

# The Difference Evaluation of The Core Competitiveness of Commercial Banks Under the Background of Green Finance

-- Based on Factor Analysis and Cluster Analysis

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**Abstract:** Green finance plays an important role in China's green low-carbon circular development economic system. As the main body of practicing the concept of green finance, commercial banks' innovation of the core competitiveness system of the banking industry has a profound impact on stimulating the motivation of China's commercial banks to implement green credit. This paper selects the data of 23 different types of commercial banks in China in 2019, innovatively introduces relevant green performance indicators to improve the core competitiveness system of commercial banks, and uses factor analysis to score and rank the competitiveness of banks. On this basis, cluster analysis is further carried out to divide commercial banks into three categories. Finally, according to the analysis results, specific suggestions are put forward.

**Keywords:** Commercial banks, Green finance, Competitiveness.

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## 1. Introduction

Since the industrial revolution in the eighteenth century, the excessive development and utilization of resources by human beings have broken the ecological balance, until the lagging effects of environmental damage, such as global warming and frequent extreme temperature problems, have sounded the alarm for human beings. The environmental problem not only poses a threat to the humanitarian aspect, but also the hidden "green swan" event has laid a hidden danger for the outbreak of the financial crisis. In September 2020, China put forward the goal of carbon neutrality for the first time in the international community, highlighting the style of a great power. The proposal of the dual carbon goal puts forward new requirements for China's high-quality development. Under the dual challenges of time urgency and quality requirements, China urgently needs to promote the deep-level reform of the social development system, and the optimization of the industrial model and economic structure is inseparable from the support of the financial system. By the end of 21 years, China's green credit scale ranks first in the world, and green credit accounts for more than 90% of green finance. As the main body of green credit business implementation, the role and efficiency of commercial banks directly affect the development of green credit. The index system of the competitiveness of commercial banks is a multi-dimensional measurement standard of commercial banks themselves. For a long time, it has been around the traditional financial indicators, which obviously does not meet the requirements of the green financial background.

Based on this, this paper considers the background of green finance, comprehensively considers the situation of China's banking industry, and improves the core competitiveness index system of commercial banks. Using factor analysis and cluster analysis, four factors are selected from 12 indicators such as innovation and scale to construct a comprehensive and comprehensive core competition index system, and rank the scores of commercial banks. Commercial banks are

divided into three categories to standardize the competitiveness standards of China's banking industry. At the same time, the introduction of relevant green business indicators can also help the implementation of green financial policies.

## 2. Literature Review

In view of the competitiveness of commercial banks and green finance, there have been many domestic and foreign scholars to explore. Some scholars have constructed and improved the competitiveness index system of commercial banks. Based on the factor analysis method, Hu Jun found that the overall financial performance of China's banks was in good condition [1]; ni Jiayue innovation introduces employee quality indicators to improve the competitiveness index system [2]; fujing uses factor analysis and cluster analysis to analyze the differences in the competitiveness of some commercial banks [3]; tang Jinxiang and others studied the competitiveness differences between Chinese and foreign commercial banks from an international perspective [4]; he Lingyun used the system GMM regression method to analyze the relationship between green credit and competitiveness of commercial banks, and concluded that internal and external policies can promote the competitiveness of commercial banks [5]; zhao Biying uses the entropy method to study that commercial banks should continue to reform and innovate to enhance the competitiveness of commercial banks.

Some scholars have studied the relationship between green finance and the performance of commercial banks. Chen Jianhua et al. constructed a multi-period DID model based on the financial data of commercial banks from 2007 to 2020, and finally concluded that green credit has a direct negative impact on the financial performance of commercial banks [6]; halit et al. found that the capital adequacy ratio of banks was significantly positively correlated with social commitment [7]. Akber believes that sustainable banks are more efficient [8]; gao Xiaoyan et al. calculated the comprehensive scores of the

operating performance of commercial banks through principal component analysis, and established models for different types of banks. The results show that the impact of green credit on commercial banks is different and lagging.

Due to the different perspectives of different scholars, sample differences and inconsistent research methods, there is no unified conclusion on the two-way interaction between green credit and commercial banks. Few scholars have combined the background of green finance to construct the core competitiveness index system of commercial banks. Considering the background of green finance, this paper selects three categories.

### 3. Research Design and Data Explanation

#### 3.1. Sample selection

Because the disclosure of green credit data in China is not uniform, under the premise of considering the availability of data, in order to ensure that the research results are universal to China 's banking industry, the samples cover 23 state-owned commercial banks, most national joint-stock commercial banks and city commercial banks. The final selection of samples is shown in Table 1.

Table 1. 23 sample banks

Bank Type	Bank Name
State-owned banks	Bank of China Postal Savings Bank Industrial and Commercial Bank Construction Bank Agricultural Bank post office savings bank
Joint-stock commercial banks	Merchants Bank Shanghai Development Bank CITIC Bank Industrial Bank Huaxia Bank Ping An Bank Everbright Bank Minsheng Bank
City Commercial Bank	Ningbo Bank Changsha Bank Qingdao Bank Suzhou Bank Shanghai Bank Guiyang Bank Zhejiang Bank Jiangsu Bank Hangzhou Ningbo Bank

#### 3.2. Data sources

The data in this paper are mainly derived from the Guotai 'an economic and financial database and the Wind database. Some of the missing data values are supplemented by the author 's manual review of the bank 's social responsibility report and annual report.

China 's commercial banks objectively and comprehensively, we not only need to consider different types of commercial banks, but also need to select relevant indicators from multiple perspectives. In this paper, the degree of green business development, profitability, development ability, bank size and so on are included in the index system. The specific indicators are shown in Table 2.

#### 3.3. Construction of index system

To construct the core competitiveness index system of

Table 2. Bank core competitiveness index system

Primary index number	Observation index	Nature of indicators	number
Innovative indicators	Green credit balances	Positive direction	X1
	Green Credit Ratio	Positive direction	X2
Capital adequacy index	Capital adequacy ratio	Positive direction	X3
	Core capital adequacy ratio	Positive direction	X4
Scale indicators	Total assets of banks	Positive direction	X5
	Number of outlets	Positive direction	X6
	Number of banks	Positive direction	X7
Developmental indicators	Revenue growth rate	Positive direction	X8
	Loan growth rate	Positive direction	X9
Profitability Indicators	Return on total assets	Positive direction	X10
	Operating income	Positive direction	X11
	Ne interest margin	Positive direction	X12

### 4. Empirical Results and Analysis

SPSS software. The results are shown in Table 3.

#### 4.1. Descriptive statistics

Descriptive statistics of sample data were performed using

**Table 3.** Descriptive statistical analysis results

Variable	minimum	maximum	standard deviatio	variance	Kurtosis	skewness
X1	46.65	13508.38	4456.87	19863725.53	0.75	1.51
X2	0.92	29.37	5.73	32.81	13.60	3.30
X3	12.44	17.52	1.31	1.72	0.21	0.94
X4	8.08	13.88	1.51	2.29	0.65	1.05
X5	3434.72	301094.36	90156.12	8128126059.03	1.03	1.48
X6	142.00	39639.00	9771.14	95475245.58	6.39	2.48
X7	4117.00	464011.00	143247.65	20519890079.62	1.78	1.74
X8	4.79	30.44	7.04	49.59	-0.62	0.34
X9	0.02	0.37	0.07	0.01	2.46	1.06
X10	0.62	1.32	0.17	0.03	0.25	0.75
X11	73.65	8551.64	2366.22	5599009.62	1.76	1.59
X12	1.48	2.55	0.29	0.08	-0.24	-0.29

It can be seen from the descriptive statistics that the variance of X1 ( green credit balance ) is extremely large, the maximum value is 13508.38, and the minimum value is only 46.65, indicating that the level of green credit business in China 's banking industry is extremely uneven. The variance of X5 ( total assets of banks ), X6 ( number of outlets ) and X7 ( number of personnel ), which indicates the scale of banks, is also relatively large, indicating that there are large differences in the scale of different types of banks in China. The kurtosis and skewness of X12 ( net interest margin ) are both negative, indicating that the overall data is very flat and shows a left-skewed distribution. From the perspective of development indicators, the standard deviation of X8 ( revenue growth rate ) is also large, indicating that the development of China 's banking industry is uneven.

## 4.2. Data preprocessing

The evaluation indexes of this paper are all positive indexes, so the index co-directional processing is avoided. In order to eliminate the influence of index dimension, Z-Score method is used to standardize the data in SPSS software.

## 4.3. Factor analysis

### 4.3.1. Applicability test

Before factor analysis, KMO and Bartlett 's spherical test were carried out. The approximate chi-square of Bartlett 's

spherical test was 330.606, and the significance level was 0, which was far less than 0.05, indicating that the correlation coefficient matrix was not a unit matrix, and there was a correlation between variables, which was in line with the premise of factor analysis. At the same time, the KMO statistic is 0.699, which is approximately 0.7, indicating that it is more suitable for factor analysis. The results are shown in Table 4.

**Table 4.** Data test results of KMO and Bartlett

KMO sampling suitability quantity		0.699
Bartlett sphericity test	Approximate chi-square	330.606
	Freedom	66
	Significance	0.000

### 4.3.2. Extraction factor

Based on the common factors extracted from the eigenvalues greater than 1, a total of four common factors were extracted. The eigenvalues were 4.986, 2.368, 1.686, and 1.478, respectively. The corresponding variance contribution rates were 41.548 %, 61.282 %, 75.331 %, and 87.648 %, respectively. The cumulative variance contribution rate reached 87.648 %, indicating that the four common factors extracted can better summarize most of the information of the original indicators. The principal component eigenvalues and variance contribution rates are shown in Table 5.

**Table 5.** Principal component eigenvalue and variance contribution rate

factor	The initial eigenvalue extracts			the square of the load			the square of the rotating load.		
	total	Variance%	Cumulative %	total	Variance%	Cumulative %	total	Variance%	Cumulative %
1	6.465	53.872	53.872	6.465	53.872	53.872	4.986	41.548	41.548
2	1.643	13.692	67.564	1.643	13.692	67.564	2.368	19.735	61.282
3	1.388	11.480	79.044	1.378	11.480	79.044	1.686	14.048	75.331
4	1.032	8.604	87.648	1.032	8.604	87.648	1.478	12.317	87.648
5	0.693	5.786	93.423						
6	0.398	3.239	96.653						
7	0.234	1.951	98.604						
8	0.086	0.637	99.241						
9	0.061	0.511	99.752						
10	0.021	0.173	99.925						
11	0.017	0.058	99.983						
12	0.002	0.017	100.000						

### 4.3.3. Name of common factors

Through the maximum variance orthogonal rotation of the four common factors extracted, the original factor load matrix is rotated, and the maximum variance orthogonal rotation matrix is obtained, as shown in table 6.

The rotated component matrix is analyzed in combination with economic significance. The common factor F1 mainly has a large load on the number of outlets, the number of personnel, the total assets of the bank, and the operating income of the commercial bank. These indicators can reflect

the scale and strength of commercial banks, so they are named as scale factors. F2 has a large load value in the return on total assets, capital adequacy ratio and core capital adequacy ratio, so it is named as the stability factor ; f3 has a large load value in the proportion of green credit balance and net interest margin, so it is named as an innovative factor ; f4 is mainly determined by revenue growth rate and loan growth rate. These two indicators can reflect the development ability and growth of commercial banks, so they are named as growth factors.

**Table 6.** Rotation factor load matrix

Z-Score	factor			
	1	2	3	4
X1	0.779	0.352	0.477	-0.091
X2	0.177	0.117	0.820	0.273
X3	0.597	0.679	-0.022	0.061
X4	0.597	0.680	-0.023	-0.248
X5	0.873	0.305	0.183	-0.271
X6	0.913	-0.215	-0.155	0.020
X7	0.919	0.255	0.109	-0.160
X8	-0.639	-0.243	0.001	0.486
X9	-0.227	-0.038	0.005	0.928
X10	0.035	0.935	-0.033	-0.044
X11	0.853	0.355	0.144	-0.262
X12	0.050	0.202	-0.833	0.250

### 4.3.4. Scores and rankings

Through the regression analysis method, the factor score coefficient matrix is obtained, and the evaluation function of each factor is obtained :

$$F1 = 0.128X1 + 0.01X2 + 0.067X3 + 0.002X4 + 0.165X5 + 0.399X6 + 0.224X7 - 0.069X8 + 0.123X9 - 0.217X10 + 0.151X11 + 0.108X12$$

$$F2 = 0.042X1 + 0.051X2 + 0.276X3 + 0.273X4 - 0.018X5 - 0.353X6 - 0.061X7 + 0.007X8 + 0.038X9 + 0.566X10 + 0.017X11 + 0.094X12$$

$$F3 = 0.232X1 + 0.494X2 - 0.06X3 - 0.053X4 + 0.04X5 - 0.196X6 - 0.015X7 + 0.048X8 + 0.003X9 - 0.001X10 + 0.018X11 - 0.531X12$$

$$F4 = 0.079X1 + 0.252X2 + 0.184X3 - 0.079X4 - 0.048X5 + 0.212X6 + 0.057X7 + 0.278X8 + 0.744X9 - 0.022X10 -$$

$$0.044X11 + 0.246X12$$

The scores of common factors of F1, F2, F3 and F4 and the contribution rate / cumulative contribution rate of each factor after rotation are used as weights to calculate the ranking of all samples. The comprehensive evaluation function is as follows :

$$F = ( 41.548 \% F1 + 19.735 \% F2 + 14.048 \% F3 + 12.317 \% F4 ) / 87.648 \%$$

According to the above function, the single score and total score of the competitive ability factor of each commercial bank are calculated, and the ranking is carried out on this basis. Because the indicators are standardized before the factor analysis, the total score of the competitiveness of commercial banks is negative, which does not mean that commercial banks have negative competitiveness. The ranking results are shown in Table 7.

**Table 7.** The common factor scores and total score results of commercial banks

bank	F1 rankings	F1 rankings	F1 rankings	F1 rankings	aggregate score	F1 rankings
1	20	8	1	4	4.075	1
2	7	4	4	14	3.300	2
3	19	2	8	15	2.978	3
4	9	13	6	10	2.508	4
5	11	18	9	1	2.205	5
6	12	6	11	16	1.027	6
7	13	3	21	3	0.748	7
8	21	1	20	13	0.511	8
9	18	9	19	2	0.452	9
10	.....	.....	.....	.....	.....	.....
11						
12	5	17	10	18	-1.750	20
13	23	15	17	20	-2.315	21
14	10	21	15	21	-2.618	22
15	16	19	19	22	-3.604	23

According to the competitiveness score and ranking table, the top six are Industrial Bank, Industrial and Commercial Bank, Construction Bank, Agricultural Bank, Qingdao Bank and Bank of China, covering the four major banks in China. As a national joint-stock commercial bank, Industrial Bank has outstanding performance and ranks first in the core competitiveness ranking. The reason is that Industrial Bank has performed well on all three factors except F1, of which factor 3 contributes the most to the core competitiveness. From the four banks at the bottom of the ranking, the final score is low because the ranking status of the four factors lags behind most banks.

From the perspective of scale factor F1, the performance of state-owned banks is not very strong. Only the Agricultural Bank of China and the Industrial and Commercial Bank of China rank in the top 10. The outstanding performance is mainly concentrated in the national joint-stock commercial banks, which shows that the scale growth and business scope of China's joint-stock commercial banks are wide, and to a certain extent, they catch up with the old state-owned commercial banks.

From the perspective of stability factor F2, the top rankings are China Merchants Bank, China Construction Bank, Bank of Ningbo, Industrial and Commercial Bank, and the rankings of state-owned banks are all around 10, indicating that the stability of state-owned banks is better than the other two types of banks. The performance of China Merchants Bank and Ningbo Bank in national joint-stock commercial banks and city commercial banks is extremely prominent, indicating that they attach great importance to the sound operation of banks.

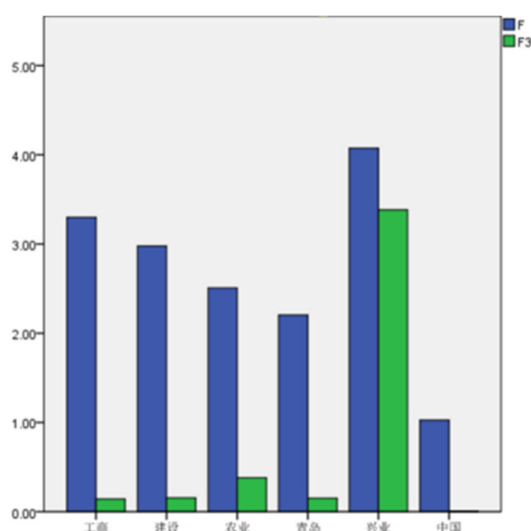


Figure 1.

#### 4.4. Cluster analysis

According to the results of the analysis, 23 banks are finally classified into one category after iteration. The results of cluster analysis show that most of the traditional state-owned banks in China are more competitive in category one, and Industrial Bank of China, a large joint-stock commercial bank, is outstanding. This may be related to the fact that Industrial Bank's green credit business ranks first in the country, and the innovation factor contributes a lot. Based on the results of the above factor analysis, the five banks are at an upper level

in the four factors, and their competitiveness is relatively strong. The second category mainly includes large-scale joint-stock commercial banks and some urban commercial banks, which are also excellent in the overall ranking of competitiveness scores. The excellent comprehensive score is mainly in the four factors. The scores are at the upper middle level, and no factor is ranked backward. Bank of China is the only state-owned commercial bank that has been dumped in the first echelon. It should re-examine its own operation and competitiveness. Category 3 mainly covers most of the city commercial banks. These banks rely on the regional economy, and their development history and social credibility are weaker than the other two types of banks, so they are always at the back end of the competitiveness ranking.

### 5. Summary and Suggestions

This paper takes 23 commercial banks in China as a sample study, covering three types of banks. This paper selects 2019, when the green credit data is fully disclosed, to construct the core competitiveness evaluation index system of commercial banks under the background of green finance, and analyzes the competitiveness of China's commercial banks through factor analysis and cluster analysis. Based on factor analysis, a total of scale factors, stability factors, innovation factors, and growth factors were extracted, and the degree of interpretation of all indicators was close to 90%. The results of cluster analysis show that the performance of China's traditional four major banks is still strong, and only the Bank of China has been thrown out of the first echelon. A few city commercial banks have better competitiveness, but the best is only at the second level. Commercial banks with weak competitiveness are basically from China's urban commercial banks, indicating that only limited to regional development often can not achieve a breakthrough in competitiveness.

In view of the above summary, each commercial bank should make a breakthrough under the condition of ensuring the balance of all aspects in combination with its own actual situation. State-owned commercial banks should vigorously develop innovative business, based on their own scale and reputation advantages to carry out green credit and other innovative business will bring development potential. Large joint-stock commercial banks should pay attention to green credit business. Under the background of green finance, green innovation will play a more obvious role in enhancing the competitiveness of banks. City commercial banks should not be limited to urban restrictions, reasonable capital increase, expand the scale.

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