

# Evaluation of Bank of China Financial Performance Based on Prospect Theory

Tingxian Wu<sup>1, \*</sup>

<sup>1</sup> Hunan University of Science and Technology, Hunan, China

\* Corresponding Author

**Abstract:** There are many methods to evaluate the company's operating ability, specifically, the financial index rating and comprehensive evaluation, while ordinary investors' evaluation of the company's operating performance is more focused on the financial data and financial indicators published by the company. At present, most of the research papers focus on building appropriate indicators, integrating indicators with mathematical logic, forming the company's comprehensive score, ranking and selecting the best. By adding the psychological factors of investors, the index is further reconstructed to obtain the comprehensive score of Bank of China. The results show that investors are not willing to invest in listed companies of Bank of China. At the same time, the results are corroborated by objective data such as share of stock turnover, turnover rate and dividend rate. With the help of the research results, investors can effectively guide stock selection in the market and obtain a stable rate of return.

**Keywords:** Prospect theory, Financial performance, Bank of China.

## 1. Introduction

With the continuous deepening of the domestic macro environment, the evaluation of the company's business performance is easily affected by many factors such as the development of the regional market, the internal and external business environment, and the macroeconomic benefits. In a comprehensive view, the evaluation of the company's business performance will be a multi-objective and multi-level decision-making problem [1]. The evaluation method of business performance can be either purely from the level of non-financial indicators or from a comprehensive research perspective,

## 2. Literature References

Guan Kaicheng (2005) established an evaluation method of non-financial indicators of enterprise performance, which is constructed from five dimensions of non-financial indicators of business strategic objectives, system construction, product quality, technological innovation, and operator quality, and introduced the concept of fuzzy set to comprehensively evaluate the level of enterprise's business capability [3]; Yang Xingyue (2011) At the level of learning and growth, the enterprise performance evaluation system [6] (the example method cannot be used in academic papers. Academically, it is necessary to summarize, list as many existing studies as possible, and classify them). However, relevant literature shows that more studies are based on financial indicators to evaluate the company's operating performance, because of the availability of financial data, the diversity of evaluation methods and the logicity. At the same time, with the update and iteration of science and technology, the original small data operation has been replaced by the computer's super big data operation, greatly improving the efficiency of research and the exploration of research methods. Many scholars have introduced mathematical methods to evaluate the financial indicator data. Liu Xuhua (2008) introduced the partial least squares (PLS) path analysis method to comprehensively evaluate the financial indicators of listed companies in China.

This method can largely integrate the original financial indicator information and effectively demonstrate its effectiveness [4]; Similarly, Lu Xiu'e et al. (2015) used the factor analysis method to build the evaluation system of listed companies, obtained the main components through the principal component analysis method, and then calculated the scores of the main components in the way of dimensionality reduction. According to the scores obtained, the relevant listed companies were ranked [7], [2]. There are more relevant methods, such as analytic hierarchy process, TOPSIS, entropy weight method, data envelopment method, partial order set theory, normal fuzzy big data, etc. They have been widely used by researchers in financial performance evaluation. The purpose of financial performance evaluation is to evaluate the ranking order of some companies' operating ability in a certain industry. Through the comparison results of these data, we can give investors or companies a reference opinion. The market information comprehenders will not maintain the assumption of a rational person, but will be mixed with psychological factors. Therefore, for the evaluation of financial indicators of enterprises' operating ability, we cannot simply consider rational mathematical calculation methods. More importantly, we should consider the psychological factors of non-data indicators, that is to describe the psychological expected results of the evaluators of a company. Psychologically, there is a certain reference point for a certain indicator or the operating ability of a company. When the company's published value is lower than this expectation, the evaluator will feel "lost". If it is higher than the evaluator's psychological expectation, the evaluator will feel "benefited". Based on different expectations, the evaluator will have different feelings. In view of this, this paper puts forward the prospect theory and applies this method to describe a psychological expectation of the evaluator, so as to obtain the business performance evaluation result of an enterprise.

This article mainly elaborates from the following parts: the first part is to review some research methods of previous researchers through the literature, the second part is to introduce relevant theoretical knowledge, the third part is to

introduce the model operation steps, the fourth part is to obtain the results of the accumulated prospect value of financial indicators of Bank of China through the model method proposed in the third part, and the fifth part is to analyze the results.

### 3. Theoretical Analysis

#### 3.1. Prospect theory

Definition 2.1[8] Integrating psychology and economics for research, Kahneman and Tversky proposed the prospect theory (Kahneman and Tversky, 1979), and further developed the cumulative prospect theory (Kahneman and Tversky, 1992). The prospect theory believes that people are bounded rational, and there is a certain deviation in their processing of information, which leads to the behavior of decision makers deviating from the traditional economic model-utility theory. The expression of its value function is:

$$v(\Delta x) = \begin{cases} \Delta x^\alpha; \Delta x \geq 0 \\ -\theta(-\Delta x)^\beta; \Delta x < 0 \end{cases} \quad (1)$$

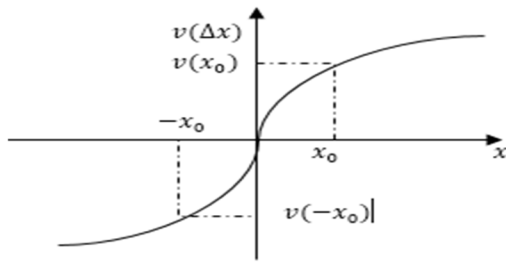


Figure 1. Theoretical value function of prospect

Among them, it  $\alpha, \beta v(\Delta x)$  is defined according to the deviation from the reference point,  $\theta \Delta x \geq 0$  representing gain and  $\Delta x < 0$  loss. It is the sensitivity of the decision-maker to loss and  $0 < \alpha, \beta < 1$  gain, and the sensitivity of the decision-maker to loss compared with gain. As shown in the figure above, the function form is a concave function at the time of gain, indicating that people are a kind of avoidance psychology. At the time of loss, the function form is a convex function, indicating that people are preferred. This value is  $(\alpha = 1.21, \beta = 1.02, \theta = 2.25)$ .

#### 3.2. Cumulative prospect theory

Definition 2.2[9] Based on the above research, Kahneman and Tversky further put forward the cumulative prospect theory. The probability is transformed into a probability weight function  $\mathcal{M}(w_j)$  (Formula 7 and Formula 8), as shown in the figure below, which not only reduces the influence of high probability events, but also expands the influence of small probability events.

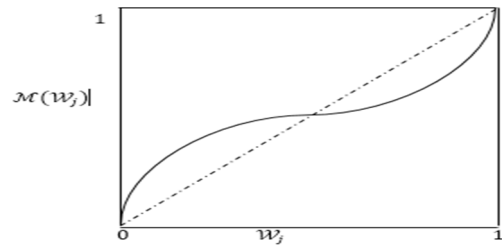


Figure 2. Probability weight function

#### 3.3. Quartile

Definition 2.3[5] Arrange the overall data from small to large, and then divide the data into four equal parts. The value at each quartile is the quartile, the first quartile is the lower quartile, the second quartile is the median, and the third quartile is the upper quartile, which is expressed by the formula  $Q_1, Q_2, Q_3$ . The quartiles under each indicator are:  $Q_{1j}, Q_{2j}, Q_{3j}; (j = 1, 2, 3, \dots, m)$ .

#### 3.4. Model Assumptions

Step 1: establish the initial matrix.

$n$  The selected samples and  $m$  indicators constitute the initial matrix:  $X = (x_{ij})_{n \times m}$ , which  $x_{ij}$  represents the  $j$  value of the  $i$  first indicator under the second sample. The indicators are both cost indicators and effect indicators.

Step 2: The indicator is positive.

Cost indicator conversion formula:

$$x_{ij} = \max\{x_{1j}, x_{2j}, x_{3j}, \dots, x_{nj}\} - x_{ij} \quad (i = 1, 2, 3, \dots, n; j = 1, 2, 3, \dots, m) \quad (2)$$

The new matrix is obtained after forward processing:

$$X' = (x'_{ij})_{n \times m}$$

Step 3: Standardize the matrix.

Standardized processing formula:

$$z_{ij} = \frac{x_{ij} - \min\{x_{1j}, x_{2j}, x_{3j}, \dots, x_{nj}\}}{\max\{x_{1j}, x_{2j}, x_{3j}, \dots, x_{nj}\} - \min\{x_{1j}, x_{2j}, x_{3j}, \dots, x_{nj}\}} \quad (i = 1, 2, 3, \dots, n; j = 1, 2, 3, \dots, m) \quad (3)$$

The new matrix is obtained after standardization:

$$Z = (z_{ij})_{n \times m}$$

Step 4: Get the quartile

The lower quartile, median and upper quartile are: The quartile in the data is extracted  $Q_{1j}, Q_{2j}, Q_{3j}; (j = 1, 2, 3, \dots, m)$  by using the formula in Excel: QUARTILE (.,), and the quartile is used as the reference point in the prospect theory.

Step 5: Calculate the probability matrix.

Calculate the  $j$  probability weight  $^i$  of the index under the sample

$$p_{ij} = \frac{z_{ij}}{\sum_{i=1}^n z_{ij}}; \quad (i = 1, 2, 3, \dots, n; j = 1, 2, 3, \dots, m) \quad (4)$$

The probability weight matrix is obtained:  $P = (p_{ij})_{n \times m}$

Step 6: Calculate entropy weight [10]

The weight of indicators can be initially obtained with the help of the entropy weight method. The specific calculation process is defined as follows:  $P = (p_{ij})_{n \times m}$  calculate the information entropy of each indicator according to the probability weight matrix:

$$e_j = -\frac{1}{\ln(n)} \sum_{i=1}^n p_{ij} \cdot \ln(p_{ij}); (i = 1,2,3,\dots, n; j = 1,2,3,\dots, m) \quad (5)$$

Use the information entropy of the obtained indicators to calculate the entropy weight of each indicator:

$$W_j = \frac{1 - e_j}{\sum_{j=1}^m (1 - e_j)} (j = 1,2,3,\dots, m) \quad (6)$$

Step 7: Find the cumulative prospect value of an estimate.

The expression of the index probability weight function in the cumulative prospect theory is ( $0 < \sigma \leq 1, \sigma = 0.65$ ):

$$\mathcal{M}(W_j) = W_j^\sigma / (W_j^\sigma + (1 - W_j)^\sigma)^{1/\sigma} (j = 1,2,3,\dots, m) \quad (7)$$

The cumulative foreground value expression is:

$$v = \sum_{j=1}^m v(\Delta Z_j) \cdot \mathcal{M}(W_j) (j = 1,2,3,\dots, m) \quad (8)$$

Where:

$$v(\Delta Z_j) = v(z_{ij} - Q_{1j}) + v(z_{ij} - Q_{2j}) + v(z_j - Q_{3j})$$

represents the  $j$  prospect value of an estimate and the quartile of the sample under the fourth indicator.

Step 8: Obtain the cumulative prospect value of each time period of the estimate, and compare the size and annual change of the corresponding prospect value.

## 4. Research Scheme Design

### 4.1. Indicator selection

The selected year is 2015-2020. In this paper, considering the imperfection of listed banks - urban commercial banks

and rural commercial banks, it is easy to have a great impact on the acquisition of index weights and reference points, so the selection of their data is eliminated. Select listed banks: state-owned large banks and joint-stock commercial banks (according to Shenwan industry classification), a total of 13, including Bank of China, China Construction Bank, Industrial and Commercial Bank of China, Bank of Communications, Agricultural Bank of China and Postal Savings Bank of China; Ping An Bank, Pudong Development Bank, Huaxia Bank, Minsheng Bank, China Merchants Bank, Guangda Bank, Zhejiang Commercial Bank and CITIC Bank.

At the same time, the selection of financial indicators is based on the Measures for the Performance Evaluation of Financial Enterprises and the actual situation. Finally, four major categories and thirteen sub-categories are selected, as shown below: profitability indicators: cost-income ratio, earnings per share, and return on net assets; Safety indicators: capital adequacy ratio, non-performing loan ratio, provision coverage ratio, asset-liability ratio; Liquidity indicators: liquidity ratio, liquidity coverage ratio, deposit and loan ratio; Growth indicators: net profit growth rate, operating income growth rate, capital accumulation rate (including cost-income ratio, non-performing loan ratio and asset-liability ratio as cost-based indicators, and other financial indicators as benefit-based indicators). The access to relevant financial data is the annual financial report published by the bank and the wind database.

This paper mainly obtains the financial data of the overall level of the industry, and takes its quartile as the reference point of three levels. Through the calculation of the method in this paper, the final data result is obtained, so as to estimate the financial index performance capability of Bank of China from 2015 to 2020. The result shows that the financial performance evaluation of Bank of China in the market presents a "lost" attitude.

### 4.2. Empirical results and analysis

From 2015 to 2020, from the perspective of the prospect value data of individual financial indicators and the overall financial indicators, the corresponding prospect value is negative, that is, the market holds a "loss" attitude towards the shares of the listed bank, Bank of China. However, to varying degrees, from 2015 to 2018, its cumulative prospects showed negative growth, a downward trend in 2019, and a rebound in 2020.

**Table 1.** Cumulative prospect value of financial indicators of Bank of China

	2015	2016	2017	2018	2019	2020
Cost-income ratio	0.0165	0.0172	0.0181	0.0204	0.0181	0.0178
Earnings per share	0.1239	0.1404	0.1534	0.1852	0.1516	0.1525
Return on net assets	0.0378	0.0589	0.0643	0.0878	0.0715	0.0329
Capital adequacy ratio	0.0698	0.0718	0.0676	0.0700	0.0632	0.1127
NPL ratio	0.0199	0.0264	0.0369	0.0696	0.0336	0.0744
Provision coverage	0.1378	0.0951	0.1029	0.1060	0.1029	0.1342
Asset-liability ratio	0.0666	0.0586	0.0760	0.0797	0.0905	0.0909
Liquidity ratio	0.0733	0.0522	0.0825	0.0633	0.0449	0.0643
Liquidity coverage	0.0610	0.1000	0.1401	0.1236	0.1082	0.0964
Deposit to loan ratio	0.0167	0.0220	0.0253	0.0304	0.0269	0.0281
Net profit growth rate	0.1799	0.1815	0.1001	0.0370	0.1473	0.0174
Operating revenue growth rate	0.0827	0.0760	0.0373	0.0536	0.0588	0.1159
Capital accumulation rate	0.1141	0.1000	0.0953	0.0734	0.0827	0.0625

### 4.3. Credibility analysis

The proportion of the transaction volume in the A-share market of the Bank of China in the transaction volume of the banking industry and its turnover rate. It can be seen from Table - 3 below that the proportion of the turnover of Bank of China's A-share transactions in the banking industry is decreasing year by year. The turnover rate of A-share transactions is relatively low, which shows that the market's purchasing power is in a "negative" state (since the stock market in 2015 is in the year of the bull market turning to a bear market, the relevant data in 2015 shows a "decoupling" state compared with other years).

The transaction price of Bank of China's A-share. According to the statistics of the monthly opening and closing prices of Bank of China from 2015 to 2020, as shown in Figure - 3 below, in addition to the impact of China's stock market in 2015, it can be seen that the price of Bank of China's A-share is relatively stable, with a small fluctuation between 3 and 5. After 2018, its price is stable at about 3.5 yuan/share. In the long run, it remains relatively stable. The inactive trading price in the market can also indirectly indicate that the market has a low purchasing power. Its investors hold the

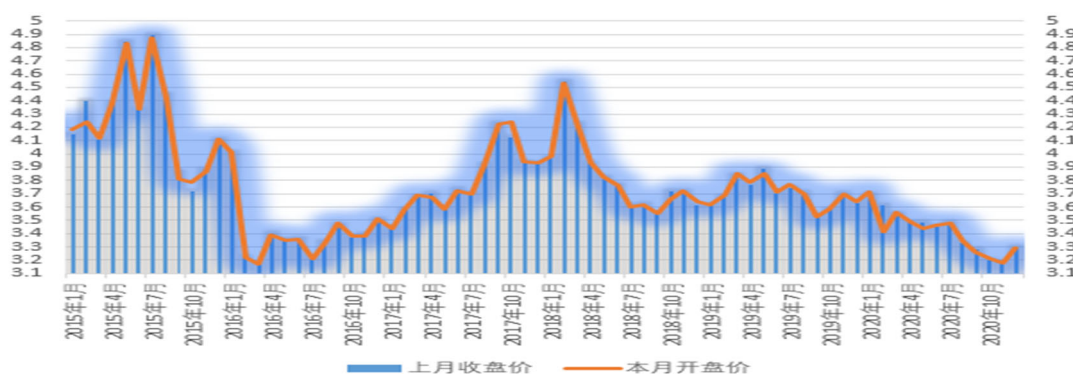
shares of Bank of China mainly considering its long-term and stable earnings.

Dividend rate. According to the statistics of the dividend distribution of Bank of China from 2015 to 2020, the annual dividend rate is calculated based on the stock price, as shown in Table - 4 below. At the same time, compared with the one-year bank loan interest rate and CPI index, holding the shares of Bank of China can effectively offset the impact of inflation, and the income from its cash dividend is slightly equal to the benchmark interest rate of loans published by the People's Bank of China. Similarly, the return on investment of bank financial products sold by banks is relatively stable and low. At the same time, as a rational investor, when conducting high-risk stock market transactions, its expected return on investment must be higher than the annual dividend rate of Bank of China, so it can also be seen that its investors have a low desire for its investment.

In general, through the indirect explanation of the above three indicators, the results calculated in this paper are in line with a practical trend, and can also show that the development of the enterprise's business ability can be well explained by applying the prospect theory.

**Table 2.** Proportion of A-share market transactions in banking and Bank of China

	2015	2016	2017	2018	2019	2020
The proportion of the banking sector in the turnover of the entire A-share market	4.14%	1.63%	2.86%	3.74%	2.86%	2.05%
Bank of China accounts for the proportion of turnover in the whole banking industry	10.17%	5.49%	1.25%	4.49%	3.07%	2.08%
Annual turnover rate	9.2%	1.32%	1.64%	1.5%	1.183%	0.942%



**Figure 3.** Bank of China's monthly opening price from 2015 to 2020

**Table 3.** Dividend yield of Bank of China and average yield on A-share market

	2015				2016	2017	2018	2019	2020
Dividend rate	5.19%				4.41%	4.64%	4.74%	5.20%	5.88%
CPI yoy	1.4%				2%	1.6%	2.1%	2.9%	2.5%
Loan benchmark interest rate	March	May	June	August	4.6%	4.6%	4.6%	4.6%	4.6%
	5.35%	5.1%	4.85%	4.6%					

This paper has the following marginal contributions. First of all, this paper refers to the psychological factors of the evaluator and applies the prospect theory to it. The key point of this theory is to find the appropriate reference point. For its selection, this paper does not refer to the optimal level of financial indicators recognized by the industry, but refers to

the financial data of representative enterprises in the industry, and obtains the quartile of each financial indicator in the industry every year, which is constructed through three levels of reference points. It can more effectively reflect the rationality of decision data. Secondly, using the probability weight of financial indicators calculated by entropy weight

method, this paper further deals with the probability weight by considering the theoretical view of increasing the influence on small probability events and reducing the influence on large probability events in the cumulative prospect theory. Finally, this paper always adheres to a dynamic view. Because the values are different each year, the psychological reference value of the evaluator will also present a dynamic process.

## 5. Conclusion Suggestions

As for the analysis of the operating capacity of Bank of China over the years, this paper, like other researchers, also forms a preliminary calculation matrix through the data collection of representative financial indicators in the same industry, and finally obtains the evaluation results of the evaluation object by comparing the financial value of the evaluation object with the value in the industry. The results calculated in this paper show that its various data and overall performance show "loss", and through the introduction and analysis of the stock price trend, dividend rate and the proportion of A-share trading volume in the banking industry of Bank of China, it shows that the operating ability of Bank of China is not superior to the level of the same industry, which also shows that its operating ability is relatively weak, and investors have relatively little desire for its investment. However, from another perspective, it can also reflect that its investment is relatively conservative and stable, especially its large size and wide range, which is related to China's economic stability, so winning in stability is also a relatively stable chess path.

At the same time, in such an era of big waves and sand washing, forging iron still needs to be hard. The development of Bank of China also needs to refer to the development experience of the same type of banks and large commercial banks. By giving full play to its own advantages, it can make up for its disadvantages, not only to be stable, but also to be stable and develop towards the best.

## References

- [1] Liu Junqi, Sun Lu, Liu Bing. Evaluating enterprise financial performance by TOPSIS method: principle and empirical analysis [J]. *Journal of Sichuan University: Philosophy and Social Sciences*, 2001 (3): 42-46.
- [2] Ye Zhangli. Empirical Study on Merger and Acquisition Performance of Chinese Listed Companies [J]. *Statistics and Decision*, 2013 (7): 165-168.
- [3] Guan Kaicheng. A fuzzy evaluation method for non-financial indicators of enterprise performance [J]. *Journal of Jiamusi University: Natural Science Edition*, 2005,23 (2): 303-306.
- [4] Liu Xuhua. Comprehensive evaluation of financial indicators of listed companies based on PLS path analysis [J]. *Mathematical Statistics and Management*, 2008,27 (4): 695-700.
- [5] Zhang Yunhua. Calculation of the quartile in statistics [J]. *China High-tech Enterprises*, 2009 (20): 173-174.
- [6] Yang Xingyue. Construction of performance evaluation index system based on balanced scorecard [J]. *Business Accounting*, 2011 (11Z): 45-46.
- [7] Lv Xiu'e, Han Lanlan. Using the factor analysis method to construct the financial index evaluation system of listed companies [J]. *Monthly Journal of Finance and Accounting (China)*, 2015 (10Z): 51-54.
- [8] Kahneman D., Tversky A. Prospect theory: an analysis of decisions under risk [J]. *Econometrica*, 1979,47(2):263-291.
- [9] Tversky A., Kahneman. Advances in prospect theory: cumulative presentation of uncertainty [J]. *Journal of Risk and Uncertainty*, 1992, 5(4): 297-323.
- [10] Song Xiaozhong, Zhang Yi. Comprehensive evaluation of industry financial performance - entropy weight principal component analysis based on financial ratio [J]. *Economic Issues*, 2011 (06): 97-101.