Financial Indicator System of Banking Listed Companies Based on Factor Analysis

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Abstract: *The healthy development of commercial banks determines the stable operation of the national economy. Measuring the financial performance of listed companies in the banking industry can provide a certain reference for rational investment of investors. However, there are many financial indicators for listed companies in the banking industry, so it is particularly important to establish an effective evaluation index system for financial performance of listed companies in the banking sector. Therefore, this paper selects 8 financial indicators of 22 listed banks, and comprehensively uses exploratory factor analysis and confirmatory factor analysis to study the financial performance indicators of China's banking listed companies. The research shows that we can effectively measure the financial performance of China's banking industry from three dimensions: profitability, value per share and solvency. This provides a certain reference value for both investors and bank managers.*

Keywords: commercial bank; financial performance; exploratory factor analysis; confirmatory factor analysis

1. Introduction

The financial industry is an important part of China's national economy. The development of the financial industry plays an important role in guiding and promoting the macro economy, while the banking industry plays a leading role in the financial industry. The effective measurement of financial performance of listed companies in the banking industry can not only provide some objective references for investors' rational investment, but also help the bank management to find problems in corporate financial governance. However, there are many indicators to measure the financial performance of listed Banks, so how to establish a simple and effective performance evaluation system becomes the key issue.

At present, there are certain papers at domestic and foreign to study the financial competitiveness evaluation of listed commercial banks. For example: Li and Wang (2013) analyzed the financial status of 16 listed Banks in 2012 from all aspects including profitability index, liquidity index, risk index and asset size. Wang (2015) and Zhang (2016) used factor analysis to study indicators data, and formed comprehensive indicators of capital status, asset quality, profitability and mobility. Li and Liu (2017) believed that bank performance should be evaluated in terms of scale, profitability, structure, cost and risk. While, Yang (2019) believed that the financial performance of China's banking industry should be measured from three dimensions: expansion ability, risk resistance ability and profitability. We can see that these evaluation systems are diverse and there are many different evaluation indicators. Some evaluation index system indicators are lengthy, and some evaluation index systems have certain defects and are not complete. At the same time, from the perspective of the construction method of the indicator system, most of the existing literature uses exploratory factor analysis, lacking of verification of the indicator system, and the stability and adaptability of the results are still questioned.

Therefore, this paper uses the factor analysis method to classify the relevant financial indicators of the bank stocks included in the banking sector, aiming at constructing a complete and effective financial competitiveness evaluation system for listed commercial banks. In order to verify the accuracy and effectiveness of common factor extraction, a combination of exploratory factor analysis (EFA) and confirmatory factor analysis (CFA) was used.

2. Data selection and variable determination

2.1. Sample Selection

Based on the standard of the Industry Sector Division of the Oriental Wealth Network, 22 listed banks in Shanghai and Shenzhen under the banking sector were selected as the research samples. It includes Ping An bank, Bank of Ningbo, Industrial and Commercial Bank of China, Agricultural Bank of China, China Construction Bank, Bank of China, Bank of Communications, Bank of Guiyang, China CITIC Bank, China Merchants Bank, China Everbright Bank, Bank of Shanghai, Industrial Bank, Bank of Jiangsu, Bank of Hangzhou, Wujiang District Bank, Changshu Rural Commercial Bank, Bank of Nanjing, Shanghai Pudong Development Bank, Beijing Bank,, China Minsheng Banking Corp and Hua Xia Bank.

2.2. Variable determination

Referring to the financial indicators usually selected in the financial field, this paper selects eight financial indicators representing the financial performance of listed banks, including earnings per share (X1), net assets per share (X2), total assets profit margin (X3), total assets net profit margin (X4), return on net assets (X5), net operating cash flow to liabilities ratio(X6), asset-liability ratio (X7), debt-equity ratio (X8). The variable types of each variable are numeric variables. In order to improve the reliability and validity of the analysis, we use the data from the fourth quarter of 2017 to the third quarter of 2018 to increase the sample size. The

data in this paper are from the annual report of 2017, the first quarter of 2018, the semi-annual report of 2018, the third quarter of 2018 and the financial indicators information of each bank stock published by Finance and Economics.

2.3. Descriptive statistics of variables

Through data collection, descriptive statistics of research variables are conducted in this paper, and table 1 is the corresponding results.

Table 1: Variables Descriptive Statistics

	min	max	mean	Standard error of mean	Standard deviation
earnings per share(X1)	0.14	2.77	0.86	0.07	0.61
net assets per share (X2)	1.76	19.96	9.32	0.47	4.43
total assets profit margin (X3)	0.17	1.16	0.57	0.03	0.26
total assets net profit margin (X4)	0.18	1.21	0.60	0.03	0.28
return on net assets (X5)	2.17	21.37	10.51	0.55	5.18
net operating cash flow to liabilities ratio (X6)	-2.46	25.80	7.07	0.63	5.90
asset-liability ratio (X7)	90.27	95.06	93.21	0.11	1.03
debt-equity ratio (X8)	927.56	1923.14	1404.12	23.38	219.30

According to Table 1, we can find the main distribution characteristics of each variable. The average earnings per share is 0.86, the minimum value is 0.14, the maximum value is 2.77, and the standard deviation is 0.61. Similarly, we can obtain the centralized and discrete trends of net assets per share, total assets profit margin, net assets return rate, net operating cash flow to liabilities ratio, asset-liability ratio, and so on.

2.4 Correlation analysis of variables

Correlation analysis was performed using SPSS Statistics 19.0. Table 2 shows the matrix of Pearson correlation coefficients between the eight variables.

Table 2: Variable correlation matrix

		X1	X2	X3	X4	X5	X6	X7	X8
X1	Pearson correlation	1	.687**	.578**	.591**	.562**	.186	.305**	.271*
	Sig.(two tails)		.000	.000	.000	.000	.083	.004	.011
X2	Pearson correlation	.687**	1	-.008	-.007	.000	.103	.383**	.322**
	Sig.(two tails)	.000		.939	.945	.996	.342	.000	.002
X3	Pearson correlation	.578**	-.008	1	.995**	.876**	.024	-.160	-.181
	Sig.(two tails)	.000	.939		.000	.000	.827	.137	.092
X4	Pearson correlation	.591**	-.007	.995**	1	.888**	.050	-.127	-.145
	Sig.(two tails)	.000	.945	.000		.000	.640	.237	.178
X5	Pearson correlation	.562**	.000	.876**	.888**	1	.081	.037	.031
	Sig.(two tails)	.000	.996	.000	.000		.453	.733	.776
X6	Pearson correlation	.186	.103	.024	.050	.081	1	.341**	.416**
	Sig.(two tails)	.083	.342	.827	.640	.453		.001	.000
X7	Pearson correlation	.305**	.383**	-.160	-.127	.037	.341**	1	.978**
	Sig.(two tails)	.004	.000	.137	.237	.733	.001		.000
X8	Pearson correlation	.271*	.322**	-.181	-.145	.031	.416**	.978**	1
	Sig.(two tails)	.011	.002	.092	.178	.776	.000	.000	
**. Significantly correlated at the 0.01 level (twotails).									
*. Significantly correlated at the 0.05 level (twotails).									

As can be seen from Table 2, there is a strong correlation between net assets per share and other seven variables, while net assets per share has a weak correlation with total assets profit margin, total assets net profit margin, and return on net assets. In particular, total assets profit margin is close to a fully positive correlation with the total assets net profit margin. What's more, we can see that asset-liability ratio has a lower negative correlation with total assets profit margin and total assets net profit margin.

3. Empirical Analysis of Financial Indicator System of Listed Banking Companies

For the research on the relationship between measured variables and potential variables, exploratory factor analysis is usually carried out on one group of samples to generate the factor structure between measured variables, and confirmatory factor analysis is carried out on another group of samples to test the fit of hypothesis factor structure, which makes the research more rigorous and scientific. Therefore, the 88 samples collected in this study were randomly partitioned according to 70% training samples and 30%

verification samples by using the function of SPSS Modeler14.2. The first step is to use the training sample to conduct exploratory factor analysis (EFA) on the eight financial variables to extract the common factor; the second step is to use validation samples to conduct confirmatory factor analysis (CFA) on the established measurement model in order to test the relationship between satisfaction measurement indicators and potential variables, and ultimately we can obtain a stable and effective comprehensive evaluation indicator system of listed banking companies.

3.1. Exploratory factor analysis

Exploratory factor analysis is an analytical method for measuring potential variables by using explicit variables to measure abstract factors using specific indicators. It was first proposed by Charles Spearman in 1904 . The starting point of exploratory factor analysis is to replace most of the information of the original variable with fewer relatively independent factor variables, which can not only reduce the workload of collecting information, but also make the information represented by the comprehensive indicators not overlap.

1) Variable Commonality
Table 3, variable commonality table, reflects the interpretation of the total variance of the original variables for all common factors. Except for the variable net operating cash flow to liabilities ratio, the commonality of all the original variables is greater than 0.7, which shows that the extracted factors can basically reflect most of the information of the original variables, and only a little information is lost, so we can think that the factor analysis has a good effect.

Table 3: Variable commonality table

Variable	Initial	Extraction
earnings per share(X1)	1.000	.941
net assets per share (X2)	1.000	.885
total assets profit margin (X3)	1.000	.952
total assets net profit margin (X4)	1.000	.956
return on net assets (X5)	1.000	.768
net operating cash flow to liabilities ratio (X6)	1.000	.657
asset-liability ratio (X7)	1.000	.870
debt-equity ratio (X8)	1.000	.905

2) Common Factor Variance
In the study, the common factors are extracted by principal component analysis, in which the contribution rate of variance is used to measure the relative importance of the factors, which reflects the explanation of the common factors to the total variance of the original variables. The eigenvalues represent the variance contribution of the common factors. Generally, the larger the eigenvalues, the higher the variance contribution rate of the common factor. The basis for determining the number of common factors is: selecting the principal component with eigenvalue >1; the principal component when the cumulative contribution rate reaches a certain value (generally70% in social research); and the inflection point for the eigenvalue curve on the gravel map. In this study, the common factors that eigenvalues >1 were extracted. As shown in Table 4 , three common factors were obtained , and the interpretation degree of the extraction factors accounted for 87.962% of the total variance .

Table 4: Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums Of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	3.330	41.625	41.625	3.330	41.625	41.625	3.193	39.908	39.908
2	2.615	32.684	74.310	2.615	32.684	74.310	2.181	27.267	67.175
3	1.092	13.653	87.962	1.092	13.653	87.962	1.663	20.787	87.962
4	.719	8.993	96.955						
5	.130	1.619	98.574						
6	.095	1.186	99.760						
7	.015	.191	99.952						
8	.004	.048	100.000						
Extraction Method: Principal Component Analysis.									

3) Factor Rotation and Naming
In this paper, the maximum variance method is used to perform the factor rotation, so that the variance of the variable load on the common factor is maximized, and the load factor is simplified from the column, which facilitates the naming of factors and the extraction of potential variables. From Table 5, it is obvious that the first common factor has a larger load on the variables X4, X3 and X5, indicating that these three variables have strong correlation and fall into one category, which can be named as profitability. The second common factor has larger loads on the variables X2 and X1, indicating that these two variables have a strong correlation, which can be named as per share value. And the third common factor has a greater load on variables X8, X6 and X7, which can be classified into one category and named as solvency.

Table 5: Rotated Component Matrix

variables	Component		
	1	2	3
total assets net profit margin X4	.976	-.027	-.046
total assets profit margin X3	.970	-.025	-.105
return on net assets X5	.866	.103	.089
net assets per share X2	-.0 95	.930	.109

earnings per share X1	.516	.813	.118
debt-equity ratio X8	-.197	.479	.798
net operating cash flow to liabilities ratio X6	.184	-.151	.775
asset-liability ratio X7	-.179	.526	.749
Extraction Method: Principal Component Analysis.			
Rotation Method: Variance max with Kaiser Normalization.			

3.2. Confirmatory factor analysis

Confirmatory factor analysis (CFA) is a statistical analysis method to explain and test the relationship between observed variables and assumed potential variables. Confirmatory factor analysis is usually based on a rigorous theoretical or empirical basis (exploratory factor analysis) to confirm the relationship between one set of measured variables and another set of factor constructs that can explain the measured variables, so as to verify the generation of a correct factor model. In this study, the use of CFA can not only verify the factor structure derived from exploratory factor analysis, but

also deal with the relationship between three potential variables and the overall financial performance. The model allows errors between measurement variables and potential variables, and can also estimate the fitting degree of sample data.

(1)Model construction and fitting
According to the results of exploratory factor analysis, the eight indicators involved in the study are all observed variables, and the three potential variables are respectively profitability, value per share, and solvency, so we can establish a comprehensive evaluation indicator model of the financial performance of listed companies in the banking sector. We use first-order confirmatory factor analysis to establish a multi-factor skew model. By importing data and calculating the estimated value with AMOS 21.0, the model can be identified with a smooth convergence, resulting in a standardized estimate model graph, as shown in Figure 1.
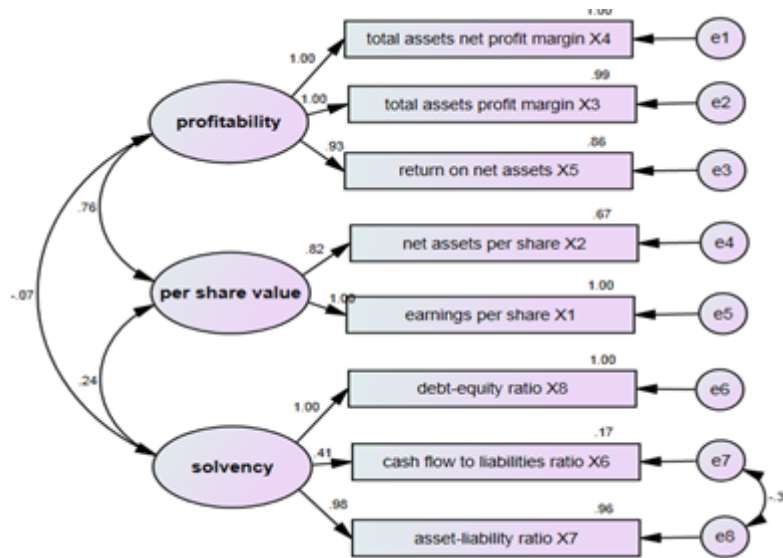

Figure 1 Standardized estimate model map

In the process of model fitting, the confirmatory factor analysis models can converge and identify smoothly. There is no negative error variance of the estimated parameters in the model, and all the error variances reach a significant level (t > 1.96), and there is no large standard error. It shows that the parameter estimation is reasonable and can further test the fitness of the overall model.

Model Evaluation
In order to test the fitting degree of the structural equation model, the internationally used fitting indexes are adopted.

The absolute fitting indexes commonly includes: the chi-square degree of freedom ratio (CMIN/DF), goodness-of-fit index (GFI), adjusted goodness-of fit index (AGFI), and root mean square error of approximation (RMSEA); the relative fitting index includes: normative fit index (NFI), comparative fit index (CFI), and incremental fit index (IFI); the Simple fitting indexes commonly includes parsimony-adjusted NFI (PNFI) and parsimony goodness-of-fit index (PGFI). Therefore, there are seven indexes mentioned above to test the degree of fitting with the original data, as shown in Table 6.

Table 6: Overall fitting index of the evaluation index model

index	Absolute fit index				Relative fit index			Simple fit index	
	CMIN/DF	GFI	AGFI	RMSEA	NFI	CFI	IFI	PNFI	PGFI
standard	(1,3)	>0.90	>0.90	<0.0 5	>0.90	>0.90	>0.90	>0.50	>0.50
model	1.241	0.964	0.938	0.034	0.938	0.987	0.987	0.648	0.555

According to statistical evaluation standard, the chi-square degrees of freedom ratio is between 1 and 3, and the smaller

the value, the better the fitting effect; the closer the values of GFI and AGFI are to 1, the better the fitting degree of the

model; the smaller the values of RMSEA, the higher the fitting degree of the model is; the closer the values of NFI, CFI and IFI are to 1, the higher the adaptability of the model is; PNFI and PGFI are all greater than 0.5,and the higher the value, the simpler the model is. By comparing with the standard, all the indexes of the evaluation model established in this study meet the requirements of model adaptation, which shows that the fitting degree of the model and observation data is good.

3.3. Research result

Based on the comprehensive analysis of the financial indicators of the listed companies in the banking sector from the aspects of exploratory factor analysis and confirmatory factor analysis, this paper establishes a relatively complete financial comprehensive evaluation system for listed companies in the banking sector, as shown in Table 7.

Table 7: Evaluation Index System of Financial Performance of Listed Banks

Evaluation factor	Specific coverage indicators
Profitability	total assets net profit margin
	total assets profit margin
	return on net assets
per shareValue	net assets per share
	earnings per share
Solvency	debt-equity ratio
	net operating cash flow to liabilities ratio
	asset-liability ratio

4. Conclusion

This paper selects eight financial indicators representing the financial performance of listed companies, and uses exploratory factor analysis and confirmatory factor analysis to comprehensively study the financial performance of listed companies in China's banking industry, which avoid the uniformity of single index research. The application of the factor analysis method serves the arbitrariness of the subjective assignment, making the evaluation results more objective, fair and accurate. This paper uses financial indicators to comprehensively evaluate financial performance, which not only provides valuable reference materials for investors' investment, but also helps the bank management to discover problems in the company's financial governance, and can actively and effectively improve development in the future.

Of course, there are some deficiencies in the study of this paper. After all, the selected indicators are only a part of the company's numerous indicators, and many other indicators that affect financial performance are not included. At the same time, the study sample size also needs to be expanded, which needs to be further improved in the future research.

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