

Comprehensive Evaluation and Analysis of RMB Credit Fund Balance Sheet of Financial Institutions in China

Wenjie Chu, Song Huang

Department of Financial Mathematics, School of Mathematical Sciences, Mudanjiang Normal University, Mudanjiang 157011, China.

Abstract: The balance of RMB credit funds in financial institutions is one of the important scales reflecting macroeconomic activities. Therefore, based on the official website of the People's Bank of China, this paper collects the relevant data in 2022, adopts the entropy-factor analysis method, and uses EXCEL and SPSSAU software to make a comprehensive evaluation from the two aspects of fund source and fund utilization. Firstly, the entropy method is used to determine the influence degree of the above two factors; secondly, on the basis of considering the influence degree, the trend and the relationship. The comprehensive factor score F_{source} and $F_{utilization}$ are obtained, and the trend and relationship between F_{source} and $F_{utilization}$ are compared and analyzed.

Keywords: RMB Credit of Financial Institutions; Source and Application of Funds; Entropy Method; Factor Analysis; Comprehensive Evaluation

Introduction

The RMB credit fund balance sheet of financial institutions can reflect the capital source, operation status and risk management ability of financial institutions, and help investors and regulators to have a more comprehensively and accurately understand the financial situation and risk situation of financial institutions. Therefore, based on the official website of the People's Bank of China, taking 2022 as the research point, the entropy value-factor analysis method is adopted to comprehensively evaluate and analyze the RMB credit fund balance sheet of financial institutions from two aspects: the source and application of funds. The source of funds, the indicators are: household deposits, non-financial enterprise deposits, corporate deposits, fiscal deposits, non-bank financial institutions deposits, overseas deposits, financial bonds, in circulation currency, liabilities to international financial institutions, respectively, $X_{source,1}, X_{source,2}, X_{source,3}, X_{source,4}, X_{source,5}, X_{source,6}, X_{source,7}, X_{source,8}, X_{source,9}$, Unit hundred million yuan, In terms of the use of funds, the selected indicators are: household loan, enterprise (business) unit loan, non-banking financial institution loan, overseas loan, bond investment, equity and other investment, gold outstanding, central bank foreign exchange outstanding, assets in international financial institutions, respectively, $X_{utilization,1}, X_{utilization,2}, X_{utilization,3}, X_{utilization,4}, X_{utilization,5}, X_{utilization,6}, X_{utilization,7}, X_{utilization,8}, X_{utilization,9}$, Unit hundred million yuan.

1. Comprehensive evaluation of funding sources based on the entropy value-factor analysis method

1.1 Analysis of influencing factors based on entropy method

Based on the data collected by the People's Bank of China, after using the Z-score standardization method, the influence weight of each index is obtained by using the SPSSAU web page analysis as shown in Table 1.

Table 1 Summary of weight calculation results by entropy method

metric	Information entropy value e_{source}	Information utility value d_{source}	weight coefficient W_{source}
$X_{source,1}$	0.9998	0.0002	5.18%
$X_{source,2}$	0.9998	0.0002	5.73%
$X_{source,3}$	0.9999	0.0001	3.16%

$X_{source,4}$	0.9990	0.0010	24.49%
$X_{source,5}$	0.9999	0.0001	2.41%
$X_{source,6}$	0.9985	0.0015	34.95%
$X_{source,7}$	0.9998	0.0002	4.13%
$X_{source,8}$	0.9998	0.0002	5.70%
$X_{source,9}$	0.9994	0.0006	14.26%

As can be seen from Table 1, the influence degree of sources of funds is ranked from high to low: fiscal deposits of international financial institutions and non-monetary household deposits in non-financial enterprise deposits, and corporate deposits of financial bond institutions and group deposits of non-banking financial institutions.

1.2 Comprehensive evaluation of funding sources based on the factor analysis method

On the basis of considering the degree of influence, the product of weight and standardized data is taken as the evaluation index, and the index data after considering the degree of influence is denoted as $Y^*_{source,i}$ ($i=1,2,3,\dots,9$), that is $Y^*_{source,i} = \omega \cdot X^*_{source,i}$, $X^*_{source,i}$ indicates the data standardized by Z-score. The adaptability test of factor analysis on $Y^*_{source,i}$ shows that although $KMO = 0.465 < 0.5$, the P value of Bartlett's sphericity test is 0.000, which rejects the null hypothesis that the correlation matrix is a unit matrix, indicating that there is a certain correlation between variables and can be used for factor analysis.

First, the explanation table of the total variance is shown in Table 2.

Table 2 Balance table of RMB credit funds of financial institutions-Interpretation table of the total variance of fund sources

ingredient	Initial eigenvalue			The sum of the load squares was extracted			Sum of the rotating load squares		
	amount to	variance percentage	accumulate	amount to	variance percentage	accumulate	amount to	variance percentage	accumulate
1	5.239	58.21	58.21	5.239	58.21	58.21	5.16	57.338	57.338
2	1.789	19.876	78.086	1.789	19.876	78.086	1.621	18.007	75.345
3	1.158	12.871	90.957	1.158	12.871	90.957	1.405	15.612	90.957
4	0.591	6.562	97.519						
5	0.119	1.327	98.845						
6	0.074	0.819	99.664						
7	0.023	0.256	99.92						
8	0.007	0.08	100						
9	2.70E-16	3.00E-15	100						

According to Table 2, the accumulation of variance is 90.957% > 950%, so it is appropriate to extract three common factors.

Furthermore, the component score coefficient matrix is shown in Table 3

Table 3 Balance table of RMB credit funds of financial institutions-Score coefficient matrix of fund source components

	ingredient		
	1	2	3
$Y^*_{source,1}$	0.204	0.069	-0.156
$Y^*_{source,2}$	0.186	-0.126	-0.116
$Y^*_{source,3}$	0.173	-0.216	-0.053
$Y^*_{source,4}$	-0.091	-0.043	0.674
$Y^*_{source,5}$	0.094	-0.382	0.021
$Y^*_{source,6}$	0.148	0.159	0.289
$Y^*_{source,7}$	0.105	0.247	0.4
$Y^*_{source,8}$	0.047	0.583	0.049
$Y^*_{source,9}$	0.204	0.069	-0.156

From Table 3, the formula for calculating the factor score is:

$$F_{source,1} = 0.204Y^*_{source,1} + 0.168Y^*_{source,2} + 0.173Y^*_{source,3} - 0.091Y^*_{source,4} + 0.094Y^*_{source,5} + 0.148Y^*_{source,6} + 0.105Y^*_{source,7} + 0.047Y^*_{source,8} + 0.204Y^*_{source,9} \quad (1-1) \quad (1-2)$$

$$F_{source,2} = 0.069Y_{source,1}^* - 0.126Y_{source,2}^* - 0.216Y_{source,3}^* - 0.043Y_{source,4}^* - 0.382Y_{source,5}^* + 0.159Y_{source,6}^* + 0.247Y_{source,7}^* + 0.583Y_{source,8}^* + 0.069Y_{source,9}^*$$

$$F_{source,3} = -0.156Y_{source,1}^* - 0.116Y_{source,2}^* - 0.053Y_{source,3}^* + 0.674Y_{source,4}^* + 0.021Y_{source,5}^* + 0.289Y_{source,6}^* + 0.4Y_{source,7}^* + 0.049Y_{source,8}^* - 0.156Y_{source,9}^* \quad (1-3)$$

$F_{source,i}$ ($i = 1,2,3$) Where is the score of each factor, the formula of the comprehensive factor score obtained with Table 2 is as follows:

$$F_{source} = 57.338\%F_{source,1} + 18.007\%F_{source,2} + 15.612\%F_{source,3} \quad (1-4)$$

$Y_{source,i}^*$ ($i = 1,2,\dots,9$) Finally, the balance table of RMB credit funds of the above and available financial institutions-the comprehensive score and ranking of fund sources are shown in Table 4.

Table 4 Balance table of RMB credit funds of financial institutions-comprehensive score and ranking of fund sources

	$F_{source,1}$	$F_{source,2}$	$F_{source,3}$	F_{source}	ranking
In January, 2022	-1.49822	2.47889	0.15465	-0.39	8
In February, 2022	-1.39493	-0.22641	0.95385	-0.69	10
In March, 2022	-0.84125	-0.36395	-1.00476	-0.7	11
In April, 2022	-0.78689	-0.87897	-0.95041	-0.76	12
00 May, 2022	-0.57357	-1.13073	-0.01155	-0.53	9
In June, 2022	0.06581	-0.63706	-0.83248	-0.21	7
In July, 2022	0.19066	-0.84111	0.52978	0.04	6
In August, 2022	0.52867	-0.11735	0.54563	0.37	5
In September, 2022	1.03601	0.52323	-0.16411	0.66	4
In October, 2022	0.76058	0.31801	1.86241	0.78	1
In November, 2022	1.14764	-0.16851	0.6417	0.73	2
In December, 2022	1.3655	1.04395	-1.72471	0.7	3

$F_{source,1}$ $F_{source,2}$ $F_{source,3}$ As can be seen in Table 4, the score increased significantly from April 2022 to December 2022 because the People's Bank of China decided to cut the deposit reserve ratio of financial institutions by 0.25 percentage points (excluding financial institutions that have implemented the 5% deposit reserve ratio). However, the unstable chart shows the fluctuating state, which leads to the increase of deposits in the People's Bank of China. $F_{source,3}$

2. Comprehensive evaluation of fund application based on entropy value-factor analysis method

2.1 Analysis of influencing factors based on entropy method

Similarly, for the standardized Z-score data of the people's credit fund balance sheet of financial institutions, the SPSSAU web page analysis of the impact weight of each indicator is shown in Table 5.

Table 5 Summary of the weight calculation results by the entropy method

Item	Information entropy value $e_{utilization}$	Information utility value $d_{utilization}$	weight coefficient $W_{utilization}$
$X_{utilization,1}$	1.0000	0.0000	0.46%
$X_{utilization,2}$	0.9998	0.0002	2.01%
$X_{utilization,3}$	0.9933	0.0067	62.92%
$X_{utilization,4}$	0.9969	0.0031	28.96%
$X_{utilization,5}$	0.9997	0.0003	2.48%
$X_{utilization,6}$	1.0000	0.0000	0.40%
$X_{utilization,7}$	0.9999	0.0001	1.25%
$X_{utilization,8}$	1.0000	0.0000	0.01%
$X_{utilization,9}$	0.9998	0.0002	1.51%

As can be seen from Table 5, the degree of influence on the use of funds is ranked from high to low: fiscal deposits of international financial institutions and non-financial enterprise deposits in the circulation of financial institutions, group deposits of financial bond institutions and deposits of non-banking financial institutions.

2.2 Comprehensive evaluation of fund utilization based on factor analysis method

$Y^*_{utilization,j}(j=1,2,\dots,9)$ Consider that on the basis of standardizing the product of the weight and the data of the use of funds, i.e. $Y^*_{utilization,j} = \omega \cdot X^*_{utilization,j}$ The factor analysis obtained $KMO = 0.527 > 0.5$, the P value of Bartlett sphericity test = 0.000, and the null hypothesis that the correlation array is the unit array was rejected, indicating that there is some correlation between variables can be used for factor analysis.

First, to determine the number of common factors in the extraction, the total variance interpretation table is shown in Table 6.

Table 6 Balance table of RMB credit funds of financial institutions-Explanation table of the total variance of fund use

ingredient	Initial eigenvalue			The sum of the load squares was extracted			Sum of the rotating load squares		
	amount to	variance percentage	accumulate	amount to	variance percentage	accumulate	amount to	variance percentage	accumulate
1	5.932	65.914	65.914	5.932	65.914	65.914	4.909	54.550	54.55
2	1.608	17.863	83.778	1.608	17.863	83.778	2.631	29.228	83.778
3	0.805	8.942	92.72						
4	0.565	6.274	98.994						
5	0.041	0.45	99.444						
6	0.032	0.356	99.799						
7	0.015	0.169	99.968						
8	0.002	0.022	99.99						
9	0.001	0.01	100						

According to Table 6, the accumulation variance contribution of the square sum of rotational load is 83.778%. $8\% > 85\%$, so it is appropriate to extract two common factors.

Secondly, the component score coefficient matrix of the use of funds is shown in Table 7.

Table 7 Balance table of RMB credit funds of financial institutions-score coefficient matrix of fund utilization components

	ingredient	
	1	2
$Y^*_{utilization,1}$	0.145	0.063
$Y^*_{utilization,2}$	0.152	0.061
$Y^*_{utilization,3}$	0.180	-0.099
$Y^*_{utilization,4}$	0.183	-0.008
$Y^*_{utilization,5}$	0.141	0.078
$Y^*_{utilization,6}$	0.258	-0.268
$Y^*_{utilization,7}$	-0.107	0.430
$Y^*_{utilization,8}$	-0.164	0.483
$Y^*_{utilization,9}$	0.202	-0.041

The formula for calculating the available factor score in Table 7 is:

$$F_{utilization,1} = 0.145Y^*_{utilization,1} + 0.152Y^*_{utilization,2} + 0.180Y^*_{utilization,3} + 0.183Y^*_{utilization,4} + 0.141Y^*_{utilization,5} + 0.258Y^*_{utilization,6} - 0.107Y^*_{utilization,7} - 0.164Y^*_{utilization,8} + 0.202Y^*_{utilization,9} \quad (2-1)$$

$$F_{utilization,2} = 0.063Y^*_{utilization,1} + 0.061Y^*_{utilization,2} - 0.099Y^*_{utilization,3} - 0.008Y^*_{utilization,4} + 0.078Y^*_{utilization,5} - 0.268Y^*_{utilization,6} - 0.430Y^*_{utilization,7} + 0.483Y^*_{utilization,8} - 0.041Y^*_{utilization,9} \quad (2-2)$$

$F_{utilization,i}(i=1,2)$ Where is the score of each factor, the formula of the comprehensive factor score obtained with Table 2 is as follows:

$$F_{utilization} = 54.550\%F_{utilization,1} + 29.228\%F_{utilization,2} \quad (2-2)$$

$Y^*_{utilization,i}(i=1,2,\dots,9)$ Finally, the comprehensive balance table of RMB credit funds of available financial institutions- -the comprehensive score and ranking of fund use are shown in Table 8.

Table 8 Balance table of RMB credit funds of financial institutions-Comprehensive score and ranking of fund use

	$F^*_{utilization,1}$	$F^*_{utilization,2}$	$F^*_{utilization,3}$	ranking
In January, 2022	-1.49245	-0.40565	-0.93	12
In February, 2022	-0.99095	-0.45765	-0.67	10
In March, 2022	-1.51694	0.40765	-0.71	11
In April, 2022	-0.40803	-0.37120	-0.33	9
00 May, 2022	0.08694	-0.57861	-0.12	7
In June, 2022	-0.55322	0.16696	-0.25	8
In July, 2022	0.42250	-0.44065	0.1	6
In August, 2022	0.74256	-0.67594	0.21	5
In September, 2022	0.70169	-0.40649	0.26	4
In October, 2022	1.56422	-0.84554	0.61	3
In November, 2022	1.10799	0.82312	0.84	2
In December, 2022	0.3357	2.78399	1	1

$F^*_{utilization,1}$ $F^*_{utilization,2}$ The scores obtained in Table 5: increased significantly from April 2022 to October 2022, because the People's Bank of China gave equal capital incentives for interest reduction to inclusive small and micro loans in the fourth quarter of 2022. Due to the impact of the epidemic, the growth rate of residents' income has declined and the consumption power has decreased, so it has been fluctuating. $F^*_{utilization,2}$

3. Summary

This paper takes the RMB credit fund balance sheet of financial institutions as the research object, and comprehensively evaluates it from two aspects of fund source and fund use. F_{source} $F_{utilization}$ To and do the time series analysis plots are shown in Figure 1.

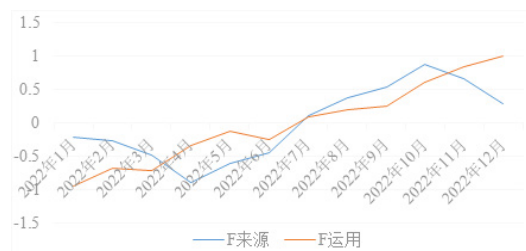


Figure 1 Trend chart of fund utilization and fund source comprehensive factor score of RMB credit fund balance table of financial institutions

F_{source} $F_{utilization}$ As can be seen from Figure 1, the (1) composite score trend chart showed a horizontal S type, which decreased from -0.2 in January 2022 to -0.4 in April 2022. 89, there was a significant increase from May 2022 to October 2022, and then a sudden decline in November 2022, from May 2022 to October 2022 but still decreased; (2) a small decline from May 2022 to October 2022, but still an overall upward trend. It can be seen that the balance sheet of RMB credit funds in 2022 is generally in a fluctuating trend and generally in an upward trend. $F_{utilization}$ $F_{utilization}$ F_{source} $F_{utilization}$

References

- [1] Lin X. Research on the preparation and application of the government balance sheet [D]. Shandong Industry and Business University, 2018:1-2.
- [2] Wang YX. Analysis of the period difference of the tail risk and its influencing factors of listed financial institutions in China [D]. Dongbei University of Finance and Economics, 2022:1-2.

- [3] Yang P. Research on risk control of ZZ Bank [D]. Henan University of Science and Technology, 2022:1-2.
- [4] Li YC. Analysis of the supply and demand of rural financial credit funds in Lufeng County, Yunnan Province [D]. Yunnan University of Finance and Economics, 2021:1-2.
- [5] Zhang YZ. Comprehensive evaluation of the performance of listed agricultural companies based on the entropy value method [J]. Rural economy and science and technology, 2022:1-2.
- [6] Zhao YC. Study on the performance evaluation of water-saving irrigation in potato based on factor analysis and cluster analysis [D]. Yunnan Normal University, 2021:34-35.
- [7] Guo ZM. Research on the construction of Z-Score real estate enterprises based on factor analysis [D]. Jiangxi Normal University, 2021:10-12.
- [8] Dai J. Analysis and research on the profitability of L Chemical Company based on the factor analysis method [D]. Shenyang Jianzhu University, 2021:19-27.
- [9] Li DR. Comprehensive strength assessment of various cities in Hebei Province based on multivariate statistical analysis [D]. Dalian University of Technology, 2021:10-16.
- [10] Jiang PJ. The CC automotive financial performance evaluation study based on the factor analysis method [D]. Liaoning Petrochemical University, 2021:10-27.
- [11] Qian ZN. Impact factor analysis of high-quality economic development level in East China [D]. Hangzhou Xidian University, 2021:18-22.
- [12] Wang XT. Study on the influence of economic policy uncertainty on the credit risk of bank financial institutions [J]. Industrial Innovation Research, 2023 (01): 126-128.
- [13] Li YH, Li ZS, Sun LN, Wang CZ, Li M. The Project Group of the People's Bank of China Nong'an County Sub-branch, Research on the development of green industry supported by banking financial institutions in economically underdeveloped Areas —— Take Nong'an County as an example [J]. Jilin Financial Research, 2022 (11): 47-49 + 62.
- [14] Lu Y. Research on the strengthening strategies of financial credit management [J]. National Circulation economy, 2022 (29): 133-136.
- [15] Ren XY. The selection and optimization of credit technology in rural financial institutions [J]. Journal of Jingdezhen University, 2022,37 (03): 66-69.

About authors

Chu Wenjie (1989-), female, Mudanjiang, Heilongjiang Province. Instructor, Master, Applied Mathematics (Stochastic Process and Its Application, Applied Statistics).

Huang Song (1999-), male, Mudanjiang, Heilongjiang Province. Bachelor, Financial Mathematics

[Fund Project] 2018 Youth Cultivation Project of Provincial Education Department (1353MSYQN016); General Project of Undergraduate Education and Teaching Reform in 2021 (SJGY20210898, SJGY20210890); General Project of Undergraduate Education and Teaching Reform in 2022 (SJGY20220609)