

Design of Quantitative Investment Strategy Based on Domestic Chip Industry

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Abstract: Select 59 concept stocks in the chip industry for quantitative analysis, use principal component analysis method and k-means clustering to process our financial indicators; use historical simulation method, variance-covariance method and Monte Carlo simulation method to calculate the VaR value of each stock for effective risk management. Based on Markowitz theory, the effective frontier of five stocks is constructed, combined with the utility of investors in different risk aversion levels, the best portfolio is selected to obtain the best portfolio of concept stocks in the chip field, using the Sharp ratio and CV ratio for performance evaluation, and the corresponding investment suggestions are given.

Keywords: Chip industry, Quantitative investment, Principal component analysis, Portfolio, Performance evaluation.

1. Foreword

A new round of global scientific and technological innovation in the new era has been started. Semiconductor chips, as the foundation of "5G + AI", are the core cornerstone of high-end manufacturing industry. At the same time, due to the development of the high-tech market, the demand for chips is increasing.

From the micro perspective, the investment analysis of chip industry concept stocks, on the one hand, helps investors to optimize capital distribution and build investment portfolio, enhance industry competitiveness; on the other hand, it helps to help enterprise investment decision makers to make a correct and reasonable judgment, and obtain higher investment returns. From a macro point of view, the quantitative investment analysis of the chip industry concept stocks is conducive to finding the deficiencies of China's existing asset evaluation system and promoting the improvement and improvement of the relevant asset evaluation system. In general, the investment value analysis

of the chip industry not only meets the needs of investment decision-makers, but also meets the needs of shareholders to obtain income.

2. Quantitative Stock Selection

This study adopts quantitative stock selection, selecting a few highly growth and highly profitable stocks from the stocks of all chip semiconductor sectors. Through the analysis of the fundamentals, growth, and profitability of individual stocks, select the best growth stocks, and build the stock portfolio. By using the quantitative investment strategy, the selected stocks are more accurate and systematic.

2.1. Alternative Stock Pool

In order to make the screening accuracy higher, 19 stocks in all chip semiconductor sectors were preliminarily screened, and 19 stocks with return on equity (ROE) greater than 8% in 2021 were selected as the alternative stock pool of stock selection for this investment.

Table 1. 19 Stocks with return on equity greater than 8%:%

Unigroup Micro Zhuo Sheng Zhongying Electronics, Zhongke Shuguang, the Great Wall of China					
ROE	9.69	29.19	19.59	13.73	13.44
Zhaoyi innovation, Tai Chi industry, Shengong shares, Shengbang shares Nasida					
ROE	11.61	9.11	21.33	15.78	12.9
Leon Micro Lexin Technology, Montage Technology, Kangtuo Infrared, Jingsheng Electromechanical					
ROE	8.47	9.85	12.73	9.94	14.01
Jiangfeng Electronics, Huiding technology and Taihang Jin Technology					
ROE	9.4	35.99	14.55	11.43	

2.2. Select Financial Indicators

When selecting the growth stocks, the financial indicators are mainly selected from the three aspects of growth ability, profitability and solvency to analyze the listed companies.

2.3. Principal Component Analysis

There is a certain correlation between the various financial indicators of the stocks, so the information reflected through the index data overlaps to a certain extent. In order to analyze the problem comprehensively and accurately, the study chose

the principal component analysis method to reduce the index dimension, analyze the correlation between the indexes, and

select the stocks with high growth and high profitability combined with k-means clustering.

Table 2. Results of the principal component analysis

Total variance interpretation						
ingredient	Initial eigenvalue			Extract the sum of load squares		
	amount to	variance percentage	accumulate%	amount to	variance percentage	accumulate%
1	5.323	59.144	59.144	5.323	59.144	59.144
2	1.700	18.889	78.032	1.700	18.889	78.032
3	1.039	11.549	89.581	1.039	11.549	89.581
4	0.526	5.844	95.425			
5	0.249	2.768	98.193			
6	0.084	0.932	99.125			
7	0.054	0.600	99.725			
8	0.024	0.261	99.987			
9	0.001	0.013	100.000			

Judging from the principal component feature root and contribution rate, the first three feature roots are 5.323, 1.700 and 1.039, respectively, and the cumulative variance contribution rate of the first three principal components reached 89.581%, covering most of the information. It shows

that the first three principal components can represent the first 9 indicators to analyze whether the stocks have high profitability and high growth, and calculates the scores and comprehensive scores of the three principal components of the 19 stocks. The calculation results are as follows:

Table 3. Main component scores and composite scores

Securities referred to as	Growth ability	profitability	debt paying ability	Comprehensive score	ranking
Zhuo Sheng micro	1.97335	0.45925	1.97638	1.40440	1
Huiding technology	3.02858	-0.01196	0.08053	1.23893	2
Montage science and technology	-0.82612	2.36953	-0.34355	0.48181	3
Lexin Technology	-1.04977	1.48790	1.36817	0.43458	4
ShenGong shares	0.68389	1.27197	-2.22871	0.26712	5
ZhaoYi innovation	-0.44230	0.77614	0.43667	0.20863	6
Shengbang shares	0.24175	0.34861	-0.14711	0.19677	7
Zhongying electronics	0.39784	0.42127	-0.95706	0.10986	8
Kang Tuo infrared	-0.74489	-0.22882	2.19598	0.09347	9
Jingsheng mechanical and electrical	-0.09560	-0.05424	-0.53028	-0.17526	10
And tai	-0.09065	-0.59561	0.06014	-0.24759	11
Unigroup national micro	-0.61188	-0.06499	0.03320	-0.26483	12
Hangjin technology	-0.50149	-0.13004	-0.66001	-0.39647	13
the Great Wall of China	-0.12739	-0.86385	-0.30298	-0.44291	14
Zhongke dawn	0.01254	-1.17998	-0.13294	-0.46796	15
Jiang Feng electronics	-0.61852	-0.66563	0.05138	-0.48950	16
Leon micro	-0.63276	-0.56341	-0.51599	-0.58109	17
Tai chi industry	-0.51463	-1.02936	-0.13606	-0.62535	18
Nathda	-0.08196	-1.74678	-0.24776	-0.74460	19

It can be seen from the comprehensive ranking of stocks, investors with limited funds can choose the top-ranked Zhuoshengwei and Huiding Technology for invest, while investors with sufficient funds can choose to make portfolio investment. However, PCA can only derive rankings between stocks and cannot classify stocks, so a combined clustering analysis can be used to further classify stocks.

2.4. K-means Clustering

Investment objects were clustered by k-means clustering to identify appropriate classification criteria. Investors can focus on a particular category in order to further study a particular category of stocks to build an optimal portfolio.

Table 4. K-means clustering results

Cluster 1 Unigroup Guowei, Zhongying Electronics, Zhongke Shuguang, Great Wall of China, Taiji Industry, Shengbang Shares, Nasida, Leone Wei, Jingsheng Mechanical and Electrical, Jiangfeng Electronics, Heertai, Hangjin Technology
Cluster 2 Zhuoshengwei, Kangtuo Infrared, Huiding Technology
Cluster 3 Zhaoyi Innovation, Shengong Shares, Lexin Technology, Montage Technology

Table 5. K-means cluster analysis

	Cluster 1	Cluster 2	Cluster 3
Growth ability	0.21856	1.41901	0.40858
Profitability	0.51033	0.07282	1.47639
Debt	0.29046	1.41763	0.19186

According to k average clustering, 19 stocks are divided into three categories, as can be seen from the table the second class of stocks for blue chips, comprehensive performance is better than the other two categories, suitable for long-term investment: the third class stock short-term profitability, but poor growth, suitable for short-term investment: the first class of stocks on each three sides, are poor, for poor performance stocks, not suitable for investment.

2.5. Preliminary Construction of The Stock Portfolio

Combine the principal composition analysis and k-mean clustering methods to construct the stock portfolio. The types

of stocks selected are: Zhuosheng Micro, Huiding Technology, Montage Technology, Lexin Technology and Kangtuo Infrared to make long-term investment and further study the risks of stocks.

2.6. Risk Management

Parameter method, historical simulation method and Monte Carlo simulation method are used to calculate the actual risk value of the selected stocks for effective risk management. According to the obtained stock price, the yield rate of each stock is calculated to obtain the in-risk value of the portfolio under the three methods. Suppose that the value of the portfolio is RMB 100 million respectively. The calculation results are as follows:

Table 6. Values of the five stocks

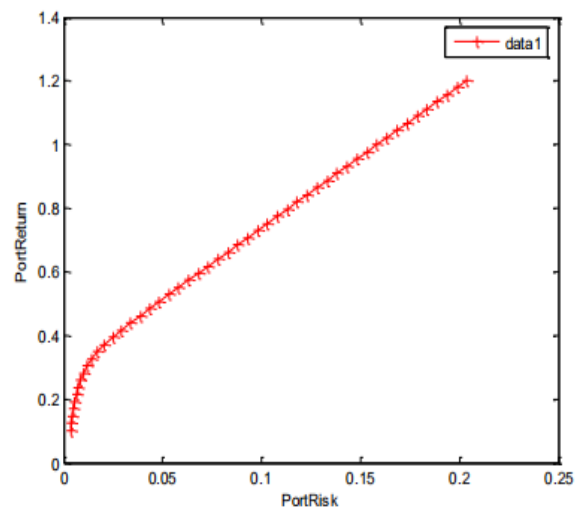
	Zhuo Sheng micro	Huiding technology	Montage science and technology	Lexin Technology	Kang Tuo infrared
covariance	0.00001195	0.00000471	0.00000304	0.00001395	0.00000764
variance	0.00015555	0.00015050	0.00013839	0.00015555	0.00012815
β	0.07681404	0.03126237	0.02193265	0.07682504	0.05963223
Expected yield	0.01404410	0.01440986	0.01457958	0.01404510	0.01389261

By the high yield, high risk theory: the higher the expected yield, the higher the underlying risk value faced. ZhuoSheng micro and le xin technology in the selected stock is the largest price volatility, the expected yield is low, to eliminate one of the stock portfolio, again in the risk value calculation, after eliminating stock portfolio in risk decline, may not be very suitable for investment, after the investment construction need to focus on the influence of the two stocks.

3. Portfolio Construction

3.1. The Construction of The Stock Effective Frontier

To seek the optimal ratio between assets, this study, based on Markowitz theory, builds an effective frontier of five stocks (generating 50 portfolios with different weight ratios) with MATLAB. The results are as follows:

**Figure 1.** Effective frontier chart of the five stock data

Select data from the effective frontier for the following table:

Table 7. Effective cutting-edge data for the 5 randomly selected stocks

Investment in	Zhuosheng Wei	Huiding Technology	Lanqi technology	Lexin technology	Contour infrared	VaR($\alpha=0.99$)	VaR($\alpha=0.95$)	Port Return	Port Risk
1	0.000	0.027	0.450	0.000	0.523	18.408	18.408	0.147	0.004
2	0.000	0.078	0.547	0.000	0.375	19.437	19.438	0.169	0.005
3	0.001	0.122	0.648	0.000	0.229	20.403	20.403	0.192	0.006
4	0.002	0.166	0.748	0.000	0.084	21.368	21.368	0.214	0.006
5	0.005	0.268	0.728	0.000	0.000	22.660	22.660	0.236	0.007
6	0.011	0.631	0.358	0.000	0.000	26.134	26.135	0.281	0.010
7	0.013	0.790	0.141	0.056	0.000	26.509	27.787	0.304	0.012
8	0.021	0.947	0.000	0.032	0.000	28.579	29.307	0.326	0.014
9	0.824	0.176	0.000	0.000	0.000	35.840	35.842	1.045	0.168
10	0.899	0.101	0.000	0.000	0.000	36.434	36.436	1.112	0.184

Each allocation scheme is obtained from the MATLAB calculation results as shown in the table above. The calculation results are the same as the analysis results in the third part, and Lexin Technology occupies a relatively small proportion, almost approaching 0. As can be seen from the data in the table, the higher the combination dispersion degree, the lower the risk it bears.

3.2. Determination of the Optimal Portfolio Weight

The utility function is used to calculate the utility of 10 different investment schemes for investors, and the optimal

portfolio weight is obtained according to the utility maximization:

$$U = E(r) - \frac{1}{2}A\sigma^2$$

E (r) is the expected return rate of the portfolio, the standard deviation of the portfolio, and A is the risk aversion of investors.

In this paper, we believe that all investors are risk aversion ($A > 0$), and the choice of A is 1,1.5,2 and 2.5, respectively, to calculate the investor utility under different A values. The results are as follows:

Table 8. Investor Utility at different A values

investment program	U(A =1)	U(A =1.5)	U (A =2)	U(A =2.5)
1	0.14448135	0.14233278	0.14233274	0.14125837
2	0.16660912	0.16414825	0.16414825	0.16291775
3	0.18870915	0.18589836	0.18589838	0.18449287
4	0.35078625	0.34378625	0.34378623	0.33568523
5	0.23280845	0.22920691	0.22920692	0.22740612
6	0.27619953	0.27109945	0.27109931	0.26854875
7	0.29770453	0.29165912	0.29165968	0.28863625
8	0.31913752	0.31207521	0.31207525	0.30854375
9	0.32026351	0.31713483	0.31703272	0.30654338
10	0.22199946	0.21189535	0.21189464	0.20274653

Through calculation, it can be seen that under the condition of different degrees of risk aversion, the utility value of investment plan 4 is higher than other schemes, so the portfolio weight of investment plan 4 is the optimal portfolio weight, namely 0.2%, top technology 16.6%, 74.8%, technology 0%, kang infrared 8.4% is the optimal portfolio weight.

3.3. Performance Evaluation

The performance evaluation results are obtained by collecting the daily closing price of 19 stocks from October 8 to 31, December 31,2021, and using the portfolio obtained with each stock weight of 1 / 19 as the benchmark for performance evaluation; the Sharp and CV ratios are calculated by the best portfolio scheme and compared with the relevant data of the benchmark.

Table Sharpe ratios and CV ratios for the 9 5 stocks

Combined average yield variance standard deviation
Sharpe ratio CV ratio

0.0035 0.0000001 0.0003 3.2360 0.0896

After calculation, it was found that the Sharp ratio of the five stocks was about 3.2360, and the value was higher than the Sharp ratio of 1.597 for the 19 stocks, indicating that the excess return of the portfolio was significantly higher than the benchmark. So the portfolio we chose is good for the investment.

Through the CV ratio, the CV ratio of the portfolio in different samples with the same coefficient is 0.0896. The CV ratio of less than the benchmark is 0.1630, indicating that the portfolio takes less risk for each unit of return, so the selected portfolio has relatively good performance.

4. Summary

The portfolio strategy is mainly based on risk control. Due to the high volatility of concept stocks, it plays a crucial role in stock selection based on financial indicators. Meanwhile, the conclusion shows that the portfolio construction is relatively successful and is useful for practical operations in different industries.

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References

- [1] Forest starts a prairie fire. Application of Economic Profit in Investment Decision and Performance Evaluation in Real Estate Industry [J]. China's collective Economy, 2022 (21): 61-63.
- [2] He Yuhan. Research on Quantitative Investment Strategies based on Matlab [J]. Business, 2022 (07): 143-146.
- [3] Wang Gangzhen, Li Wenbo, Zhu Jiaming. A Quantitative Portfolio Strategy based on the AI Industry [J]. Journal of Shenyang University (Social Sciences edition), 2022,24 (01): 44-51.
- [4] Zou Luxi. Quantitative investment research based on a multifactor model [J]. China Business Theory, 2021 (24): 100-103.
- [5] Zhou Hang. Risk assessment and prevention and control strategies of quantitative investment in financial derivatives [J]. Bohai Rim Economic Outlook, 2021 (05): 29-31.
- [6] Ding Qi. Research on Stock Multifactor Quantitative Investment Strategies Based on Principal Component Analysis [J]. Time Finance, 2020 (17): 74-76.