

Research Article

Evaluating the Sustainable Growth of Small- and Medium-Sized Construction Enterprises Using the Multicriteria Decision-Making Method

Wenbao Wang,¹ Wenhe Lin ,² Xinyi Dai,² Yingzheng Yan,² and Aiping Xuan²

¹College of Civil Engineering, Yango University, Fuzhou, China

²College of Management & College of Tourism, Fujian Agriculture and Forestry University, Fuzhou, China

Correspondence should be addressed to Wenhe Lin; 253062775@qq.com

Received 23 June 2020; Revised 20 August 2020; Accepted 26 August 2020; Published 9 September 2020

Academic Editor: Fuqiang Gu

Copyright © 2020 Wenbao Wang et al. This is an open access article distributed under the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

Sustainable growth plays an important role in the development of small- and medium-sized construction enterprises and has increasingly become a hot topic in the political and academic arenas. Growth is an important indicator for measuring the operational status and development potential of listed enterprises and is of great significance for studying sustainable growth. Considering the development of small- and medium-sized construction enterprises, a growth evaluation index system that includes growth resources, growth ability, and growth innovation was established, and a growth evaluation model was constructed using the improved entropy-VIKOR algorithm. Evaluation and analysis of the sustainable growth of small- and medium-sized construction enterprises listed before the end of 2012 were conducted. The parameter sensitivity, weight sensitivity, and effectiveness of the evaluation model were analysed. The empirical results showed that compared with the TOPSIS method and the traditional VIKOR method, the multicriteria evaluation model for the sustainable growth of small- and medium-sized construction enterprises proposed in this paper had better stability and effectiveness. Finally, the key influencing factors, growth ranking, and dynamic growth types of small- and medium-sized construction enterprises were analysed, and targeted suggestions were proposed. The research results can provide a reference for managers, investors, and regulators.

1. Introduction

Small- and medium-sized enterprises (SMEs) constitute an important part of the overall national economy, and the growth of SMEs is the internal impetus for the development of enterprises and the national economy. The growth of SMEs is an important indicator used to measure the operating conditions and development potential of listed enterprises. At present, small- and medium-sized construction enterprises account for more than 90% of the total number of construction enterprises in China [1], and they have become an indispensable part of China's construction industry. However, small- and medium-sized construction enterprises lag far behind large construction enterprises in terms of the overall professional level, management systems, scale effects, and technological innovation ability. Therefore,

the sustainable growth of small- and medium-sized construction enterprises is becoming a hot research topic and is related not only to the interests of managers and investors but also to the economic development of the entire country. With the development of the capital market, the evaluation of the sustainable growth of small- and medium-sized construction enterprises has become increasingly complicated and a key focus for firms, investors, and government management departments.

Enterprise growth refers to the business capability, sustainable development ability, and, importantly, the evaluation of the future development of an enterprise. In terms of dynamic potential, enterprise growth can be divided into sustainable growth and interrupted growth (maintenance and reduction). Sustainable growth is reflected in the continuous expansion of the market scale of the industry and

the expansion of the enterprise's market share and scale of business; the increase in operating benefits year over year; the continuous improvement of the enterprise's system, culture, and organization; the enterprise's adaptability to the internal and external environments. Many scholars around the world have examined the growth of enterprises and revealed important findings. In China, Wang [2] used China's listed companies in the environmental protection industry as an example and selected 14 financial indicators, including profitability, financial risk, operating capacity, and growth level, for principal component analysis, arguing that growth is greatly affected by profitability. Hu et al. [3] studied enterprise growth using the principal component projection method based on multi-index comprehensive evaluation. Gong and Lv [4] proposed a model for enterprise growth evaluation based on R language data analysis. Xia et al. [5–10] studied the growth of SMEs based on factor analysis. Zhao et al. [11] established an index system based on the dynamic ability angle and used the fuzzy comprehensive evaluation method to construct an evaluation model of the growth of high-tech enterprises. In addition, Cao and Chang analysed the influencing factors of enterprise growth [12, 13]. In other countries, Zeng [14] studied the evaluation of enterprises' technological innovation capabilities using two-tuple linguistic information. Liu et al. [15] established a growth quality model for LED listed companies on the basis of industrial innovation theory, corporate governance theory, and enterprise organization theory. Using the network analysis method, Lahdelma and Laakso [16] conducted a network evaluation of companies. Additionally, Lefley and Sarkis [17] applied the FAP model to the evaluation of strategic information technology projects. Thus, the literature focuses mainly on the empirical analysis of the factors related to the growth of enterprises and seldom examines the construction of an evaluation model. Many studies consider the evaluation of enterprise growth in China through the construction of index systems and evaluation models. However, most growth evaluation research adopts a single evaluation method (e.g., analytic hierarchy process, principal component analysis, mutation progression method, and ideal point method), and a method is selected based on the application of mathematics, without identifying the validity of the method itself or the reference value of the investigation results. Therefore, it is necessary to use the combination evaluation method to study the evaluation of enterprises' sustainable growth.

2. Research Methods and Evaluation Indicators

2.1. Research Methods. Compared to the traditional single evaluation method, the multicriteria decision-making compromise method has the advantages of intuitive analysis principles and simple calculations [18]. Additionally, entropy weight and multicriteria decision-making evaluation methods, especially the entropy-TOPSIS method, have been widely used in research on urban industry competitiveness, regional system development, and even enterprise evaluation. Moreover, the VIKOR method outperforms the TOPSIS method in multicriteria decision-making because it can rank alternatives according to their proximity to the ideal solution, while the TOPSIS method cannot account for the importance of alternative solutions or their proximity to the positive and negative ideal solutions. Unlike the TOPSIS

method, the VIKOR method also considers the maximization of group utility and the minimization of individual regrets simultaneously, as well as the subjective preferences of decision makers, and it provides a more reasonable solution that can achieve a compromise among priorities when dealing with ranking problems [19]. In recent years, the VIKOR method has been applied in several fields, such as sustainable and renewable energy [20], supplier selection [21], and project selection [22]. It is also combined with attribute weight determination methods. For example, the analytic hierarchy process can be combined with the VIKOR eclectic ranking method to construct a flexible multicriteria decision framework [23]. Entropy weight and the VIKOR method are also combined for use in project risk assessment [24]. An entropy-VIKOR combination method has been proven able to solve multiattribute evaluation and decision problems. However, the traditional VIKOR method uses the information regarding only the positive ideal solution, not the negative ideal solution. Although the positive ideal solution and the negative ideal solution often have a certain degree of correlation, the negative ideal solution still has its own unique information. Therefore, we should make full use of the information on the negative ideal solution to ensure the rationality of the decision results. Therefore, in this paper, the VIKOR method is improved to make full use of positive and negative ideal solution information to evaluate the sustainable growth of small- and medium-sized construction enterprises, and the practicable research results can serve as a reference for managers, investors, and regulators.

The improved entropy-VIKOR algorithm adopted in this paper is constructed as follows:

- (1) Establishment of the decision matrix for the evaluation criteria.

It is assumed that there are n evaluation indicators and m evaluation objects for multiattribute decision-making problems. Matrix X is composed of evaluation index values, X_{ij} represents the j th index value of the i th evaluation object, and the decision matrix is as follows:

$$(X_{ij})_{m \times n} = \begin{pmatrix} X_{11} & X_{21} & K & X_{m1} \\ X_{12} & X_{22} & K & X_{m2} \\ K & K & K & K \\ X_{1n} & X_{2n} & K & X_{mn} \end{pmatrix}. \quad (1)$$

- (2) Standardization of the indicators.

Considering that the data for each indicator are of different dimensions, it is necessary to perform dimensionless processing on all indicator data. When the evaluation index has the criterion of benefit type (the larger the value, the better), x_{ij} is calculated as follows:

$$x_{ij} = \frac{x'_{ij} - \min_i(x'_{ij})}{\max_i(x'_{ij}) - \min_i(x'_{ij})}. \quad (2)$$

When the evaluation indicator has cost-type criteria (the smaller the value, the better), x_{ij} is calculated as follows:

$$x_{ij} = \frac{\max_i(x'_{ij}) - x'_{ij}}{\max_i(x'_{ij}) - \min_i(x'_{ij})}. \quad (3)$$

Additionally, when the indicator has a fixed criterion (the closer the value is to an ideal value β , the better), x_{ij} is calculated as follows:

$$x_{ij} = \frac{1.0 - |x'_{ij} - \beta|}{\max_i |x'_{ij} - \beta|}. \quad (4)$$

(3) Calculating the normalized decision matrix.

The normalized decision matrix is expressed as follows:

$F = [p_{ij}]_{m \times n}$; in the formula,

$$p_{ij} = \frac{x_{ij}}{\sum_{i=1}^m x_{ij}}, \quad i = 1, 2, \dots, m; j = 1, 2, \dots, n. \quad (5)$$

(4) Determining the entropy weight of the evaluation index.

First, the entropy value of index j is calculated:

$$E_j = -K \sum_{i=1}^m p_{ij} \ln p_{ij}, \quad i = 1, 2, \dots, m; j = 1, 2, \dots, n. \quad (6)$$

In the formula, $k = (1/\ln m) > 0$, $0 \leq E_j \leq 1$. Then, the difference coefficient of the j th indicator is calculated: $g_j = 1 - E_j$. If j is to keep a certain value, the smaller the difference g_j of X_{ij} is, the larger the value of E_j is. From this, the weight of each indicator can be defined as follows:

$$W_j = \frac{g_j}{\sum_{j=1}^n g_j}. \quad (7)$$

(5) Determining the positive ideal solution and the negative ideal solution.

If the j th criterion has the property of the larger, the better, then the positive ideal solution set A^* and the negative ideal solution set A^- can be expressed as follows:

$$\begin{aligned} A^* &= \left\{ \max_{j=1}^n f_{ij} \mid i = 1, 2, \dots, m \right\} \\ &= \{f_1^*, f_2^*, \dots, f_j^*, \dots, f_n^*\}, \\ A^- &= \left\{ \min_{j=1}^n f_{ij} \mid i = 1, 2, \dots, m \right\} \\ &= \{f_1^-, f_2^-, \dots, f_j^-, \dots, f_n^-\}. \end{aligned} \quad (8)$$

Additionally, if smaller is better for the j th criterion, then the positive ideal solution set A^* and the negative ideal solution set A^- can be expressed as follows:

$$\begin{aligned} A^* &= \left\{ \min_{j=1}^n f_{ij} \mid i = 1, 2, \dots, m \right\} \\ &= \{f_1^*, f_2^*, \dots, f_j^*, \dots, f_n^*\}, \\ A^- &= \left\{ \max_{j=1}^n f_{ij} \mid i = 1, 2, \dots, m \right\} \\ &= \{f_1^-, f_2^-, \dots, f_j^-, \dots, f_n^-\}. \end{aligned} \quad (9)$$

(6) The group utility value and the individual regret value are then calculated. With the positive ideal solution as a reference, the ratio of the distance between the i th scheme and the positive ideal solution is as follows:

$$S_i^+ = \sum_{j=1}^n w_j \frac{(f_j^* - f_{ij})}{(f_j^* - f_j^-)}. \quad (10)$$

The ratio of the distance between the i th scheme and the negative ideal solution is as follows:

$$R_i^+ = \max_j \left[w_j \frac{(f_j^* - f_{ij})}{(f_j^* - f_j^-)} \right]. \quad (11)$$

Taking the negative ideal solution as a reference, the distance ratio between the i th scheme and the positive ideal solution is as follows:

$$S_i^- = \sum_{j=1}^n w_j \frac{(f_{ij} - f_j^-)}{(f_j^* - f_j^-)}. \quad (12)$$

The distance ratio between the i th scheme and the negative ideal solution is as follows:

$$R_i^- = \max_j \left[w_j \frac{(f_{ij} - f_j^-)}{(f_j^* - f_j^-)} \right]. \quad (13)$$

The evaluation values of group utility and individual regret are as follows:

$$\begin{aligned} S_i &= \frac{S_i^+}{S_i^-}, \\ R_i &= \frac{R_i^+}{R_i^-}, \end{aligned} \quad (14)$$

where w_j is the weight of the j th criterion, S_i can be seen as a consent decision indicator, and R_i can be seen as an opposition decision indicator. Assuming that every decision-maker can vote for or against every plan, the smaller the S_i scheme is, the more people agree with it, and the smaller the R_i scheme is, the fewer people oppose it. Therefore, smaller is better for S_i and R_i .

- (7) Calculating the VIKOR comprehensive indicator Q and sorting the pros and cons.

The VIKOR comprehensive indicator of the i th scheme can be obtained by the following formula:

$$Q_i = \nu \left[\frac{S_i - S^*}{S^- - S^*} \right] + (1 - \nu) \left[\frac{R_i - R^*}{R^- - R^*} \right], \quad (15)$$

where $S^* = \min_i S_i$, $S^- = \max_i S_i$, $R^* = \min_i R_i$, $R^- = \max R_i$, and ν represents the weight of the distance ratio between the ideal solution and the negative ideal solution (the value is usually set to 0.5). In the above equation, ν represents the decision-making mechanism coefficient. When $\nu > 0.5$, it means that the decision is made according to the majority of resolutions. When $\nu = 0.5$, it means that the decision is made according to agreement. When $\nu < 0.5$, it means that the decision is made in favour of the opposition. In VIKOR, we set ν to be 0.5 when pursuing the maximization of group utility and the minimization of individual regret.

- (8) According to the VIKOR method, the selected objects are sorted according to S , R , and Q values, from small to large.
- (9) Acquiring the best ranking of selection objects. According to the order of Q from small to large, the first selection object X^1 is the best selection object when it meets the following two conditions:

Condition 1 (acceptance advantage): $DQ = (1/(n-1))$ meets $Q(X^2) - Q(X^1) \geq DQ$.

Condition 2 (stability of decision): the best selection object X^1 must be the best according to the Q value ranking and the S or R value ranking at the same time to ensure the stability of the decision.

If the above conditions cannot be met at the same time, there is a compromise satisfactory solution set (that is, there is more than one satisfactory solution), which can be divided into two situations:

- (1) If condition 1 is not met, X^1, X^2, \dots, X^n constitute a set of alternative compromise satisfactory solutions. X^n is the maximum n value determined by $Q(X^n) - Q(X^1) < DQ$.
- (2) If condition 2 is not satisfied, then X^1 and X^2 constitute a set of alternative compromise satisfactory solutions; that is, X^1 and X^2 can be selected as satisfactory solutions.

2.2. Construction of the Evaluation Index System. Penrose defined an enterprise as a resource aggregate that relies on a particular management structure and whose economic benefits are based on resources and capabilities; thus, we establish an analysis framework of enterprise resources, enterprise capabilities, and enterprise growth [19]. Hall divided enterprise resources into tangible resources, intangible resources, and capabilities [24]. Enterprise capability itself is also a system of rich content, and Lavie

described the process of capability reconstruction as a two-stage process model based on the zero-order capability level and considering the capability gap [25]. Based on Penrose's theory of enterprise growth, this paper establishes the growth evaluation index system for small- and medium-sized construction enterprises from the three aspects of growth resources, growth capability, and growth innovation (as shown in Table 1) by referring to the research results of scholars in recent years [26–28] and considering the characteristics of listed construction enterprises, such as economies of scale, profitability, labour intensity, resource consumption, sensitivity to policy and the ecological environment, profitability, operation, concomitant development and expansion, consistency of debt payment, and risk-averse behaviour [29]. The indicator system consists of 3 criteria layers, 10 factor layers, and a total of 25 indicators.

2.3. Types of Dynamic Growth of Enterprises. To explore the growth process of small- and medium-sized construction enterprises horizontally, it is necessary to extend the time span considered. The growth of an enterprise can be dynamically divided into continuous growth and interrupted growth (maintenance and reduction) [30]. This paper proposes a feasible classification method for reference. The growth rankings of small- and medium-sized construction enterprises from 2013 to 2016 are denoted as X_1, X_2, X_3 , and X_4 and are calculated using the annual growth rate to obtain the increment (or change amount) of the new ranking of enterprises, $I_i = -((X_{i+1} - X_i)/X_i)$ ($i = 1, 2, 3, 4$).

Based on the annual growth rate, the mean and variance (SD) of the enterprises' annual growth rate are calculated. The mean and variance of the growth rate are the main basis for the vertical comparison of the growth of small- and medium-sized construction enterprises in this paper. The calculation formulas are as follows:

$$\begin{aligned} \text{mean} &= \sqrt[3]{(1 + I_1)(1 + I_2)(1 + I_3)} - 1, \\ \text{SD} &= \sqrt{\frac{1}{n} \sum_{i=1}^n (I_i - \bar{I})^2}. \end{aligned} \quad (16)$$

Finally, the enterprises studied in this paper can be classified into six growth categories, including steady growth, fluctuating growth, steady negative growth, fluctuating negative growth, steady maintenance, and fluctuating maintenance. The basis for classification is as follows:

- (A) Mean > 0 , $\underline{\text{SD}} < \text{average (SD)}$ steady growth
- (B) Mean > 0 , $\underline{\text{SD}} > \text{average (SD)}$ fluctuating growth
- (C) Mean < 0 , $\underline{\text{SD}} < \text{average (SD)}$ steady negative growth
- (D) Mean < 0 , $\underline{\text{SD}} > \text{average (SD)}$ fluctuating negative growth
- (E) Mean $= 0$, $\underline{\text{SD}} < \text{average (SD)}$ steady maintenance
- (F) Mean $= 0$, $\underline{\text{SD}} > \text{average (SD)}$ fluctuating maintenance

TABLE 1: The growth evaluation index system of small- and medium-sized construction enterprises.

| Target layer | Criteria layer | Factor layer | Indicator layer |
|--|-------------------|--------------------------------|--|
| The growth evaluation index system of small- and medium-sized construction enterprises | Growth resources | Intangible resources | Ratio of intangible assets, growth rate of intangible assets |
| | | Tangible resources | Increasing rate of fixed assets, cash ratio, inventory, accounts receivable |
| | | Human resources | Number of employees, quality of employees |
| | | Operation capacity | Accounts receivable turnover, current asset turnover, inventory turnover, turnover of fixed assets |
| | Growth ability | Profitability | Operating gross profit margin, return on equity, return on assets |
| | | Debt-paying ability | Asset-liability ratio, current ratio, quick ratio |
| | | Marketing ability | Net profit margin on sales, market share |
| | | Market anticipation capability | Price earning (PE) ratio, price/book (PB) value ratio |
| | Growth innovation | Technological innovation | Growth rate of research and development, input intensity |
| | | Service innovation | Diversity of products or services |

2.4. *Sample Selection and Data Source.* How to maintain rapid growth and steady and sustainable development in an environment of fierce competition is the realistic and challenging problem faced by small- and medium-sized construction enterprises. To ensure a sufficient sample size and considering the reliability and integrity of data sources, this study selects small- and medium-sized construction enterprises listed before December 31, 2012, as the sample. Excluding the enterprises with incomplete data, we selected 26 enterprises and analysed sample data from four consecutive years: 2013, 2014, 2015, and 2016. The sample is shown in Table 2. The indicator data are obtained from the WIND database; these data include the information disclosed by the sample companies in their annual reports.

3. Empirical Research Results and Analysis

3.1. Evaluation Results for Enterprise Growth

3.1.1. *The Sample Data Were Processed following the Steps of the Entropy-VIKOR Algorithm.* The weight value of each index layer is calculated using formulas (6) and (7). The weight of the factor layer is the sum of the weights of the corresponding index layer, and the weight of the criterion layer is the sum of the weights of the corresponding factor layer. The weight values of the criterion layer, factor layer, and index layer are shown in Table 3.

Table 3 shows that the contribution rate of the operation capacity index is the largest, with a weight of 0.3443, indicating that enterprise growth needs to be judged by considering multiple aspects and cannot be determined by a single index. Additionally, intangible resources, tangible resources, and human resources accounted for a relatively large proportion, with weights of 0.2917, 0.1184, and 0.0864, respectively, indicating that these resources to a large extent represent the growth capacity of enterprises. This finding shows that these four factors have a strong influence on the growth of small- and medium-sized construction enterprises.

The positive ideal solution and the negative ideal solution of each index are determined, and the VIKOR comprehensive index Q is calculated. Taking 2016 as an example, $Q(X^2) - Q(X^1) = 0.0855 - 0.000 = 0.0855 \geq DQ = 1/(n-1) = 1/25 = 0.04$, and X^1 is the evaluation object with the top S or R ranking, so it needs to be ranked only according to the Q value [31]. The ranking of Q values in each year is shown in Table 4.

3.1.2. *Enterprise Growth Rankings.* Table 4 shows that the enterprises with the highest growth in 2016 were YABAITE, Gold Mantis, HONGTAO, QDDFTT, and ZCT, and the enterprises with the lowest growth were BXLQ, YT-ECO, GHE, ZSSF, and PALM. According to the data for the four years studied, the top four companies are Gold Mantis, ZCT, HONGTAO, and Orient Landscape, and the bottom four companies are BXLQ, YT-ECO, ZSSF, and GHE.

According to Section 2.3, which deals with the classification of dynamic growth types for enterprises, there are 6 small- and medium-sized construction enterprises with steady growth, 16 with steady negative growth, and 4 with fluctuating negative growth, as shown in Table 4.

3.2. *Effectiveness Analysis of Evaluation Methods.* To verify the effectiveness of this method, it is compared with the TOPSIS method and the traditional VIKOR method in this paper. TOPSIS is one of the methods most widely used for multiattribute decision-making. By detecting the distance between the evaluation object and the optimal solution and the worst solution, the closeness degree is used to rank all schemes. Taking 2016 as an example, the ranking results according to each method are shown in Table 5.

Among them, the greater the relative closeness of the TOPSIS method is, the higher the ranking is; the smaller the Q value of the traditional VIKOR method and the improved VIKOR method is, the higher the ranking is. Table 5 shows that YABAITE ranks first and QDDFTT, Gold Mantis, and ZCT all rank in the top five, but the specific ranking

TABLE 2: The sample companies.

| Number | Stock code | Company abbreviation | Number | Stock code | COHR |
|--------|------------|----------------------|--------|------------|-----------|
| 1 | 002047.SZ | BAUING | 14 | 002323.SZ | YABAITE |
| 2 | 002051.SZ | CAMC | 15 | 002325.SZ | HONGTAO |
| 3 | 002060.SZ | GHE | 16 | 002375.SZ | YASHA |
| 4 | 002061.SZ | ZCT | 17 | 002431.SZ | PALM |
| 5 | 002062.SZ | HR | 18 | 002469.SZ | Sanwei |
| 6 | 002081.SZ | Gold Mantis | 19 | 002482.SZ | GRANDLAND |
| 7 | 002116.SZ | China Haisum | 20 | 002541.SZ | HOLU |
| 8 | 002135.SZ | ZSSF | 21 | 002542.SZ | ZHCGE |
| 9 | 002140.SZ | DHC | 22 | 002545.SZ | QDDFTT |
| 10 | 002178.SZ | Yanhua Smartech | 23 | 002586.SZ | RECLAM |
| 11 | 002200.SZ | YT-ECO | 24 | 002620.SZ | Ruihe |
| 12 | 002307.SZ | BXLQ | 25 | 002628.SZ | CDR&B |
| 13 | 002310.SZ | Orient Landscape | 26 | 002663.SZ | Pbland |

TABLE 3: Index weight of each level.

| Target layer | Criteria layer | Weight | Factor layer | Weight | Indicator layer | Weight | | |
|---|----------------------|--------|----------------------|-----------------------------------|-------------------------------------|--------|-----------------------------------|--------|
| Growth index system for small- and medium-sized listed construction enterprises | Growth resources | 0.4965 | Intangible resources | 0.2917 | The proportion of intangible assets | 0.0947 | | |
| | | | | | Intangible asset growth rate | 0.1970 | | |
| | | | Tangible resources | 0.1184 | Growth rate of fixed assets | 0.0494 | | |
| | | | | | Cash ratio | 0.0587 | | |
| | | | Human resources | 0.0864 | Operation capacity | 0.3443 | Inventory | 0.0060 |
| | | | | | | | Accounts receivable | 0.0043 |
| | | | | | Profitability | 0.0292 | Number of employees | 0.0624 |
| | | | | | | | Staff quality | 0.0240 |
| | | | Growth ability | 0.4562 | Debt-paying ability | 0.0261 | Accounts receivable turnover rate | 0.0851 |
| | | | | | | | Current asset turnover | 0.0346 |
| | Marketing capability | 0.0520 | | | Market expectation ability | 0.0046 | Inventory turnover | 0.1589 |
| | | | | | | | Fixed asset turnover | 0.0657 |
| | Growth innovation | 0.0474 | | | Technology innovation | 0.0459 | Gross operating margin | 0.0127 |
| | | | | | | | Return on equity | 0.0049 |
| | | | Service innovation | 0.0015 | Market expectation ability | 0.0046 | Return on assets | 0.0116 |
| | | | | | | | Asset-liability ratio | 0.0169 |
| | | | | | Current ratio | 0.0050 | | |
| | | | | | Quick ratio | 0.0042 | | |
| | | | | | Net profit margin | 0.0095 | | |
| | | | | | Market occupancy | 0.0425 | | |
| | | | | Price earnings ratio | 0.0026 | | | |
| | | | | Price/book value ratio | 0.0020 | | | |
| | | | | Growth rate of R&D cost | 0.0123 | | | |
| | | | | Intensity of R&D input | 0.0336 | | | |
| | | | | Diversity of products or services | 0.0015 | | | |

differs by the method. Furthermore, from Table 6, it can be seen that the correlation coefficient of the three methods is high, and thus the evaluation results of the three methods are relevant and different, indicating the effectiveness and rationality of the improved method. The Q value of the improved VIKOR method is obviously smaller than that of the traditional VIKOR method. Taking only the positive ideal

solution as the reference, the actual evaluation value is unreasonably high, indicating the importance of considering the information of the negative ideal solution to ensure rational decision-making; this figure also shows the superiority of the improved VIKOR method.

The purpose of the validity test is to verify the error between the evaluation result and the true value. Correlation

TABLE 4: Enterprise Q value ranking (2013–2016).

| Enterprise | Years | | | | | | | | Type of growth |
|------------------|--------|------|--------|------|--------|------|--------|------|-----------------------------|
| | 2013 | | 2014 | | 2015 | | 2016 | | |
| | Q | Rank | Q | Rank | Q | Rank | Q | Rank | |
| BAUING | 0.4981 | 11 | 0.3526 | 10 | 0.2250 | 6 | 0.3704 | 9 | Steady negative growth |
| CAMC | 0.7292 | 19 | 0.4391 | 15 | 0.5560 | 18 | 0.5628 | 13 | Steady growth |
| GHE | 0.5916 | 17 | 0.7736 | 23 | 0.7724 | 25 | 0.8860 | 24 | Steady negative growth |
| ZCT | 0.1439 | 4 | 0.0579 | 3 | 0.0839 | 4 | 0.1259 | 5 | Steady negative growth |
| HR | 0.5682 | 14 | 0.5177 | 17 | 0.5064 | 16 | 0.7175 | 21 | Steady negative growth |
| Gold Mantis | 0.0343 | 2 | 0.0145 | 2 | 0.0492 | 3 | 0.0855 | 2 | Steady negative growth |
| China Haisum | 0.4787 | 9 | 0.4303 | 14 | 0.3474 | 10 | 0.5541 | 12 | Steady negative growth |
| ZSSF | 0.8239 | 24 | 0.7044 | 22 | 0.6248 | 22 | 0.8012 | 23 | Steady growth |
| DHC | 0.5545 | 13 | 0.5517 | 19 | 0.5109 | 17 | 0.6127 | 18 | Steady negative growth |
| Yanhua Smartech | 0.5705 | 15 | 0.3927 | 12 | 0.0000 | 1 | 0.5465 | 11 | Fluctuating negative growth |
| YT-ECO | 0.7606 | 21 | 0.6917 | 20 | 0.6598 | 23 | 0.9002 | 25 | Steady negative growth |
| BXLQ | 0.8973 | 25 | 0.9196 | 25 | 1.0000 | 26 | 0.9996 | 26 | Steady negative growth |
| Orient landscape | 0.2362 | 6 | 0.1574 | 5 | 0.2143 | 5 | 0.2974 | 6 | Steady negative growth |
| YABAITE | 0.5114 | 12 | 0.3650 | 11 | 0.5674 | 19 | 0.0000 | 1 | Steady negative growth |
| HONGTAO | 0.1263 | 3 | 0.1775 | 6 | 0.0447 | 2 | 0.0901 | 3 | Steady negative growth |
| YASHA | 0.0000 | 1 | 0.4401 | 16 | 0.4167 | 12 | 0.5885 | 15 | Fluctuating negative growth |
| PALM | 0.7795 | 22 | 0.2314 | 8 | 0.6035 | 21 | 0.7841 | 22 | Fluctuating negative growth |
| Sanwei | 0.2904 | 7 | 0.3369 | 9 | 0.2379 | 7 | 0.3051 | 7 | Steady negative growth |
| GRANDLAND | 0.7541 | 20 | 0.6950 | 21 | 0.4703 | 14 | 0.5692 | 14 | Steady growth |
| HOLU | 0.5838 | 16 | 0.5179 | 18 | 0.5716 | 20 | 0.6219 | 19 | Steady negative growth |
| ZHCGE | 0.6413 | 18 | 0.0082 | 1 | 0.3613 | 11 | 0.5933 | 17 | Fluctuating negative growth |
| QDDFTT | 0.4925 | 10 | 0.4176 | 13 | 0.2801 | 8 | 0.1187 | 4 | Steady growth |
| RECLAM | 0.2025 | 5 | 0.1535 | 4 | 0.3153 | 9 | 0.4292 | 10 | Steady negative growth |
| Ruihe | 0.9205 | 26 | 0.8666 | 24 | 0.4602 | 13 | 0.3239 | 8 | Steady growth |
| CDR&B | 0.7892 | 23 | 1.0000 | 26 | 0.6780 | 24 | 0.5927 | 16 | Steady growth |
| Pbland | 0.3458 | 8 | 0.2220 | 7 | 0.4772 | 15 | 0.6751 | 20 | Steady negative growth |

TABLE 5: Ranking results of each method in 2016.

| Enterprise | TOPSIS method | | VIKOR method | | Improved VIKOR method | |
|------------------|----------------------|------|--------------|------|-----------------------|------|
| | Relative closeness C | Rank | Q | Rank | Q | Rank |
| BAUING | 0.1166 | 13 | 0.8884 | 9 | 0.3704 | 9 |
| CAMC | 0.1070 | 15 | 0.9005 | 11 | 0.5628 | 13 |
| GHE | 0.0803 | 24 | 0.9825 | 23 | 0.8860 | 24 |
| ZCT | 0.2942 | 3 | 0.6911 | 4 | 0.1259 | 5 |
| HR | 0.1000 | 19 | 0.9816 | 22 | 0.7175 | 21 |
| Gold Mantis | 0.2909 | 5 | 0.6656 | 3 | 0.0855 | 2 |
| China Haisum | 0.1342 | 8 | 0.8889 | 10 | 0.5541 | 12 |
| ZSSF | 0.0927 | 22 | 0.9957 | 26 | 0.8012 | 23 |
| DHC | 0.1224 | 9 | 0.9510 | 19 | 0.6127 | 18 |
| Yanhua Smartech | 0.1192 | 10 | 0.9347 | 17 | 0.5465 | 11 |
| YT-ECO | 0.0772 | 26 | 0.9947 | 25 | 0.9002 | 25 |
| BXLQ | 0.0775 | 25 | 0.9826 | 24 | 0.9996 | 26 |
| Orient Landscape | 0.1661 | 7 | 0.7114 | 5 | 0.2974 | 6 |
| YABAITE | 0.5286 | 1 | 0.0000 | 1 | 0.0000 | 1 |
| HONGTAO | 0.2926 | 4 | 0.7170 | 6 | 0.0901 | 3 |
| YASHA | 0.1116 | 11 | 0.9307 | 16 | 0.5885 | 15 |
| PALM | 0.0970 | 21 | 0.9685 | 21 | 0.7841 | 22 |
| Sanwei | 0.1848 | 6 | 0.8807 | 8 | 0.3051 | 7 |
| GRANDLAND | 0.1040 | 17 | 0.9188 | 14 | 0.5692 | 14 |
| HOLU | 0.1067 | 16 | 0.9500 | 18 | 0.6219 | 19 |
| ZHCGE | 0.1084 | 14 | 0.9092 | 13 | 0.5933 | 17 |
| QDDFTT | 0.2954 | 2 | 0.4918 | 2 | 0.1187 | 4 |
| RECLAM | 0.1120 | 12 | 0.9252 | 15 | 0.4292 | 10 |
| Ruihe | 0.0974 | 20 | 0.8598 | 7 | 0.3239 | 8 |
| CDR&B | 0.0924 | 23 | 0.9644 | 20 | 0.5927 | 16 |
| Pbland | 0.1013 | 18 | 0.9075 | 12 | 0.6751 | 20 |

TABLE 6: The correlation between the 2016 evaluation results and the excess return rate ranking.

| | TOPSIS method | Traditional VIKOR method | | Improved VIKOR method |
|--------------------------|-------------------------|--------------------------|--------|-----------------------|
| Excess return | Correlation coefficient | -0.151 | 0.143 | 0.120 |
| | Sig. | 0.460 | 0.485 | 0.559 |
| | Number of enterprises | 26 | 26 | 26 |
| TOPSIS method | Correlation coefficient | 1.000 | 0.832* | 0.867** |
| | Sig. | | 0.000 | 0.000 |
| | Number of enterprises | 26 | 26 | 26 |
| Traditional VIKOR method | Correlation coefficient | | 1.000 | 0.931** |
| | Sig. | | | 0.000 |
| | Number of enterprises | | 26 | 26 |

analysis of the annual excess return of enterprise stocks and the growth rankings of enterprises is one of the most commonly used methods in the literature. Based on the assumption of rational market investment, enterprise stocks with high growth rankings should be favoured by investors and have a high rate of return. The sample firms were ranked according to the annual excess rate of return, and the sequential data and evaluation results were analysed by Spearman correlation, as shown in Table 6. The results of the traditional VIKOR method and the improved VIKOR method are positively but nonsignificantly correlated with the ranking of the annual excess return of stocks, while the TOPSIS method is negatively but nonsignificantly correlated. This finding also shows that the evaluation results of the traditional VIKOR method and the improved VIKOR method are better than those of the TOPSIS method.

Further analysis of the basic performance of the sample compared the excess earnings performance of enterprises with different rankings. Evaluation accuracy was obtained by comparing the top 5 evaluation results with the median value of the excess return rate of all sample firms, while the bottom 5 results were compared with the median value to obtain the evaluation error rate. The validity test for the evaluation results of the small- and medium-sized construction enterprises listed in 2016 is shown in Table 7. The traditional VIKOR method and the improved VIKOR method are highly effective.

To verify the comparison of the dynamic growth types of enterprises, financial data from 2017 are considered. The growth types of enterprises in 2013–2016 and the growth rate of net profit in 2017 are shown in Table 8. The table shows that in 2017, the ranking of the average net profit growth rate of stable growth enterprises improved as follows: VIKOR method (43.69%) > TOPSIS method (28.05%) > traditional VIKOR method (-177.8%). The ranking of the average net profit growth rate of enterprises with negative growth (including stable negative growth and fluctuating negative growth) is as follows: VIKOR method (-31.39%) < TOPSIS method (-28.26%) < traditional VIKOR method (40.02%). These rankings show that the improved VIKOR method best distinguishes the advantages and disadvantages of enterprise growth.

Therefore, the improved VIKOR evaluation method proposed in this paper makes full use of the information for both the positive and negative ideal solutions to make the evaluation results more practical and reasonable.

3.3. Sensitivity Analysis

3.3.1. Parameter Sensitivity Analysis. To study the influence of the decision mechanism coefficient ν of the improved VIKOR method on the growth evaluation of small- and medium-sized construction enterprises, the influence of model parameters on the ranking results of schemes is determined through sensitivity analysis [32]. Taking 2016 as an example, this section conducted a sensitivity analysis by selecting different ν values. The value of parameter ν is evaluated from the interval $[0, 1]$ with a step length of 0.1 to analyse the growth sequencing of construction enterprises. As shown in Figure 1, the top company ranked first in all 11 experiments (100%), 8 companies (100%) ranked in the top 30% (top 8) in the 11 experiments, and 6 companies (75%) ranked in the bottom 30% (the last 8) in the 11 experiments.

The sensitivity analysis of the traditional VIKOR method to the coefficient V of the decision mechanism is shown in Figure 2. In the 11 experiments, the first-ranked enterprise ranked first in all experiments (100%), 5 enterprises (62.5%) ranked in the top 30% (top 8) in all experiments, and 4 (50%) enterprises ranked in the bottom 30% (bottom 8) in all experiments.

3.3.2. Sensitivity Analysis of Weights. When the original evaluation information objectively empowers each evaluation criterion and the weight changes, do the findings for an enterprise's growth change? What changes take place? Through sensitivity analysis, it can be determined that potential changes in the weight of the evaluation criteria lead to a change in the evaluation results, which is the key to effectively using the model and implementing quantitative decisions [32]. Taking 2016 as an example, this paper adopts a perturbation method to analyse the sensitivity of the weight of the evaluation criteria; that is, when the weight of the model evaluation criteria is slightly disturbed, the growth evaluation results for the sample enterprises may change accordingly. The initial weight of the evaluation criteria C_j is w_j ; thereafter, a disturbance is denoted as $\dot{w}_j = \eta w_j$ ($0 \leq \dot{w}_j \leq 1$), and the variation interval of the parameter η is $0 \leq \eta \leq (1/w_j)$. According to the normalization of the weight, the other weight changes in accordance with the change in w_j , denoted as $\dot{w}_k = \emptyset w_k$, $k \neq j$, $k = 1, 2, \dots, n$, and satisfies

TABLE 7: Effectiveness test of 2016 evaluation results.

| | Top 5 | Bottom 5 | Evaluation accuracy (%) | Evaluation error rate (%) |
|--------------------------|-------|----------|-------------------------|---------------------------|
| TOPSIS method | 2 (5) | 3 (5) | 40 | 60 |
| Traditional VIKOR method | 3 (5) | 2 (5) | 60 | 40 |
| Improved VIKOR method | 3 (5) | 2 (5) | 60 | 40 |

TABLE 8: Dynamic classification of enterprise growth in 2013–2016.

| Methods | Growth type and average growth rate of net profit | | | | | | | |
|--------------------------|---|------------------------|--------------------|------------------------|------------------------|------------------------|--------------------------|------------------------|
| | Steady growth | Net profit growth rate | Fluctuating growth | Net profit growth rate | Steady negative growth | Net profit growth rate | Volatile negative growth | Net profit growth rate |
| TOPSIS method | 7 | 28.05 | 1 | -46.31 | 12 | -79.48 | 6 | 74.18 |
| Traditional VIKOR method | 6 | -177.8 | 1 | -43.32 | 15 | 42.92 | 4 | 29.14 |
| Improved VIKOR method | 6 | 43.69 | 0 | | 16 | -46.52 | 4 | 29.14 |

$$w'_k + \sum_{k \neq i, k=1}^n w'_k = 1, \tag{17}$$

that is,

$$\eta w_j + \phi \sum_{k \neq i, k=1}^n w_k = 1. \tag{18}$$

The solution is $\phi = ((1 - \eta w_j) / (1 - w_j))$. For the weight of each evaluation criterion, when different parameters are adopted for perturbation, the corresponding evaluation results of the growth of construction enterprises are obtained by using the improved VIKOR method. The weights of the 25 evaluation indicators in this paper were changed, 1/2 and 1/3 were taken in turn, and 50 experiments were performed to obtain the analysis results, as shown in Figure 3. The top company ranked first in 48 of the 50 experiments (96%); the top 30% (top 8) companies ranked in the top 30% in 7 (87.5%) out of the 50 experiments, and 6 (75%) enterprises ranked in the bottom 30% (the bottom 8) in 50 experiments.

The sensitivity analysis of the traditional VIKOR method to weights is shown in Figure 4. The first-ranked enterprise ranked first (96%) in 48 of the 50 experiments. Five (62.5%) enterprises ranked in the top 30% (top 8) of all 50 experiments, and 6 (75%) enterprises ranked in the bottom 30% (bottom 8) of all 50 experiments.

The sensitivity analysis of the TOPSIS method to weights is shown in Figure 5. The first-ranked enterprise ranked first (100%) in the 50 experiments, 5 enterprises (62.5%) ranked in the top 30% (top 8) in all 50 experiments, and 6 (75%) enterprises ranked in the bottom 30% (bottom 8) in all 50 experiments.

3.3.3. Comparative Analysis. The sensitivity analysis of the three methods is shown in Table 9. In terms of parameter sensitivity, the average ranking consistency rate of the improved VIKOR method is 91.67%, which is higher than 70.83% of the traditional VIKOR method; in terms of weight

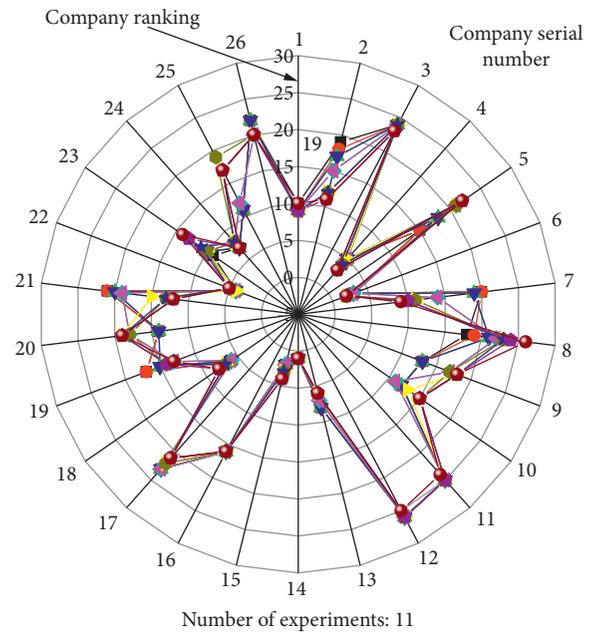


FIGURE 1: Improved VIKOR method parameter V sensitivity analysis results.

sensitivity, the average value of the improved VIKOR method is 86.17%, which is higher than the 79.17% of the TOPSIS method and the 77.83% of the traditional VIKOR method. Therefore, the improved VIKOR method is more stable than the traditional VIKOR method and the TOPSIS method.

4. Discussion and Conclusions

- (1) It can be seen from the index weight of each level (Table 3) that operation ability has the largest influence on enterprise growth. This finding is different from the finding in the literature [2] that the growth of listed companies in China’s environmental protection industry is affected by profitability. The

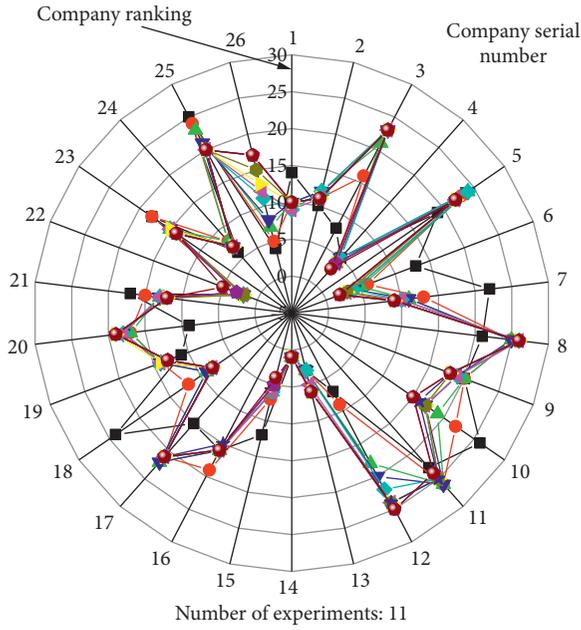


FIGURE 2: Traditional VIKOR parameter V sensitivity analysis results.

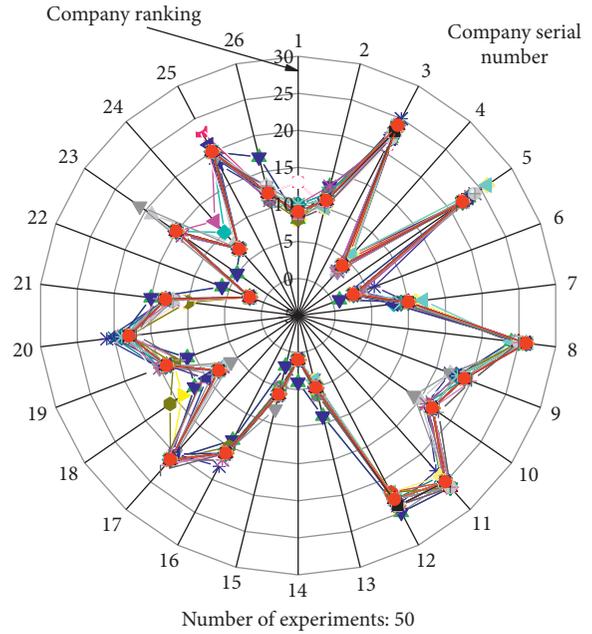


FIGURE 4: Weight sensitivity analysis results of the traditional VIKOR method.

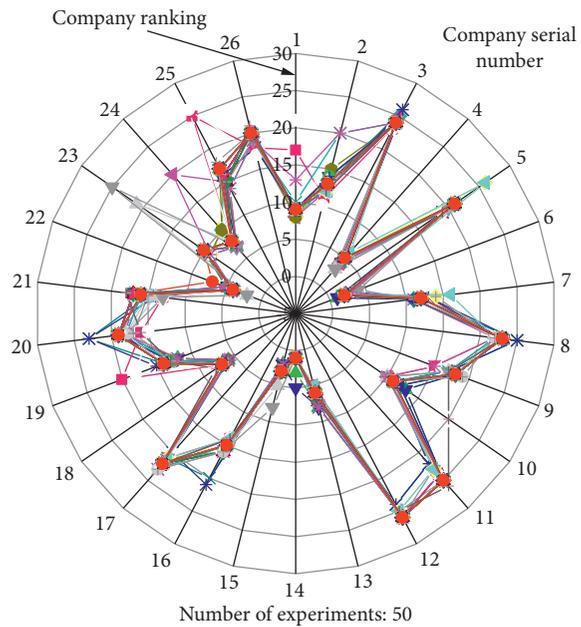


FIGURE 3: Weight sensitivity analysis results of the improved VIKOR method.

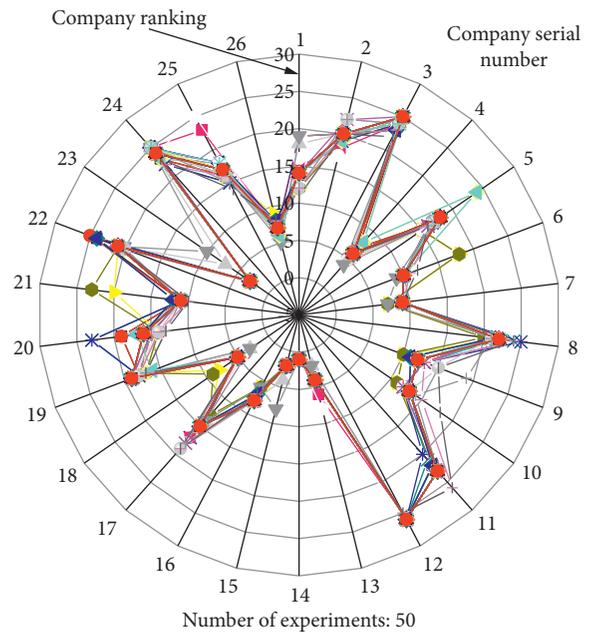


FIGURE 5: Weight sensitivity analysis results of the TOPSIS method.

difference in these findings is mainly due to the many uncertain factors, such as fierce bidding, engineering change, cost increases, inflation, and government policies that hinder the realization of earnings for construction enterprises. Therefore, construction enterprises should strengthen their operational capacity management and improve their operational management levels. They should focus on strengthening the management of operating

capacity, intangible resources, tangible resources, human resources, and other key factors to improve growth.

- (2) Regarding the comparison and analysis of the growth ranking of small- and medium-sized construction enterprises, Table 4 shows that ZTC, Golden Mantis, Oriental Garden, HONGTAO, Sanwei, and RECLAM are all ranked in the top 10 for growth between 2013 and 2016, while GHE, ZSSF, YT-ECO, and BXLQ are all ranked in the bottom 10. This

TABLE 9: Results of the sensitivity comparison.

| Categories | Comparison items | TOPSIS method | Traditional VIKOR method Ranking consistency rate (%) | Improved VIKOR method |
|-----------------------|------------------|---------------|--|-----------------------|
| Parameter sensitivity | Top 1 | | 100 | 100 |
| | Top 30% | | 62.5 | 100 |
| | Bottom 30% | | 50 | 75 |
| | Mean value | | 70.83 | 91.67 |
| Weight sensitivity | Top 1 | 100 | 96 | 96 |
| | Top 30% | 62.5 | 62.5 | 87.5 |
| | Bottom 30% | 75 | 75 | 75 |
| | Mean value | 79.17 | 77.83 | 86.17 |

finding indicates that there is a serious imbalance in the growth performance of small- and medium-sized construction enterprises. Well-developed enterprises maintain good performance, while enterprises with poor development continually face difficulties. Therefore, enterprise managers and regulatory departments should conduct targeted management measures according to the ranking of the enterprise.

- (3) Regarding the analysis of the dynamic growth of small- and medium-sized construction enterprises, Table 4 shows that there are 6 companies with stable growth, 16 with stable negative growth, and 4 with fluctuating negative growth. Only 23% (6) of the enterprises present positive growth, while 77% (20) present negative growth, indicating that the selected small construction enterprises have poor overall performance in terms of sustainable growth. This poor performance can be explained by several problems that are commonly faced by small- and medium-sized construction enterprises compared with large construction enterprises. As small- and medium-sized enterprises have weak market competitiveness, it is difficult for them to win bids for large projects, so they can rely only on large enterprises or engage in subcontracting projects. Small- and medium-sized construction enterprises have financing difficulties, declining economic benefits, and a low ability to withstand risks. They also face a serious shortage of high-level technical development and management talent, and family management is prominent. These enterprises are also limited by institutional issues, such as the division of the construction market and the qualification access system. The earnings of small- and medium-sized construction enterprises are affected by many uncertain factors. To face these challenges, such enterprises should seize opportunities, improve their independent innovation capabilities, innovate in project management, establish and improve modern enterprise systems based on a corporate governance structure, accelerate transformation and upgrading, transform their development mode, and achieve sustainable development.
- (4) Regarding the effectiveness analysis of the improved VIKOR method, Tables 5 and 6 indicate that the

correlation coefficients of the evaluation results of the TOPSIS method, traditional VIKOR method, and improved VIKOR method are high. The improved VIKOR method is shown to be effective and superior to the traditional VIKOR method in terms of the Q value. From Table 6, it can be seen that the evaluation results of the traditional VIKOR method and the improved VIKOR method are better than those of the TOPSIS method and are positively but nonsignificantly related to the annual excess return rate of stocks. This finding shows that stocks with higher growth rankings are more favoured by investors and have higher returns than those with lower growth rankings. However, because China's stock market is still an emerging market, speculation is strong, and value investment is difficult to promote; thus, this correlation is not significant. By further analysing the basic performance of the sample and comparing the different enterprises by their performance in terms of excess returns, it is concluded that the evaluation model has high effectiveness. Table 8 shows that the improved VIKOR method can distinguish the advantages and disadvantages of enterprise growth better than the TOPSIS method and the traditional VIKOR method, so its results are more practical. This finding shows that the evaluation model has good effectiveness.

- (5) Regarding the sensitivity analysis of the improved VIKOR method, the ranking consistency rate reaches 75%, which shows that the ranking of small- and medium-sized construction enterprises with high growth and low rankings is not sensitive to the change in the V parameter. The ranking consistency rate also reaches 75% according to the weight sensitivity analysis of the evaluation model, which shows that the VIKOR method is not sensitive to weight disturbances.

In summary, based on the shortcomings of the traditional VIKOR method, this paper proposes an improved entropy-VIKOR algorithm that simultaneously considers information on positive and negative ideal solutions. It calculates the group utility value and the individual regret value by taking the positive and negative ideal solutions as references, respectively, and makes full use of the information on positive and negative ideal solutions, so that the

decision-making results are in line with reality. Based on this algorithm, the growth evaluation model of small- and medium-sized construction enterprises, including growth resources, growth ability, and growth innovation, is established. Through sensitivity and effectiveness analysis, it is concluded that the evaluation model proposed in this paper has better stability and effectiveness than the TOPSIS method and the traditional VIKOR method. The evaluation results are analysed, and several suggestions are put forward. The evaluation results analysed in this paper can provide a reference for managers, investors, and regulatory departments.

Data Availability

Data can be made available upon request.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this article.

Acknowledgments

This project was supported by the Project of Ecological Civilization Research Centre of Fujian Social Sciences Research Base in 2018 under grant KXJD1805A, Research Project in FAFU of General Secretary Xi Jinping's Important Thought and Exploration Practice in Fujian under grant XSX201805, National Scientific Research Project Cultivation Progress of Social Sciences in FAFU in 2018 under grant xpy201808, and Project of Fujian Soft Science under grant 2019R0036.

References

- [1] N. Lu, Y. Q. Li, and J. Liu, "Study on appraisal model for the growth of small and medium-sized construction enterprises," *Construction Economy*, vol. 36, no. 3, pp. 5–9, 2015.
- [2] Y. F. Wang, "Principal component analysis of enterprise growth: a case study of listed companies in environmental protection industry," *China Management Informationization*, vol. 13, no. 19, pp. 38–41, 2010.
- [3] J. Hu, W. Wang, D. Jiang, and J. S. Yang, "The growth evaluation model and its application of fitness club of Jiangsu province," *Sports & Science*, vol. 1, pp. 55–62, 2018.
- [4] S. Gong and Q. H. Lv, "Construction of index system and prediction of growth of sporting goods industry in China: data analysis based on R language," *Journal of Shenyang Sport University*, vol. 37, no. 3, pp. 15–22, 2018.
- [5] S. L. Xia and N. N. Wang, "Growth evaluation of Jiangsu venture listed companies based on factor analysis method," *Science & Technology Management Research*, vol. 24, pp. 70–74, 2014.
- [6] F. H. Gong and J. Gao, "Research on growth of small and medium manufacturing enterprises," *Journal of Xian Technological University*, vol. 1, pp. 46–51, 2013.
- [7] D. Y. Shen, "Study on the endogenous growth of SMEs based on technological innovation capability," *Modern Economic Science*, vol. 3, pp. 116–123, 2017.
- [8] H. F. Wang and Y. Zhao, "A comparative study on the growth of hi-tech enterprises in various provinces and cities of China based on the factor analysis method," *Science & Technology Management Research*, vol. 4, pp. 59–64, 2013.
- [9] T. Lv and L. Pan, "Research on evaluation of the growth of new energy listed companies in China," *Journal of Industrial Technological & Economics*, vol. 2, pp. 118–125, 2017.
- [10] Y. J. Zhu, "Growth evaluation index of small and medium-sized enterprise and empirical study," *Science & Technology Management Research*, vol. 13, pp. 75–78, 2013.
- [11] Z. W. Zhao, P. Wang, and M. Y. Liu, "The growth evaluation research on high-tech enterprises based on dynamic cap," *Science & Technology Management Research*, vol. 23, pp. 74–77, 2016.
- [12] H. M. Cao and Y. Chang, "Analysis of the effect of financial credit evaluation on the impact of growth," *On Economic Problems*, vol. 10, pp. 113–117, 2015.
- [13] L. X. Zhang, P. Wang, and D. S. Liu, "Growth factors model building and empirical analysis of small and medium sized technology enterprises," *Science & Technology Management Research*, vol. 1, pp. 95–102, 2016.
- [14] Z. Zeng, "A novel model for enterprise technological innovation capability evaluation with 2-tuple linguistic information," *Journal of Intelligent & Fuzzy Systems*, vol. 31, no. 1, pp. 541–546, 2016.
- [15] Z. Liu, S. Hu, R. Mu, and L. Chen, "Research on the evaluation of growth quality of listed LED companies," *Light & Engineering*, vol. 3, pp. 232–238, 2017.
- [16] T. Lahdelma and S. Laakso, "Network analysis as a method of evaluating enterprise networks in regional development projects," *Evaluation*, vol. 22, no. 4, pp. 435–450, 2016.
- [17] F. Lefley and J. Sarkis, "Applying the FAP model to the evaluation of strategic information technology projects," *International Journal of Enterprise Information Systems*, vol. 1, no. 2, pp. 69–90, 2017.
- [18] Y. J. Zhu, "Research on optimal selection of evaluation methods for innovative enterprises," *Journal of Anhui University (Philosophy and Social Sciences)*, vol. 6, pp. 143–147, 2009.
- [19] A. M. Rugman and A. Verbeke, "Edith Penrose's contribution to the resource-based view of strategic management," *Strategic Management Journal*, vol. 23, no. 8, pp. 769–780, 2002.
- [20] A. Mardani, E. Zavadskas, K. Govindan, A. A. Senin, and A. Jusoh, "VIKOR technique: a systematic review of the state of the art literature on methodologies and applications," *Sustainability*, vol. 8, no. 1, p. 37, 2016.
- [21] A. Sanayei, S. Farid Mousavi, and A. Yazdankhah, "Group decision making process for supplier selection with VIKOR under fuzzy environment," *Expert Systems with Applications*, vol. 37, no. 1, pp. 24–30, 2010.
- [22] K. Salehi, "A hybrid fuzzy MCDM approach for project selection problem," *Decision Science Letters*, vol. 1, pp. 109–116, 2015.
- [23] K. Chatterjee and S. Kar, "Unified Granular-number-based AHP-VIKOR multi-criteria decision framework," *Granular Computing*, vol. 2, no. 3, pp. 1–23, 2017.
- [24] R. Hall, "The strategic analysis of intangible resources," *Strategic Management Journal*, vol. 13, no. 2, pp. 135–144, 2006.
- [25] D. Lavie, "Capability reconfiguration: an analysis of incumbent responses to technological change," *Academy of Management Review*, vol. 31, no. 1, pp. 153–174, 2006.
- [26] H. Sun, X. P. Sun, and Z. Q. Fan, "An evaluation and empirical study on competitiveness of civil engineering construction enterprises in shanghai stock market," *Science & Technology Progress & Policy*, vol. 13, pp. 102–106, 2011.

- [27] Y. J. Li, H. Y. Liu, and S. Y. Hao, "Competitiveness evaluation of construction industry of every province in China based on factor analysis and cluster analysis," *Journal of Huazhong University of Science and Technology*, vol. 2, pp. 78–83, 2014.
- [28] G. W. Liu, F. Deng, and M. Wang, "Industrial competitiveness assessment for Chinese construction industry," *China Civil Engineering Journal*, vol. 7, pp. 157–164, 2011.
- [29] R. X. Fan and M. J. Wang, "Analysis and evaluation of the financial quality of the listed building enterprise model," *Journal of Railway Science and Engineering*, vol. 3, pp. 695–701, 2015.
- [30] A. Awasthi and G. Kannan, "Green supplier development program selection using NGT and VIKOR under fuzzy environment," *Computers & Industrial Engineering*, vol. 91, pp. 100–108, 2016.
- [31] T. Z. Liu and Y. Yu, "Research on comprehensive evaluation of academic journal based on combined weight and VIKOR," *Mathematics in Practice and Theory*, vol. 49, no. 1, pp. 313–322, 2019.
- [32] R. Simanaviciene and L. Ustinovichius, "Sensitivity analysis for multiple criteria decision making methods: TOPSIS and SAW," *Procedia—Social and Behavioral Sciences*, vol. 2, no. 6, pp. 7743–7744, 2010.