

Empirical research on financial capability evaluation of A-share listed companies in the securities industry based on principal component analysis

Xiuping Wang & Tuoyu Wang*

School of Economics and Management, Jiangsu University of Science and Technology, Zhenjiang, Jiangsu, China

ABSTRACT: Based on the relevant financial data indicators of A-share markets of Shanghai and Shenzhen in 2009, with all of 29 listed companies in the securities industry as the research objects, this paper selects 10 variables that can fully reflect the financial capability indicators and uses the principal component analysis to carry out the empirical research on the financial capability. The research results show that the comprehensive financial capability of listed companies in A-share securities industry must be focused on the following four capabilities, investment and income, profit, capital composition and debt repayment and cash flow indicators. In addition, the principal component analysis can effectively evaluate the financial capability of listed companies in A-share securities industry, and solve the problems in the previous analysis methods, such as excessive indicators information overlapping and so on.

Keywords: financial capability; securities industry; A-share listed companies; principal component analysis

1 INTRODUCTION

The empirical research on the financial capability of A-share listed companies in the securities industry aims at strengthening the financial risk management and control, responding to changes in market policies, enhancing financial innovation capability, enhancing the financial capability of the company and promoting comprehensive and integrated development of various business in the security company through focusing on the relevant financial data of the company. The financial capability of the security company is mainly affected by the following two aspects: the first is greater business risks in its securities brokerage, constant return and investment bank; the second is the changes in the policies and regulations at the regulatory level, such as amendment of the Securities Law, reform of IPO issuing system (implementation of the registration system) and changes in the management policy of mergers and acquisitions of listed companies. As an important embodiment of the profitability of the security company, the financial capability has an important

theoretical and practical significance on its research. In theory, the research of the financial capability evaluation can make the company fully grasp the financial capability, so as to effectively improve and enhance its financial capability, strengthen its competitive capability, and further enrich the theory of financial capability evaluation, thus providing theoretical support for enhancing and improving the company's financial capability evaluation; in practice, it can make the enterprises more clearly understand the core role of financial capability in the development process, so that the company can use the quantitative indicators as the evaluation criteria, and fully test the company's financial strategy, cost budget and internal control and other specific effects in practice. Therefore, the empirical research on the financial capability of A-share listed companies in the securities industry is very necessary.

2 LITERATURE REVIEW

The research on the financial capability of A-share listed companies is divided into qualitative and quan-

*Corresponding author: 849404983@qq.com

titative analysis. Qualitative analysis is a kind of financial analysis method established based on the qualitative analysis represented by DuPont analysis, but there are some problems in practice, such as too much emphasis on the short-term behavior of the company, failure to effectively solve the valuation of intangible assets and other issues. The quantitative analysis is divided into univariate analysis and multivariate analysis. Due to relatively strong choice of univariate subjectivity, the content of data analysis is easy to be unfair, and the conclusion obtained in the use of multiple univariate models has larger deviation, with a very little effect on the financial capability evaluation. At present, the theoretical research of the basic mathematical statistics is mature, and the research of the multivariate analysis model is sound, so that the application for the multivariate statistical analysis in the research of the financial capability is popularized. Based on the financial data of listed companies, by using the advantages of multivariate statistical analysis, that is, in the analysis process, the choice of index weight avoids the influence of subjective factors, so as to ensure that the empirical research of the financial capability is scientific, rigorous, objective and fair as much as possible.

In discussion and empirical research on a variety of mathematical multivariate statistical analysis methods, the principal component analysis has been widely applied to the empirical research on the evaluation of financial capability of listed companies, which has indeed effectively solved the problems in the analysis and evaluation of financial capability in terms of the actual research results. Xu Fengju and Wang Feng (2008) introduced the principal component analysis on the basis of the existing financial risk theory, and verified the scientificity and rationality of its method^[1]. Wei Qingping (2009) constructed the mathematical model by using the principal component analysis, and evaluated the bank loan risks of China's universities, found out and confirmed that the financial risk management of colleges and universities with the core of loan risk control becomes the main theoretical and practical problems in the university financial management^[2]. With 15 GEM manufacturing listed companies as the research objects, Liu Yanbao and Wu Yaping (2012) used the principal component analysis and equalization method for dimensionless processing and used the covariance matrix of the basic indicators as an input, so that its evaluation score can reflect the inherent investment value of these companies to some extent^[3]. Jia Weiyang (2013) used the principal component analysis to evaluate the financial capability of listed companies in China's logistics industry, and selected the panel data to comprehensively analyze the financial situation of listed companies in the logistics industry in the horizontal and vertical manner^[4]. Dong Yinxia (2014) carried out the principal component analysis for the business performance of China's commercial banks. The research results show that, the

evaluation results obtained by this method better reflect the overall development level and trend of the performance of the sample banks in space and time^[5]. With China's manufacturing listed companies as the research objects, Pan Min and Zeng Min (2015) researched and evaluated the financial risks based on the principal component analysis, and the research results showed that the valuable investment opportunities, good cash flow and improvement of the management efficiency of the company is a positive and effective way to reduce the financial risks of China's manufacturing listed companies and enhance the financial capability^[6].

3 RESEARCH DESIGN

3.1 *Theory and basic ideas*

The financial capability evaluation should be based on the enterprise value. This paper believes that the financial capability of A-share listed security company should be involved in the analysis of historical financial data, in order to reveal the company's current investment and earning capacity, profitability, capital composition and solvency and capacity of cash flow indicator. Meanwhile, it should also be involved in the analysis and judgment of the enterprise's future financial capability.

In this paper, the research of the financial capability uses the principal component analysis, which is also known as the principal component analysis method, a kind of important mathematical multivariate statistical analysis method, aimed at screening out fewer important variables from the original multiple variables through the linear transformation. Its mathematical idea is called as "dimensionality reduction". The concept of principal component was first proposed and introduced by Karl parson in 1901, which was not discussed specific to non-random variables. In 1933, Hotelling promoted this theory to random vectors, and the research field was more extensive and in-depth. Its basic idea is to reassemble a large number of the original indicators with certain correlation (such as P indicators) into a set of new mutually independent comprehensive indicators to replace the original indicators^[7].

3.2 *Selection of indicators*

According to the annual financial report of A-share securities listed company in 2015 disclosed by the information disclosure website, cninfo, Shanghai Stock Exchange and Shenzhen Stock Exchange designated by China Securities Regulatory Commission, this paper screens out indicators that can fully reflect the indicators of financial capability of listed companies in A-share securities industry, and mainly focuses on the impact of a total of 10 financial indicators (in

terms of investment and earning capacity, profitability, capital composition and solvency and cash flow indicator) on the company's financial capability. In order to facilitate the subsequent processing and analysis of relevant data, each financial indicator is named. The selection and naming of financial indicators are shown in Table 1:

Table 1. Selection of financial indicators

Indicator type	Indicator name	Variable
Investment and earning capacity	Basic earnings per share (RMB)	X_1
	Net assets per share(RMB)	X_2
	Return on equity - weighted average (%)	X_3
	Undistributed profit per share (RMB)	X_4
Profitability	Rate of return on total assets (%)	X_5
	Total asset profit rate (%)	X_6
Capital composition and solvency	Net assets ratio (%)	X_7
	Asset-liability ratio	X_8
Capacity of cash flow indicator	Return on assets cash flow (%)	X_9
	Ratio of net cash flow to net profit (%)	X_{10}

3.3 Selection of research objects

Currently, all of 29 security companies in A-share markets of Shanghai and Shenzhen in China are selected as the research objects. 29 listed security companies basically contain large-scale state-owned integrated and local brokers, and each company is quite representative, with its own business advantages and characteristics, which can comprehensively and systematically analyze the financial capability situation of China's listed security companies. On this basis, 29 listed security companies are the research objects, and the basic information is selected as shown in Table 2.

3.4 Modeling

The establishment of the principal component analysis model for evaluation of financial capability of A-share securities listed companies is based on the research on the internal structure relations between the correlation matrixes of the original financial indicators of 29 listed security companies acquired to find out several comprehensive indicators under a certain situation,

namely, principal components, in order to make the comprehensive indicators become linear combination of the original indicators. The comprehensive indicators not only retain the information of original indicators, but also linearly independent, so as to grasp the core in the research of many problems in the complexity of variables. Detailed analysis steps are as follows:

Assuming that there are n samples, and the number of observed indicators for each sample is p , then the raw data can be expressed as follows:

$$X_1 = x_{11} + x_{12} + \dots + x_{1p}$$

$$X_2 = x_{21} + x_{22} + \dots + x_{2p}$$

$$\dots \quad \dots \quad \dots$$

$$X_n = x_{n1} + x_{n2} + \dots + x_{np}$$

(1) Standardize the raw data. The raw data is written as the matrix, that is, $X =$

$$\begin{bmatrix} x_{11} & x_{12} & \dots & x_{1p} \\ x_{21} & x_{22} & \dots & x_{2p} \\ \dots & \dots & \dots & \dots \\ x_{n1} & x_{n2} & \dots & x_{np} \end{bmatrix}, \text{ and}$$

the index value of each sample is standardized according to $X_i = \frac{X_i^* - E(X_i^*)}{\sqrt{D(X_i^*)}}$. Where, $E(X_i^*)$ and $D(X_i^*)$

respectively represent the mean value and variance of the index value for each sample;

(2) Establish the correlation coefficient matrix for variables: $r_{ij} = \frac{1}{n} \sum_{i=1}^n X_{i1} \times X_{ij} (i, j=1, 2, \dots, p)$ represents the correlation coefficient between each standardized indicator X_i , and the correlation coefficient matrix is $R = (r_{ij})_{p \times p} = X^T X$;

(3) Solve the characteristic value of R , $\lambda_1 \geq \lambda_2 \geq \dots \geq \lambda_p \geq 0$ and the corresponding unit eigenvectors:

$$a_1 = \begin{bmatrix} a_{11} \\ a_{21} \\ \vdots \\ a_{p1} \end{bmatrix}, a_2 = \begin{bmatrix} a_{12} \\ a_{22} \\ \vdots \\ a_{p2} \end{bmatrix}, \dots, a_p = \begin{bmatrix} a_{1p} \\ a_{2p} \\ \vdots \\ a_{pp} \end{bmatrix}$$

Table 2. List of listed companies in the securities industry

No.	Stock code	Stock abbreviation	No.	Stock code	Stock abbreviation
1	601788	Everbright Securities	16	002736	Guoxin Securities
2	601688	Huatai Securities	17	601377	Industrial Securities
3	601555	Dongwu Securities	18	601198	Dongxing Securities
4	600837	Haitong Securities	19	600909	Huaan Securities
5	601901	Founder Securities	20	600958	Orient Securities
6	600999	Merchants Securities	21	600369	Southwest Securities
7	600030	CITIC Securities	22	000783	Changjiang Securities
8	601211	GuotaiJunan	23	002797	First Capital Securities
9	000776	GF Securities	24	601375	Central Plains Securities
10	000166	Shenwan Hongyuan	25	600061	GuotouAnxin
11	000750	Guohai Securities	26	600109	Sinolink Securities
12	002500	Shanxi Securities	27	300059	Oriental Wealth
13	000728	Guoyuan Securities	28	601881	China Galaxy Securities
14	000686	Northeast Securities	29	601099	Pacific Ocean
15	002673	Western Securities	—	—	—

(4) Write the principal component: $Y_i = a_{1i}X_1 + a_{2i}X_2 + \dots + a_{pi}X_p$ ($i=1,2,\dots,p$), and calculate the overall score for each sample.

4 EMPIRICAL ANALYSIS

Based on the above modeling, we standardize the raw data by SPSS20.0 statistical software^[8]. Standardized variable correlation KMO and Bartlett's test results are shown in Table 3:

Table 3. KMO and Bartlett test

Sampling of enough measurement of Kaiser-Meyer-Olkin		.579
Bartlett's sphericity test	Approximate chi-square	491.083
	df	45
	Sig.	.000

As can be seen from Table 3, the observed value of Bartlett's sphericity test statistic is 491.083 and the corresponding probability P is close to 0. If the significance level α is 0.05. Since the probability P is less than the significance level α , the null hypothesis should be rejected, indicating that there is a significant difference in the correlation coefficient matrix and the unit matrix. Meanwhile, KMO value is 0.579. The correlation between data is general, but is still greater than the critical value, 0.5. Meanwhile, according to KMO metric given by Kaiser, the original variables are suitable for the corresponding principal component analysis.

As can be seen from Table 4, the system screens out four principal component factors, with the accumulating contribution rate of 97.587%, indicating that four principal component factors contain the amount of information for 97.587% of raw data, so they are used to assess the company's financial capability, basically including the information of all indicators. Other characteristic roots are less than 1. The influencing dynamics indicator of the principal component is generally subject to 1. If it is less than 1, it means that the influencing dynamics of this main factor is not as good as a basic variable, so the first four principal components with the characteristic root of greater than 1 can only be selected.

Table 4. Total variance explained

Component	Initial characteristic value			Extracted quadratic sum			Rotated quadratic sum		
	Total	Variance %	Accumulation %	Total	Variance %	Accumulation %	Total	Variance %	Accumulation %
1	3.783	37.830	37.830	3.783	37.830	37.830	2.877	28.767	28.767
2	2.948	29.478	67.308	2.948	29.478	67.308	2.789	27.887	56.654
3	1.705	17.052	84.359	1.705	17.052	84.359	2.092	20.916	77.570
4	1.323	13.228	97.587	1.323	13.228	97.587	2.002	20.017	97.587
5	.110	1.095	98.682						
6	.092	.916	99.598						
7	.017	.173	99.771						
8	.014	.144	99.915						
9	.004	.043	99.959						
10	.004	.041	100.000						

Extraction method: Principal component analysis.

In addition to Table 4, it can also be verified by the scree plot (Figure 1). The first component factor has a very high characteristic value, with the largest contribution to explanation of the original variables. The last five component factors have a relatively small characteristic value, with the smallest contribution to explanation of the original variables, which can be negligible, further indicating that the extraction of four principal component factors is more scientific and reasonable.

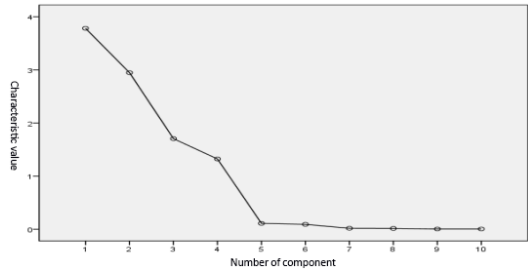


Figure 1. Scree plot

Then, according to the non-uniqueness of the factor loading matrix and the relationship between the principal component factors and the original financial index variables, there is also a need to rotate the factor loading matrix. The component matrix after rotation and the component score coefficient matrix are respectively shown in Table 5 and Table 6:

Table 5. Rotation component matrix^a

	Component			
	1	2	3	4
X3	.977	.009	.038	.015
X5	.934	-.094	.330	-.017
X6	.932	-.046	.281	.045
X1	.124	.967	-.141	.041
X2	-.203	.955	.090	.109
X4	-.050	.941	-.111	.168
X8	-.226	.075	-.968	-.024
X7	.264	-.064	.960	.050
X9	.033	.104	.055	.991
X10	.003	.153	.013	.986

Extraction method: Principal component.

Rotation method: orthogonal rotation method with Kaiser normalization.

a: convergence after 5 iterations of rotation.

As can be seen from the rotation component matrix (see Table 5), X_3 , X_5 , X_6 have a higher load on the first principal component, so the comprehensive factor F1 mainly reflects the company's investment and earning capacity and profitability; X_1 , X_2 , X_4 , X_8 have a higher load on the second principal component, so the comprehensive factor F2 mainly reflects its investment and earning capacity, capital composition and solvency; X_7 has a higher load on the third principal component, so the comprehensive factor F3 mainly reflects its capital composition and solvency; X_9 , X_{10} have a higher load on the fourth principal component, so the comprehensive factor F4 mainly reflects its capability of cash flow indicator. To sum up, the extracted four principal components can basically reflect all of the indicator information.

Table 6. Component score coefficient matrix

	Component			
	1	2	3	4
X1	.100	.366	-.056	-.080
X2	-.089	.361	.147	-.051
X3	.409	.022	-.184	.000
X4	.018	.340	-.009	-.010
X5	.327	.002	-.005	-.020
X6	.337	.011	-.034	.010
X7	-.091	.030	.510	-.014
X8	.110	-.029	-.524	.026
X9	-.002	-.066	-.016	.514
X10	-.004	-.050	-.031	.508

Extraction method: principal component.

Rotation method: Orthogonal rotation with Kaiser normalization.

Component score.

The relationship between the original financial index variables and the principal component factors can be directly obtained from the component score coefficient matrix (Table 6):

$$(1) F_1 = 0.1X_1 - 0.089X_2 + 0.409X_3 + 0.018X_4 + 0.327X_5 + 0.337X_6 - 0.091X_7 + 0.11X_8 - 0.002X_9 - 0.004X_{10}$$

$$(2) F_2 = 0.366X_1 + 0.361X_2 + 0.022X_3 + 0.34X_4 + 0.002X_5 + 0.011X_6 + 0.03X_7 - 0.029X_8 - 0.066X_9 - 0.05X_{10}$$

$$(3) F_3 = -0.056X_1 + 0.147X_2 - 0.184X_3 - 0.009X_4 - 0.005X_5 - 0.034X_6 + 0.51X_7 - 0.524X_8 - 0.016X_9 - 0.031X_{10}$$

$$(4) F_4 = -0.08X_1 - 0.051X_2 - 0.000X_3 - 0.01X_4 - 0.02X_5 + 0.01X_6 - 0.014X_7 + 0.026X_8 + 0.514X_9 + 0.508X_{10}$$

To calculate the comprehensive principal component by the ratio of the characteristic values corresponding to each principal component to the sum of the characteristic values of the extracted principal components as the weight, the comprehensive evaluation function of the finance can be obtained as follows:

$$F = 0.39 * F_1 + 0.30 * F_2 + 0.17 * F_3 + 0.14 * F_4$$

To substitute the financial indicator data of 29 listed security companies into the above formula, and comprehensively rank the financial indicator score (retaining four decimal places), the rank is shown in Table 7:

5 RESEARCH CONCLUSION AND SUGGESTIONS

The following conclusions can be obtained by analysis of the comprehensive score in Table 7.

(1) Orient Securities, Guoxin Securities, Guotai Junan, Huaan Securities and Everbright Securities have the comprehensive financial indicators ranked in the top five; Oriental Wealth has the comprehensive financial indicators ranked in the first place; Huaan Securities belongs to the younger small and medium-sized security company. However, viewing from the principal component analysis, there are differences in the following three financial capability indicators - investment and earning capacity, profitability, capital composition and solvency. Due to abundant expansion of the company's securities business, Oriental Wealth has a rapid growth in the investment and earning capacity; the Internet financial business represented by the Internet + is particularly prominent; Guotai Junan, Guoxin Securities and Everbright Securities are China's old large security companies, with a large volume, abundant financial resources and extensive business, which actively promote the traditional business, and are also committed to financial innovation, and transform to the Internet securities traders under the background of big data era, and the principal component analysis is also fully verified.

(2) Founder Securities, Pacific Ocean, Dongxing Securities, First Capital Securities and Central Plains Securities have the comprehensive financial indicators ranked in the last five, which have weaker performance in the investment and earning capacity, profitability, capital composition and solvency and capacity of cash flow indicator, and the composite score of the overall financial capability is lower than the overall level of A-share listed security companies. In the principal component analysis, there are some shortcomings in the financial capability indicators, so there is an urgent need for the company to seriously identify the underlying causes and conduct self-reflection, carry out targeted improvement, in order to fully enhance the company's comprehensive financial capability in the future. We can see that, the advantage of using the principal component analysis is scientific validity, objective evaluation of the financial data, and avoiding the subjectivity brought by other evaluation methods, overlapping information and other problems. As mentioned in the introduction, the financial capability of listed companies in A-share securities indus-

Table 7. Principal component score

Name of security company	First principal component score	Second principal component score	Third principal component score	Fourth principal component score	Total score	Rank of total score
Everbright Securities	18.7115	4.7635	-33.7798	1.0040	3.1245	5
Huatai Securities	15.3465	4.1280	-35.5961	1.8327	1.4288	23
Dongwu Securities	16.0836	2.0842	-33.5755	0.9768	1.3268	24
Haitong Securities	15.7015	3.5853	-34.3493	1.6382	1.5892	20
Founder Securities	13.1801	1.1562	-30.4905	-0.4649	0.2387	29
Merchants Securities	19.6869	3.5491	-38.6454	0.4035	2.2294	12
CITIC Securities	14.7094	4.9879	-30.5971	3.1112	2.4671	8
Guotai Junan	18.0459	5.9678	-32.8524	1.7127	3.4831	3
GF Securities	17.5959	4.2400	-35.7271	2.5709	2.4207	11
Shenwan Hongyuan	21.6589	0.7957	-38.2158	3.8201	2.7238	7
Guohai Securities	15.8761	1.7671	-28.6075	-0.5122	1.7868	18
Shanxi Securities	14.8309	1.5274	-27.5031	2.4491	1.9096	15
Guoyuan Securities	13.5719	4.4193	-25.4111	0.9963	2.4384	10
Northeast Securities	21.0311	2.4163	-40.3412	0.7181	2.1696	13
Western Securities	17.2431	1.1785	-33.9982	1.3957	1.4941	21
Guoxin Securities	24.5862	3.2377	-36.9645	1.1470	4.4365	2
Industrial Securities	20.5847	1.0938	-39.5588	1.4609	1.8357	17
Dongxing Securities	15.9531	1.5684	-35.7368	1.7910	0.8677	27
Huaan Securities	24.1061	0.6160	-39.9291	2.6825	3.1738	4
Orient Securities	20.1730	2.5509	-38.7300	0.4144	2.1066	14
Southwest Securities	16.9183	1.2606	-27.9854	1.6015	2.4430	9
Changjiang Securities	19.3126	0.8847	-38.7495	1.8173	1.4643	22
First Capital Securities	16.6179	0.3097	-35.7758	3.5629	0.9908	26
Central Plains Securities	17.5617	0.5020	-34.7893	1.1518	1.2467	25
Guotou Anxin	17.1618	2.3751	-35.8842	2.5454	1.6617	19
Sinolink Securities	15.1190	2.0537	-24.9470	4.0633	2.8404	6
Oriental Wealth	37.6424	3.7558	-28.7729	0.8944	11.0411	1
China Galaxy Securities	17.9688	2.3553	-36.0660	1.9485	1.8560	16
Pacific Ocean	15.7640	0.5224	-31.7472	-2.2134	0.5978	28

try is mainly affected by internal and external factors of the risks of securities business itself and regulatory layer in the securities industry, and verified by the empirical research of the principal component analysis. Therefore, based on the research results of this paper, in order to enhance the financial capability of A-share listed security companies, the following suggestions are put forward: (a) to participate in the innovation of the Internet + financial business and enhance profitability under the background of big data; (b) to profoundly understand the performance of capital market and information timely issued by the regulatory layer, and compressively research and judge the impact on the company's investment and earning capacity; (c) to draw development experience and lessons from foreign security companies, and pay attention to its capital composition and solvency; (d) to strictly control the impact of the financial leverage, margin trading and derivative financial products on its capacity of operating cash flow.

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