MONASH University | MALAYSIA

**BFW3540 - Modeling in Finance**

**Assessment 2**

**Tutor: Ms. Darniya Prabu**

**Contents**

This report provides an in-depth analysis of the U.S. stock market from 2018 to 2022, highlighting the intricate interactions between macroeconomic factors, monetary policies, and industry-specific dynamics.

The objective is to conduct a thorough investigation of key economic indicators, the Federal Reserve's strategic responses, and their effects across various sectors. The report aims to provide clear insights into market influences and to offer strategic recommendations for future challenges.

The analysis begins with a review of the macroeconomic environment, examining essential metrics such as GDP growth, inflation, and labour market trends. It then explores the adjustments in monetary policy by the Federal Reserve and their impact on the financial markets. A sector-by-sector analysis follows, discussing how different industries have navigated the economic stresses. The conclusion synthesises these insights, offering forecasts and strategic advice based on the established trends.

## I. Macroeconomic Analysis

The U.S. economy experienced significant fluctuations, largely driven by external factors like the COVID-19 pandemic. Early 2018 saw strong economic growth fueled by consumer spending and business investments, which boosted GDP. However, the pandemic's onset in early 2020 led to a rapid economic decline due to extensive lockdowns and supply chain interruptions, halting economic activities sharply (Dutillo et al., 2021). By mid-2020, fiscal stimulus from the government and the easing of restrictions began to foster a rapid, though uneven, economic recovery across different sectors. Inflation dynamics during this period were equally volatile. By 2021, the consumer price index (CPI) experienced its most substantial rise in decades (Trading Economics, n.d.), exacerbated by a rapid reopening of economies and a resurgence in consumer demand which outstripped supply chain capacities. Inflation, while still above the FOMC's 2 percent goal, has significantly decreased over the last

year without raising unemployment rates (Board of Governors of the Federal Reserve System, 2024).

Before the pandemic, unemployment was notably low, but rapid closures led to a sharp rise in joblessness. The recovery varied across sectors, with technology and services bouncing back faster than manufacturing and retail, largely due to a shift towards remote work and digital services (Ahmed et al., 2023). Additionally, policy changes aimed at enhancing worker flexibility and security significantly influenced the labour market's adaptation to these challenging conditions. The labour market has maintained a low unemployment rate, with monthly job gains averaging 239,000, keeping it close to historic lows (Board of Governors of the Federal Reserve System, 2024).

## II. Monetary Policy

The Federal Reserve navigated a complex economic landscape with key policy decisions aimed at stabilising and stimulating the U.S. economy. As the economy began to recover from the pandemic, the focus shifted towards managing inflation and tapering asset purchases, reflecting a gradual tightening of monetary conditions. The markets responded to Federal Reserve announcements with heightened volatility. The initial rate cuts and quantitative easing in 2020 led to a rapid recovery in stock prices, particularly benefiting sectors like technology and consumer discretionary, which are sensitive to changes in interest rates. However, since July 2023, the FOMC has maintained the federal funds rate at 5¼ to 5½ percent, aiming to manage inflation and economic growth by making borrowing more expensive (Board of Governors of the Federal Reserve System, 2024). The long-term effects on borrowing and investment were mixed; while low rates facilitated corporate borrowing and encouraged leveraged investments, they also prompted concerns about asset bubbles and financial instability.

Looking ahead, the future direction of the Federal Reserve's monetary policy will likely depend on how economic recovery interacts with inflation trends. If inflation continues, the policy could shift towards more specific interventions to stabilise certain sectors, or broader changes might be made to counteract economic downturns. According to Blinder & Alan (2023) The FOMC will keep the federal funds rate steady, awaiting more certainty that inflation aligns with the 2 percent target, while adjusting policies as needed based on economic data. These anticipated policy adjustments will be crucial for shaping market expectations and investment strategies in the coming years.

## III. Industry Analysis

The real estate sector saw residential areas excel while commercial spaces weakened, largely due to increased demand for suburban homes during the pandemic and the shift to remote work. The sharp rise in mortgage interest rates, reaching nearly 8 percent by October 2023, significantly reduced housing demand and slowed the real estate market. Existing home sales dropped notably, especially for lower-income buyers, while new home construction saw a modest recovery. Despite high rates, strong labour markets and remote work helped sustain some housing demand.

The energy sector experienced significant volatility, transitioning towards renewables while fluctuating oil and gas prices. The document (Board of Governors of the Federal Reserve System, 2024), highlights a 4.9 percent decline in consumer energy prices over the past year, driven by increased U.S. oil production and reduced demand. Natural gas prices also fell due to high production and inventories. Additionally, increased focus on sustainability stimulates greater investment in renewable energy, transforming the industry's future. Additionally, in the given data in February 2022, EagleClaw Midstream and Altus Midstream (ALTM) merged, forming Kinetik (KINETIK, 2024), the largest publicly traded midstream company (Jiyang et al., 2020).

The technology sector thrived, driven by an accelerated shift towards digital solutions and remote working technologies during the pandemic. Companies focusing on cloud computing, cybersecurity, and e-commerce solutions saw significant growth (Hodson, 2018). The sector's resilience is also attributed to continuous innovation and increased reliance on technology across other industries.

Communication services were essential during the pandemic, facilitating remote work, education, and entertainment. This sector saw increased demand for broadband and mobile services, with significant investments in 5G technology and infrastructure upgrades to support higher data usage and connectivity needs (Fossung et al., 2021). According to the given data, Formed in 2019 by the merger of Viacom and CBS, the company is a subsidiary of National Amusements, Inc. Initially named ViacomCBS, it rebranded as Paramount Global in 2022 (Paramount, 2019).

This sector, which includes automotive, hospitality, and retail industries, faced significant challenges but also opportunities. E-commerce surged as consumers shifted online, benefiting companies with strong digital platforms. However, traditional retail and hospitality struggled with lockdowns and changing consumer preferences.

The industrial sector faced significant disruption but showed signs of recovery by adapting to new market conditions. Supply chain challenges and a shift towards automation and smart technologies characterised this recovery. Companies in aerospace, manufacturing, and construction had to navigate the complexities of disrupted supply chains and changing regulatory environments.

The financial services sector exhibited moderate growth between 2018 and 2022, delivering a five-year return of 7.5% and a CAGR of 6%. The sector's underperformance relative to the broader S&P 500 (86%) is primarily due to rising inflation and interest rates, which increased operational costs and impacted profitability. Financial services adapted to an evolving landscape of regulatory changes and technological disruption (Arthur et al., 2019).

The sector saw a surge in digital banking services as consumers embraced online and mobile platforms. The report notes that while the U.S. banking system remains stable, rising interest rates have tightened credit availability, leading to stricter lending standards and reduced loan demand from businesses and consumers (Board of Governors of the Federal Reserve System, 2024).

Utilities demonstrated stability, driven by consistent consumer demand, though the shift towards renewable energy sources introduced new dynamics. Regulatory changes supporting green energy initiatives influenced operational and investment decisions within the sector, with an increased focus on sustainability and efficiency improvements (Pham et al., 2023).

This report aims to deliver a detailed evaluation and strategy recommendations for investment portfolios tailored to the varying risk levels of Blackrock AM's clients. These strategies, derived from both conventional and advanced investment methodologies, are designed to maximise returns while effectively managing risk exposures.

## I. Without short selling strategy

Investment strategies that avoid short selling, while suitable for risk-averse investors, may limit portfolio effectiveness. This approach restricts diversification to only long positions, decreasing hedging opportunities and the potential to profit from market downturns. As a result, portfolios executing short selling often show higher returns and better risk management, providing key advantages in volatile markets. This method will be conducted since it performs well compared to the portfolio without a short sale.

## II. With short selling strategy

Blackrock AM utilises a sophisticated mean-variance optimization approach to create adjusted investment portfolios matching individual risk levels—low, medium, and high. This method optimally aligns historical data and asset volatility to balance each strategy's risk against potential returns. Low and high-risk portfolios are determined with the highest and lowest points in the efficient frontier. Subsequently, the medium-risk portfolio are measured by the sharpe ratio with 0.9 percentile, which outperformed in comparison to a 0.8 percentile in terms of return by roughly 10%.

**Low-risk Portfolio:** The low-risk portfolio offers a conservative approach with an annualised return of 3.78% and a low standard deviation of 12.32%. This portfolio is strategically composed of stable, low-volatility assets, which are less receptive to market fluctuations. It aims to generate stable, reliable returns with minimal risk to principal investment.

**Medium-risk Portfolio:** With an annualised return of 36.24% and a standard deviation of 18.31%, the medium-risk portfolio is for investors seeking balanced growth. It is optimised with moderate levels of risk and to obtain returns in asset value over a medium to long-term.

**High-risk portfolio:** The high-risk portfolio targets an aggressive growth strategy with an annualised return of 54.56% and a higher standard deviation of 24.52%. It primarily invests in high-return stocks. This portfolio is suitable for investors with a high-risk tolerance, which seeks to capitalise on high-return chances with higher volatility and risk.

## III. Critical analysis with short sales

When unexpected price rises in stocks, potential unlimited losses will be seen due to no upper limit to how high prices can go. This also can trigger a margin call, requiring investors to fund more to cover the deficit.

Additionally, unacceptable stock allocation is not only noticeable with ARTNA at roughly 75% in a high-risk portfolio but also in a medium-risk portfolio with 67% on average. This inadequate diversification occurs due to the limited constraints.

## IV. Comparative Analysis of Equally Weighted Portfolio Performance

Contrary to the equally weighted portfolio, Blackrock AM's optimised portfolios, which execute short selling, illustrate a more refined approach to risk management and potential return. The equally weighted portfolio offers a straightforward but less nuanced,

which implies a higher risk without necessarily maximising returns, as it equally distributes capital across all 20 stocks without considering individual asset performance or volatility.

Unlike, the portfolios are constructed with short sale-categorised into low, medium, and high-risk, which describe a conscious measurement of risk and return based on specific investor preferences. These portfolios leverage short sales to enhance diversification and adjust exposure dynamically, allowing them to capitalise on market upturn and downturn. It not only hedges against potential losses in market decline but also generates gains. The strategic use of short sale enables the client to manage risk more effectively with superior returns.

Executing a 5% risk-free rate offers investors opportunities to enhance returns through borrowing or to lower portfolio volatility through lending. This flexibility shifts the capital market line, influencing our investment strategies to better align with client's risk tolerance. It highlights the strategic advantage of reallocating between risk-free and risky assets to maximise returns for a specific risk level.

## I. Capital Market Line

The Capital Market Line describes the relationship between risk and return for efficient portfolio management (Ganti, 2019). The slope, determined by the Sharpe ratio, represents the additional return. The intersection with this line and the efficient frontier is at the optimal risky portfolio.

The option to borrow or lend at a risk-free rate of 5% per annum, can contribute to significant changes to the portfolio management. The investor would be able to leverage more efficiently to seek higher returns although they might be with increased risk exposure, which can attract risk lover investors to amplify their overall performance.

## II. Changes in a portfolio

### a. Without short sales (Appendix 3 and 5)

The sharpe ratios ranging from various percentiles represents a wide range of risk-adjusted returns, leading to an optimal portfolio. In comparison with the portfolio not utilising the capital market line, a more optimised portfolio illustrates a more conservative approach, focusing on a combination of high-risk and no-risk assets. By applying this strategy, a significant 90% is invested in riskier assets while a small fraction is allocated to safer options. This method manages to achieve a solid annual return of 33.12%, all while substantially reducing volatility to 28.12%. This comparison emphasises the essential dilemma in investment strategies: the choice between pursuing potentially higher returns with increased volatility, or

selecting a more cautious approach that provides lower, but steadier returns, according to Evidence Based Investing (2024).

b. With short sale (Appendix 2 and 4)

Compared to the portfolio suggested in Part 2(f), the expected return and volatility would be identical to those of the high-risk portfolio, as the optimised weight at the highest Sharpe ratio is 1. This indicates that the investor will allocate 100% of their investment to risk assets, without any allocation to risk-free rate.

III. Critical analysis

a. Volatility (Appendix 6)

Standard deviation is commonly used in portfolio management as a risk indicator by measuring how much returns deviate from their average. However, its usefulness is limited because it treats all deviations the same, whether they are gains or losses. This means it does not distinguish between good volatility that comes from high returns and harmful volatility from losses. Because of this, standard deviation alone may not give clients a clear understanding of the type of risks present in their portfolios. As an illustration, the three skyrocketed stocks, ALTM, APRN, HOV, are highly volatile even though the values are positive. This type of output would be misleading.

b. Capital Market Line

The Capital Market Line (CML) models the risk-return trade-off for efficient portfolios, but it has several limitations. It assumes the existence of a completely risk-free asset and that all investors share uniform information and expectations, which is rarely the case. The CML uses only standard deviation to measure risk, overlooking factors like skewness and liquidity needs. It also presupposes that investors are rational, choosing only portfolios that maximise returns for a given risk level.

## IV. Alternative Strategy

The Arbitrage Pricing Theory (APT) can be recommended, which is a multifactor approach that forecasts asset returns based on multiple macroeconomic elements, such as inflation and GDP growth, with each factor having its own beta value (Hayes, 2020). This includes various determinants, providing a more detailed risk-return assessment. It assumes that arbitrage opportunities are temporary because they are quickly exploited, resulting in market balance. With less dependence on market efficiency, APT suits a wider array of assets and aligns more closely with actual market scenarios with such empirical testability (Huberman, 1982).

This report discusses the additional analysis which can be provided, which is industry-specific analysis. . Overlooking industry-specific risks in portfolio construction can significantly undermine both the resilience and effectiveness of investments.

I. Communication Services and Consumer Cyclical Sectors (Appendix 7)

In the Communication Services sector, there has been a significant pivot in high-risk investments by 57.5%, representing an aggressive initiation towards more highly profitable growth with increased growth. On the other hand, the Consumer Cyclical sector illustrates any notable trend among the three categories. The potential reason would be that consumer goods are not significantly affected by economic shifts. Hence the risks are nearly negative, which shows a steady characteristic.

II. Energy Sector (Appendix 7)

The energy sector shows a significant increase in risk at all levels, with low and medium risks describing increases of - 10.95% and 15.89% respectively. A diversified strategy such as renewable energy as well as more volatile industries from oil and gas in a fluctuating global market are required to be cautiously taken into consideration. In reality, 4.9% of the drop in consumer energy price is observed with an increase in U.S. oil production and the reduction of consumer demand (Board of Governors of the Federal Reserve System, 2024).

III. Real Estate, Technology and Utilities Sectors (Appendix 7)

Real Estate sector has observed the highest risk at 50.71% while it has dropped by 70%, which ended up at -19.42%. This industry is heavily affected by the change of interest rate as well as economic growth. For instance, the sharp rise in mortgage interest rate up to 8% is heavily affecting the housing demand. The Technology sector shows the

different movements in all categories of risks. The advancement in the technology sector is remarkable and new trends has been emerging all of the years. Although the risks are high, the return would come consistently, followed by the compounded annual growth rate (CAGR) at 12% on average. A 5-year return in the technology sector being double that of the S&P 500 indicates substantial outperformance, suggesting that investments in technology have yielded twice the returns of the broader market, reflecting higher growth, innovation, and an increased risk tolerance among investors for potentially higher rewards. Subsequently, the Utilities sector has shown the highest percentage of risks at 76.67% in comparison with the other sectors. Predictability in regulations, diversification and stability are one of the attractive points to counterbalance the uncertainty of high-risk investments. Hence when optimising a portfolio, taking into account to hedge the risks with predictable sectors are significantly crucial.

## IV. Limitations and Recommendations

Notable limitations would be that the efficient frontier does not only show uncertainty in volatility but also the single-factor model does not highlight in-depth analysis. Hence, the section mentioned outlines potential industry-specific analysis with collected data as well as the compound annual growth rate as benchmark. Considering risks to specific industries when building a portfolio can greatly strengthen its resilience and impact.

## References


Ahmad, M., Khan, Y. A., Jiang, C., Kazmi, S. J. H., & Abbas, S. Z. (2021). The Impact of COVID-19 on Unemployment rate: an Intelligent Based Unemployment Rate Prediction in Selected Countries of Europe. *International Journal of Finance & Economics*, *28*(1). https://doi.org/10.1002/ijfe.2434

Arthur, K. N. A., & Owen, R. (2019). A Micro-ethnographic Study of Big Data-Based Innovation in the Financial Services Sector: Governance, Ethics and Organisational Practices. *Journal of Business Ethics*, *160*(2), 363–375. https://doi.org/10.1007/s10551-019-04203-x

Baker Hughes. (2019, October 17). *BHGE changes its name to Baker Hughes Company | Baker Hughes*. Www.bakerhughes.com. https://www.bakerhughes.com/company/news/bhge-changes-its-name-baker-hughes-company

Blinder, A. S. (2023). Landings, Soft and Hard: The Federal Reserve, 1965–2022. *Journal of Economic Perspectives*, *37*(1), 101–120. https://doi.org/10.1257/jep.37.1.101

Board of Governors of the Federal Reserve System. (2024). *Board of Governors of the Federal Reserve System Monetary Policy rePort*. https://www.federalreserve.gov/publications/files/20240301_mprfullreport.pdf

Evidence Based Investing. (2024). *Investor Dilemma*. Evidencebasedinvestingllc.com. https://evidencebasedinvestingllc.com/investor-dilemma/#:~:text=The%20Investors

Ganti, A. (2019). *Capital Market Line (CML) Definition*. Investopedia. https://www.investopedia.com/terms/c/cml.asp

Hayes, A. (2020, November 17). *Understanding Arbitrage Pricing Theory*. Investopedia. https://www.investopedia.com/terms/a/apt.asp

Hodson, E. L., Brown, M., Cohen, S., Showalter, S., Wise, M., Wood, F., Caron, J., Feijoo, F., Iyer, G., & Cleary, K. (2018). U.S. energy sector impacts of technology innovation, fuel price, and electric sector CO2 policy: Results from the EMF 32 model intercomparison study. *Energy Economics*, *73*, 352–370. https://doi.org/10.1016/j.eneco.2018.03.027

Huberman, G. (1982). A simple approach to arbitrage pricing theory. *Journal of Economic Theory*, *28*(1), 183–191. https://doi.org/10.1016/0022-0531(82)90098-9

Jiang, Y., Ho, Y.-C. (Chad), Yan, X., & Tan, Y. (2020). When Online Lending Meets Real Estate: Examining Investment Decisions in Lending-Based Real Estate Crowdfunding. *Information Systems Research*. https://doi.org/10.1287/isre.2019.0909

KINETIK. (2024, August 9). *EagleClaw Midstream & Altus Midstream Merger | Kinetik*. Kinetik. https://www.kinetik.com/about-us/merger-at-a-glance/

Niu, H., Lu, Y., & Wang, W. (2021). Does investor sentiment differently affect stocks in different sectors? Evidence from China. *International Journal of Emerging Markets*, *ahead-of-print*(ahead-of-print). https://doi.org/10.1108/ijoem-11-2020-1298

Son Duy Pham, Thac, T., & Hung Xuan Do. (2023). Natural gas and the utility sector nexus in the U.S.: Quantile connectedness and portfolio implications. *Energy Economics*, *120*, 106632–106632. https://doi.org/10.1016/j.eneco.2023.106632

Talbot, D., & Boiral, O. (2015). GHG Reporting and Impression Management: An Assessment of Sustainability Reports from the Energy Sector. *Journal of Business Ethics*, *147*(2), 367–383. https://doi.org/10.1007/s10551-015-2979-4

Trading Economics. (2024). *United States Consumer Price Index (CPI)*. Tradingeconomics.com; TRADING ECONOMICS. https://tradingeconomics.com/united-states/consumer-price-index-cpi

Yahoo Finance. (2024). *Economic Sector Performance Dashboards - Yahoo Finance*. Yahoo.com. https://finance.yahoo.com/sectors/technology/

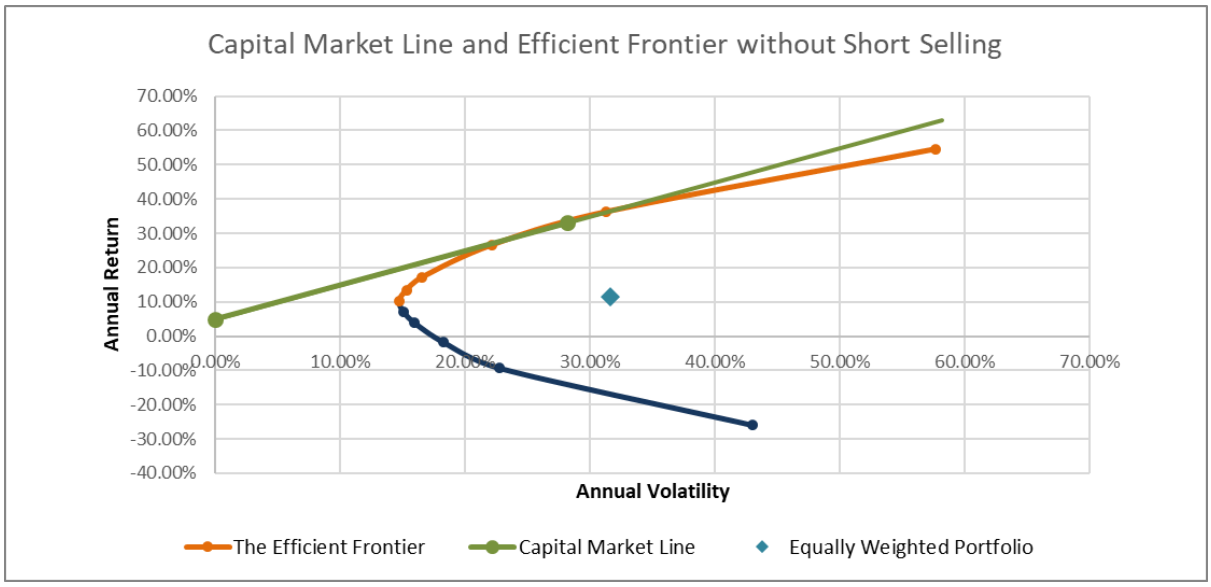
# Appendix

| Equally Weighted Portfolio | |
|---|---|
| Annualized Returns | 11.59% |
| Standard Deviation | 31.62% |
| Weights | |
| WTTR | 0.05 |
| ALTM | 0.05 |
| APPN | 0.05 |
| FPH | 0.05 |
| SOI | 0.05 |
| ATUS | 0.05 |
| APRN | 0.05 |
| MOG | 0.05 |
| BXMT | 0.05 |
| HOV | 0.05 |
| WSO | 0.05 |
| VOXX | 0.05 |
| BHGE / BKR | 0.05 |
| VIACA | 0.05 |
| CRD | 0.05 |
| TCX | 0.05 |
| ARTNA | 0.05 |
| AMRC | 0.05 |
| MGY | 0.05 |
| QUAD | 0.05 |

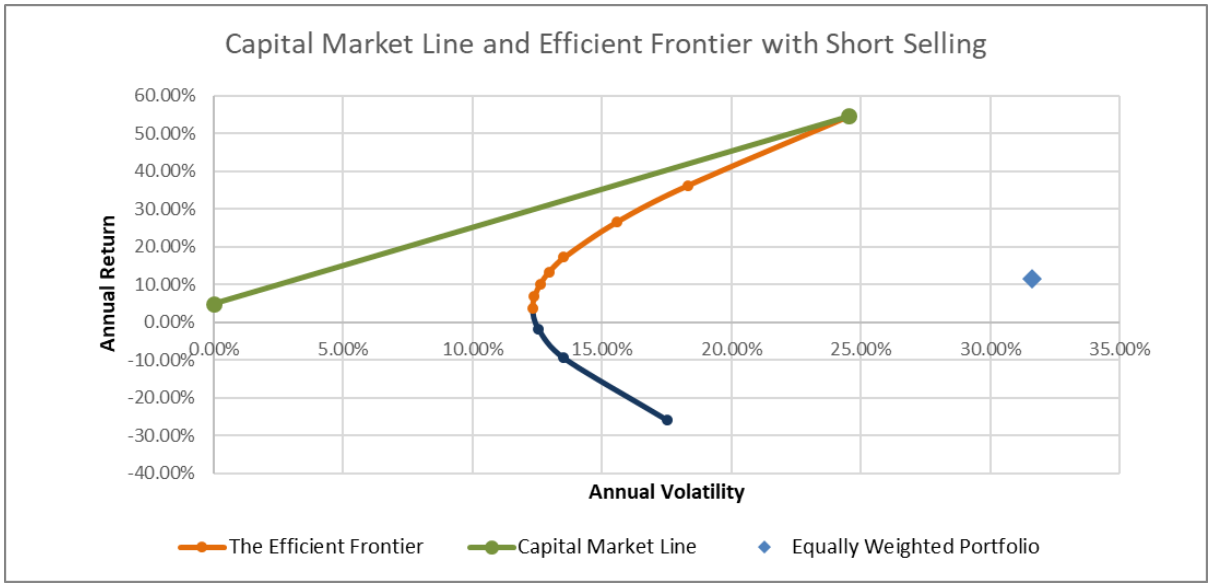
| With short Seling | | | |
|---|---|---|---|
| | Low-Risk | Medium-Risk | High-Risk |
| Annualized Returns | 3.78% | 36.24% | 54.56% |
| Standard Deviation | 12.32% | 18.31% | 24.52% |
| | Weights | | |
| WTTR | -0.0241 | -0.0536 | -0.0713 |
| ALTM | -0.0230 | -0.0124 | -0.0074 |
| APPN | 0.0118 | 0.0738 | 0.1064 |
| FPH | -0.0091 | -0.2048 | -0.3149 |
| SOI | 0.0368 | -0.0084 | -0.0346 |
| ATUS | -0.1009 | -0.2249 | -0.2920 |
| APRN | 0.0340 | 0.0071 | -0.0061 |
| MOG | 0.0047 | 0.0413 | 0.0749 |
| BXMT | 0.5403 | 0.3167 | 0.1919 |
| HOV | -0.0404 | -0.0113 | 0.0056 |
| WSO | 0.1308 | 0.3247 | 0.4246 |
| VOXX | -0.0359 | 0.0129 | 0.0423 |
| BHGE / BKR | -0.0086 | 0.0239 | 0.0378 |
| VIACA | 0.0195 | -0.1741 | -0.2830 |
| CRD | 0.0629 | 0.0062 | -0.0276 |
| TCX | 0.0584 | 0.0016 | -0.0318 |
| ARTNA | 0.4586 | 0.6583 | 0.7667 |
| AMRC | -0.0366 | 0.0619 | 0.1195 |
| MGY | -0.1146 | 0.1558 | 0.3113 |
| QUAD | 0.0355 | 0.0052 | -0.0124 |

| Without short Seling | |
|---|---|
| | Low-Risk |
| Annualized Returns | 10.17% |
| Standard Deviation | 14.72% |
| Weights | |
| WTTR | 0.0000 |
| ALTM | 0.0000 |
| APPN | 0.0000 |
| FPH | 0.0000 |
| SOI | 0.0000 |
| ATUS | 0.0000 |
| APRN | 0.0156 |
| MOG | 0.0000 |
| BXMT | 0.2145 |
| HOV | 0.0000 |
| WSO | 0.1331 |
| VOXX | 0.0000 |
| BHGE / BKR | 0.0000 |
| VIACA | 0.0000 |
| CRD | 0.0650 |
| TCX | 0.0215 |
| ARTNA | 0.5398 |
| AMRC | 0.0000 |
| MGY | 0.0000 |
| QUAD | 0.0105 |

Appendix 1: Equally Weighted Portfolio, Portfolios with short sales and without short sales




Appendix 2: Capital Market Line and Efficient Frontier without Short Sale




Appendix 3: Capital Market Line and Efficient Frontier with Short Sale

| Without Short Selling | | | |
|---|---|---|---|
| Percentile | Annual Volatility | Annual Exp Return | Sharpe Ratio |
| 0 | 43.00% | -26.03% | -0.721616912 |
| 0.1 | 22.81% | -9.46% | -0.634080976 |
| 0.2 | 18.30% | -1.89% | -0.376275964 |
| 0.3 | 15.99% | 3.78% | -0.076103168 |
| 0.4 | 15.12% | 6.88% | 0.124423117 |
| 0.5 | 14.72% | 10.17% | 0.351171175 |
| 0.6 | 15.27% | 13.37% | 0.547767871 |
| 0.7 | 16.54% | 17.17% | 0.735583777 |
| 0.8 | 22.16% | 26.65% | 0.976780636 |
| 0.9 | 31.24% | 36.24% | 1.000065821 |
| 1 | 57.64% | 54.56% | 0.859708603 |
| Optimal portfolio: | 0.31240567 | 0.362426233 | 1.000065821 |

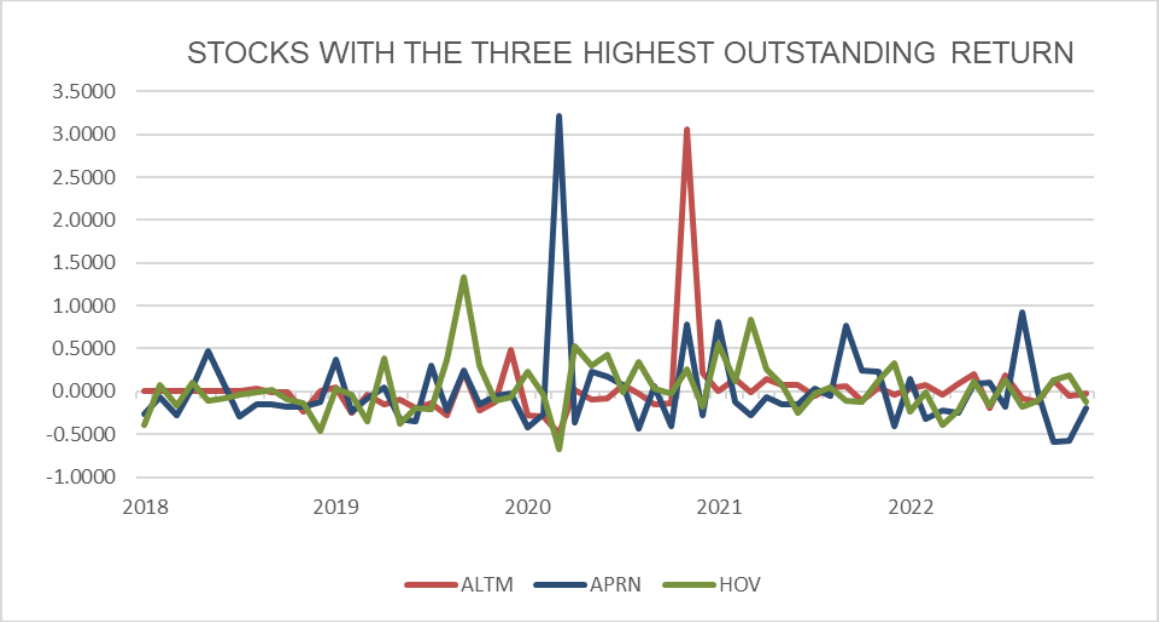
| Capital Market Line | | |
|---|---|---|
| Weight | Annual Volatility | Annual Return |
| 0 | 0 | 0.05 |
| 0.9 | 0.281165103 | 0.331183609 |

Appendix 4: Output without short sales

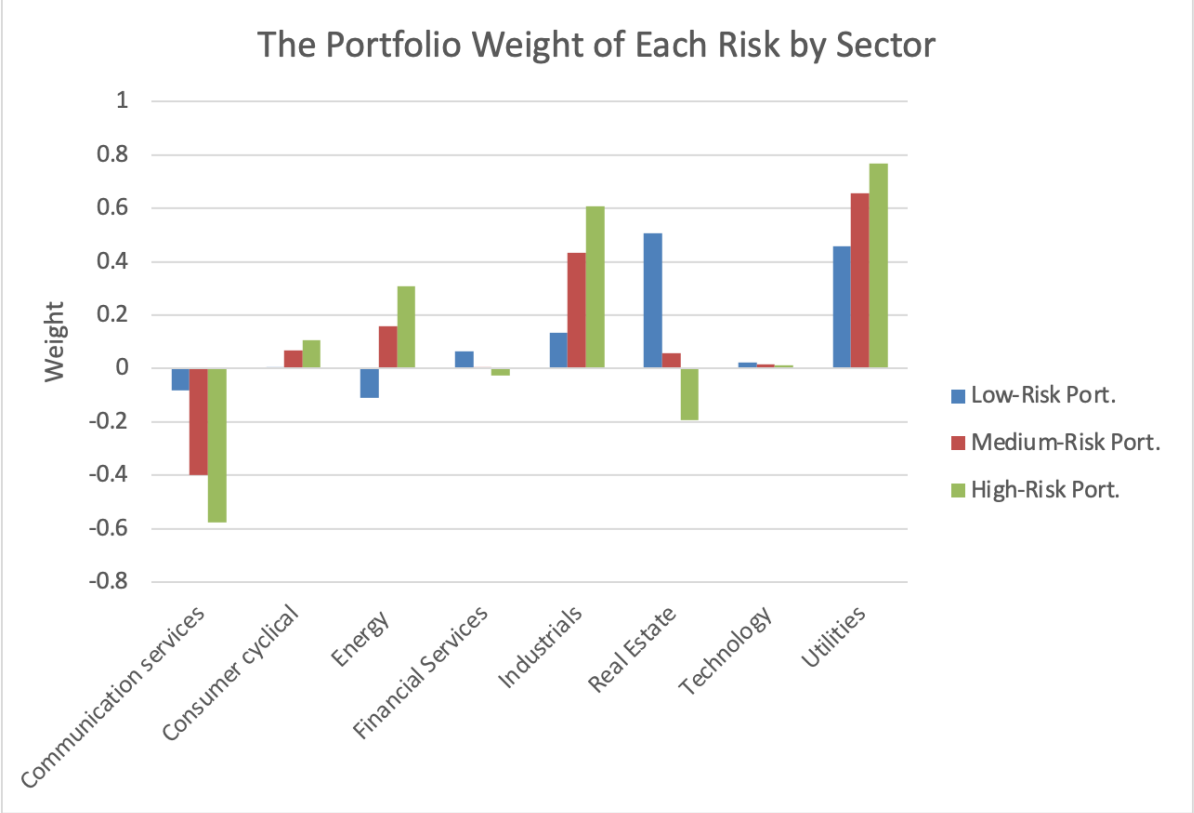
| With Short Selling | | | |
|---|---|---|---|
| Percentile | Annual Volatility | Annual Exp Return | Sharpe Ratio |
| 0 | 17.53% | -26.03% | -1.77001095 |
| 0.1 | 13.51% | -9.46% | -1.070409457 |
| 0.2 | 12.55% | -1.89% | -0.548766004 |
| 0.3 | 12.32% | 3.78% | -0.098756693 |
| 0.4 | 12.38% | 6.88% | 0.151943489 |
| 0.5 | 12.60% | 10.17% | 0.410101332 |
| 0.6 | 12.95% | 13.37% | 0.646201711 |
| 0.7 | 13.52% | 17.17% | 0.899801768 |
| 0.8 | 15.58% | 26.65% | 1.389486214 |
| 0.9 | 18.31% | 36.24% | 1.706330739 |
| 1 | 24.52% | 54.56% | 2.021241194 |
| Optimal portfolio: | 0.245175528 | 0.545558876 | 2.021241194 |

| Capital Market Line | | |
|---|---|---|
| Weight | Annual Volatility | Annual Return |
| 0 | 0 | 0.05 |
| 1 | 0.245175528 | 0.545558876 |

Appendix 5: Output with short sales




Appendix 6: Stocks with the three highest outstanding return




Appendix 7 : The Portfolio Weight of Each Risk by Sector