Research on the Construction of Performance Evaluation Index System of Real Estate Listed Companies based on the Perspective of Variable Weight

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Abstract

With the development of the real estate industry in the new era, it is urgent to build a performance evaluation index system for real estate companies in the new era. Based on the standard value of performance evaluation indicators of real estate enterprises (2020 edition), this paper combs relevant domestic and foreign literatures, and constructs seven categories including profitability, anti-risk ability, growth ability, financing ability, scale ability, operation ability, and social responsibility ability. Part of the evaluation index system. Taking 10 listed real estate companies in Southwest China as the research objects, through the combination of entropy weight method and variable weight theory, the performance evaluation index system of listed real estate companies in Southwest China is constructed. The results of this paper show that traditional financial ability is still an important ability for real estate companies to maintain their own advantages, but non-financial abilities such as financing ability and social responsibility ability are taking more and more weight in the performance evaluation of real estate companies.

Keywords

Index Construction; Listed Real Estate Companies; Entropy Weight Method; Variable Weight Theory.

1. Introduction

With the transformation and upgrading of the real estate industry, the real estate industry has transformed from the large-scale development stage in the past to the post-development period focusing on high-quality development, which indicates that the performance evaluation standards of real estate companies will also change with the changes in the industry. Therefore, it is urgent to maintain the competitive advantage of real estate companies in the new era, improve their management level, and improve the efficiency level of real estate companies. Therefore, this paper studies and constructs the performance evaluation index system of listed real estate companies, which has certain practical significance.

Scholars mainly use financial indicators to evaluate the performance of listed real estate companies. In order to evaluate the performance level of the selected 23 listed real estate companies, Jie Lin and Xungang Zheng (2008) constructed a performance evaluation index system including profitability, growth ability, solvency, asset management ability and equity expansion ability" [1] . Xiao Pei (2011) added a new index to the original "four capabilities" index system - liquidity, and then constructed a new evaluation index system to evaluate the financial performance of 30 Shenzhen-listed real estate companies in 2010 [2]. Jing Wang et al. (2013) added two indicators of cash flow and capital structure to the original "four capabilities" indicator evaluation system, and then constructed a more distinctive indicator evaluation system to evaluate 22 A shares Financial performance of listed real estate companies in 2011 [3].

The methods for determining the weight of the evaluation index system mainly include two categories: subjective weighting and objective weighting. Subjective weighting methods such as expert evaluation method [4], analytic hierarchy process (AHP) [5], fuzzy comprehensive evaluation method [6], etc. are greatly influenced by human factors and have certain limitations; BP neural network [7], Objective weighting methods such as data envelopment analysis (DEA) [8], Topsis [9] can more accurately determine the weight of indicators, but they have strict requirements on indicator data. For some indicators that are difficult to quantify, objective weighting methods exist. large error. Therefore, existing studies usually combine the subjective and objective weighting methods. However, the existing weight determination methods often ignore the influence of the data itself on the index weight. When a certain index is seriously deviated, its weight will change accordingly. As a more accurate theory, the variable weight theory can effectively analyze the weights of indicators and avoid subjective mistakes. At present, the variable weight theory is widely used in engineering, and there is less research on enterprise performance.

The research results show that the performance evaluation index system of real estate companies is still mainly based on financial indicators, and the determination of weights is often not objective and reasonable. Therefore, this paper takes 10 listed real estate companies in Southwest China as samples, and takes the performance evaluation index standard value of real estate enterprises (2020 version) as the standard and combines the characteristics of my country's real estate industry. Based on seven aspects of scale capability, operational capability and social responsibility capability, a large number of relevant indicators were initially screened, and then 26 indicators were finally determined.

2. Construction of Performance Evaluation Indicators for Listed Real Estate Companies

2.1. Characteristics of the Real Estate Industry

(1) Deeply influenced by policy

As one of the important industries in my country's economic development, the real estate industry is deeply influenced by the government's economic policies, mainly in the following aspects: First, the development of real estate is subject to the government's use and restriction of land. Second, lending in the real estate industry is affected by policies, and therefore, will affect financing. Third, housing prices and the operation of the real estate industry are subject to the government's restrictions on real estate transactions and various taxes, fees, and interests.

(2) The real estate industry is a capital-intensive and high-risk industry

Due to the long period of real estate development and the large scale of development, real estate companies take a long time to return funds. During the period of real estate development, if the capital turnover rate of the enterprise cannot keep up with the project development cycle, the enterprise faces a greater risk of capital chain breakage. In addition, my country's real estate development enterprises are regulated by the regional economic level and national policies, and there are risks of uncertainty within the enterprise and at the market level when conducting economic activities.

(3) The real estate industry has great social responsibility

Real estate development enterprises must not only create profits and be responsible for the interests of shareholders, but also give back to the society and create social value. It is necessary to protect the legitimate rights and interests of consumers, safeguard the interests of employees, and make contributions to environmental protection, social donations, protection of vulnerable groups and protection of the legitimate rights and interests of workers.

2.2. Key Performance Factors of Listed Real Estate Companies

(1) The core competitiveness of an enterprise consists of the profitability and growth ability of the enterprise. Real estate is a capital-intensive industry and an industry that is easily affected by policies. The high-leverage operation of enterprises often brings huge pressure to break the capital chain during the market adjustment period; and once the market improves, the risks borne by enterprises in order to compensate for capital will easily lead to higher house prices and blind hoarding of land, which further pushes up the industry. The uncertainty and risk of the enterprise increase the difficulty of the operation of the enterprise, and the enterprise must make steady profits in order to achieve sustainable operation. Therefore, real estate companies must enhance their core competitiveness in order to ensure the normal operation of the company.

(2) Real estate companies are capital-intensive companies. The company's economic activities require a large amount of capital investment and support. In recent years, due to the implementation of various government control policies, companies need to lack their own unique core competition. Therefore, real estate companies should strengthen their short-term solvency and long-term solvency to resist possible risks.

(3) The scale of an enterprise reflects the overall strength of a company to a certain extent. Under efficient operation and management, economies of scale can effectively realize a virtuous value-added cycle of capital, which has a certain degree of influence on improving the performance of the company.

(4) Financing capability is of great significance to real estate companies, and the acquisition and operation of projects are inseparable from the support of strong financing capabilities. The strength of financing ability can guarantee the cash flow of the enterprise to a certain extent, which has a certain significance for the performance of the enterprise.

2.3. Preliminary Determination of Evaluation Indicators

In this paper, considering the characteristics of the real estate industry, based on the principle of index design, focusing on the factors affecting the shutdown of listed real estate companies, and comprehensively considering the national standards for enterprise performance evaluation and the research of many scholars, the listed real estate companies in Southwest China are considered. The performance evaluation index system is initially divided into a system with first-level indicators such as profitability, anti-risk ability, operating ability, growth ability, financing ability, scale ability and social responsibility ability. For specific indicators, please refer to Table 1 below

2.4. Data Correlation Test

In the comprehensive evaluation of multiple indicators, the phenomenon of strong correlation between indicators is prone to occur, and the use of indicators with repeated information at the same time will cause the evaluation results to be distorted. Therefore, the correlation test of indicators should be carried out before comprehensive evaluation. When the correlation coefficient $r \geq 0.95$ between variables, apply one variable instead of the other. This paper uses SPSS software to test the correlation of the indicators of each ability level, and obtains the correlation coefficient matrix between the indicators. The specific operation steps are as follows:

(1) Correlation test of profitability indicators

From the correlation coefficient matrix, the correlation coefficients of net profit rate, weighted return on equity, return on total assets, and net profit are all less than 0.950, so the four variables are retained. The profitability correlation coefficient matrix is shown in Table 2.

Table 1. Performance evaluation index system of listed real estate companies

Target layer	Criterion layer	Indicator layer
Performance Evaluation Index System of Real Estate Listed Companies	Profitability	Net profit rate Weighted ROE Net profit Roa
	Anti-risk ability	Current ratio Quick freezing ratio Assets and liabilities Net operating cash
	Operational capability	Inventory turnover Accounts Receivable Turnover Total asset turnover Fixed asset turnover
	Growth ability	Growth rate of home sales area Growth rate of main business Net profit growth rate Total asset growth rate Total floor area of land bank planning
	Financing ability	Cash inflow from financing activities Overall average cost of financing
	Ability to scale	Real estate business income Total assets Net assets Sales area Home sales Number of items for sale
	Social responsibility ability	Tax amount Provide job growth rates

Table 2. Profitability correlation coefficient

Variable	Net profit rate	Weighted ROE	Roa	Net profit
Net profit rate	1			
Weighted ROE	0.798	1		
Roa	0.499	0.160	1	
Net profit	0.366	0.603	0.085	1

(2) Correlation test of anti-risk ability

From the correlation coefficient matrix, the correlation coefficients of current ratio, quick-freezing ratio, asset-liability ratio, and net operating cash amount are all less than 0.950, so the four variables are retained. The anti-risk ability correlation coefficient matrix is shown in Table 3.

Table 3. Correlation coefficient matrix of anti-risk ability

Variable	Current ratio	Quick ratio	Assets and liabilities	Net operating cash
Current ratio	1			
Quick ratio	0.698	1		
Assets and liabilities	-0.829	-0.764	1	
Net operating cash	-0.164	-0.286	-0.114	1

(3) Operational Capability Relevance Test

From the correlation coefficient matrix, it is known that the correlation coefficients of inventory turnover ratio, accounts receivable turnover ratio, total asset turnover ratio, and fixed asset turnover ratio are all less than 0.950, so the four variables are retained. The operating capacity correlation coefficient matrix is shown in Table 4.

Table 4. Business Capability Correlation Coefficient Matrix

Variable	Inventory turnover	Accounts Receivable Turnover	Total asset turnover	Fixed asset turnover
Inventory turnover	1			
Accounts Receivable Turnover	0.063	1		
Total asset turnover	0.871	0.173	1	
Fixed asset turnover	0.473	0.788	0.572	1

(4) Correlation test of growth ability

From the correlation coefficient matrix, we know that the correlation coefficients of the growth rate of housing sales area, the growth rate of main business, the growth rate of net profit, the growth rate of total assets, and the total construction area of land reserve planning are all less than 0.950, so the five variables are all retained, and the growth rate The ability correlation coefficient matrix is shown in Table 5.

Table 5. Growth ability correlation coefficient matrix

Variable	Growth rate of home sales area	Growth rate of main business	Net profit growth rate	Total asset growth rate	Total floor area of land bank planning
Growth rate of home sales area	1				
Growth rate of main business	0.195	1			
Net profit growth rate	0.468	-0.101	1		
Total asset growth rate	0.249	0.378	-0.064	1	
Total floor area of land bank planning	0.303	0.182	-0.158	0.470	1

(5) Correlation test of financing ability

From the correlation coefficient matrix, it is known that the correlation coefficient between the cash inflow of financing activities and the overall average financing cost is less than 0.950, so

the two variables are retained. The financing capacity correlation coefficient matrix is shown in Table 6.

Table 6. Correlation coefficient matrix of financing capacity

Variable	Cash inflow from financing activities	Overall average cost of financing
Cash inflow from financing activities	1	
Overall average cost of financing	-0.202	1

(6) Scale capability correlation test

From the correlation coefficient matrix, it is known that the correlation coefficients between real estate operating income and sales area, and real estate operating income and real estate sales are all greater than 0.950. Therefore, the real estate operating income is removed, and the remaining variables are retained. The scale capacity correlation coefficient matrix is shown in Table 7.

Table 7. Scale Capability Correlation Coefficient Matrix

Variable	Total assets	Net assets	Real estate business income	Sales area	Real estate sales	Number of items for sale
Total assets	1					
Net assets	0.914	1				
Real estate business income	0.966	0.888	1			
Sales area	0.926	0.866	0.988	1		
Real estate sales	0.936	0.851	0.986	0.947	1	
Number of items for sale	0.792	0.677	0.850	0.875	0.831	1

(7) Social responsibility ability test

From the correlation coefficient matrix, it is known that the correlation coefficients of employment growth rate and tax amount are both less than 0.950, so the two variables are retained. The social responsibility ability correlation coefficient matrix is shown in Table 8.

Table 8. Social Responsibility Capability Correlation Coefficient Matrix

Variable	Employment growth rate	Tax amount
Employment growth rate	1	
Tax amount	-0.036	1

After the initial selection of indicators and the test of index correlation, the performance evaluation index system of Southwest Real Estate Listed Company was finally determined, as shown in Table 9 below.

Table 9. The final performance evaluation index system of listed real estate companies

Target layer	Criterion layer	Indicator layer
Performance Evaluation Index System of Real Estate Listed Companies	Profitability	Net profit rate
		Weighted ROE
		Net profit
		Roa
	Anti-risk ability	Current ratio
		Quick freezing ratio
		Assets and liabilities
		Net operating cash
	Operational capability	Inventory turnover
		Accounts Receivable Turnover
		Total asset turnover
		Fixed asset turnover
	Growth ability	Growth rate of home sales area
		Growth rate of main business
		Net profit growth rate
		Total asset growth rate
		Total floor area of land bank planning
	Financing ability	Cash inflow from financing activities
		Overall average cost of financing
	Ability to scale	Total assets
		Net assets
		Sales area
		Home sales
		Number of items for sale
	Social responsibility ability	Tax amount
		Provide job growth rates

3. Establishment of the Weight of the Performance Evaluation Index System of Real Estate Companies

3.1. Entropy Weight Method

According to the explanation of the basic principles of information theory, information is a measure of the degree of order of the system, and entropy is a measure of the degree of disorder of the system. According to the definition of information entropy, for an index, the entropy value can be used to judge the degree of dispersion of an index. The smaller the information entropy value is, the greater the degree of dispersion of the index. The larger the value, if the values of an index are all equal, the index will not work in the comprehensive evaluation. Therefore, the information entropy tool can be used to calculate the weight of each index, which provides a

basis for comprehensive evaluation of multiple indicators. The specific calculation method is as follows:

Assuming that the evaluation object has m samples and n indicators, construct the judgment matrix Z:

$$Z = \begin{bmatrix} X_{11} & \cdots & X_{1m} \\ \vdots & \ddots & \vdots \\ X_{n1} & \cdots & X_{nm} \end{bmatrix}$$

Perform dimensionless processing on the data to obtain a new judgment matrix, in which the expression of the elements is:

$$R = (r_{11})_{m \times n}$$

Then the entropy of the evaluation index is:

$$H_j = -\frac{1}{\ln m}\left[\sum_{i=1}^{m} f_{ij} \ln f_{ij}\right] \tag{1}$$

$$f_{ij} = \frac{r_{ij}}{\sum_{i=1}^{m} r_{ij}} \tag{2}$$

Among them, $0 \leq H_i \leq 1$, in order to make $\ln f_{ij}$ meaningful, it is assumed that $f_{ij} = 0$, $f_{ij} \ln f_{ij} = 0$, $i = 1, 2, \ldots, m; j = 1, 2, \cdots, n$.

Calculation of the entropy weight (W_j) of the evaluation index:

$$W_I = \frac{1 - H_j}{m - \sum_i^m r_{ij}} \tag{3}$$

In the formula, W_I entropy is the entropy weight coefficient of the evaluation index, and it satisfies $\sum_{j=1}^{n} w_j = 1$.

3.2. Variable Weight Theory

The core of the variable weight implementation is to construct an appropriate state variable weight vector S(X). At present, there are many variable weight vector types such as sum type, product type and exponential type. Because the exponential state variable weight vector has the advantages of obvious decision-making requirements, flexible parameter setting, and strong model expansion ability, it is adopted in this paper. Specific steps are as follows:

(1) Determine the constant weight of each evaluation index

Assuming X=(x_1, x_2, x_3..., x_n), W=(W_1, W_2, W_3, W_4,... W_n), S(X)=($S_1(X)$, $S_2(X)$, $S_3(X)$, ...$S^n(X)$) represents the state variable weight vector.

In this paper, by using the entropy weight method, the constant weight variables of the corresponding index set U are obtained, W=(W_1,W_2,W_3,W_4,...W_n).

(2) Construct a suitable state variable weight vector

Drawing on the research results related to the variable weight theory, the state variable weight vector S(X) is constructed as follows:

$$S_j(X_i) = \begin{cases} e^{-T(X_{ij} - U)} & (y_{ij} \leq U) \\ 1 & (y_{ij} \geq U) \end{cases} \qquad (4)$$

$$J = 1, \ldots, n; \; T \geq 0, 0 < U \leq 1$$

In the formula, U is called the negative level; when the j-th index state value y_ij is not higher than U, the weight is increased by implementing variable weights. for the purpose of punishing it. T is called the penalty level, which directly reflects the strength of the decision-making requirement for the balance of factors; the larger T is, the more obvious the penalty effect is, and the optimal result is more inclined to the plan with balanced performance among the indicators. In practical applications, decision makers can set the value of TU by themselves according to decision requirements.

3.3. Weight Determination of Combined Weighting Method

Table 10. Evaluation index weight

Index	Weights
Net profit rate	0.0507
Weighted ROE	0.0317
Net profit	0.0379
Roa	0.0425
Current ratio	0.0225
Quick freezing ratio	0.0415
Assets and liabilities	0.0158
Net operating cash	0.0323
Inventory turnover	0.0230
Accounts Receivable Turnover	0.0409
Total asset turnover	0.0250
Fixed asset turnover	0.0503
Growth rate of home sales area	0.0385
Growth rate of main business	0.0341
Net profit growth rate	0.0422
Total asset growth rate	0.0322
Total floor area of land bank planning	0.0389
Cash inflow from financing activities	0.0433
Overall average cost of financing	0.0437
Total assets	0.0451
Net assets	0.0499
Sales area	0.0359
Home sales	0.0518
Number of items for sale	0.0494
Tax amount	0.0491
Provide job growth rates	0.0306

Calculate the variable weight vector of each candidate program index.

Using the factor constant weight variable W and the state variable weight vector S(X), the variable weight vector $W(X) = (W_1(X), W_2(X), \ldots W_n(X))$ can be obtained by calculating W and S(X) The normalized Hadamard product representation is:

$$W(X_i) = \frac{W_i S(X_i)}{\sum_{j=1}^{n} W_j S_j(X_i)}, i = 1, 2, \ldots n \qquad (5)$$

which is: $W(Y_i) = (w_1(Y_i), \ldots, w_n(Y_n))$

$$W_j(Y_i) = \frac{w_j S_j(Y_j)}{\sum_{j=1}^{n}(w_j S_j(Y_i))}$$

$$j = 1, \ldots, n$$

In the formula, $W_j(Y_i)$ is the final weight of the j-th indicator of the i-th company after the weight change is implemented. It is not difficult to see that the weight comprehensively integrates the decision makers' subjective preference for the importance of indicators, the decision-making requirements for the balance between indicators, and the objective information of each candidate program, and changes with the change of the value of the program indicators.

This paper collects the data of listed real estate companies in Southwest China in 2016, and then obtains the weights of the performance evaluation indicators of real estate companies through the entropy weight method and variable weight theory as shown in Table 10.

4. Conclusions and Recommendations

4.1. Research Conclusions

By studying 10 listed real estate companies in Southwest China and collecting data from the annual reports of each company in 2016, this paper draws the following conclusions:

(1) Financial indicators are still the focus of performance evaluation. According to the weight coefficients obtained by the entropy weight method and the variable weight method, financial indicators still occupy an important position in the performance evaluation of real estate companies. As a capital-intensive company, real estate companies have a long development cycle and face high capital risks, so financial indicators can accurately reflect the company's performance.

(2) Non-financial indicators are the new force in performance evaluation. With the reform and transformation of the real estate industry, the content of the performance evaluation of the real estate industry has changed from a single financial indicator in the past to a combination of financial indicators and non-financial indicators. The financing ability, scale ability and social responsibility ability related to real estate companies occupy an increasingly important position in the performance evaluation of real estate companies.

4.2. Research Recommendations

(1) Paying attention to the financial situation is still the focus of real estate companies. Real estate companies should still take the prevention of financial risks as the company's key focus. Only by having a good financial situation can we provide a solid foundation for the development of real estate companies. In particular, the focus of financial indicators, such as the asset-liability ratio, net debt ratio, cash short-term debt ratio, etc. after excluding advance receipts.

(2) Improving non-financial indicators is a solid force for real estate companies to improve their own competitiveness. In addition to traditional financial management, real estate companies must improve their non-financial status in a highly competitive environment, strive to improve their social responsibility capabilities, strengthen corporate financing capabilities, and maintain their capital stability. Through non-financial status, a business can have its own unique competitive advantage.

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