



SUSTAINABLE INVESTMENTS THROUGH LONG-TERM VALUE INVESTING

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1. Introduction

With the rise of retail investors, turbulent market conditions and cryptocurrencies, we often hear stories of investments that have returned enormous amounts of profits. These stories lead many to make irrational decisions with the hopes of achieving large gains in short periods of time. There should be a warning label with such decisions, there is a lack of discussion pertaining to the level of risk exposure of an investment with potential for large gains. If the objective of investing is to increase wealth, and individuals have decades left till retirement, then the only logical solution is an investment strategy that carries low risk with a steady level of growth over the long term.

There is a wealth of empirical evidence for the viability of long-term investments, with notable pioneers such as Warren Buffet, Benjamin Graham and Sir John Marks Templeton. With that said, there is an important need for short term investments, after all, people can't wait decades to realise profits for a mortgage or other important short-term goals. This leads us to this report which will outline stage one of a four stage strategy. The report will be segmented into four sections:

1. Portfolio Construction
2. Portfolio Optimisation
3. Risk Management
4. Shortfalls and conclusions

2. Portfolio Construction

This section will highlight the necessary steps for identifying stocks that appear to be either trading below their intrinsic value, or companies with strong fundamentals that will stand the test of time. In simple, stage one will leverage strong fundamentals to make safer investments. The need for safer investments hasn't been as prevalent as recent times with soaring inflation, an energy crisis, supply chain issues (in particular, lack of semiconductors) and the overall downturn of the global economy. Where one opportunity is missed, another presents itself. As the saying goes, "Buy stocks the way you buy groceries, not the way you would buy perfume" (*Ben Graham*). These tumultuous times provide an opportunity to purchase stocks at a discount, so the need for a robust strategy right now can be more beneficial than during bull runs.

A. Data

The bulk of the data used in this project comes from FinancialModelingPrep.com on S&P500 listed companies for 2011 – 2021 Q4. The price to earnings growth ratio and enterprise value to revenue have been obtained from the yahoo finance API. Whilst there are hundreds of potential metrics that can be used to assess the financial strength of a company, I will be looking at a handful that I deem most important. The appendices will provide a breakdown of each factor and its importance, the metrics include:

- **Free cash flow yield** – this value will be compared with sector averages as well being assessed over time to check if it is growing.
- **Peg ratio (5Y Expected)** – a value of less than 1.5 and greater than 0 will be indicated as good and will also be compared with sector averages.

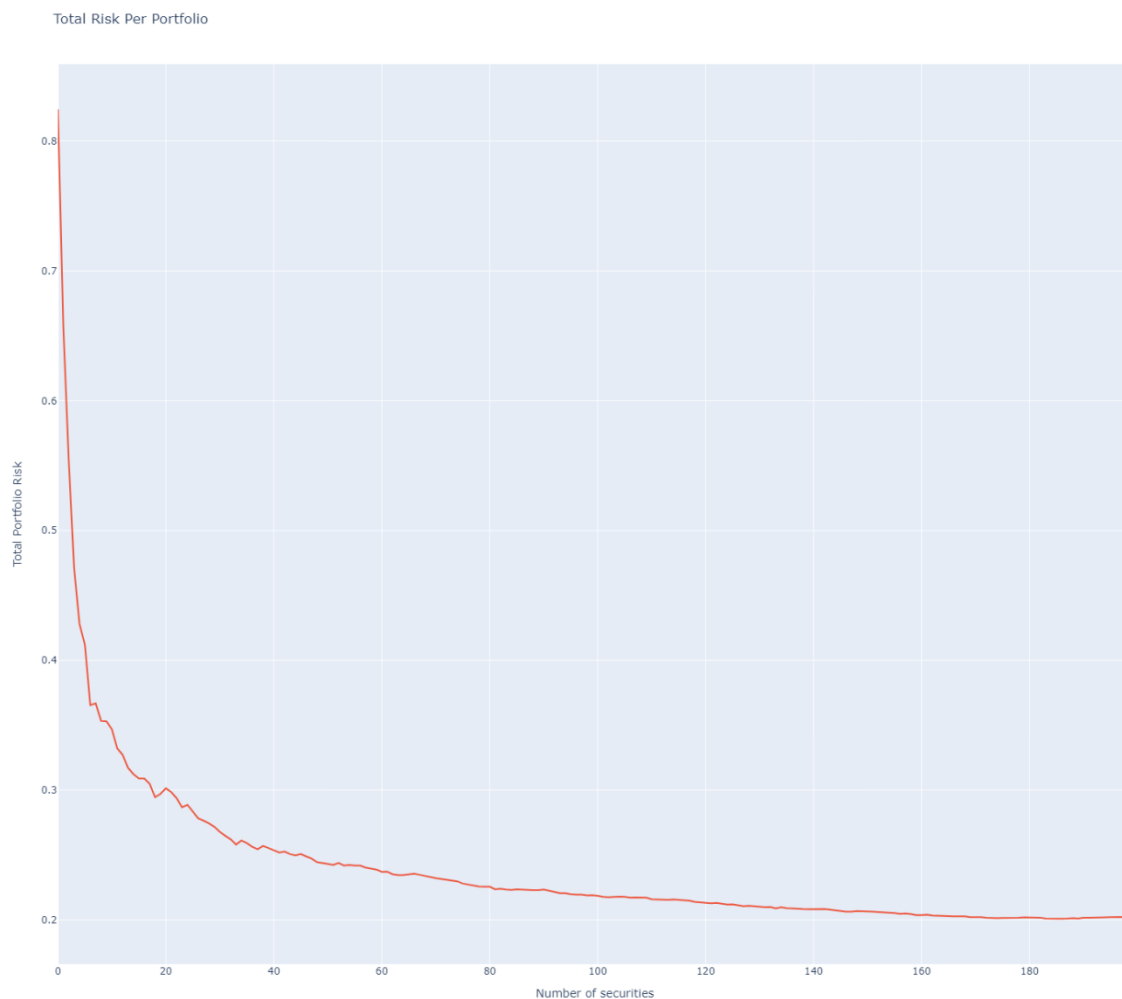
- **Enterprise to revenue** – a value of less than 2 will be considered good and will also be compared against sector averages.
- **Enterprise value multiple** – this value will be compared with sector averages which will be classified as good for a value less than its sector average.
- **Operating profit margin** – this value will be compared with sector averages to see if a company is outperforming or underperforming the sector.
- **Net profit margin** – the evolution of the profit margin over time will be checked to see if it is getting better or worse.
- **Return on equity** – this value will be checked against sector averages as well as its growth over time.
- **Return on capital employed** – the growth over time will be checked to see if it's getting better or worse.
- **Debt ratio** – a ratio of less than 1 will be considered good and the value will be compared against sector averages.
- **Debt to equity ratio** – a ratio of less than 2 will be considered safe and the value will also be compared to the sector average.
- **Interest coverage** – this will be checked to see if the value is increasing over time.
- **Price to free cash flow** – this will be compared to sector averages as well as classifying a value of less than 15 as good.
- **Price to earnings ratio** – a PE ratio greater than the sector average by 20% will be considered as potentially expensive.
- **Earnings per share** – the value will be checked over time to see if it's getting better and will also be compared with the sector average.
- **Price to book ratio** – a value of less than 2 will be highlighted as potentially undervalued as well as checking the value against the sector average.
- **Book value per share** – this value will be checked over time to see if it is growing.
- **Discounted cash flow** – a discounted cash flow value greater than the market price will indicate a potentially undervalued stock.
- **Piotroski score** – a value of 6 or greater will be considered as good.
- **Intrinsic value** – a secondary measure that will be compared to the stock price and will be used in the same way as the discounted cash flow.

In the first instance, I use expected returns indicated by the CAPM to reduce the 503 listed companies. The CAPM highlights the minimum amount of return an investor should be willing to take given the systematic risk. The annualized return is calculated to indicate the average expected return, then an alpha is calculated by taking the difference between the annualized return and the CAPM expected return. If the alpha is positive, it suggests the stock is above the capital market line and is potentially undervalued as the expected return is greater than the minimum amount of return an investor should be willing to take given its risk. Hence, I order the alpha values in descending order and take the top 200 stocks, these will be the stocks that will be analysed.

The second step is to convert the fundamental metrics to a form that provides more insights than its raw form. In the points above I outline how each metric will be used, for some variables I calculate compounded annual growth rates, for others I compare with sector average and lastly, I compare some with a given threshold. In any case, there are too many variables to incorporate all when filtering, so, I filter based on 4-5 conditions and then analyse all the variables as a collective to assess the filtering strength.

As a final stage of the portfolio construction, I identify the optimal number of securities to include in my portfolio. This is done by calculating the volatility of a single stock then progressively adding one stock to the portfolio, recalculating the volatility and repeating. The final iteration is a portfolio that consists of all 200 stocks. Below we can see the results of the plot, a single stock starts with an expected volatility of 82% and a 200-stock portfolio has an expected volatility of 20%, which also makes the case for diversification.

Graph showing total risk per number of securities



The rules-based filtering was recalibrated in a trial-and-error type fashion where I tried different combinations of fundamental metrics and thresholds. The final rules used for the stocks of the final portfolio were:

1. A growing free cash flow yield. That is, the growth of the previous year free cash flow yield being greater than the 5-year compounded annual growth rate.
2. A book value per share greater than 10%.
3. Debt to equity ratio of less than 5.
4. A Piotroski score of 6 or greater.

This highlighted 29 companies that fulfil this condition and had enough stocks that provided an acceptable level of risk for me. The difference in total risk between 29 stocks and 200 was around 7%.

3. Portfolio Optimisation

The second stage of the project was to identify an optimal allocation to maximise returns for a given level of risk. Hence, I use a combination of Monte Carlo simulation and risk adjusted returns in the form of the Sharpe ratio to compare different portfolio allocations. Below I highlight the top 10 percentage growth for the filtered stocks.

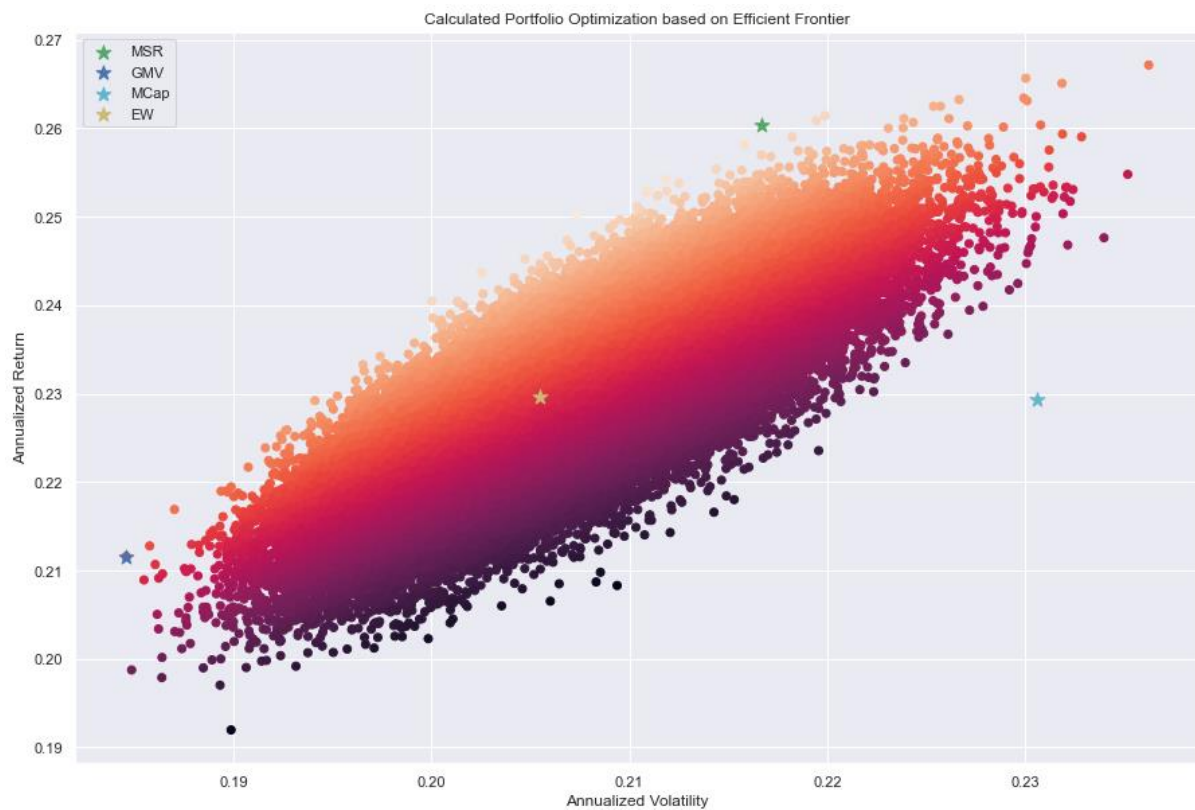
Graph showing top 10 percentage growth for chosen companies (2015 – 2022)



I then checked correlations between the stocks and the S&P500 which highlighted positive correlation amongst all the stocks and the S&P500. The reason this was not addressed in this project is that a part of the four-stage strategy is a bond portfolio that is negatively correlated with the stock market (this will be discussed further in the conclusion).

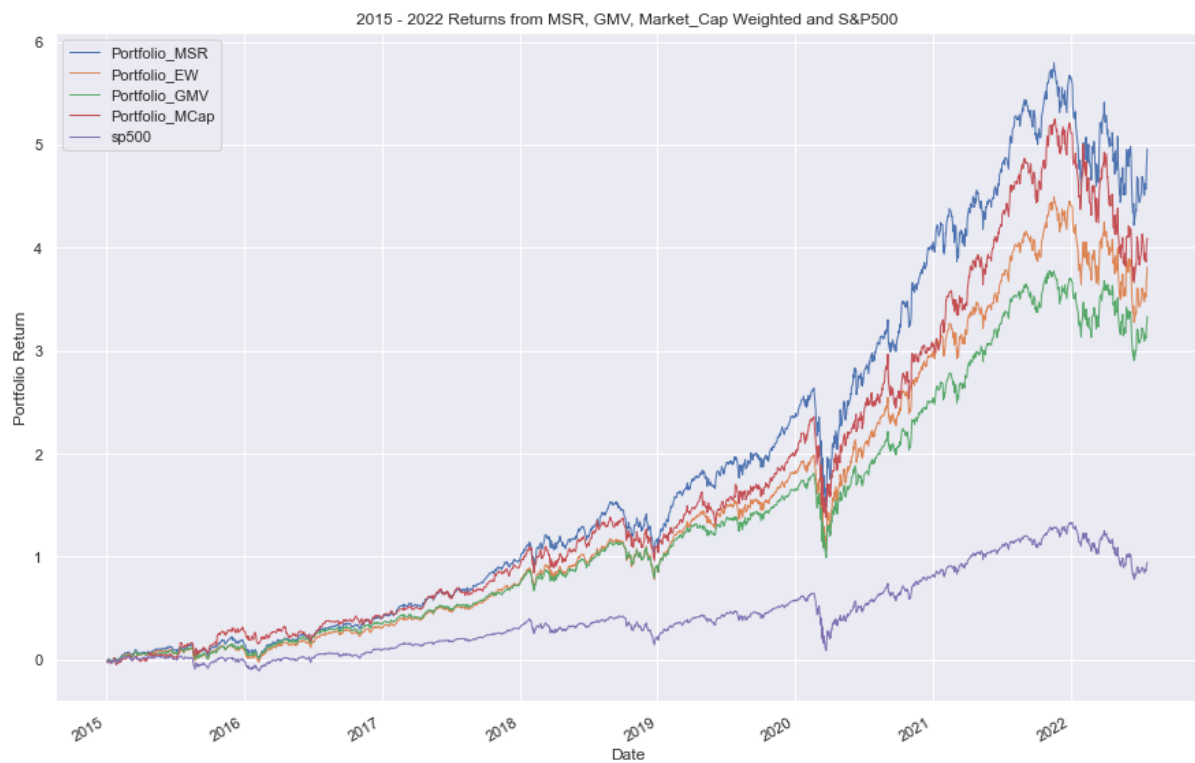
I then created an equally weighted portfolio which consisted of around 3.45% allocation in each of the stocks. This was one of three benchmarks; it's noted that a well optimised portfolio should outperform an equally weighted portfolio. A market capitalization weighted portfolio was also created and the S&P500 index was also highlighted as a benchmark. Then, Monte Carlo simulation was used to create 100,000 randomly generated weights. The max Sharpe ratio portfolio was extracted from the Monte Carlo and the global minimum variance. In the best interest of space, the weightings have been left on the python workbook and will not be displayed here. The graph below shows the efficient frontier for the 100,000 portfolios with the max Sharpe, min volatility, equally weighted and market cap weighted being highlighted.

Graph showing efficient frontier



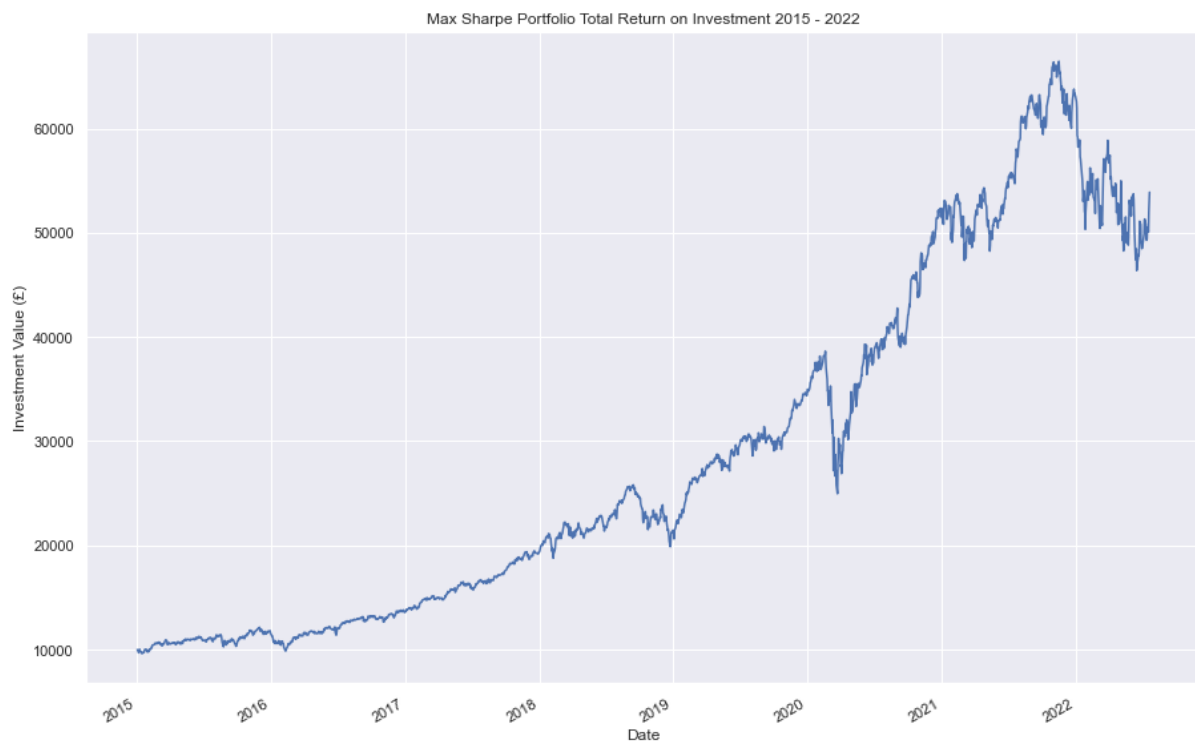
The portfolios were backtested from 2015 – 2022 and the results shown below. In the graph below we can see the optimised max Sharpe ratio outperforms all the benchmarks which is an indication the optimisation has worked as planned.

Graph showing performance of each portfolio (2015 – 2022)



Now, we will see how much a £10,000 investment in 2015 would be in 2022. As we can see below, a £10,000 investment in the MSR portfolio in 2015 would be £53,881 in 2022.

Graph showing the evolution of a £10,000 investment in the MSR portfolio



Finally, a table is provided below to highlight key metrics of all four portfolios. We can see that the max Sharpe portfolio not only provides the highest annualized return, but also gives the best value for

risk adjusted returns. This means that the max Sharpe portfolio provides the best returns per unit of risk taken.

	Annualized Return	Annualized Volatility	Sharpe Ratio	Skewness	Kurtosis
Equal. Weight. Portfolio	22.962036	20.546393	0.975939	-0.356196	10.681592
Market Cap Portfolio	22.933044	23.055361	0.868477	-0.165676	7.736655
Global Min Var Portfolio	21.159445	18.460226	0.988582	-0.391071	10.882987
Max Sharpe Portfolio	26.037282	21.667074	1.067393	-0.252372	10.071414

It can also be seen below that there is an overweight position on tech stocks which could cause problems for the overall performance of the portfolio. According to Bloomberg more than a trillion has been wiped out from the tech sector in 2022, this could signal further losses ahead and highlights the risk of having an overweight position in tech stocks.

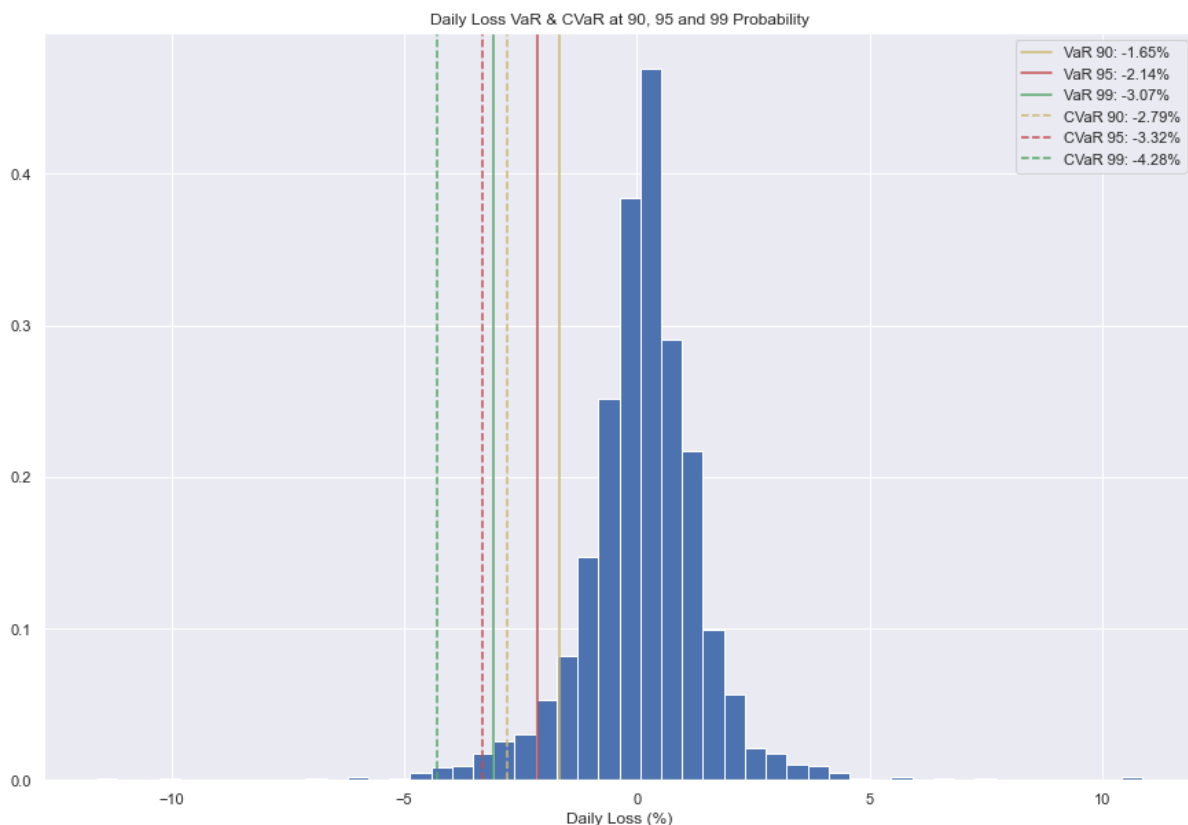
Percentage weightings of each sector of the portfolio

sector	
Information Technology	34.482759
Health Care	17.241379
Consumer Discretionary	10.344828
Industrials	10.344828
Communication Services	6.896552
Materials	6.896552
Consumer Staples	3.448276
Energy	3.448276
Financials	3.448276
Real Estate	3.448276

4. Risk Management

For the final section we will check some key exposure metrics in the form of value at risk and expected shortfall. The value at risk will highlight the likelihood of potential daily losses at the 90, 95 and 99% confidence and in all cases, we will check the potential daily losses in the worst 10, 5 and 1% cases using the expected shortfall.

Graph showing VaR and CVaR at 90, 95 and 99%



Here we can see that there is a 99% likelihood losses will not exceed -3.07% per day and a 95% likelihood losses will not exceed -2.14% per day according to the 99 and 95 VaR. In the worst 1% of cases the losses are likely going to exceed -4.28% per day and for the worst 5% of cases losses are likely going to exceed -3.32% per day. Whether these figures are good or bad is dependent on individual risk preferences. Furthermore, the expectation for this portfolio is to be rebalanced every month so the VaR_95 has been assessed over the next 30 days. As we know volatility scales with the square root of time, there is a 95% likelihood that losses over the next 30 days will not exceed -11.7%. Finally, using a normal cumulative distribution function we check the probability the portfolio will lose more than 50% in the next 252 days. It is shown on the python notebook that there is an 11% likelihood that losses will exceed 50% in the next 252 days, in other words, there is an 89% likelihood that losses in the next year will be less than 50%.

5. Conclusion and Further Considerations

This report highlights a potentially well diversified portfolio with market beating returns at a relatively low risk. The strategy, however, does not come without flaws, some of which include:

- Exchange rate risk unaccounted for
- Overweight investment in technology stocks
- Overweight in Google by including both class A and class C stocks
- Pure fundamentals have been accounted for, but an optimal strategy should also look at risk in a sector, challenges sectors face, performance of the CEO, vision of the company and how those lines up with general sentiment in the market.

An important fact that has been avoided in the body of the report but is crucial in highlighting is the lack of negatively correlated stocks. It was noted earlier that all the stocks were positively correlated with the S&P500 index, an optimal strategy should have negatively correlated securities. Thus, this brings us to the final comments of the investment strategy. As mentioned at the beginning of this report, this is part one of four in an overall strategy, the other three will briefly be discussed. With this portfolio there will be three more portfolios as an overall strategy that will consist of four portfolios. The four portfolios include:

1. **Value portfolio** – the portfolio outlined in this report and will hold 30% of the total funds allocated.
2. **Dividend portfolio** – this will consist of purely dividend stocks and will hold 40% of total funds allocated. This portfolio will provide regular cash flow.
3. **Bonds portfolio** – this will be the portfolio that is negatively correlated with the stocks in the other portfolios as a way of hedging our exposure. This will hold 20% of total funds allocated.
4. **Speculative portfolio** – this will be a portfolio of growth stocks that have high risk and high reward. This will be a short-term portfolio and will hold 10% of total funds allocated.

The overall strategy will be to add additional funds every month and rebalance before adding more funds. The rebalancing will include recalibrating the weights but also potentially adding additional stocks from the profits accumulated. It must be noted that the rebalancing will only take place if the allocation deviates more than 5% from its original weighting.

Appendices

Fundamental Metrics

FACTOR	DESCRIPTION
FREE CASH FLOW YIELD	<p>The ratio divides the free cash flow per share, which reflects the amount of cash available for distribution after necessary expenses and investments, by the market capitalization. Growing free cash flow yield is commonly viewed as a signal of outperformance of operations.</p> <p>This is a financial solvency ratio that compares the free cash flow with the market cap. In general, a higher FCFY is more attractive as it indicates a company can satisfy its debt and other obligations. This metric will be assessed over time and compared to the sector average. A FCFY above the sector average will be considered good and vice versa. Moreover, this measure highlights the company's flexibility to increase its intrinsic value during good times, and smoothly tide over difficulties during bad times which is of particular importance to value investors.</p>
PEG RATIO (5Y EXPECTED)	<p>This ratio is calculated by dividing the P/E ratio by expected annual earnings per share growth. Unlike most other ratios the PEG ratio is a forward-looking ratio. Since growth is a key component of a stocks expected return, the inclusion of the growth rate gives the PEG ratio an advantage, however, it also has disadvantages. This ratio allows us to see how cheap a stock is relative to its growth rate. All things being equal, a lower PEG ratio is better. Whilst traditional literature indicates a PEG ratio of less than 1 as a litmus test for undervalued stocks, a shift in the rise of tech companies and other sectors has</p>

	skewed this. A value of less than 1.5 and greater than 0 will be used as a positive indicator and the PEG ratio will also be compared with the sector average.
ENTERPRISE TO REVENUE RATIO	The EV/R ratio compares a company's revenue to its enterprise value, so, a lower value the better. This value will be compared with its sector average. If it's lower it will be classified as good, if it's higher it will be classified as bad. We will also look at the raw value and consider an EV/R of less than 2 to be good.
ENTERPRISE TO VALUE MULTIPLE	The multiple is calculated as EV/EBITDA is used to determine the value of a company but should only be used when comparing companies in the same sector. A low value relative to peers indicated the company might be undervalued. A value lower than the sector average will be classified as good and a value higher than the sector average as bad. This ratio is the most encompassing and generally considered most useful when valuing a stock.
OPERATING PROFIT MARGIN	This measures how much profit a company makes on a dollar of sales after paying for variable costs of production. The operating profit margin represents how efficiently a company can generate profit through its core operations. This value will be compared to sector averages. A value higher than the sector average will be classified as outperforming and lower than the sector average underperforming
NET PROFIT MARGIN	This measure indicates how much profit is generated as a percentage of revenue. To determine the financial health of a company using this metric we will check if the profit margin is increasing over time.
RETURN ON EQUITY (ROE)	This metric is a measure of financial performance and is calculated by dividing the net income by shareholders equity. The ROE can indicate a company's profitability and efficiency in generating profits. The higher the ROE, the more efficient a company's management is at generating income and growth from its equity financing. A high ROE can be an indication of an undervalued stock. This will be used in two forms, firstly, we will check if the ROE is increasing over time. Secondly, is the ROE higher than the sector average.
RETURN ON CAPITAL EMPLOYED	This is another metric for assessing a company's profitability and capital efficiency. In essence, it indicates how well a company is generating profits from its capital as it is used. The growth of ROCE will be analysed to see if a company is becoming more efficient over time.
DEBT RATIO	The debt ratio is the ratio of total debt to total assets. It can be interpreted as the proportion of a company's assets that are financed by debt. A ratio greater than 1 shows that a considerable portion of a company's debt is funded by assets, which means the company has more liabilities than assets. Therefore, a debt ratio of less than 1 indicates the company has more assets than debt. Hence, a debt ratio of less than 1 will be classified as good.
DEBT-EQUITY RATIO	This ratio highlights the degree to which a company is financing its operations through debt versus owned funds. Whilst a general rule of D/E below 2 being considered "safe" and greater than 2 considered "risky", the value will be compared against the sector average as D/E in specific sectors will vary greatly.
INTEREST COVERAGE	This is a debt and profitability ratio that will be used to determine how easily a company can pay the interest on its outstanding debt. The higher the value the better as it shows there are enough profits to cover interest payments. This will be analysed over time to see if the situation is getting better, worse or staying stable.
PRICE TO FREE CASH FLOW	This is an equity valuation metric used to compare a company's per share market price to its per share amount of free cash flow. A lower value typically indicates a company is undervalued and its stock is

	<p>relatively cheap in relation to its free cash flow. This metric will be compared with sector averages. A value of less than 15 will be considered good as a PFCF of less than 15 indicates it is trading for a market cap that's less than 15 times the free cash flow over the previous 12 months. A negative PFCF will be a warning sign but does not immediately disqualify a company.</p>
PRICE TO EARNINGS RATIO	<p>The P/E ratio measures a company's share price relative to its earnings per share. This metric indicates the dollar amount an investor can expect to invest in a company to receive \$1 of that company's earnings. A high P/E indicates a stock's price is high relative to its earnings and could potentially be overvalued. It could, however, indicate investors expect higher earnings growth in the future. A relatively low ratio could mean that investors believe the company is struggling to perform against others in the same industry, or that the stock is simply undervalued. This value will be compared with companies in the same sector. A P/E ratio that is more than 20% higher than the sector average will be considered expensive relative to the sector average, although, this will not be a strict condition. Companies categorised as expensive could be due to expected higher earnings growth in the future.</p>
EARNINGS PER SHARE	<p>This metric is calculated as a company's profit divided by the outstanding shares of its common stock. It serves as an indicator of a company's profitability. The higher the EPS, the more profitable it is considered it be. The value will be compared against sector averages as well as change over time.</p>
PRICE TO BOOK RATIO	<p>This ratio is used to determine the valuation of the company with respect to its balance sheet strength. Generally, a higher P/B value indicates an overvalued company as the price may be too high given the book value of the stock. A benchmark P/B value of less than 2 will be used for potentially undervalued companies but the P/B will also be compared with sector averages. A P/B ratio of less than 1 implies the shares are selling for less than the company's actual intrinsic value and will be considered optimal in this project. A negative ratio could indicate a company is insolvent, or on the verge of bankruptcy, however, it's possible that a company with strong financials can have a negative PB ratio. A negative PB ratio will be considered on a case-by-case basis.</p>
BOOK VALUE PER SHARE (BVPS)	<p>This ratio weighs stockholders' total equity against the number of shares outstanding and can be used to measure the value of a stock. In this study we will check the change of BVPS over time to see if the book value is getting better or worse over time. This is an important indicator as a growth in the BVPS leads to a growth in the intrinsic value.</p>
DISCOUNTED CASH FLOW	<p>This is a valuation method used to estimate the value of an investment based on its expected future cash flows. Essentially, DCF attempts to figure out the value of an investment today, based on projections of how much money it will generate in the future. A DCF value greater than the market price highlights a potential undervalued stock. The DCF price will not be calculated but will be taken from FinancialModelingPrep.com</p>
PIOTROSKI SCORE	<p>This is a discrete score between zero and nine that reflects nine criteria used to determine the strength of the financial position of a company. The score provides 1 point per criteria that is met, with 9 being the best score and 0 being the worst. The criteria are as follows:</p> <ul style="list-style-type: none"> • Positive net income • Positive return on assets in current year

PRICE FAIR VALUE

- Positive operating cash flow in current year
- Cash flow from operations greater than net income
- Lower long-term debt in current period compared to previous year
- Higher current ratio compared to previous year
- No new shares issues in past 12 months (lack of dilution)
- Higher gross margin compared to previous year
- Higher asset turnover ratio compared to previous year

The Piotroski Score has been taken from FinancialModelingPrep.com

The fair value will be calculated as follows:

Fair Price = $EPS \times (1 + \text{Growth})^n \times P/E$ = Future Price / Rate of return

Where n indicates number of forecast years