Optimal Portfolio Strategies in Chinese Equity Market

Zhenrong Zou *

International Business School, Jinan University, Zhuhai, China

* Corresponding Author Email: zzrpeter@stu2021.jnu.edu.cn

Abstract. In the dynamic landscape of financial markets, the strategic construction of investment portfolios is pivotal for investors aiming to maximize returns while managing risk. This research delves into the optimization of portfolios by focusing on two key objectives: maximizing the Sharpe ratio and minimizing volatility. Through the analysis of seven representative Chinese stocks, this study introduces a forward-looking approach to portfolio construction that adapts to current market conditions. By employing a comprehensive set of descriptive statistics and a rigorous out-of-sample testing methodology, the research constructs and validates two distinct portfolios against the CSI 300 Index. The findings reveal a nuanced understanding of risk-adjusted returns and provide actionable insights for investors seeking to refine their portfolio strategies. This paper contributes to the financial management literature by offering a practical framework that addresses existing gaps and highlights the importance of incorporating market dynamics into portfolio optimization. The study's robust methodology and its application to a diverse set of stocks provide a solid foundation for future research to build upon, with the potential to enhance investment performance across varying market cycles.

Keywords: Portfolio construction; Sharpe ratio; volatility minimization; Chinese stocks.

1. Introduction

The construction of investment portfolios is a cornerstone in modern financial management, serving as a critical tool for investors seeking to optimize returns while managing risk. A well-diversified portfolio can mitigate unsystematic risk and enhance long-term investment performance, making it an essential aspect of financial planning for both individual and institutional investors. The importance of portfolio construction is further underscored by the dynamic nature of financial markets, where economic conditions, market sentiment, and regulatory changes continuously reshape the risk-return landscape. As such, investors must continually reassess and adjust their portfolios to maintain alignment with their investment objectives and risk tolerance.

In the domain of portfolio construction, numerous studies have enriched the theoretical and practical understanding of optimizing investment strategies. Liu investigated the impact of volatility persistence on portfolio risk and proposed a diversification model to address this issue. Another study developed an optimal portfolio model focusing on financial asset volatility, comparing its risk diversification capabilities with the mean-variance model, and finding the former to be more effective [1]. A review paper traced the evolution of portfolio theory, noting the shift in understanding from diversifying risk through asset quantity to recognizing the inevitability of systematic risk [2]. A practical approach to building an optimal portfolio using the Sharpe Index Model, which aims to balance expected returns with risk to achieve the best risk-return profile [3]. A paper on integrating stock selection models with portfolio optimization theory aimed to enhance the overall investment process by combining stock picking with fund allocation [4]. Bian, Yin, Michael, Shi and Zhang tackle the issue of allocating assets in large-scale minimum variance portfolios, offering an effective strategy for managing portfolios with extensive asset diversification [5]. Lastly, the research by Huang and Jin on the Markowitz optimal portfolio in the carbon financial market offers insights into the integration of environmental factors, promoting sustainable investing through portfolio optimization [6].

While these studies have advanced the field, gaps remain. This study aims to address these limitations by introducing a robust and adaptive approach to portfolio construction. This paper focuses on the creation of two specific portfolios: one that maximizes the Sharpe ratio and another

that minimizes volatility. By analyzing a representative selection of Chinese stocks and employing a comprehensive set of descriptive statistics, this paper constructs portfolios that not only reflect the market conditions of current years but also incorporate forward-looking adjustments. The methodology is validated through a rigorous out-of-sample test, and the results are compared against the performance of the CSI 300 Index, providing valuable insights for investors seeking to optimize their portfolio construction strategies. Through this work, this essay contributes to the literature by offering a practical framework that enhances the risk-adjusted return of investment portfolios, while also highlighting areas for future research and refinement.

2. Data

This paper focuses on the analysis of seven prominent stocks from the Chinese equities market, based on their market capitalization. It includes the stock codes 600519, 601398, 601628, 600036, 000977, 002230, and 603178, and examines their closing prices from August 2, 2018, to August 2, 2019. These data are divided into a training dataset and a test dataset. The training dataset, spanning from August 2, 2018, to April 16, 2019, is utilized to compute the average returns and covariance matrices, which are essential for building the target investment portfolios. The test dataset, covering the period from April 17, 2019, to August 2, 2019, serves to assess the effectiveness of the chosen investment strategies by comparing their total returns to those of the CSI 300 Index.

The fundamental data for the seven stocks are outlined in Table 1, with additional details provided in Table 2 and Fig. 1. As per Table 2, Kweichow Moutai exhibits the highest average return for the specified timeframe, while the Industrial and Commercial Bank of China demonstrates the lowest volatility. Fig. 1 illustrates that Kweichow Moutai achieves the most significant cumulative return at 37.17%, as opposed to China Film and Shenglong Automotive Powertrain System, which experience a decline in their cumulative returns, ending at -16.35% and -13.54%, respectively.

Table 1. Selected stocks.

Code	Company
600519	Kweichow Moutai Co., Ltd
601398	Industrial and Commercial Bank of China Limited
601628	China Life Insurance Company Limited
600036	China Merchants Bank Co., Ltd.
000977	China Film Co., Ltd.
002230	iFLYTEK Co., Ltd.
603178	Ningbo Shenglong Automotive Powertrain System Co.,Ltd.

Table 2. Descriptive statistics of the daily return of the 11 stocks.

	Min	Max	Mean	Std Dev	CumulativeReturn
600519	-0.1000	0.0655	0.0016	0.0233	37.17%
601398	-0.0438	0.0631	0.0002	0.0122	2.21%
601628	-0.0898	0.1002	0.0014	0.0233	30.41%
600036	-0.0591	0.0628	0.0013	0.0187	31.53%
000977	-0.1002	0.1002	-0.0001	0.0348	-16.35%
002230	-0.1002	0.1001	0.0007	0.0289	6.99%
603178	-0.1000	0.0850	-0.0003	0.0225	-13.54%

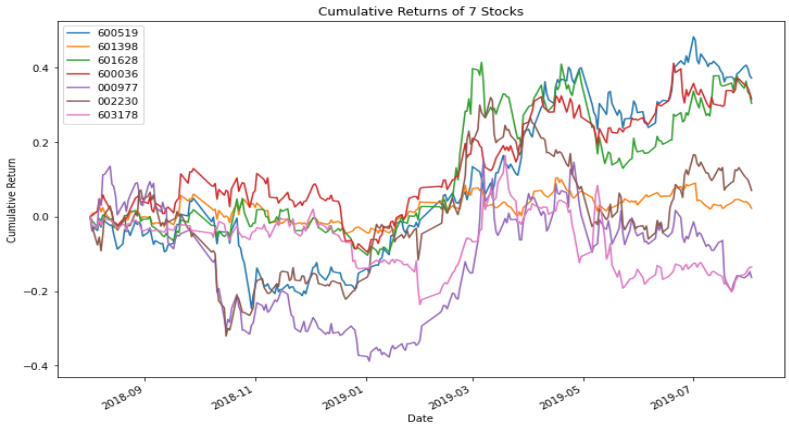

Fig. 1 Cumulative returns of selected stocks.

3. Methods

The mean variance model examines the balance between the portfolio expected return and the risk. The portfolio return and the variance are as follows:

$$\mu_p = \sum_i w_i \mu_i \tag{1}$$

Where w_i is the i^{th} component weight of the portfolio, μ_i is the expected return of the i^{th} component.

$$\sigma_p^2 = \sum_i \mu_i^2 w_i^2 + \sum_i \sum_j \sigma_i \sigma_j w_j \, w_i \rho_{ij} \tag{2}$$

Where σ_i is the standard deviation of the asset i returns, and ρ_{ij} is the correlation coefficient between the returns on assets i and j. Therefore, calculating the average return and the covariance matrix of the stocks is essential.

In this paper, there are two specific types of portfolios: one that maximizes the Sharpe ratio and another that minimizes volatility.

The Sharpe ratio is a prevalently used tool for measuring and evaluating the risk-adjusted return in investments. The calculation is as follows:

$$SR = \frac{R_p - R_f}{\sigma_p} \tag{3}$$

Where R_f is the risk-free rate, R_p is the portfolio expected return and σ_p is the standard deviation. Investment portfolios that offer identical anticipated returns can achieve a more favorable Sharpe ratio by reducing their standard deviation. Consequently, a portfolio with the higher Sharpe ratio is deemed more efficient as it optimizes performance relative to the risk taken. For investors with a conservative approach to risk, adopting a minimum variance strategy is advantageous. This approach allows them to mitigate the risk associated with equity investments, all while preserving their overall market participation. As a result, identifying the portfolio with the least volatility can be instrumental for guiding investment decisions.

4. Results

The optimal investment portfolios can be identified by analyzing their characteristics. In the case of the least volatile portfolio, the distribution of stock allocations is as follows: Kweichow Moutai (Stock Code: 600519) dominates with a substantial 80.55% share, followed by other entities such as China Minsheng Banking Corp. (601398) at a minimal 0.63%, China Shenhua Energy (601628) at 5.39%, and several others with smaller percentages. Notably, the allocation for Shenglong

Automotive (603178) is negligible. In contrast, the portfolio optimized for the highest Sharpe ratio allocates a significant portion to China Minsheng Banking Corp. (601628) and China Merchants Bank (600036), with Kweichow Moutai (600519) and Zhejiang Century (002230) also featuring prominently, while excluding insignificant stocks entirely. As depicted in Table 3, the minimum volatility portfolio exhibits a volatility rate of 0.969882%, whereas the maximum Sharpe ratio portfolio has a Sharpe ratio of -52.89% (See Table 4). It is worth noting that Kweichow Moutai (600519) constitutes over three-quarters of the minimum volatility portfolio. Additionally, both the Industrial and Commercial Bank of China (601398) and Shenglong Automotive (603178) have minimal presence in the allocations of these two distinct portfolios.

Table 3. Weight of each stock in the two optimal portfolios.

	Minimum variance	Maximum sharpe ratio
600519	80.55%	22.08%
601398	0.63%	0.00%
601628	5.39%	27.91%
600036	4.52%	43.60%
000977	3.51%	0.00%
002230	5.40%	6.42%
603178	0.00%	0.00%

Table 4. Return and volatility of the two portfolios.

	Mean Return	Volatility	Sharpe ratio
Min variance	-0.0013	0.0097	-0.5289
Max sharpe ratio	0.0000	0.0173	-9.5974

With the asset allocations identified, the subsequent phase involves computing the cumulative returns for the portfolios. By applying the stock weights to the test data ranging from April 17, 2019, to August 2, 2019, daily returns for each portfolio can be determined, leading to the calculation of cumulative returns. For comparative analysis, the returns of the CSI 300 Index during this timeframe are also gathered. As illustrated in Fig. 2, the portfolio with the highest Sharpe ratio generally surpasses the broader market's performance, whereas the portfolio with the lowest variance tends to lag yet remains relatively close to it. The cumulative return figures are as follows: -0.91% for the maximum Sharpe ratio portfolio, -9.31% for the minimum volatility portfolio, and -8.31% for the CSI 300 Index, as detailed in Table 5. Fig. 2 also shows that, for most of the period, both the minimum volatility and maximum Sharpe ratio portfolios outperform the CSI 300 Index. Notably, the maximum Sharpe ratio portfolio experienced a significant increase in the last 45 days, ultimately outpacing the CSI 300 Index, despite being on par with it before June 15, 2019. As for the minimum variance portfolio, its returns mirrored those of the benchmark throughout the observed period.

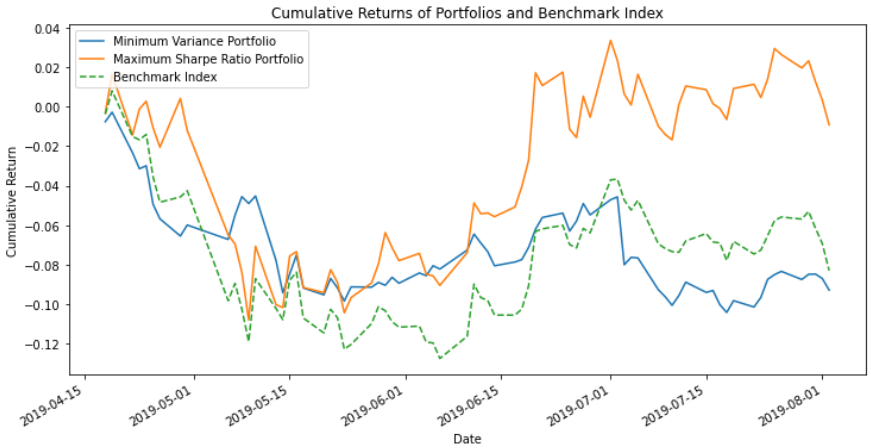

Fig. 2 Comparison between CSI 300 index return and the portfolio returns.

Table 5. Cumulative return comparison.

	Cumulative Return
Max Sharpe Ratio	-0.91%
Min Volatility	-9.31%
CSI 300 Index	-8.31%

To ensure the validity of the findings, a robustness check is essential. This involves initially removing the stocks with the smallest proportions from the portfolio, namely the Industrial and Commercial Bank of China (Stock Code: 601398) and Shenglong Automotive (Stock Code: 603178). Following this adjustment, the process of calculating cumulative returns is repeated. Table 6 presents the revised asset weights for the two optimized portfolios, indicating a shift in the dominant components for the minimum variance portfolio while the maximum Sharpe ratio portfolio's composition remains constant, with a consistent emphasis on the stock represented by 600036 for both strategies. Subsequently, the cumulative returns for these three portfolios are computed and benchmarked against the CSI 300 index. The results, depicted in Fig. 3 and detailed in Table 7, mirror the previous findings for the maximum Sharpe ratio portfolio, which continues to exhibit the highest cumulative return. However, the trajectory of the minimum risk portfolio, now with modified weights, diverges from the initial analysis and aligns more closely with the other portfolio's performance. This consistency in methodology and outcomes confirms the effectiveness and reliability of the approach.

Table 6. Weight of the remaining 5 stocks in the two portfolios (%).

	Minimum variance	Maximum sharpe ratio
600519	4.76%	22.12%
601628	10.59%	27.87%
600036	64.25%	43.67%
000977	3.03%	0.00%
002230	17.37%	6.35%

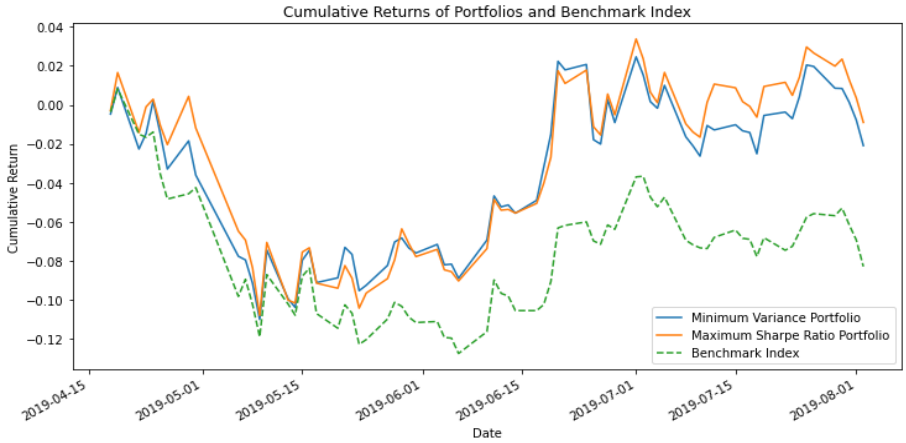

Fig. 3 Comparison between CSI 300 index return and the altered portfolio returns.

Table 7. Altered cumulative return comparison.

	Cumulative Return
Max Sharpe Ratio	-0.91%
Min Volatility	-2.10%
CSI 300 Index	-8.31%

5. Conclusion

The study successfully develops and validates a practical framework for investment portfolio optimization, focusing on the maximization of the Sharpe ratio and the minimization of portfolio

volatility. By analyzing a diverse set of Chinese stocks and employing out-of-sample testing, the research provides a robust methodology for investors to enhance their risk-adjusted returns. The forward-looking adjustments incorporated into the portfolio construction reflect the dynamic nature of financial markets, offering a more adaptable approach to asset allocation. This research contributes to the field by bridging the gap between theoretical models and real-world applications, particularly in the context of Chinese stocks.

However, the study acknowledges certain limitations. The reliance on historical data may not fully capture the market's dynamic changes, and the exclusion of certain stocks could affect the generalizability of the findings. Future research could explore the integration of additional market data and the inclusion of a broader range of financial instruments to further refine the optimization process. Additionally, the potential impact of emerging market trends and regulatory changes on portfolio performance warrants further investigation.

References

[1] Hai-Fei L., Xin-Dan L I., Wei B., et al. Optimal portfolio and diversification based on persistent volatility. Journal of Management Sciences in China, 2019.

[2] Jun-Yi T. Investment Portfolio Theory Development Review: The History, Present, and Future of Diversified Investing. HANS Pub, 2020.

[3] Balaji, S., Edward, J.A. Construction of Optimal Portfolio Using Sharp Index Model with Special Reference to Banking, Pharmaceutical and FMCG Sectors. Proceedings of the Conference, 2023.

[4] Xiang-Gang L., Ze-Ren W. Stock Prediction Method Based on Machine Learning and Portfolio Research. HANS Pub, 2021.

[5] Bian Z., Liao Y., O'Neill M., Shi J., Zhang X. Large-scale minimum variance portfolio allocation using double regularization. Journal of Economic Dynamics and Control, 2020, 116: 103939.

[6] Wen-Lin H., Jin L. Carbon financial market's Markowitz optimal portfolio research. HANS Pub, 2021.