



Research on Performance Evaluation Index System of Emergency Fund Guarantee Based on Improved Mutation Progression Method

Yilin Wang¹(✉), Yan Peng¹, and Xiaoqing Liu²

¹ Department of Management Engineering and Equipment Economics, Naval University of Engineering, Wuhan 430032, China

1010299047@qq.com

² Wuhan Branch Center of Fund Collection and Payment Management Center of the Rear Security Department of the CMC, CMC, Wuhan 430032, China

Abstract. On the basis of using TOPSIS theory to sort indicators at all levels, this paper combined with the basic ideas of catastrophe theory and algorithm steps, proposed a performance evaluation model of emergency fund guarantee based on TOPSIS and catastrophe series method, in order to manage and control emergency fund guarantee better.

Keywords: abrupt change progression method · Performance evaluation index · Emergency fund guarantee

1 Introduction

The performance evaluation of emergency fund guarantee is not only an effective way to supervise and correct the deviation of emergency fund guarantee activities, but also an important part of the performance management of emergency fund guarantee. Therefore, the performance evaluation model can fully prevent and resolve the risks in emergency fund guarantee, which has a very important significance for ensuring the actual supply of emergency fund and fund safety, ensuring the completion of emergency action tasks and improving the efficiency of fund use [1].

2 Features

2.1 High Requirements for the Timeliness of the Fund Guarantee

Emergencies are highly uncertain and cannot be predicted in advance, which puts forward high requirements for the emergency fund guarantee, and must complete the fund raising and allocation work and all related preparatory work in a short time. It requires the simplification of the emergency fund guarantee procedure to ensure that emergency funds are in place in time, which is also an important content of the performance evaluation of emergency funds [2].

© The Author(s) 2024

S. H. B. D. M. Zailani et al. (Eds.): ICMSEM 2023, 259, pp. 1566–1573, 2024.

https://doi.org/10.2991/978-94-6463-256-9_159

2.2 Special Disposal Environment

Special environment brings difficulties to emergency fund guarantee. First, it will lead to an increase in the demand for emergency fund guarantee. Secondly, it is impossible to obtain funds from local banks, which makes it difficult to carry out the fund guarantee work; Third, the insufficient information has a great impact on the fund security, which objectively causes greater difficulty for the forward and follow-up of funds, increasing the pressure of continuous security.

2.3 Outstanding Security Risks of Emergency Funds

In the actual completion of the task, the emergency fund payment forms are diverse, various management and supervision systems can't be very perfect, especially prone to "incomplete procedures, unclear bills, money and material disconnection, accounting discrepancies" and other phenomena.

3 Methods

The improved mutation progression method can solve the limitation of catastrophe progression method on the number, reduce the influence of subjectivity on weight effectively. Also, the calculation method is simpler and faster.

3.1 Contents of Performance Evaluation Indexes

This paper divides the emergency fund guarantee performance evaluation index into four stages. In each stage, the corresponding performance evaluation index of emergency fund guarantee is constructed from the three perspectives of fund security, guarantee timeliness and task completion degree. The specific 18 evaluation indicators are shown in Table 1 [3, 4].

3.2 Weight of Emergency Fund Guarantee Performance Evaluation

Use TOPSIS method to judge the importance of indicators.

- (1) Construct the original data matrix P, the specific formula is shown in the formula (1).

$$P = \begin{bmatrix} p_{11} & p_{12} & p_{13} \\ \dots & \dots & \dots \\ p_{i1} & p_{i2} & p_{i3} \end{bmatrix}, (i = 18) \tag{1}$$

- (2) Construct the standard matrix Q, the specific formula is shown in the formula (2-4). The normalization formula of the positive index:

$$Q_{mn} = \frac{x_{mn}}{\sqrt{\sum_m x_{mn}^2}}; \tag{2}$$

Table 1. Performance evaluation indicators of emergency fund guarantee

Stage Division	Specific Indicators	Nature
Fund reserve phase	Accuracy in forecasting emergency funding requirements	Forecast amount of emergency fund requirement $\frac{\text{Forecast amount of emergency fund reserve amount}}{\text{Final amount of emergency fund}}$
	The degree to which the amount of capital reserves meets the needs	$\frac{\text{Emergency fund reserve amount}}{\text{Forecast amount of emergency fund requirement}}$
	The extent to which the amount of emergency funds meets the need	$\frac{\text{Emergency fund limit}}{\text{Forecast amount of emergency fund requirement}}$
Funding commissioning phase	Feasibility of emergency fund mobilization plan	Qualitative analysis
	The level of clarity of responsibility and authority for activating emergency funds	Qualitative analysis
	Response time to activate emergency funds	Quantitative analysis
	The completeness of documents related to the use of emergency funds	Qualitative analysis

(continued)

Table 1. (continued)

Stage Division	Specific Indicators	Nature
	Rate of timely arrival of emergency funds	Nature <i>The amount of emergency funds in place on time</i> $\frac{\text{Actual amount of emergency fund in place}}{\text{Total emergency plan}}$
	Detail level of emergency plan	$\frac{\text{The number of contingency plans for the use of emergency funds}}{\text{Total emergency plan}}$
Fund delivery phase	Bank delivery speed	Quantitative analysis
	Task body transport capital speed	Quantitative analysis
	Actual availability of emergency funds	$\frac{\text{Actual amount of emergency fund in place}}{\text{Contingency fund plan disbursements}}$
	The degree of implementation of internal control system	Qualitative analysis
Fund payment phase	The extent to which responsibility for payment is clearly implemented	Qualitative analysis
	Actual degree of transparency in emergency fund management	Qualitative analysis
	Emergency fund violation utilization rate	$\frac{\text{The amount of emergency funds illegally used}}{\text{Actual disbursement of emergency funds}}$
	The degree of perfection of payment vouchers	Qualitative analysis
	Review of final accounts of emergency funds	Qualitative analysis

The normalization formula of negative index:

$$Q_{mn} = \frac{1/x_{mn}}{\sqrt{\sum_m^i (1/x_{mn})^2}}; \tag{3}$$

$$Q = \begin{bmatrix} q_{11} & q_{12} & q_{13} \\ \dots & \dots & \dots \\ q_{i1} & q_{i2} & q_{i3} \end{bmatrix}, (i = 18) \tag{4}$$

(3) Solve “positive ideal solution” and “negative ideal solution”, the specific formula is shown in the formula (5).

$$\begin{cases} Q^+ = \{(\max Q_{ij} | j \in J_1), (\min Q_{ij} | j \in J_2)\} \\ Q^- = \{(\min Q_{ij} | j \in J_1), (\max Q_{ij} | j \in J_2)\} \end{cases} \tag{5}$$

Q^+ : the positive ideal solution; Q^- : the negative ideal solution;
 J_1 : positive index set; J_2 : the negative indicator set.

(4) Index importance ranking, the specific formula is shown in the formula (6–8).

Calculate the distance between the indicators to the “positive ideal solution” and the “negative ideal solution” respectively, and the importance of the indicators is ranked.

$$L^+ = \sqrt{\sum_{m=1}^I (Q_n^+ - Q_{nm})^2} \tag{6}$$

$$L^- = \sqrt{\sum_{m=1}^I (Q_n^- - Q_{nm})^2} \tag{7}$$

$$J_n = \frac{L_n^-}{L_n^- + L_n^+} \tag{8}$$

Weight calculation by mutation progression method.

1. According to the ranking of indicators calculated by TOPSIS above, the gradient division of indicators is carried out.
2. Using the bifurcation point set equation and the normalization formula in Table 2, combined with TOPSIS to calculate the index weight.

4 Results

The result is shown in Table 3.

From the perspective of index weight, the timely rate and arrival rate of funds, the clarity of responsibility and the accuracy of emergency fund demand forecast are the key points that need to be paid attention to for emergency fund guarantee. The proportion of timely arrival rate and actual arrival rate of emergency fund is the highest. The key point of emergency fund guarantee is the timeliness of guarantee. The clarity degree of specific responsibilities such as the responsibility of fund payment and the authority to

Table 2. Bifurcation point set equation and normalization formula of each mutation

Type	Bifurcation set equation	Normalization formula
Cusp	$a = -6x^2, b = 8x^3$	$x_a = \sqrt{ a }, x_b = \sqrt[3]{ b b }$
Swallowtail	$a = -6x^2, b = 8x^3, c = -3x^4$	$x_a = \sqrt{ a }, x_b = \sqrt[3]{ b }, x_c = \sqrt[4]{ c }$
Butterfly	$a = -10x^2, b = 20x^3, c = -15x^4, d = 4x^5$	$x_a = \sqrt{ a }, x_b = \sqrt[3]{ b }, x_c = \sqrt[4]{ c }, x_d = \sqrt[5]{ d }$
Hut	$a = -21x^2, b = 70x^3, c = -105x^4, d = 84x^5, e = -35$	$x_a = \sqrt{ a }, x_b = \sqrt[3]{ b }, x_c = \sqrt[4]{ c }, x_d = \sqrt[5]{ d }, x_2 = \sqrt[6]{ e }$

Table 3. Performance evaluation index and weight of emergency fund guarantee

Specific Indicators	Importance	Results	Weights
Rate of timely arrival of emergency funds	12.90%	10.00%	11.45%
The extent to which responsibility to pay is clearly implemented	10.70%	7.92%	9.31%
The accuracy of emergency funding needs forecasts	10.38%	7.40%	8.89%
Degree of clarity of responsibility authority for activating emergency funds	7.88%	7.88%	7.88%
Actual availability rate of emergency funds	7.49%	7.73%	7.61%
The degree of implementation of internal control system	6.41%	4.55%	5.48%
Feasibility of contingency fund mobilization plan	4.90%	5.94%	5.42%
Review of final accounts for emergency funds	4.32%	6.22%	5.27%
Degree of detail of emergency plan	4.25%	5.41%	4.83%
Bank delivery speed	4.08%	5.56%	4.82%
Response time to activate emergency funds	4.08%	5.30%	4.69%
Actual degree of transparency in emergency fund management	3.86%	4.94%	4.40%
Degree of completeness of documents related to activating emergency funds	3.74%	4.28%	4.01%
Speed of transportation funds for task subjects	3.74%	4.16%	3.95%
The degree to which the amount of capital reserves meets the demand	3.54%	3.98%	3.76%
The amount of emergency funds meets the degree of need	2.86%	3.24%	3.05%
Emergency fund violation utilization rate	2.86%	3.10%	2.98%
Degree of perfection of payment vouchers	2.01%	2.33%	2.17%

use the fund represents the degree of emphasis on the security of emergency fund, while the demand prediction is an overall grasp of emergency fund guarantee. In addition, the implementation of the internal control system, emergency plan, fund settlement audit and transportation speed are also important aspects to evaluate the performance of emergency fund guarantee [5].

5 Conclusion

According to the relevant documents of emergency fund management, on the basis of systematic analysis of the performance of emergency fund guarantee, combined with the task stage of emergency action in peacetime, the performance evaluation index of emergency fund guarantee is selected from three aspects: timeliness of guarantee, fund security and task completion degree [6]. The TOPSIS method is used to improve the importance ranking of indicators in the mutation series method, and the evaluation index system of emergency fund guarantee performance is constructed, which overcomes the limitation of subjective weighting in the traditional evaluation methods, and improves the accuracy of the evaluation of emergency fund guarantee performance. The results of index weight show that the emphasis of the evaluation of emergency fund guarantee performance lies in timeliness and safety. This also accords with the principle connotation of emergency fund guarantee.

References

1. Lin Yuanyuan. Research on Budget Performance Management of Fiscal Emergency Funds. Beijing: China Finance and Economics Press, 202:40–50.
2. Yu Yanfang, Chen Hongya. Deal with public security emergency fiscal expenditure performance evaluation index system of the study. Journal of baoding college journal, 2021(01):15–25. DOI: <https://doi.org/10.13747/j.carolcarrollnkibdxzb.2021.01.003>.
3. Wang Jie, Rao Haiqin. Analysis on Performance Evaluation System of financial Expenditure of Emergency management in China. Financial Economics, 2013(02):85–87.
4. Hu Zhiyong, Wang Zecai. Budget performance index system of building standard and its application. Journal of economic aspect, 2020(12):92–99. The DOI: <https://doi.org/10.16528/j.carolcarrollnki.22-1054/f,202012092>.
5. Zheng Fanghui, Liu Antheque. Theory of fiscal expenditure performance evaluation structure system. Journal of Chinese administrative management, 2020(7):41–48. DOI: <https://doi.org/10.19735/j.issn.1006-0863.2020.07.06>.
6. Li Jinshan, Wang Qianqian. Fiscal expenditure performance evaluation system of authority: the introduction of 3 e dimension and improve. Journal of financial research, 2018(3):14 to 23. The DOI: <https://doi.org/10.19477/j.carolcarrollnki.11-1077/f2018.03.002>.

Open Access This chapter is licensed under the terms of the Creative Commons Attribution-NonCommercial 4.0 International License (<http://creativecommons.org/licenses/by-nc/4.0/>), which permits any noncommercial use, sharing, adaptation, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons license and indicate if changes were made.

The images or other third party material in this chapter are included in the chapter's Creative Commons license, unless indicated otherwise in a credit line to the material. If material is not included in the chapter's Creative Commons license and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder.

