# FACTOR-BASED PORTFOLIO OPTIMIZATION USING MARKET ANOMALIES

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# INTRODUCTION

- Efficient Market Hypothesis is a heavily debated topic in economics
- Anomalies are things that push back against the EMH
- Using these anomalies to construct investment portfolios could provide value to investors
- Extremely relevant for firms, investors and analysts

# LITERATURE REVIEW (BEFORE MODEL BUILDING)

Many economists claim that anomalies are mainly hypothetical and are arbitraged out of the market before investors can really take advantage of them (Latif, 2011)

Others believe that there truly are inefficiencies, and they can be systematically exploited to "beat the market". (Fama, E. F., & French, K. R, 1993)

The most widely studied and persistent anomalies include momentum, value, volatility, volume, cash dividends, and calendar effects (Yalçın, 2010) (Latif, 2011) (Jegadeesh 1993)

Through research the most prominent anomalies appear to be value, momentum, size and volatility (Cakici 2013)

# LITERATURE REVIEW (FOR MODEL BUILDING)

The stocks selected were the companies that are currently in the S&P 500 as this is a common practice in similar research.

When using current S&P companies for historical analysis, survivorship bias must be accounted for. (Malkiel, B. G., 2003)

Research says to reduce annual returns of the model by between 1%-3% in order to account for the survivorship bias. (Barberis, N., Shleifer, A., & Wurgler, J., 2005)

For momentum, the returns from the last year minus returns from the last month to avoid short-term reversal effect. (Cakici, N., Fabozzi, F. J., & Tan, S.,2013)

# METHODOLOGY

- Take all 500 companies from S&P over the selected period. (2005-2025 and 2012-2017)
- The portfolio will be constructed using the top 20% of the companies based on the selected factor (100 companies).
- The portfolio will be rebalanced quarterly to keep the companies with the best values for the respective factor.
- Since equal weighting will be used for the portfolios, the average of the returns for the 100 companies over the quarter they were included in the portfolio will be tracked.
- The cumulative returns for the portfolio will be summed up over the time selected.
- The annual returns of the portfolios will be scaled down by 3% to account for the survivorship bias

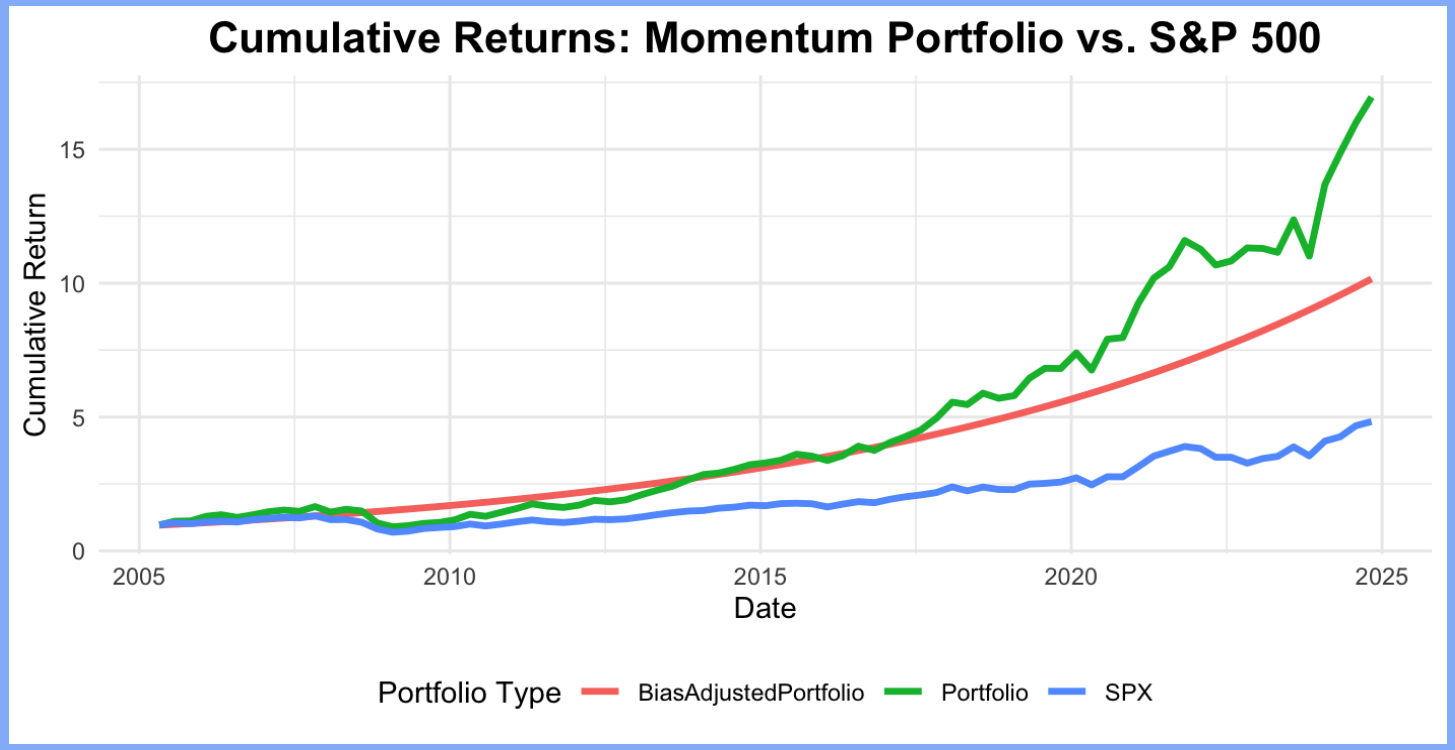
# DATA

- All data acquired from Bloomberg
- Momentum calculated by subtracting 1-month returns from 1-year returns
- The value portfolio uses PE ratio. Volatility portfolios use volatility from the past year
- Annual and cumulative returns will be compared to benchmark S&P 500 returns to determine model success. Volatility of each will also be compared

# 20 YEAR RESULTS (MOMENTUM)

- Momentum portfolio saw an average annual return of 16.93% from 2005-2025
- Standard Deviation of 16.36% over same period
- Even if subtracting off 3% for the survivorship bias and adjusting for inflation it still retains a 11.11% annual return
- Sharpe ratio of 0.77

Around 16x your money versus 5x your money with S&P 500

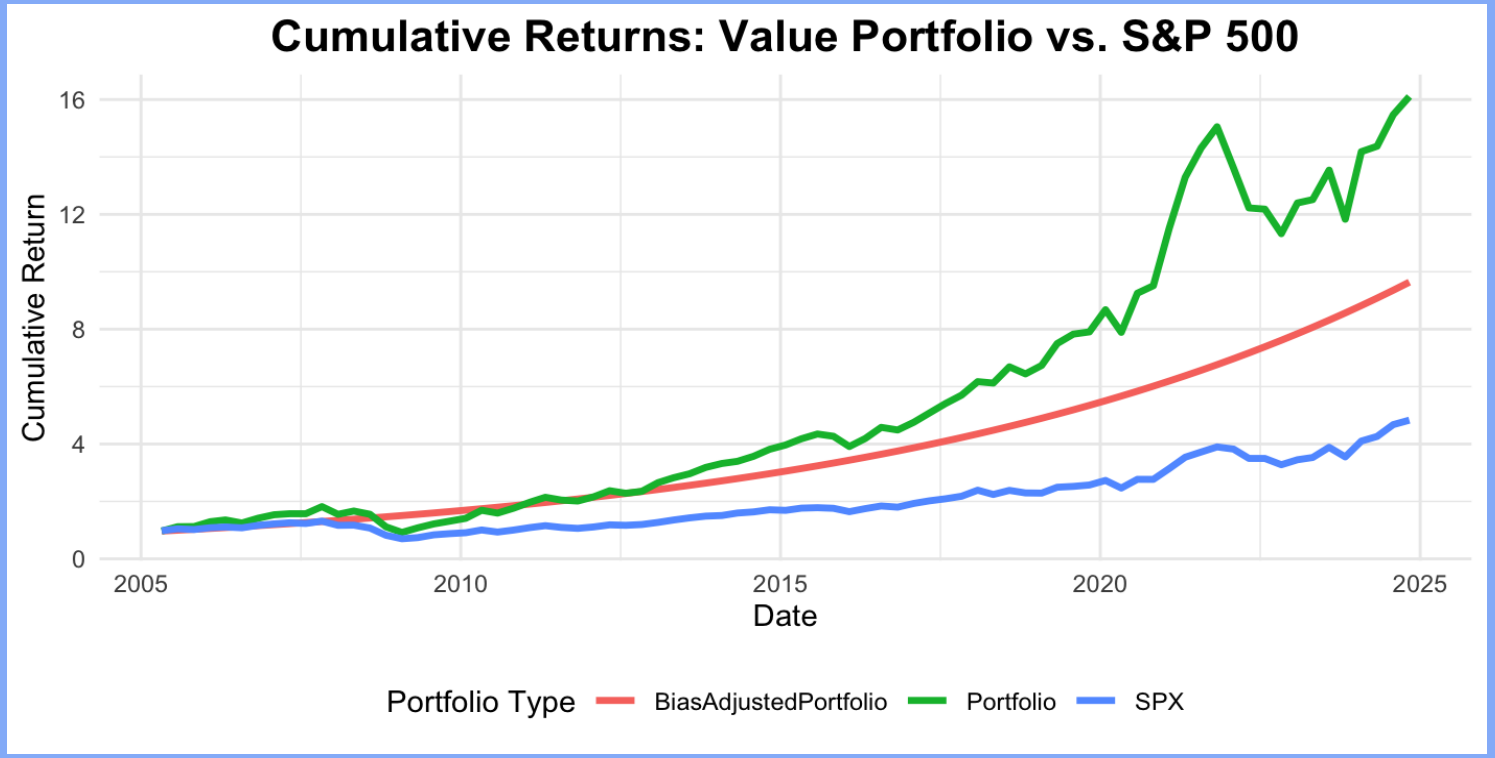



S&P annual return is 9.22%, volatility 15% and Sharpe ratio is 0.3286

# 20 YEAR RESULTS (VALUE)

- Value portfolio saw an average annual return of 16.89% from 2005-2025
- Standard Deviation of 17.82% over same period
- Adjusted annual return of 11.07%
- Sharpe ratio of 0.71

Around 16x your money versus 5x your money with S&P 500

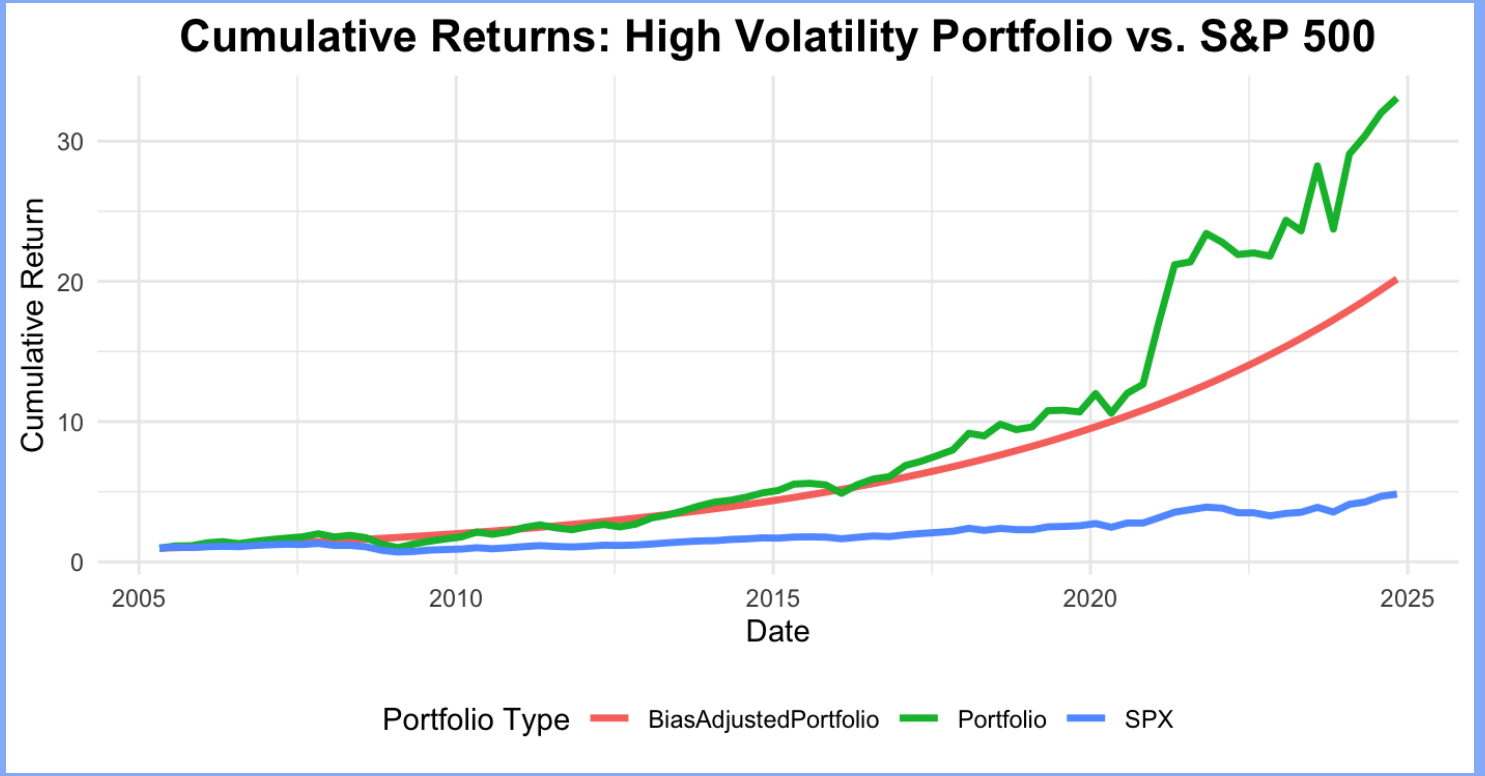



S&P annual return is 9.22% and Sharpe ratio is 0.3286

# 20 YEAR RESULTS (HIGH VOLATILITY)

- High volatility portfolio saw an average annual return of 21.77% from 2005-2025
- Standard Deviation of 20.66% over same period
- Adjusted annual return of 15.96%
- Sharpe ratio of 0.85

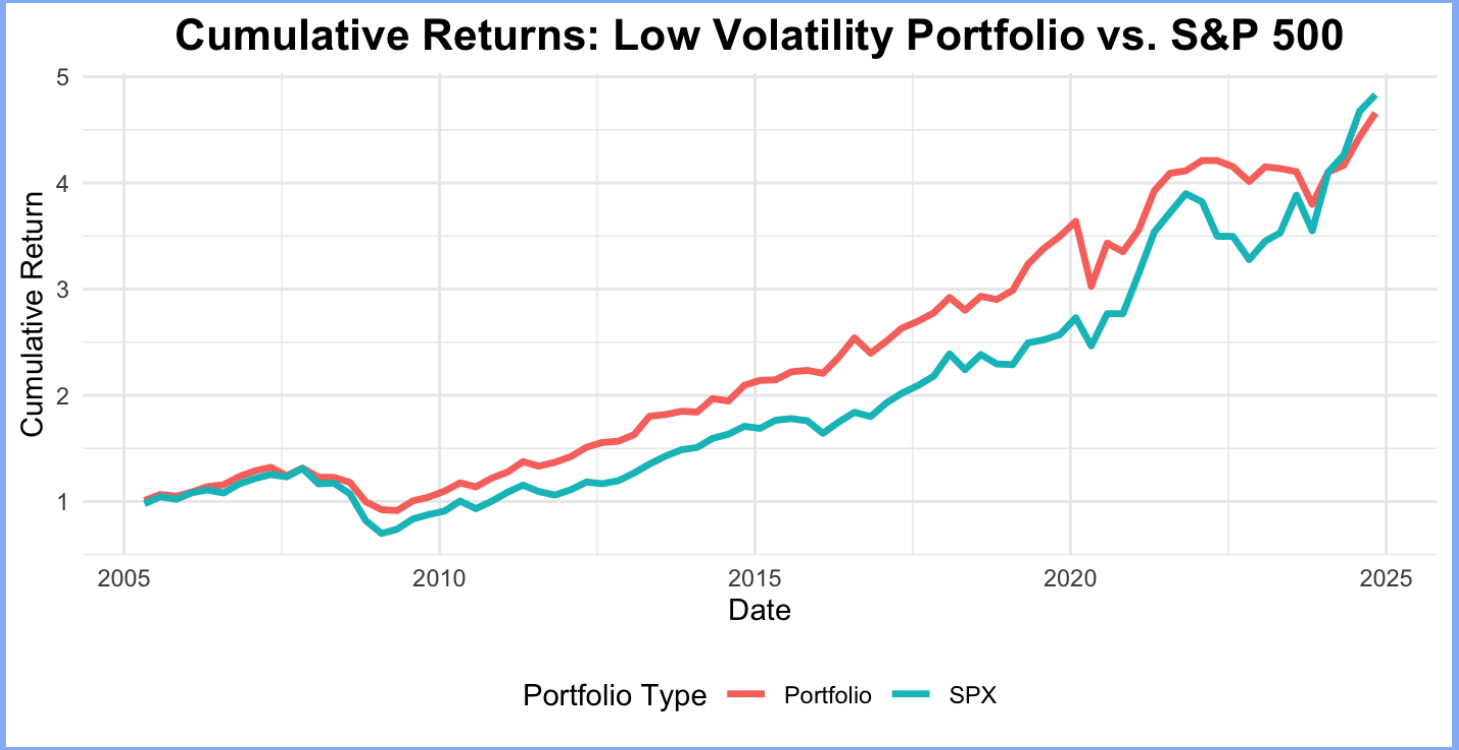
Around 32x your money versus 5x your money with S&P 500




S&P annual return is 9.22% and Sharpe ratio is 0.3286

# 20 YEAR RESULTS (LOW VOLATILITY)

- Low volatility portfolio saw an average annual return of 8.69% from 2005-2025
- Standard Deviation of 10.45% over same period
- So similar to the S&P it likely does not include the survivorship bias or indicates too harsh of corrections
- Sharpe ratio of 0.42

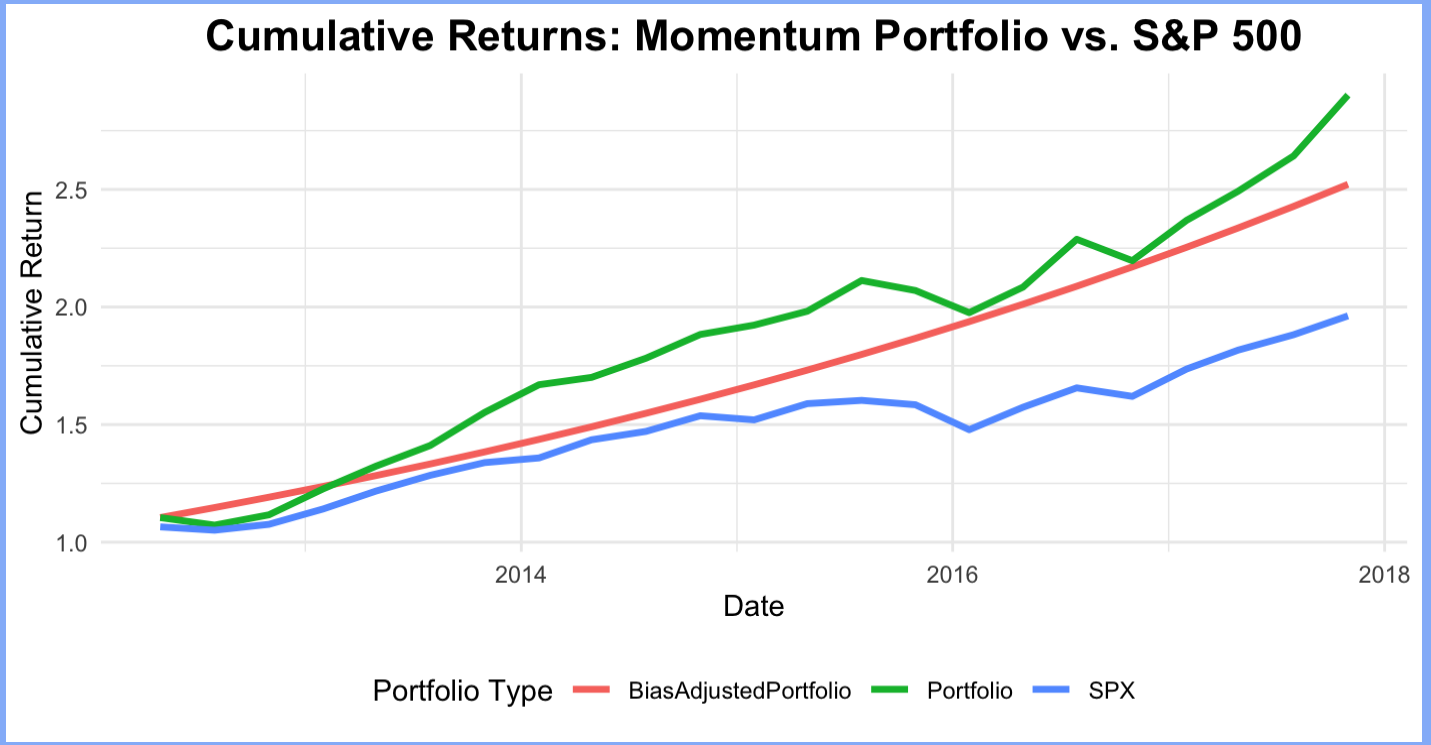



S&P annual return is 9.22% and Sharpe ratio is 0.3286

# 5 YEAR RESULTS (MOMENTUM)

- Momentum portfolio saw an average annual return of 20.82% from 2012-2017
- Standard Deviation of 9.14% over same period
- Subtracting off 3% gives 17.82% annual return.
- Sharpe ratio of 1.81

Around 3x your money versus 2x your money with S&P 500

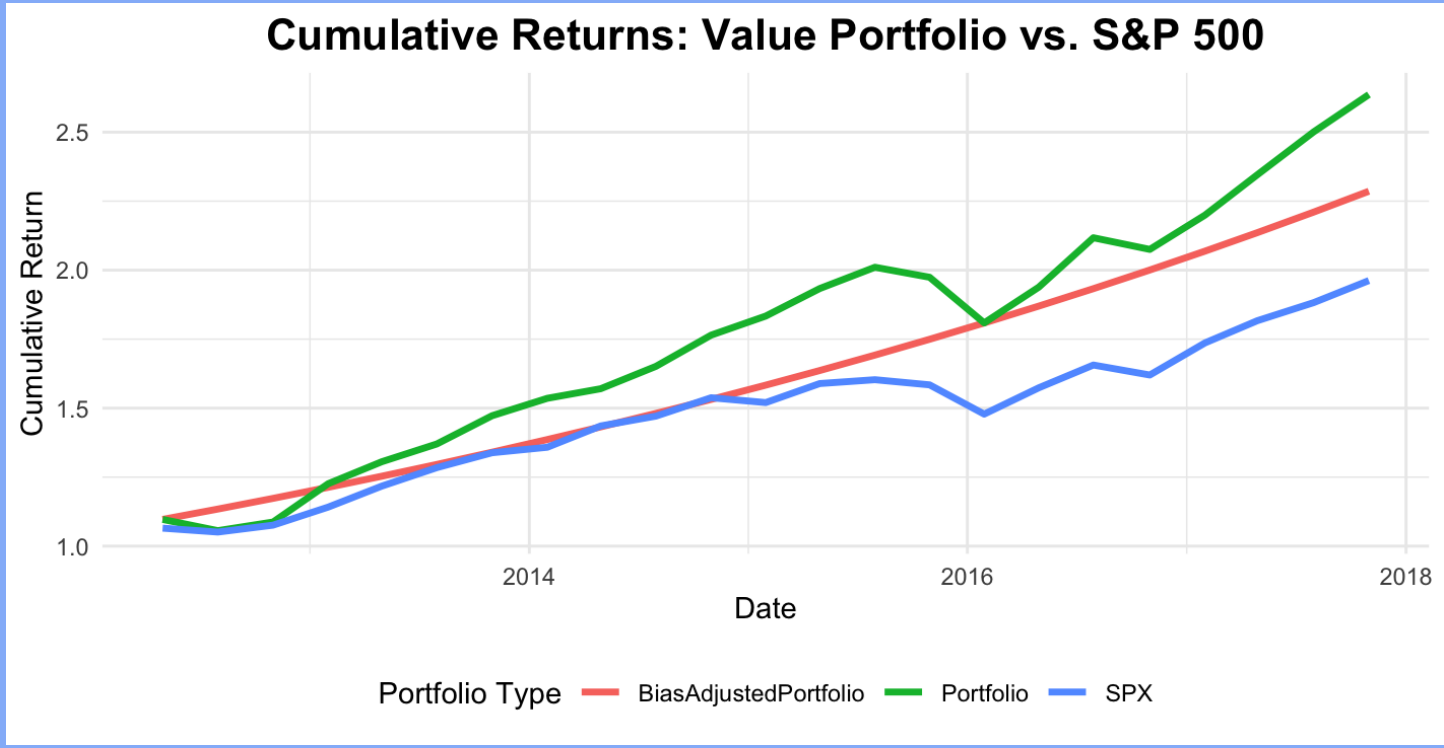



S&P annual return is 12.53% and Sharpe ratio is 0.86

# 5 YEAR RESULTS (VALUE)

- Value portfolio saw an average annual return of 18.83% from 2012-2017
- Standard Deviation of 9.32% over same period
- Subtracting off 3% gives 15.83% annual return. (Inflation negligible for time length)
- Sharpe ratio of 1.56

Around 2.75x your money versus 2x your money with S&P 500

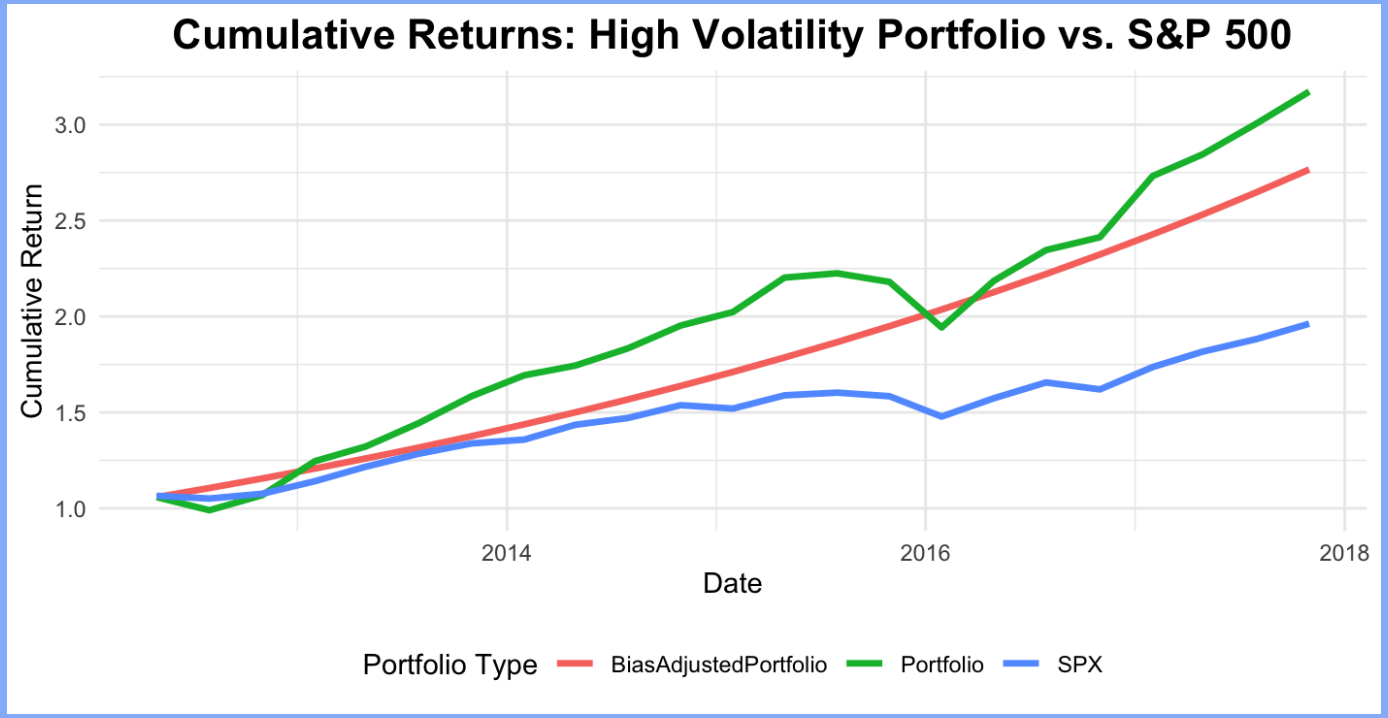



S&P annual return is 12.53% and Sharpe ratio is 0.86

# 5 YEAR RESULTS (HIGH VOLATILITY)

- High volatility portfolio saw an average annual return of 23.03% from 2012-2017
- Standard Deviation of 12% over same period
- Subtracting off 3% gives 20.03% annual return. (Inflation negligible for time length)
- Sharpe ratio of 1.56

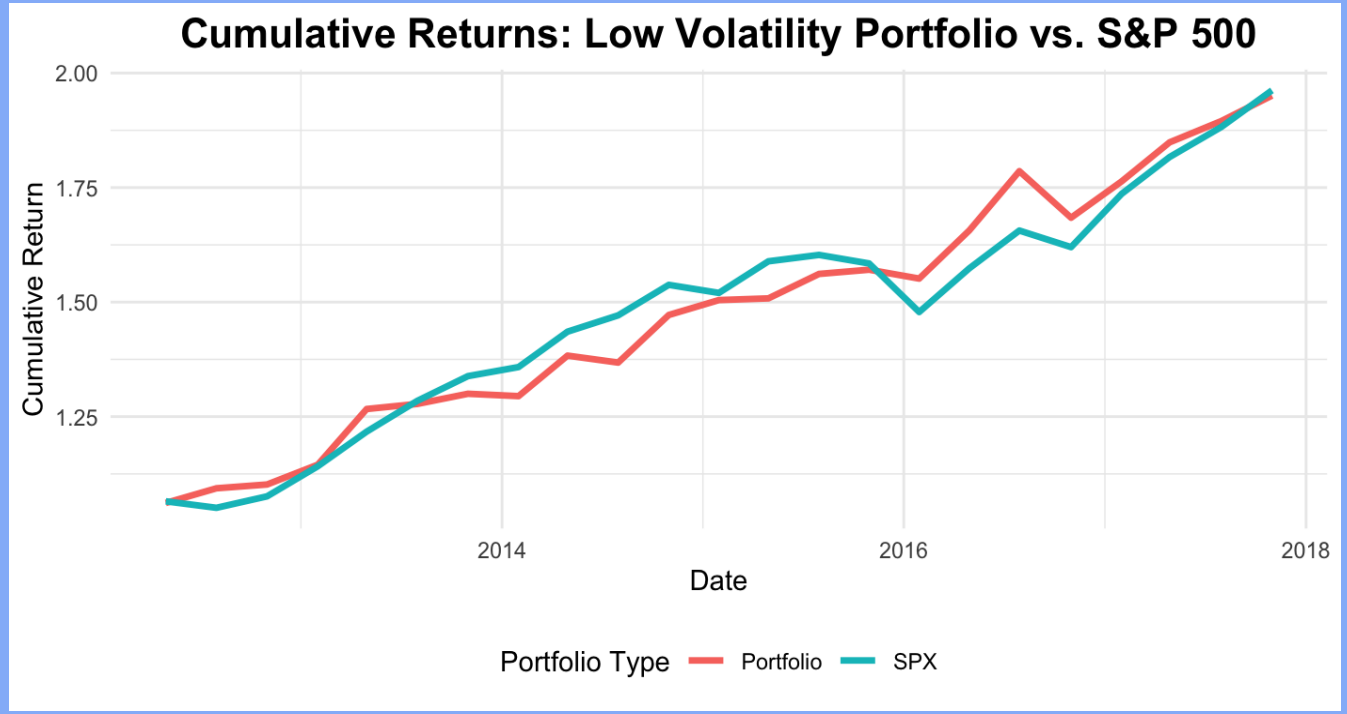
Around 3.25x your money versus 2x your money with S&P 500




S&P annual return is 12.53% and Sharpe ratio is 0.86

# 5 YEAR RESULTS (LOW VOLATILITY)

- Low volatility portfolio saw an average annual return of 12.26% from 2012-2017
- Standard Deviation of 7.32% over same period
- Again so similar to S&P that we must question survivorship bias
- Sharpe ratio of 1.13




S&P annual return is 12.53% and Sharpe ratio is 0.86

# TABLES OF ALL RESULTS

2005-2025

| Portfolio | Cumulative Return | Bias Adjusted | Annual Return | Volatility | Sharpe Ratio |
|---|---|---|---|---|---|
| Momentum | 1595% | 916% | 16.93% | 16.36% | 0.77 |
| Value | 1510% | 864% | 16.89% | 17.82% | 0.71 |
| High Volatility | 3208% | 1917% | 21.77% | 20.66% | 0.85 |
| S&P 500 | 383% | 383% | 9.22% | 15.02% | 0.33 |

2012-2017

| Portfolio | Cumulative Return | Bias Adjusted | Annual Return | Volatility | Sharpe Ratio |
|---|---|---|---|---|---|
| Momentum | 190% | 152% | 20.80% | 9.14% | 1.81 |
| Value | 164% | 129% | 18.83% | 9.32% | 1.56 |
| High Volatility | 217% | 177% | 23.03% | 12.00% | 1.56 |
| S&P 500 | 96% | 96% | 12.53% | 9.54% | 0.86 |

# SUMMARY OF RESULTS

- Over 20 years momentum, value and high volatility portfolios were clearly superior to the S&P 500 even when adjusting for survivorship bias and inflation
- Over 5 years with no big dips in S&P 500 the portfolios were even better achieving Sharpe ratios above 1 meaning the return is worth far more than the risk taken
- Low volatility portfolio was super similar to the S&P likely due to the bigger companies being the ones with low volatilities and S&P being cap weighted
- Clearly the portfolios are significantly better than the S&P and the anomalies do in fact exist

# CRITIQUE AND FUTURE EXPLORATION

- Being able to obtain the current S&P 500 data at every time stamp would allow us to eliminate the survivorship bias but that is hard to obtain
- The market in the United States is relatively strong and consistent, the method could just be amplifying results. Would be interesting to see a different market
- S&P 500 is safe and has tons of huge companies it would be interesting to see different indexes or use smaller companies. Could also then use size as a factor
- Used monthly data as there were already over a million data values in my dataset. Using daily data could provide slightly more accurate results.
- Use weighted values for the portfolios rather than equal weighting to see if the extreme values could increase profits even higher

# QUESTIONS?