Portfolio Optimization for Real Estate Industry, Food and Beverage Industry, Energy Industry, Medicine Industry, Finance Industry and Retail Industry in Chinese Capital Market

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Abstract. Creating a portfolio is one of the mainstream ways for investors to avoid risks. This paper focuses on Chinese investment market, and selects six different industries in A-shares, which are preferred by Chinese investors, i.e., real estate industry, food and beverage industry, energy industry, medicine industry, finance industry and retail industry. This paper selected six representative assets from these industries for analysis. This paper selects the closing price data of these six assets in the past year, simulates 10,000 different investment portfolios by Monte Carlo simulation, and then uses the mean variance model to select the maximum Sharpe ratio portfolio and the minimum volatility portfolio. After getting the weights of the two groups of assets, this paper used the real income data of nearly two months to test the performance of the portfolio. The results show that: In the maximum Sharpe Ratio portfolio, Poly Development accounted for the max proportion, which is 35.05%, however, Tongrentang accounted for the min proportion, which is only 0.26%. And in the minimum volatility portfolio, the max percentage is Tsingtao Brewery, which is 50.82%, while the min percentage is Chenguang, which is 0.84%. This research results have certain reference value for investors.

Keywords: Mean-variance model; portfolio management.

1. Introduction

A-shares, that is, ordinary shares in RMB, refer to ordinary shares issued by registered companies in China, listed in China, marked with face value in RMB, and subscribed and traded by domestic institutions, organizations or individuals in RMB. In 2010, China surpassed Japan to become the second largest economy in the world. With the rapid development of China's economy, China has increasingly become one of the most important capital markets in the world. According to the data of Shanghai Stock Exchange and Shenzhen Stock Exchange (www.sse.com.cn) on June 17th, the total market value of A shares has reached RMB 65,267,373 million, or about USD 9,724.6 billion. In recent years, thanks to the support of Chinese government policies and the deepening of international economic exchanges, the number of A-share listed stocks and types of industries have increased rapidly. At the same time, China has a large population and a huge market, so it is a good choice for investors to invest in A-share. However, in recent years, consumers' willingness to consume tends to be conservative, and the differences in operating conditions among different industries are becoming more and more obvious. For example, the profitability of stocks related to tourism is not as stable as that of water, electricity and gas stocks. The risk of investing in a single stock is increasing.

A diversified portfolio may enable investors to obtain higher returns at the same risk[1]. However, investors' psychology is risk-averse, and they are always committed to choosing the best portfolio with minimize risks and maximize expected returns[2]. The mean variance model proposed by Markowitz is considered to be the most widely used model to analyze the selection of portfolio[3]. And after obtaining the optimal portfolio, some certain indicators are needed to evaluate the performance of the portfolio[4].

However, at present, there is still a lack of research on China's capital market and multi-industry portfolio. At present, the main research direction lies in the research of single industry portfolio. For example, Mo studied the performance of venture capital portfolio in American aviation industry, and pointed out the great impact of the epidemic on aviation industry[5]. Hans, Sahamkhadam and Stephan studied the best portfolio performance of global timber and forestry industry, and compared

it with the global S&P index [6]. Ahzari and Kvazirian studied the best investment portfolios of the 32 most important enterprises in the agricultural industry of Tehran Stock Exchang [7]. Shenbagasuriyan and Palanisamy studied the problem of the choice of investors and portfolio management in Indian capital market [8]. Sharafi, Nourollahzadeh and Sarraf studied the issue of investment portfolio selection with 76 pharmaceutical and steel companies active in the stock market [9].

The main work of this paper is as follows: Firstly, the selection of stocks. I take the real estate industry, food and beverage industry, energy industry, pharmaceutical industry, financial industry and retail industry of Shanghai Stock Exchange, selecting six stocks from these six different industries, which are Poly Development, Tsingtao Brewery, Huaneng International, Tongrentang, Everbright Securities and Chenguang. The market conditions and government policies faced by these six industries are significantly different, so their respective risk sources are different. Therefore, it can be assumed that the investment portfolio composed of these six stocks can diversify risks. Secondly, Monte Carlo simulation is used to simulate 10,000 different portfolios, and an effective set of all possible portfolios is obtained. Then, the mean variance model is used to select the maximum Sharpe ratio combination and the minimum volatility combination. Again, compare the maximum Sharpe ratio combination with the minimum volatility combination. By comparing the cumulative returns of the two portfolios and the Shanghai Composite Index, the best portfolio is determined. After determining the best portfolio, the five-factor model is used to analyze and evaluate the performance of the best portfolio.

2. Data

The data of this paper comes from Netease Finance (https://money.163.com), and this paper selects the representative enterprises of the above six industries as examples, Poly Development, Tsingtao Brewery, Huaneng International, Tongrentang, Everbright Securities and Chenguang. The stock codes are BLFZ(600048), QDPJ(600600), HNGJ(600011), TRT(600011), GDZQ(601788) and CGGF(603899). The reason why selected these six stocks is that these six enterprises are basically one of the most common brands in the Chinese market, which can represent the management level of this industry, or have good profitability in the past, and are the stocks that investors are more willing to choose.

The closing price data of the latest year, from June 17th, 2021 to June 17th, 2022, are chosen for further cleaning and disposal. Then 243 pieces of data were collected. In this paper, linear returns were continue to calculated for these closing price data, so 242 pieces of data are finally collected. This paper divides these data into two parts. Firstly, using 201 pieces of data from June 17, 2021 to April 15, 2022 to find the optimal portfolio, and 41 pieces of data from April 18, 2022 to June 17, 2022 to verify the performance of the portfolio. After analyzing and calculating these data, the basic information obtained in this paper is as follows:

Table 1. Descriptive statistics of these selected assets

	BLFZ	QDPJ	HNGJ	TRT	GDZQ	CGGF
Mean	0.00246	-0.00078	0.00306	0.00160	-0.00112	-0.00222
Variance	0.00090	0.00093	0.00168	0.00095	0.00030	0.00064
Max Return	0.1	0.10002	0.10105	0.10004	0.05712	0.08900
Min Return	-0.09976	-0.09254	-0.10036	-0.08770	-0.06987	-0.06107

As the table illustrates, when it comes to the mean returns of these data, the highest is HNGJ, and the lowest is CGGF. As for the variance of these data, HNGJ is the highest, however, GDZQ is the

lowest. Moreover, the max return and the min return were all appear at HNGJ. This paper also calculated their cumulative returns.

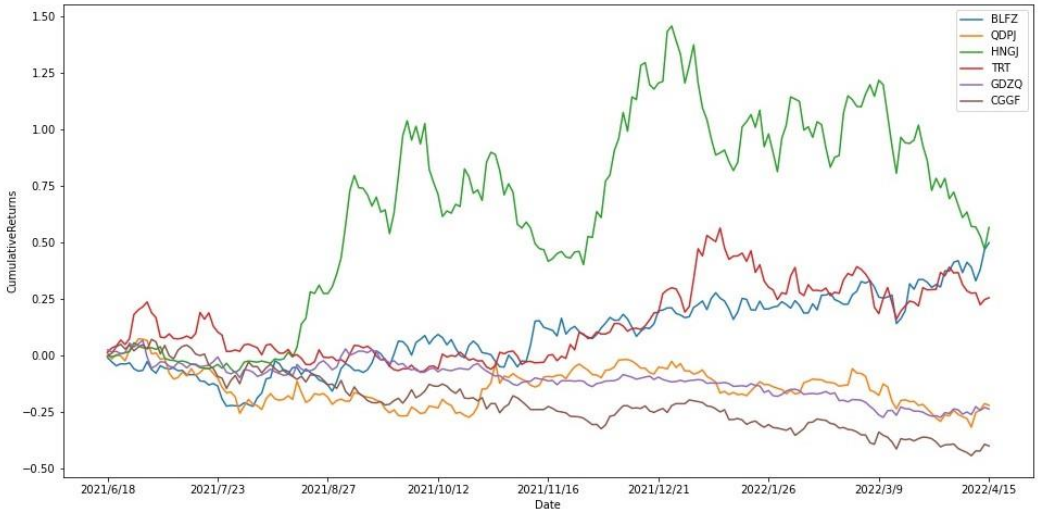


Fig. 1. Cumulative returns of the six stocks

These results were visualized and this paper found that basically, in these 10 months, HNGJ has maintained the highest cumulative income, while CGGF has the lowest cumulative income.

3. Methods

3.1 Monte Carlo method

When Monte Carlo method is used to simulate a certain process, the computer will automatically and randomly generate various probability distributions. These simulation results will generate an effective set, and we can get numerical solutions of practical problems according to the purpose of use [10].

3.2 Linear Returns

$$\text{Linear Returns} = \frac{r_{i+1} - r_i}{r_i} \tag{1}$$

Where, r_i is the return of one asset in period i, r_{i+1} is the return of one asset in the next period of i. This formula is used to calculate the change range of the current period compared with the previous period (https://www.anevis-solutions.com/2016/properties-linear-discrete-continuous-returns/).

3.3 Mean-variance Model

Investors have two goals when making investment decisions: the highest possible rate of return and the lowest possible risk of uncertainty. It is best to achieve the best balance between these two mutually restrictive goals. Markowitz used mathematical statistics to define risk as the volatility of the rate of return, and applied this method to investment decision.

The following premises form the basis of the mean-variance model: 1. The probability distribution of securities returns within a specific holding period is the foundation upon which investors base their decision-making for each investment. 2. Investors calculate the risk of their portfolio of assets using the variance or standard deviation of those securities' predicted return rates. 3. The risks and returns of securities are the only factors considered by investors. 4. Investors demand the highest return at a

particular risk level; conversely, they desire the lowest risk at a particular return level. The effective frontier theory and the calculation method for expected return and risk of a securities portfolio were developed by Markowitz based on the presumptions. The following is the precise formula:

Firstly, calculate the expected returns of one portfolio.

$$\text{Return Rate Vector: } R = (r_1, r_2, \dots, r_i)^T \tag{2}$$

$$\text{Weight Vector: } W = (w_1, w_2, \dots, w_i)^T \tag{3}$$

The return of assets and its weight together constitute the portfolio return.

$$\text{Expected Return of Portfolio: } E(R_P) = W^T R = \sum_i w_i r_i \tag{4}$$

$$\sum_i w_i = 1 \tag{5}$$

Where, r_i is the return of each asset in the portfolio. w_i is the weight of each asset in the portfolio. $E(R_P)$ is the expected return of the portfolio. After determining the expected return, we began to measure the risk, which can be expressed as variance in statistics.

$$\text{Variance: } \sigma_P^2 = \text{var}\left(\sum_i w_i r_i\right) = \sum_{ij} w_i w_j \text{cov}(r_i r_j) \tag{6}$$

Where, σ_P^2 is the variance of the portfolio. Furthermore, we can use Sharpe Ratio to express the relationship between portfolio's risk and return.

$$\text{Sharp Ratio} = \frac{E(R_P) - R_f}{\sigma_P} \tag{7}$$

Where, R_f is the return of risk-free asset [11].

4. Result

Firstly, this paper simulates 100,000 portfolio results with different weights by Monte Carlo Method according to the earnings data of six stocks from June 17th, 2021 to April 15th, 2022, and shows the expected returns and volatility of these portfolios in the same chart, as shown in the following figure:

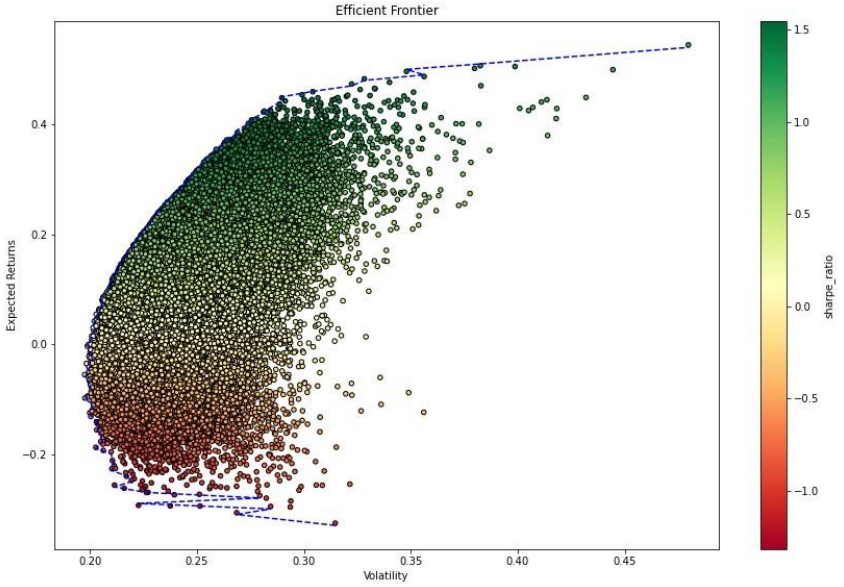


Fig. 2 Efficient frontier retrieved by Monte Carlo Method

As it shown in this figure that these results form a sector area, which is called the effective set, and the arc boundary of the effective set is called the efficient frontier. According to the chart and the mean variance model, the optimal portfolio can be obtained, namely the Maximum Sharpe Ratio portfolio and the Minimum Volatility portfolio. They can be learned as the portfolio with the largest excess return per unit risk and the portfolio with the lowest risk in the above effective set. The calculated portfolio weights and the Sharp Ratio and the Volatility are in the following tables:

Table 2. Asset weights under two criterions

	BLFZ	QDPJ	HNGJ	TRT	GDZQ	CGGF
Maximum Sharpe Ratio portfolio	35.05%	1.31%	34.90%	0.26%	27.48%	1.00%
Minimum Volatility portfolio	12.38%	50.82%	14.59%	16.14%	5.23%	0.84%

Table 3. Portfolio characteristics of the two portfolios

	Sharp Ratio	Volatility	Returns
Maximum Sharpe Ratio portfolio	154.69%	28.97%	44.82%
Minimum Volatility portfolio	28.11%	19.76%	-5.55%

As can be seen from the figure, the results of the two portfolios are quite different. In the Maximum Sharpe Ratio portfolio, BLFZ has the largest weight, reaching 35.05%, while TRT has the smallest weight, only 0.26%. In the Minimum Volatility portfolio, QDPJ has the largest weight, reaching 50.82%, which has already exceeded half of the entire portfolio, but the lowest weight is CGGF, only 0.84%. Compared with these two portfolios, the weights of BLFZ, QDPJ, HNGJ, TRT and GDZQ are quite different, while CGGF has a similar smaller weight in whichever portfolios.

After getting the weights of each asset in the portfolio, in order to verify the performance of the best portfolio, this paper use the real closing price data from April 18, 2022 to June 17, 2022, and

apply the respective weights in the optimal portfolio to get the real risk and return performance of the optimal portfolio in these two months, and compare it with the Shanghai Securities Composite Index. Shanghai Securities Composite Index refers to the composite index of all the stock prices of Shanghai Stock Exchange, while it is considered as the market level of A-shares (https://wiki.mbalib.com/wiki/Shanghai Securities Composite Index). If the return of the optimal portfolio in these two months is greater than the Shanghai Securities Composite Index, it will be considered effective.

For the Maximum Sharpe Ratio portfolio, this paper calculates the cumulative returns of the portfolio and the Shanghai Securities Composite Index, and the results are 2.834% and 3.795% respectively, which means that the return performance of the Maximum Sharpe Ratio portfolio is not better than the market level.



Fig. 3 Comparison of Maximum Sharpe Ratio portfolio and the market level

But for Minimum Volatility portfolio, the cumulative return of the portfolio is 7.921%, which is nearly twice the return of the market level. Therefore, the return performance of Minimum Volatility portfolio is not only better than that of the market level, but also better than that of Maximum Sharpe Ratio portfolio.



Fig. 4 Comparison of Minimum variance portfolio and the market level

5. Conclusion

At present, the research on investment portfolio is mostly concentrated in single industry and related industries, while the research on industries with large business scope is lacking. However, in fact, the more irrelevant the distribution of industries is, the more different their risk sources are, and the more the investment portfolio can disperse the risk of assets. This paper has officially noticed this point, and selected real estate industry, Food and beverage industry, energy industry, medicine industry, finance industry and retail industry these six industries to research, in order to inspire and reference other potential investors.

In this paper, Monte Carlo simulation is used to simulate tens of thousands of different portfolios, and an effective set of all possible portfolios is obtained. Then, the mean variance model is used to select the maximum Sharpe ratio portfolio and the minimum volatility portfolio. It is found that the real estate industry and the food and beverage industry occupy the largest share in these two portfolios respectively. However, in the end, when evaluating the performance of the optimal portfolio, the comparison result with the Shanghai Security Composite Index deviated from the expectation, and the return performance of the maximum Sharpe ratio portfolio was not better than the market level. The reason analyzed in this paper is that the data sources of the optimal portfolio and the data used in the evaluation come from different periods, during which the asset returns and risks conditions in the portfolio have changed. Therefore, investors need to think dynamically when choosing a portfolio.

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