evaluation model of supervision risk in electricity transaction based on unascertained rational number

This paper builds the warning index system for transaction supervision risk that is applicable to the united and mutual power market. It contains 4 first class indexes namely market synergies, trading plans, contracts and settlements and energy efficiency including 10 second indexes which are shown in table 1.

Table 1. The warning index system for transaction supervision risk that is applicable to the united and mutual power market

the first class index	**the second class index**
market coordination	provincial trading volume
	the ratio of transaction volume in the total electricity
	clean energy efficiency
trading plan	the completion rate of base electricity plan
	the implement balanced rate of base electricity plan
contract and settlement	the rate of contract record
	the rate of settlement completion
	the rate of settlement prompt
energy efficiency	the rate of clean energy consumption
	the year-on-year growth rate of coal saving calculation

(1) the overall thinking

1)Conduct a comprehensive credibility model for power market experts, drawing the comprehensive credibility of the experts involved in the evaluation;

2)The second class index are marked by each expert;

3)According to the credibility of experts and the grade, calculate the scores of the two class index and the score is belong to unascertained rational number;

4)Finally, combining the weight of second class indexes and the scores, calculate the scores of first class indexes. By that analogy, calculate the score of the general goal.

(2) Conducting the comprehensive credibility model for power market experts

According to the expert title, academic qualifications and working years, determine the credibility of the experts which is shown in table 2.

Table 2. Expert Credibility Assessment Standard Classification

Item	**Job title**			**Education**				**Working-age (year)**		
Category	Senior Title	Interm ediate	Junior title	Master's degree	Undergr aduate	Specia list	High school	⩾ 20	20~ 10	<10
Confidenc e interval	[8,10]	[4,7]	[1,3]	[8,10]	[7,10]	[3,6]	[1,3]	[8,10]	[4,7]	[1,3]

ε_i(i =1,2,3) is the job title, education, working-age respectively, and then the credibility of experts isβ_i that can be expressed by the formula (1).

$$\beta_i = \frac{\sum_{i=1}^{3} \varepsilon_i}{30} \qquad (1)$$

The closer the value of β_i is to 1, the more trustworthy this expert is and the more accurate the judgment is. Conversely, the smaller β_i is, the less likely it is to believe this expert.

The credibility of experts $B_1,B_2,\ldots B_n$ involved in comprehensive evaluation are $\bar{\alpha}_1, \bar{\alpha}_2, \wedge, \bar{\alpha}_n$。

The comprehensive credibility of expert B_i for expert group $B_1,B_2,\ldots B_n$ is α_i.

$$\alpha_i = \frac{\bar{\alpha}_i}{\sum_{k=1}^{n} \bar{\alpha}_k} \quad (i = 1, 2, \wedge, n) \qquad (2)$$

The comprehensive credibility of expert group $B_1,B_2,\ldots B_n$ is α.

$$\alpha = \frac{1}{n}(\bar{\alpha}_1 + \bar{\alpha}_2 + \wedge + \bar{\alpha}_n) \qquad (3)$$

(3) The uncertainty quantization of expertise

This paper uses the unascertained rational number to quantify the evaluation information of experts. $A_1,A_2,\ldots A_m$ are the assessment of A, and the experts $B_1,B_2,\ldots B_n$ use the percentile system to rate the indicator factors, drawing the scoring table.

The scores of factor A are $C_{i1}, C_{i2},\ldots, C_{in}$, respectively, and the comprehensive credibility of experts are $\alpha_1, \alpha_2,\ldots,\alpha_n$,.Now, arrange the $C_{i1}, C_{i2},\ldots, C_{in}$ into $C_{ij1}, C_{ij2},\ldots, C_{ijn}$, then the paper draws the unascertained rational number of the factor A.

$$f_i(x) = \begin{cases} \alpha_{ij1} & x=C_{ij1} \\ \alpha_{ij2} & x=C_{ij2} \\ \ldots & \ldots \\ \alpha_{ijk_i} & x=C_{ijk_i} \\ 0 & x \notin \{C_{ij1}, C_{ij2}, \ldots, C_{ijk}\} 且 x \in G \end{cases} \qquad (4)$$

In the formula,

$f_i(x)$ is the unascertained rational number of the factor A.

i=1,2,..,m;

A_{ij1}, A_{ij2},…, A_{ijk} are the sum of experts' comprehensive credibility which the score are C_{ij1}, C_{ij2},…, C_{ijk}.

The weight of factor A_i is w_i, so the uncertain quantizer of object A is C.

$$C = \sum_{i=1}^{m} w_i f_i(x) \qquad (5)$$

3. The analysis of case

The paper supposes that there are three power market experts involved in the evaluation. Through the model of experts' comprehensive reliability, the comprehensive reliability of experts are 0.5,0.3,0.2 respectively. The scores of second class index in market coordination index are shown in table 3.

Table 3. The scores of second class index in market coordination index

	Expert 1	**Expert 2**	**Expert 3**
provincial trading volume	75	80	78
the ratio of transaction volume in the total electricity	65	60	66
clean energy efficiency	40	50	35

The scores of market coordination index are shown in table 4.

Table 4. The scores of market coordination index

score	40.43	52.33	61.63	75.10
credibility	0.105	0.270	0.365	0.260

The higher the score, the greater the risk. Table 4 shows that the probability of 60 or more is 62.5%, indicating that in the electricity market transaction at this stage, the market coordination that the first class index has certain risks. So the relevant person should strengthen the supervision of market coordination, make early warning response to the indicator and put forward countermeasures to avoid greater risks.

4. Conclusion

The comprehensive evaluation method of supervision risk in electricity transaction based on unascertained rational number in this paper solves the problem of uncertainty in the current supervision risk evaluation in power transaction. At the same time, the model facilitates the risk supervisor to identify and judge the risk level, avoiding the ever-worsening of trading risk, and instruct power supervisors to take appropriate measures to effectively monitor the risks.

5. References

[1] Wen Xu, Yan Wei, Wang Junmei, et al. Regional Energy-Saving Electricity Market and Stochastic Programming Power Purchasing Model Considering Assessment on Energy Consumption in Trans-Provincial Transaction [J]. *Power System Technology*,2013,**2**:500-506.

[2] Zeng Bo, Li Yingzi, Zhang Jianhua, et al. Comprehensive Evaluation Model and Method for Smart Distribution Network Planning Under New Electricity Market Layout[J]. *Power System Technology*,2016,**40(11)**:3309-3315.

[3] Zhang Xinjie, Ge Shaoyun, Liu Hong, et al. Comprehensive assessment system and method of smart distribution gird[J]. *Power System Technology*, 2014, **38(1)**:3642-3649.

[4] Yu Hongyan, Ji Shenjia. Estimation and Comparison on prediction accuracy of weight array model based on FAHP[J]. *Statistics and Decision*,2017,**23**:74-78.

[5] Li Hongxia, Ren Jiahe. Study on the effectiveness of emergency signs based on ordering relation and fuzzy comprehensive evaluation[J]. *Journal of Xi'an University of Science and Technology*,2017,**5**:706-711.

[6] Wang Fei, Du Lijuan. Low-carbon Economy Comprehensive Evaluation Based on Entropy Weight and Grey Correlation and TOPSIS [J]. *Science and Technology Management Research*,2013,**7**: 48-51.

[7] Li Cunbin, Yu Xinyi, Wang Zhijie. Risk Assessment on Photovoltaic Power Generation Project by Grey Correlation Analysis and TOPSIS Method[J]. *Power System Technology*, 2013,**6**:1514-1519.

[8] Zhao Zitong, Shen Junhui, Xu Peng, et al. The application of unascertained mathematics method to the extraction of integrated deformation modulus value in intensive altered rock zone[J]. *Journal of Chengdu University of Technology(Science & Technology Edition)*,2016,**3**:119-124.

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