Research on Validity of Performance Evaluation Methods of Local Government's Precaution of Land Expropriation

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Abstract. Based on the practice of performance evaluation of local government's precaution of mass incidents triggered by land expropriation, connotations of validity of performance evaluation methods of local government's precaution of mass incidents triggered by land expropriation were defined; a measurement model to verify validity of performance evaluation methods was established; and Xiangyang City was taken as an example for empirical analysis, so as to sequence 9 performance evaluation methods according to their validity. The results showed that in the case of performance evaluation of Xiangyang's precaution of mass incidents triggered by land expropriation, the Artificial Neural Network Comprehensive Evaluation (ANNCE) and Fuzzy Comprehensive Evaluation (FCE) methods were of the highest validity.

Introduction

During the transition period, governments at all levels attach great importance to the work of Mass Incidents Triggered by Land Expropriation (MITLE) and accelerate the formation of a scientific and effective emergency management system and performance evaluation systems. However, in the process of vigorously preventing MITLE, there are phenomena such as behavioral misconduct and results which are difficult to obtain social identification. This highlights the low performance of local governments in preventing MITLE and the difficulty in accurately measuring the performance of local government's precautions. The choice of performance evaluation methods directly affects the results of preventive performance measurements. Studying the effectiveness of local government's precautions of MITLE performance evaluation methods can scientifically and reasonably evaluate the performance of precautions of MITLE, and reduce the bias of evaluation results, which would provide support for comprehensive and profound evaluation of local government's ability to prevent MITLE and improve local governments' performance evaluation.

Certain results in the effectiveness research of performance evaluation methods were achieved by scholar at home and abroad. Szmidt (2011) indicated that the effectiveness of a comprehensive evaluation method is to calculate the Spearman rank correlation coefficient (SRCC) between the rank sequence and the benchmark rank sequence obtained by various evaluation methods. Sun Yanwu (2013) studied the effectiveness of eight comprehensive evaluation methods by generating benchmark rank sequence, rank correlation coefficient calculation and rank correlation coefficient test. Li Jiaona (2013) applied the analytic hierarchy process to conduct an empirical study on the government response management performance evaluation of the Wukan incident. Li Yanan (2015) established a performance evaluation index system for precautions of MITLE, and utilized fuzzy comprehensive evaluation method to conduct performance evaluations.

Defining the Validity of Performance Evaluation Methods of Local Government's Precaution of MITLE

The validity of performance evaluation methods of precaution of MITLE refers to the degree of correlation between the evaluation value and the real performance value calculated from the performance of the local government's precautions of MITLE by using performance evaluation methods. The ultimate goal of precautions of MITLE performance evaluation is to sequence and

rank the behavioral performance of the assessed local government's precaution of MITLE. Different performance evaluation methods are in fact aggregating data information from different technical perspectives and sorting the objects to be evaluated. Obviously, any kind of performance evaluation method ranking will have errors and people will find it difficult to be convincing. The evaluation method would be more effective, if the difference between the results of the performance evaluation and the real situation is smaller. The purpose of the performance evaluation method effectiveness analysis is to determine the best method or method set to obtain the closest real level of precaution against MITLE.

Based on the existing literature review results, the following nine commonly used methods were selected as samples: Analytic Hierarchy Process (AHP), Technique for Order Preference by Similarity to an Ideal Solution (TOPSIS), Fuzzy Comprehensive Evaluation (FCE), Factor Analysis (FA), Entropy Comprehensive Evaluation (ECE), Grey Comprehensive Evaluation (GEC), Rough Set Comprehensive Evaluation (RSEC), Artificial Neural Network Comprehensive Evaluation (ANNCE), and Real Coding Based Accelerating Genetic Algorithm - Projection Pursuit Classification Evaluation (RAGA-PPC).

Measures of Validity of Precaution of MITLE Performance Evaluation Methods

Measurement Indicators

(1) Spearman rank correlation coefficient. The Spearman rank correlation coefficient of the ranking result between the two methods is calculated to determine the proximity between methods. There are a set of k evaluated objects, and there are n kinds of performance evaluation methods, D_i indicates the difference between the ranking order of the evaluation results of no. i evaluation object in the two methods. The calculation formula of the Spearman rank correlation coefficient is as follows:

$$R = 1 - \frac{6\sum_{i=1}^{k} D_i^2}{k\left(k^2 - 1\right)} \tag{1}$$

R value is observed. If R is larger and close to 1, this indicates a better correlation between the two evaluation methods.

(2) Similarity. This indicator is used to measure the “gap” between the rankings of multiple performance evaluation methods, and the validity of various evaluation methods can be measured according to the value of similarity. Assuming there are n kinds of evaluation objects, and m evaluation methods, and the similarity of the performance evaluation method of no.j is based on the Spearman rank correlation coefficient conversion. The calculation formula is as follows:

$$R_j = \frac{1}{m-1}\sum R \tag{2}$$

In the above formula, R is the Spearman rank correlation coefficient. If the similarity of a performance evaluation method is higher, then this performance evaluation method is more effective than other methods.

(3) Dispersion degree. In performance evaluation, the dispersion degree is calculated by the average of ranking orders between the ranking results and the other methods. Assuming there are an evaluation objects, m is the number of evaluation methods. Set the ranking of results of the no. j performance evaluation method as the standard order, then the formula of calculating dispersion degree of the no. j performance evaluation method is as follows:

$$D_j = \frac{1}{m-1}\sum_{k=1}^{m-1}\sum_{i=1}^{n} D_{ijk}, (i = 1, 2, \cdots n;\ j = 1, 2, \cdots m) \tag{3}$$

If the ranking of no. j performance evaluation method is $X_{ij} = X_{ik}$, then $D_{ijk} = 1$, otherwise

$D_{ijk}=0$. A smaller dispersion of a certain performance evaluation method indicates the difference between the method and other methods in understanding the evaluation object is smaller, and thus this method is more effective.

The effectiveness criteria for performance evaluation methods are similarity and smaller dispersion degree.

Measurement Model

With regard to performance evaluation of local government's precaution of MITLE, it is assumed that n kinds of performance evaluation methods are used, and the indicator set of performance evaluation is $E_n=\{x_1,x_2,\cdots,x_m\}$, m indicates the number of indicators to be evaluated, and $R_n=\{r_{i1},r_{i2},\cdots,r_{ij},\cdots,r_{ik}\}$ represents the results of n kinds of evaluation methods, $(1<i\le n)$ indicates the order value of evaluated object j, which is calculated by performance evaluation method i, and k is the number of objects evaluated. According to the Sequence-number Summation Theory, $B_n=\{b_1,b_2,\cdots,b_i,\cdots,b_k\}$ indicates benchmark rank sequence, which is the sequence that best reflects the real situation of the object being evaluated.

Performance Evaluation

Determining the Benchmark Rank Sequence

On the basis of the Sequence-number Summation Theory, a reasonable benchmark rank sequence is obtained based on the evaluation results calculated by various methods. It is assumed that D_S indicates the sequence position matrix of k evaluated object calculated by no. n performance evaluation methods, wherein $r_{ij}\,(i=1,2,\cdots,n;\ j=1,2,\cdots,k)$ indicates the order of the evaluated object j that is determined by the no. i performance evaluation method, and the obtained hierarchical sequence matrix is D_S'.

$$\mathbf{Ds}^0=\begin{bmatrix} r_{11}^0 & \cdots & r_{1j}^0 & \cdots & r_{1k}^0 \\ \vdots & \vdots & \vdots & \vdots & \vdots \\ r_{i1}^0 & \cdots & r_{ij}^0 & \cdots & r_{ik}^0 \\ \vdots & \vdots & \vdots & \vdots & \vdots \\ r_{n1}^0 & \cdots & r_{nj}^0 & \cdots & r_{nk}^0 \end{bmatrix}=\begin{bmatrix} \mathbf{Rn}_1^0 \\ \vdots \\ \mathbf{Rn}_i^0 \\ \vdots \\ \mathbf{Rn}_n^0 \end{bmatrix} \tag{4}$$

$Sum(j)$ represents the sum of the sorting numbers of the evaluated object j, and then sorted according to $Sum(j)$ to obtain benchmark rank sequence B_n.

$$Sum(j)=\sum_{i=1}^{l} r_{ij}' \tag{5}$$

$$B_n=\{Sum(1),Sum(2),\cdots,Sum(k)\} \tag{6}$$

Calculating Rank Correlation Coefficient

Correlation analysis was performed on B_n and R_{n_i}. It is assumed that $F_n=\{f_{i1},f_{i2},\cdots,f_{ij},\cdots,f_{ik}\}$ is the sequence of performance evaluation values. f_{ij} represents the performance score of the evaluated object j under the evaluation method I. The scores of F_n were sorted to obtain $R_{n_i}=\{r_{i1},r_{i2},\cdots,r_{ij},\cdots,r_{ik}\}$, which is the sorting matrix of k evaluation objects.

If there is no equal element in F_n, the performance value of each evaluation object is not equal,

then the SRCC (Spearman rank correlation coefficient) of B_n and R_{n_i} is calculated as:

$$R_{is} = \frac{12\sum_{j=1}^{k} b_j \times r_{ij} - 3k(k+1)^2}{k(k^2-1)} \quad (7)$$

After the SRCC were calculated and the statistical test was completed, the similarity and dispersion degree of each performance evaluation method were measured (where the similarity is the positive index and the dispersion degree is the negative index), and nondimensionalized. Comprehensive measurement value was obtained by summing up the results, and performance evaluation methods were sorted according to the comprehensive measurement results, to determine the validity of precaution of MITLE performance evaluation method, and analyze and discuss the results.

Empirical Analysis

Xiangyang City of Hubei Province was selected as the case study of local government's precaution of MITLE performance evaluation method. Xiangyang City is located in the northwest of Hubei Province, in the midstream of the Hanjiang River, covering an area of 19,700 square kilometers. The local governments of 9 districts (counties, cities) under the jurisdiction of Xiangyang City were the evaluated objects of this study. The government is the target of performance evaluation for this methodological study. The 9 evaluated objects were coded, namely, Xiangcheng District (XC), Xiangzhou District (XZ), Fancheng District (FC), Zaoyang City (ZY), Laohekou City (LH), Yicheng City (YC), Gucheng County (GC), Baokang County (BK), Nanzhang County (NZ). The SRCC, similarity, and the dispersion degree of 9 performance evaluation methods were calculated using the above steps.

Table 1, Similarity, dispersion degree and ordering of nine performance evaluation methods

Order	AHP	FA	TOPSIS	FCE	ECE	GEC	ANNCE	RSEC	RAGA-PPC
Similarity	0.952	0.833	0.692	0.972	0.867	0.933	0.986	0.915	0.958
Dispersion Degree	21.0	23.8	24.1	20.6	23.3	21.8	20.0	22.1	20.9
Comprehensive Ranking	4	8	9	2	7	5	1	6	3

The validity of the nine methods was ranked according to the combined value: ANNCE>FCE>RAGA-PPC>AHP>GEC>RSEC>ECE>FA>TOPSIS. The result indicates that the most effective performance evaluation results were ANNCE and FCE, followed RAGA-PPC.

Summary

According to the ranking results, ANNCE and FCE methods were of the highest validity, followed by RAGA-PPC. The validity of ANNCE, FCE and RAGA-PPC was at the top of the list. The accuracy of the ANNCE method depends on a large training sample, and does not require a large amount of data, and its ability to adapt to various performance evaluation scenarios is strong. The FCE method is an effective method to deal with the subjective and objective evaluation index system and the case of performance evaluation of precaution of MITLE which has multiple evaluation subjects. RAGA-PPC can effectively reduce dimensionality to avoid the subjectivity of experts dealing with weights. So it obtains evaluation results of high accuracy and quality, and it is suitable for performance evaluation of quantitative indicators and a combination of quantitative and qualitative indicators.

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