

Measurement and statistical analysis of financing efficiency of listing companies

—taking Shandong Province as a case

Guizhen Meng

Accounting School of Shandong Women's University, Jinan, China

*Corresponding author: Guizhen Meng, mengguizhen@163.com

Abstract

The thesis adopts the principal component analysis and entropy method to set up a model for calculating and carrying out a statistical analysis of the financing efficiency of listing companies within the jurisdiction of Shangdong Province. First, the thesis sets up a financing efficiency evaluation indicator system according to financing theories. Next, it adopts the principal component analysis to abstract five principal factors influencing the financing efficiency. Later, the thesis adopts the entropy method to analyze the total score of each sample. Later, it draws the conclusion that the listing companies within the jurisdiction of Shandong Province universally have a low financing efficiency. Lastly, the thesis analyzes the reason for drawing the conclusion and proposes relevant countermeasures.

Keywords: *financing efficiency; principal component analysis; entropy method*

1 Introduction

Compared with non-listing companies, listing companies enjoy advantages in capital, talent, technology and management. The reason for the advantage in capital is that listing companies have convenient financing channels and more financing opportunities. Whether listing companies can utilize such advantages to improve their financing efficiency is an important representation of their quality levels. First, the thesis sets up a complete financing efficiency evaluation indicator system based on financing theories. Next, it adopts the principal component analysis to analyze five principal components that influence the financing efficiency of listing companies in Shangdong Province. It then adopts the entropy method to

calculate the total score of each sample and draws a research conclusion. Lastly, it analyzes the reason for the conclusion and proposes relevant countermeasures.

2 Set up a financing efficiency evaluation indicator system

There are two financing means for enterprises: endogenous financing and exogenous financing.¹ Listing companies lay a bigger emphasis over exogenous financing, which makes exogenous financing the research object of the thesis. The financing efficiency evaluation indicator system is consisted of three categories of indicators: indicators reflecting the financing process, indicators reflecting financing effect and control variables.²

2.1 Indicators reflecting the financing process

The financing efficiency can be reflected through the financing speed and capital costs.³ In exogenous financing, the financing speed of bank loans is the fastest. Therefore, the proportion of total bank loans to exogenous financing is taken as the specific indicator representing the financing speed.⁴ The exogenous financing is further divided into equity financing and debt financing.⁵ For this reason, there are three specific indicators that reflect financing costs: equity capital cost, debt capital cost and weighted average cost of capital.

2.2 Indicators reflecting financing effect

The financing effect needs to be measured comprehensively from several aspects and is rather complicated.⁶ Generally speaking, financing effect is divided into four categories: profitability, cash flow generation ability, risk level and operating effect.

- 1) The profitability reflects whether financing will bring more profits to enterprises. The profitability of an enterprise can be represented through three specific indicators: operating profit ratio, ROE and ROA.
- 2) The cash generation ability reflects whether financing will bring more net cash in-flows. This ability is represented by TCNCFO (Total Capital Net Cash Flow from Operating).
- 3) The risk level reflects whether financing affects the solvency of an enterprise. It is represented by the current ratio, the asset-liability ratio and the cash ratio of total liabilities.
- 4) The operating effect reflects whether financing affects the asset turnover rate of an enterprise. It is represented by the total asset turnover ratio.

2.3 Control variables

To some extent, there are certain correlations between the governing situation of an enterprise and its corporate scale. Both are taken as control variables in Table 1.

Table 1-Table styles

Major Type	Minor Type	Indicator Name	Indicator Calculation	Indicator Code
Indicators Representing Financing Process	Financing Speed	Proportion of Bank Loans	Ending Total Bank Loans ÷ Ending Exogenous Financing	X1
	Financing Cost	Equity Capital Cost	Calculation of capital and asset pricing model: $KE=RF+\beta(RM-RF)$	X2
		Debt Capital Cost	Weighted calculation of short-term loan capital cost, long-term loan capital cost and bonds payable capital cost	X3
		Weighted Average Cost of Capital	Weighted calculation of equity capital cost and debt capital cost	X4
Indicators Reflecting Financing Effect	Profitability	Operating Profiting Ratio	Annual Operating Profit ÷ Annual Operating Revenue	X5
		ROE	Annual Net Profit ÷ Ending Total Net Capital	X6
		ROA	Annual Net Profit ÷ Ending Total Capital	X7
	Cash Generation Ability	Total Capital Net Cash Flow from Operating	Annual Operating Net Cash Flow ÷ Ending Total Capital	X8
	Risk Level	Flow Ratio	Ending Flowing Capital ÷ Ending Flowing Liabilities	X9
		Asset-liability Ratio	Ending Total Liabilities ÷ Ending Total Capital	X10
		Cash Ratio of Total Liabilities	Net Cash Flows from Annual Operating ÷ Ending Total Liabilities	X11
	Operating Effect	Total Asset Turnover	Annual Main Business Revenues ÷ Ending Total Capital	X12
Control Variable	Governing Situation	Share Ratio of the Largest Shareholder	Share Ratio of the Largest Shareholder ÷ Ending Total Capital Share	X13
	Corporate Scale	Logarithm of Ending Total Capital	Natural Logarithm of Ending Total Capital	X14

Note: In Table 1, KE represents equity capital cost. RF is the non-risky rate of return, which takes the interest rate of one-year national bond as its value. β is the market risk coefficient of listing company stocks and is abstracted from CSMAR. RM is the weighted average rate of returns of shares held by listing companies and is obtained through the statistical data of Shanghai Stock Exchange

3 Modeling calculation and statistical analysis of financing efficiency of listing companies in Shangdong province

3.1 Sample selection and data processing

The data of listing companies within the jurisdiction of Shangdong during 2012 and 2014 is abstracted as samples. 135 enterprises are selected and there are 405 samples. All the data comes from CSMAR. The data processing is carried out through SPSS20.0 and Excel 2010 software.

The indicator data and statistical result data that correspond to sample companies are calculated according to the above-mentioned indicator system.

3.2 Principal component analysis of financing efficiency evaluation indicators

The principal component analysis refers to reorganizing various correlated indicators into a set of irrelevant comprehensive indicators to replace original indicators. Generally speaking, the mathematic processing is to combine various original indicators linearly as new comprehensive indicators.

The specific analysis procedures are as follows:

- 1) *Standardization of indicator data:* In it, $u_1i, u_2i \dots u_{pi}(i=1, \dots, p)$ is the characteristic vector that corresponds to the characteristic value of X's covariance matrix Σ . It is an original variable that has undergone standardized processing. In the actual application, there are usually different indicator dimensions. Before the calculation, there is a need to standardize primitive data and adopt the SPSS software for automatic implementation.
- 2) *Judge the Correlations between Indicators:* There is a strong correlation between the financing speed and debt capital cost. In the meantime, there is also correlation between the financing speed and the logarithms of the weighted average capital cost, current ratio, total cash to liability ratio and ending total capital. There are significant correlations between many variables, which prove the overlapping between them in information.

- 3) *Determine the Number of Principal Components:* As is known through Table 2, five principal components are abstracted, namely $p=5$. It can be seen that the accumulated contribution rate of the former five principal components have reached 75.608%. It is thus only necessary to select the former five principal components to basically represent the information of original indicators.

Table 2-Abstraction of principal components from variance analysis

Component	Original Characteristic Value			Variance Abstraction and Loading			Rotation Square and Loading		
	Sum	Variance %	Accumulation %	Sum	Variance %	Accumulation %	Sum	Variance %	Accumulation %
1	3.692	28.402	28.402	3.692	28.402	28.402	2.856	21.971	21.971
2	1.930	14.847	43.249	1.930	14.847	43.249	1.930	14.847	36.819
3	1.581	12.158	55.407	1.581	12.158	55.407	1.816	13.965	50.784
4	1.450	11.152	66.560	1.450	11.152	66.560	1.814	13.955	64.739
5	1.176	9.049	75.608	1.176	9.049	75.608	1.413	10.869	75.608
6	.881	6.777	82.385						
7	.712	5.479	87.863						
8	.584	4.493	92.357						
9	.504	3.876	96.233						
10	.209	1.606	97.839						
11	.136	1.046	98.885						
12	.095	.732	99.616						
13	.050	.384	100.000						

Table 3-Rotated component matrix

	Component				
	1	2	3	4	5
Debt Capital Cost	.887				
Financing Speed	.832				
Logarithm of Ending Total Capital	.779				
Current Ratio	-.543	.508			
Total Cash-Liability Ratio		.884			
Total Capital Net Cash Flow from Operating		.808			
Equity Capital Cost			.928		
Weighted Average Capital Cost			.910		
ROA ROE				.855	
Cash Ratio of Total Liabilities				.699	
Total Asset Turnover Ratio				.625	
Operating Profit Ratio					.802
Share Ratio of the Largest Shareholder					.533

Note: In Table 3, the abstract method is the principal component analysis method. The rotation converges after six iterations.

As is seen from Table 3, Principal Component 1 mainly explains the information related to the debt capital cost, financing speed and ending total capital. The Principal Component 2 mainly explains the information related to the current ratio, the cash ratio of total liabilities and the total capital net cash flow from operating. The Principal Component 3 mainly explains the information on the equity capital cost and weighted average capital cost. The Principal Component 4 mainly explains the information on ROA, ROE and the total asset turnover ratio. The Principal Component 5 mainly explains the information on the operating profit ratio and the share ratio of the biggest shareholder.

4) Determine the expression of principal component F_i

Table 4-Coefficient matrix of component score

	Component				
	1	2	3	4	5
Funding Speed	.287	.020	-.055	-.019	-.029
Equity Capital Cost	.099	.032	.522	-.008	-.001
Debt Capital Cost	.320	.035	-.032	-.015	.029
Weighted Average Capital Cost	-.081	-.022	.492	.000	-.004
Operating Profit Ratio	-.049	-.111	.026	.013	.585
ROA ROE	.012	-.126	-.006	.495	.082
Return on Total Assets	-.011	.049	-.011	.351	.219
Total Capital Net Cash Flow from Operating	.203	.511	.079	.108	-.125
Current Ratio	-.158	.228	-.162	-.230	.083
Total Cash-Liability Ratio	.009	.504	-.024	-.130	-.066
Total Asset Turnover Ratio	.029	.043	.001	.375	-.370
Share Ratio of the Largest Shareholder	.147	.001	-.022	.018	.408
Logarithm of Ending Total Asset	.353	.193	.070	-.010	.160

Note: In Table 4, the abstraction method is the principal component analysis method. The rotation method: varimax rotation method with Kaiser standardization.

The calculation formula of each principal component is obtained from the principal coefficient matrix of Table 4.

$$F1=0.287 \times X1 + 0.099 \times X2 + 0.32 \times X3 - 0.081 \times X4 - 0.049 \times X5 + 0.012 \times X6 - 0.011 \times X7 + 0.203 \times X8 - 0.158 \times X9 + 0.009 \times X11 + 0.029 \times X12 + 0.147 \times X13 + 0.353 \times X14$$

$$F2=0.02 \times X1 + 0.032 \times X2 + 0.035 \times X3 - 0.022 \times X4 - 0.111 \times X5 - 0.126 \times X6 + 0.049 \times X7 + 0.511 \times X8 + 0.228 \times X9 + 0.504 \times X11 + 0.043 \times X12 + 0.001 \times X13 + 0.193 \times X14;$$

$$\begin{aligned}
 F3 &= -0.055 \times X1 + 0.522 \times X2 - 0.032 \times X3 + 0.492 \times X4 + 0.026 \times X5 - 0.006 \times X6 - \\
 & 0.011 \times X7 + 0.079 \times X8 - 0.162 \times X9 - 0.024 \times X11 + 0.001 \times X12 - 0.022 \times X13 + 0.07 \times X14; \\
 F4 &= -0.019 \times X1 - 0.008 \times X2 - 0.015 \times X3 + 0 \times X4 + 0.013 \times X5 + 0.495 \times X6 + 0.351 \times X7 + 0.108 \times X8 - \\
 & 0.23 \times X9 - 0.13 \times X11 + 0.375 \times X12 + 0.018 \times X13 - 0.01 \times X14; \\
 F5 &= -0.029 \times X1 - 0.001 \times X2 + 0.029 \times X3 - 0.004 \times X4 + 0.585 \times X5 + 0.082 \times X6 + 0.219 \times X7 - \\
 & 0.125 \times X8 + 0.083 \times X9 - 0.066 \times X11 - 0.37 \times X12 + 0.408 \times X13 + 0.16 \times X14
 \end{aligned}$$

- 5) *Conduct Fi Naming of Principal Components:* As is know from the above-mentioned analyses, Principal 1 mainly introduces the information on three indicators: equity capital cost, financing speed and ending total capital scale. Fi is named as the financing process indicator; Principal Component 2 mainly explains three indicators: current ratio, total cash-liability ratio and total capital net cash flow from operating. F2 is named as operating capability indicator; Principal Component 3 mainly explains the information on two indicators: equity capital cost and weighted average capital cost. F3 is named as the financial capital cost indicator; Principal Component 4 mainly explains the information on three indicators: ROA, ROE and total capital turnover ratio. F4 is named as the profiting capacity indicator; Principal Component 5 mainly explains the information on two indicators: operating profit ratio and the share ratio of the biggest shareholder. F5 is named as governance condition indicator.

3.3 Evaluate the financing efficiency of listing companies in shangdong province with entropy method

- 1) *Data Selection:* There are five evaluation indicators in 405 samples: F1, F2, F3, F4 and F5; X_{ij} is the j th indicator value of sample I ($i=1,2,\dots,405$; $j=1,2,3,4,5$)
- 2) *Non-negative Processing of Data:* There are negative values in the data, which makes it unfavorable for final calculation. It is thus necessary to conduct the non-negative processing of data before the calculation. In the meantime, the logarithms are calculated when entropy values are used later. In order to prevent logarithms from being meaningless, the data should be move horizontally. For positive indicators:

$$y_{ij} = \frac{x_{ij} - \min(x_{1j}, x_{2j}, \dots, x_{nj})}{\max(x_{1j}, x_{2j}, \dots, x_{nj}) - \min(x_{1j}, x_{2j}, \dots, x_{nj})}$$

($i=1,2,\dots,405$; $j = 1,2,\dots,5$)

For negative indicators:

$$y_{ij} = \frac{\max(x_{1j}, x_{2j}, \dots, x_{nj}) - x_{ij}}{\max(x_{1j}, x_{2j}, \dots, x_{nj}) - \min(x_{1j}, x_{2j}, \dots, x_{nj})}$$

($i=1,2,\dots,405$; $j = 1,2,\dots,5$)

3) *Calculate the Proportion:* It is the proportion of the sample i in indicator j to such indicator:

$$P_{ij} = \frac{y_{ij}}{\sum_{i=1}^{405} y_{ij}}$$

($i = 1,2,\dots,405$, $j=1,2,\dots,5$)

4) *Calculate the Entropy Value of Indicator j :*

$$e_j = -k \sum_{i=1}^{405} P_{ij} \ln P_{ij}$$

In the formula, $k>0$, $k=1/\ln(n)$ and $e_j>0$. $k=0.00049$. The entropy values of five indicators are respectively 0.00296, 0.00293, 0.00296, 0.00292 and 0.00295

5) *Calculate the Difference Coefficient of Indicator j :* For indicator j , the bigger the differences between indicators are, the bigger its role on evaluation and the lower the entropy value is:

$$g_j = 1 - e_j, \quad 0 < g_j < 1, \quad \sum_{j=1}^5 g_j = 1$$

The variation coefficients of five indicators are respectively 0.99704, 0.99707, 0.99704, 0.99708 and 0.99705.

6) *Work out the Weighted Value*

$$w_j = \frac{g_j}{\sum_{j=1}^5 g_j} \quad (j \in [1,5])$$

The weighted values of five indicators are obtained, which are respectively 0.199997, 0.200003, 0.199997, 0.200005 and 0.199999.

7) *Calculate the Total Score of Each Sample:*

$$S_i = \sum_{j=1}^5 w_j P_{ij} \quad (i = 1,2 \dots 405)$$

Through calculation, the financing efficiency of the sample company is obtained, which is listed as follows Fig.1:

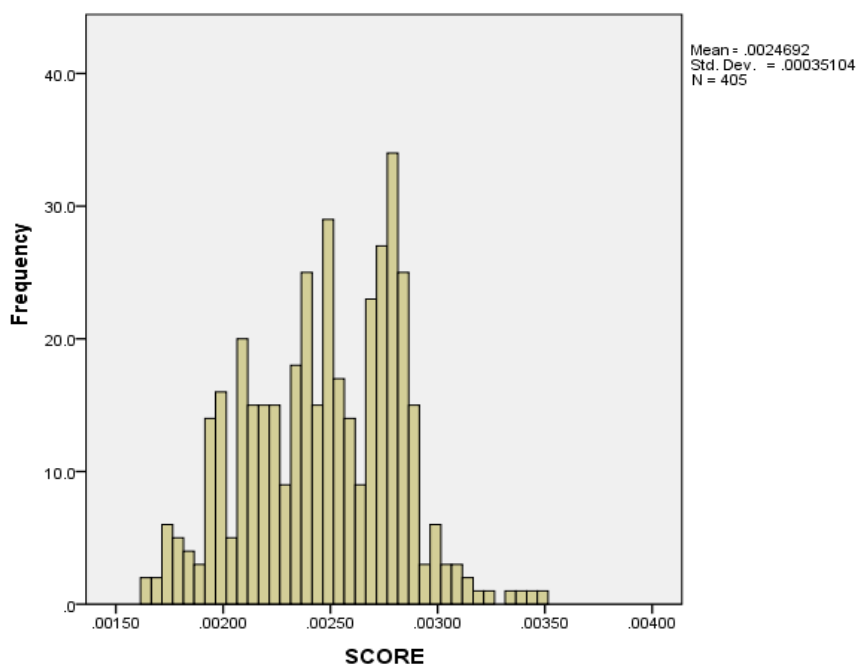


Fig.1- Distribution Diagram of Total Score

- 8) *Draw the Conclusion According to the Total Score*: The closer the calculation results are to 1, the higher the efficiency is. The smaller the results are, the lower the efficiency is. As is shown above, the financing efficiency of most companies is around 0.00247; the maximum value is only 0.00351; the minimum value is only 0.00164. The thesis thus draws the conclusion that the financing efficiency of listing companies in Shandong is universally low.

4 Analysis of reason and countermeasures

4.1 Analysis of reason

- 1) *The profiting ability is low, which influences the accumulation of endogenous capital and relies on exogenous financing*: According to the regulations of the Corporate Law of People's Republic of China, the net profits of enterprises should put aside legal surplus reserved funds before making up for the past annual loss. After that, it pays for preferential stock dividends, abstracts discretionary surplus reserves, and pays for common share dividends. Only by generating more profits will enterprises have more reserved benefits following the payment of stock dividends. The more the reserved profits are, the more enterprises can provide capital support for corporate development. According to the statistics of sample data related to 405 listing companies within the jurisdiction of Shandong Province, there are 67 samples whose operating profit margins are negative, accounting for 16.54% of the total samples. There are 42 samples whose

returns on net assets are negative, accounting for 10.62% of the total samples. There are 43 samples whose ROA is negative, accounting for 10.62%. In 405 samples, the average values of the operating profit margins, ROA and ROE are respectively 6.52%, 7.28% and 3.97%. The average values of the operating profit margins, ROA and ROE of large and medium-sized enterprises in Shangdong in 2012 were respectively, 6.46%, 16.31% and 7%. According to the comparison, the ROA and ROE of listing companies in Shangdong are significantly lower. After deducting the paid stock dividends, such profits leave few profits for enterprises. The profit values of partial companies are negative, which fail to bring reserved benefits. The small scale of reserved profits cause the corporate development to lack financial support and be more dependent on exogenous financing.

- 2) *The debt financing means is used inadequately and fails to give play to the advantage of debt financing:* In exogenous financing, the capital costs of bank loans and bonds payable are low. If the benefits of corporate assets are bigger than paid interests, there will be positive financial leverage, which increases shareholders' wealth and corporate values. According to the statistics of sample companies, there are 68 samples that have no bank loans, accounting for 16.79% of total samples. There are 335 samples that have zero payable debts, accounting for 82.72% of total samples. This means a large proportion of companies fail to utilize the debt financing means well or give play to the positive financial leverage effect.
- 3) *The proportion of equity capital cost is high and the equity financing proportion is low, m unfavorable for maximizing corporate values:* It is most convenient for listing companies to adopt equity financing. However, the disadvantage of high capital costs is quite prominent. According to statistics, the average value of the equity capital costs of all sample companies is 7.45%, which is higher than the average values of the operating profit ratio, ROA and ROE of all sample companies. There are 171 samples whose proportions of equity financing to exogenous financing are bigger than 50%, accounting for 44.22% of total samples. If the profits of the capital used by enterprise are low, there is a small surplus after making high payments to shareholders. Although the rights and interests of shareholders are guaranteed, they only create limit values for the company.

4.2 Countermeasures

- 1) *Improve the profitability:* Regarding the composition of operating profits, the key element that influences corporate profits is mainly the operating business activity.

Enterprises should work hard to improve their main operating incomes based on main businesses. In the meantime, they should lower various cost expenditures and improve corporate performance levels.

- 2) *Increase the proportion of debt financing:* This is because the proportion of debt financing costs to exogenous financing is low. It is necessary to lower the average capital cost proportion of enterprises on the whole by increasing the proportion of debt financing. On the precondition that the investing profiting ratio of enterprises is bigger than the debt interest rate, increasing the proportion of debt financing will bring more financial leverage benefits and create values for enterprises.
- 3) *Lower the proportion of debt financing appropriately:* The proportion of equity financing costs in exogenous financing is higher. It is necessary to lower the average capital cost ratio on the whole by lowering the proportion of equity financing. On the precondition of having fixed corporate profiting capacity, lowering the proportion of equity financing can reduce the burden of paying higher payment to shareholders and increase the surplus benefits of enterprises.

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