

Active Vs. Passive Investment in The Post-Pandemic U.S. Stock Market: A Sharpe Ratio-Based Portfolio Optimization Compared to the S&P 500

Zicheng Wang *

School of Economics, The University of Edinburgh, Edinburgh, The United Kingdom

* Corresponding Author Email: s2296153@ed.ac.uk

Abstract. As the world economy gradually recovers from the pandemic, forming an optimal portfolio to generate excess return while reducing risk is getting more priority from investors. Supply chain bottleneck, inflationary pressure and structural transformation all significantly impacted the equity market, creating both risks and opportunities. In this era of change and uncertainty, the US stock market remains a global focal point for many investors due to its large market capitalization and liquidity. This paper focuses on the US stock market, and selected five leaders from different industries, Technology, Finance, Energy, Retail and Health, for portfolio analysis, with specific focus from 2021 onwards. They will be formed into a portfolio that maximizes the Sharpe ratio generated and compared against the market benchmark. The result showed this actively formed portfolio will generate 19.411% cumulative return, exceeding S&P 500's 0.474%. Sharpe ratio calculated would be 10.27, offering enormous returns to per unit of additional risk taken. This result would provide insights to investors who are indecisive between active or passive investment strategy.

Keywords: Sharpe ratio; portfolio management; S&P 500; mean variance model.

1. Introduction

Despite a history-breaking recession during the pandemic, the US economy saw a quick recovery only four months after the crash [1]. Expansionary fiscal and monetary stimulus from the US government boosted market confidence alongside strong performances from leading technological firms [2]. As the market recovers, many investors are shifting their focus back to the US stock market. With the purpose of maximizing expected returns while minimizing variance, portfolio formation is a key strategy investor should take. By diversifying investments into different stocks, a well-constructed portfolio allows investors to reduce systematic risk while gaining considerable returns. Naturally, index funds, including S&P 500 and Dow Jones Industrial Average, become a popular choice for most investors. However, some active investors are seeking to form their own investment portfolio and attempt to outperform the market.

While some successfully generated excess returns, some performed much worse than the market average, and in general, there has been no clinching argument on which strategy appears to be better. Cristiana's work on Romanian stock market showed a weaker performance was demonstrated by individually selected portfolios compared to the market index [3]. Barry and Dhruv's work in the US market showed similar results in the case of passive option-based strategy [4]. In the large-cap US equity market, evidence suggested a lower risk adjusted return and a significantly reduced volatility from active management [5]. When incorporating the fund fees, 90% of passive ETF funds outperform their matched active funds, and similar results were observed in case of hedge funds [6-7].

However, Gowri Shankar's work showed that an actively constructed S&P Index consistently outperformed the passively formed Russell Index in the US market throughout 1994 to 2004 [8]. Nicolas and Michael's work also showed value stocks can also outperform the market within the research time zone [9]. Other papers demonstrated the preferences of active and passive strategy might depend on the market condition. In a bull market, Dale and Mitchell discovered a declined inflow into passive funds between 2009 and 2017 and concluded a mix of two strategies should be

considered [10]. Therefore, it can be observed that there's no conclusive evidence on which strategy appears to be the better one, leaving room for further investigation.

This paper will focus on five publicly listed leaders in the US stock market from different industries, ranging from technology, finance, energy retail and health. By formulating a portfolio with these stocks, their performance will be compared against the market index, S&P 500, focusing exclusively on the post-pandemic era, from 2021 to 2025. The mean variance model is used to compute the maximum Sharpe ratio of the portfolio formed and compare the result with the market benchmark to determine the better strategy. This paper will provide insights to investors who are indecisive between active and passive investment and help identify portfolio allocation that could optimize risk-adjusted returns in a real-world context.

2. Data

The data sets used in this paper are extracted from Investing Finance (Investing.com). Five publicly traded and leading firms in various industries were selected, including NVIDIA (Technology), JP Morgan (Finance), Exxon (Energy), Costco (Retail) and Eli Lilly (Health). Their monthly returns from February 2021 to April 2025 were used to compute the empirical result of this paper, where percentage change between each month was used to represent the return of these stocks. The dataset across this period was split into training set and testing set, where the first part, from February 2021 to December 2023, was used to establish the model, and the latter, from January 2024 to April 2025, was used to test the outcome of the model.

Each firm selected represents one of the best performers in its own industry, and a portfolio consisting of these five companies was formed to be compared against the monthly return of S&P 500, which was considered as the market return. Monthly return of US treasury T-bill will be used as the risk-free rate. This ensures a preliminarily diversified portfolio and covers different sectors of the economy.

By conducting preliminary analysis of the stock data from February 2021 to December 2023, this paper shows the descriptive statistics and cumulative return of these stocks in Table 1 and Fig. 1.

Table 1. Descriptive Statistics for five stocks

	NVIDIA	JP MORGAN	EXXON	COSTCO	ELI LILLY
MEAN RETURN	5.21%	1.09%	2.72%	2.14%	3.31%
VARIANCE	2.65%	0.60%	0.85%	0.53%	0.66%
MAXIMUM RETURN	36.34%	20.46%	26.92%	13.89%	21.92%
MINIMUM RETURN	-32.03%	-14.84%	-13.66%	-15.35%	-11.16%
CUMULATIVE RETURN	237.38%	16.69%	97.21%	69.32%	148.00%

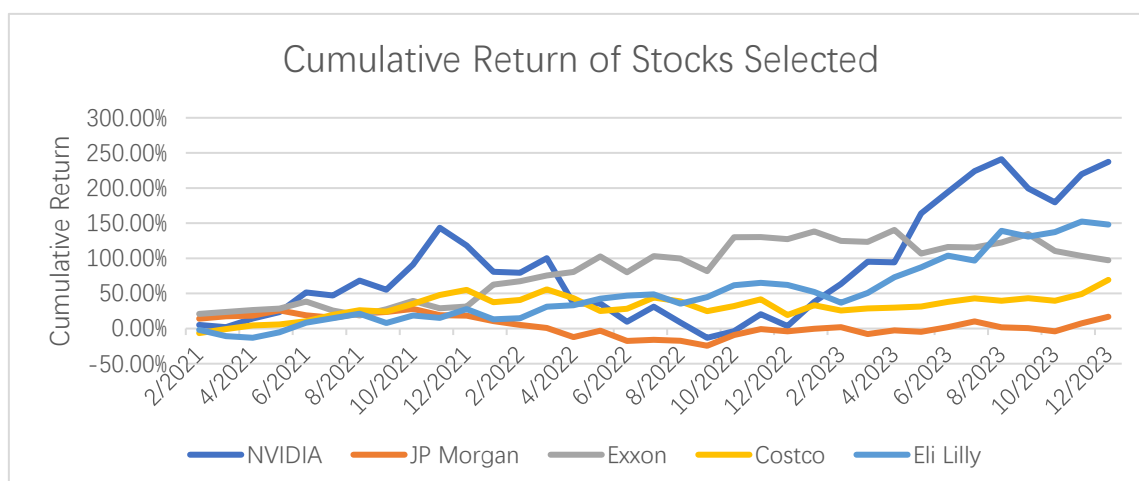


Fig. 1 Cumulative of stocks overtime

It can be observed that since 2021, NVIDIA performed the best average return among selections, but it also corresponds to highest volatility. Eli Lilly offers second highest cumulative and average return, but with lower variance compared to NVIDIA. Costco tends to be the most stable stock, and JP Morgan can be said to have the lowest performance, with a cumulative return of only 16.69%.

3. Method

Mean and variance of the portfolio need to be calculated to determine the optimal investment choice. Portfolio's expected return is calculated via the following equation.

$$\mu_p = \sum_{i=1}^n w_i \mu_i \quad (1)$$

Where w_i and μ_i represent the weighting and expected return of i^{th} stock. Portfolio variance is calculated via the following equation.

$$\sigma_p^2 = \sum_{i=1}^n w_i^2 \sigma_{ii} + \sum_{i=1}^n \sum_{j>1}^n 2w_i w_j \sigma_{ij} \quad (2)$$

Where σ_{ij} is the covariance between stock i and j , and σ_{ii} indicates stock i 's own variance.

This paper will use Sharpe Ratio as the primary benchmark to compare active portfolio formation and passive investment. Sharpe Ratio provides the risk adjusted return and gives a direct comparison of the return from optimal portfolio and market index, which is calculated via the following equation.

$$\text{Sharpe Ratio} = \frac{r_p - r_f}{\sigma_p} \quad (3)$$

Where r_p is the portfolio return, r_f is the risk-free rate, σ_p is the standard deviation of the portfolio. Higher Sharpe Ratio indicates more return for each additional unit of risk taken. With the purpose of testing potential outperformance from active management, maximizing Sharpe Ratio turns out to be the main indicator this paper considers. Thus, by substituting portfolio return and standard deviation in, this paper solves for the weighting that would maximize the Sharpe Ratio, under the constraint of weightings should sum to one.

$$\max_w \frac{\sum_{i=1}^n w_i \mu_i - r_f}{\sqrt{\sum_{i=1}^n w_i^2 \sigma_{ii} + \sum_{i=1}^n \sum_{j>1}^n 2w_i w_j \sigma_{ij}}}, \text{ subject to } \sum_{i=1}^n w_i = 1. \quad (4)$$

4. Result

By simulating the data from 2021 to 2023 and solving equation (4), the weighing of stocks in the maximum Sharpe Ratio portfolio can be calculated and is shown in the following Table 2.

Table 2. Weightings of each stock in the optimal portfolio

STOCK	WEIGHTING (%)
NVIDIA	0.985
JP MORGAN	3.017
EXXON	28.741
COSTCO	33.380
ELI LILLY	33.877

Applying these weightings to equations (1), (2) and (3) above, one can calculate the expected return, variance and Sharpe Ratio of this optimal portfolio (See Table 3).

Table 3. Descriptive statistics of the maximum Sharpe Ratio portfolio

	EXPECTED RETURN (%)	VARIANCE (%)	SHARPE RATIO
MAXIMUM SHARPE RATIO PORTFOLIO	2.702	0.228	10.27

Noting the dataset was collected as a monthly return, this expected return in Table 3 indicates a monthly 2.7% return on the portfolio formed, exceeding returns yielded from both S&P 500 and US T-Bill's monthly. The Sharpe Ratio of 10.27 indicated for one more unit of variance in this portfolio, it would yield an extra 10.27 unit of return.

To further test the return from this portfolio, the weighting will be applied to the stock returns collected from 2024 to April 2025 and be compared with S&P 500's return in the same time period. The cumulative return between optimal portfolio and market return are shown in Table 4 and Fig. 2.

Table 4. Cumulative Return Comparison

	CUMULATIVE RETURN
MAXIMUM SHARPE RATIO PORTFOLIO	19.411%
S&P 500	0.474%

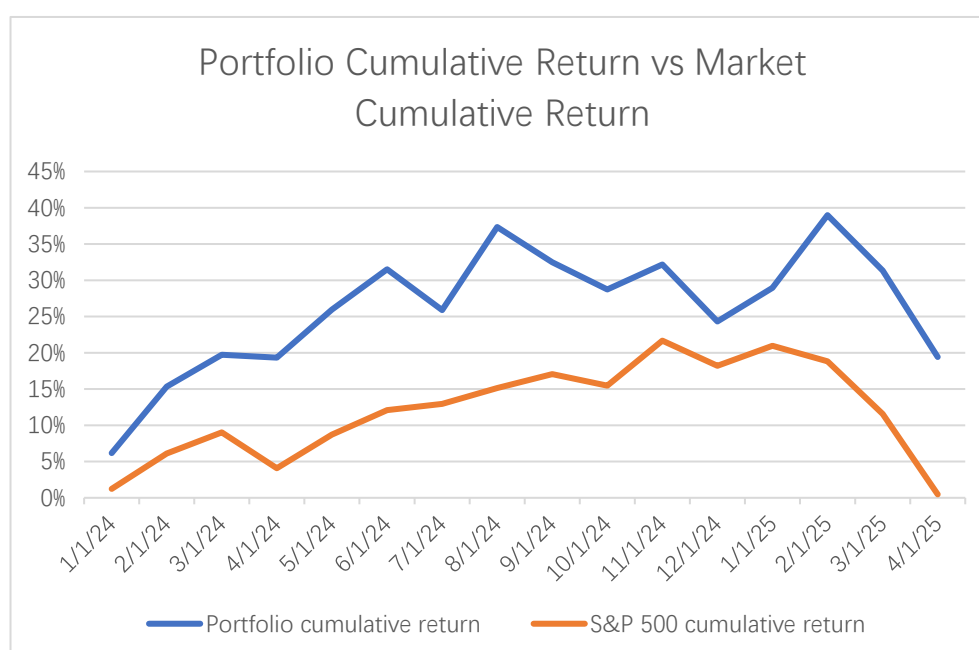


Fig. 2 Comparison between Maximum Sharpe Ratio and S&P 500 Cumulative Return

From Fig. 2 and Table 4, it can be observed that the maximum Sharpe Ratio portfolio and S&P 500 follows a similar trend between 2024 and 2025, experiencing an upward sloping trend until February 2025, then both declined drastically. S&P 500 almost fell back to its position in 2024, thus yielding a cumulative return of only 0.474%, while the maximum Sharpe Ratio portfolio still generated excess return compared to its starting point, providing investors with a return of 19.411%.

Thus, it can be said that the maximum Sharpe Ratio strategy in this case provides an excess return compared to passively investing in the S&P 500 data. Investors who wish to maximize their return per unit of risk should follow this strategy and form their own optimal weighting within the stocks they selected.

5. Conclusion

This paper studies the performance of five industrial leaders in the US stock market, and compares the portfolio formed against S&P 500 in the post-pandemic era. The returns of these stocks are

analyzed and compared. Following the maximum Sharpe ratio strategy, investors could obtain an optimal portfolio that significantly outperforms the market. The actively formed portfolio offers higher cumulative return than the passively constructed market index, at the cost of higher variance. This study expands on the current repertoire of research regarding investment strategy and offers valuable insights to future investors who wish to optimize their return.

This analysis could be further extended by considering more randomly selected stocks instead of purely focusing on industrial leaders. These stocks could also be evaluated on a longer time scale to capture performance across growth and recession. Other risk-adjusted performance metrics might also be used in future to offer a more comprehensive comparison between active and passive investment.

References

- [1] Coutino A. Fed's monetary policy mistake and the US post-COVID economic recovery. Moody's Analytics, 2023.
- [2] Golubeva O. Firms' performance during the COVID-19 outbreak: International evidence from 13 countries. *Corporate Governance: The International Journal of Business in Society*, 2021, 21(6): 1011–1027.
- [3] Tudora C. Active portfolio management on the Romanian stock market. *Procedia - Social and Behavioral Sciences*, 2012, 58: 543–551.
- [4] Feldman B, Roy D. Passive options-based investment strategies: The case of the CBOE S&P 500 BuyWrite Index. Ibbotson Associates, 2004.
- [5] Šindelář J. Can active investment managers beat the market? A study from the U.S. large cap equity segment. University of Finance and Administration, 2022.
- [6] Elton E J, Gruber M J, de Souza A. Are passive funds really superior investments? An investor perspective. *Financial Analysts Journal*, 2019, 75(3): 7–19.
- [7] Pauli J F T, Gehringer A. Active versus passive investment strategy and market outperformance: Are hedge funds overrated. 2025.
- [8] Shankar S G. Active versus passive index management: A performance comparison of the S&P and the Russell indexes. *The Journal of Investing*, 2006, 15(2): 71–78.
- [9] Pfister N, Kendzia M J. Outperforming the S&P 500 through investment plays. Preprints, 2023, 2023040739.
- [10] Prondzinski D, Miller M. Active versus passive investing: Evidence from the 2009–2017 market. Davenport University, 2018.