

PORFOLIO ANALYSIS USING Markowitz Portfolio Theory

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Introduction

The report includes a detailed examination and creation of a portfolio of 10 securities, each of which is composed of eight firms, one metal, and one cryptocurrency. The securities will be studied from January 1st, 2021 to December 31st, 2021.

Every investor's primary goal is to enhance the value of his or her portfolio and earn returns while limiting the risks or uncertainties connected with it. Risk managers can calculate the best proportion of investment for each asset or security and manage the portfolio while reducing risk/uncertainty. There are two sorts of investment approaches: top-down and bottom-up. This report used the Top-Down strategy, in which we first allocated assets and then selected security.

The firm's raw returns were computed using the fundamental formula $(P_t - P_{t-1})/P_{t-1}$. The covariances were determined, and the portfolios were analyzed using the Markowitz Model Portfolio with these values to obtain the minimal variance and tangency portfolios. The efficient frontier was then generated using the same model.

Overview of Manufacturing Sector in India

Manufacturing is one of India's fastest expanding industries. Narendra Modi, India's Prime Minister, has started the "Make in India" campaign to put India on the map as a manufacturing center and to get worldwide prominence for the Indian economy. By 2022, the government hopes to have created 100 million new employment in this industry.

According to a study performed by the Federation of Chambers of Commerce and Industry of India (FICCI), capacity utilization in India's manufacturing sector remained at 72.0 percent in the second quarter of FY22, indicating a considerable rebound in the industry. In July 2021, the total index was 134.0. Growth in natural gas, steel, cement, fertilizer, coal, oil refining, and power production aided the index's increase. Natural gas output climbed by 18.9 percent in July 2021,

followed by coal (18.7 percent), oil refining (6.7 percent), fertilizer (0.5 percent), steel (9.3 percent), cement (21.8 percent), and power (21.8 percent) (9.0 percent).

Securities Selected For Analysis

ASAHI INDIA



Asahi India Glass Ltd.

Asahi India Glass Ltd (AIS) is India's premier integrated window and glass solution provider, with a strong presence in both the automotive and building and construction industries. Their product solutions cover the whole automotive, building & construction, and consumer glass ranges, and are designed to provide both aesthetic and practical benefits. Asahi India Glass has a market valuation of \$1.52 billion as of March 2022. According to the statistics, this places Asahi India Glass as the 3851st most valuable business in the world by market value. Their combined assets are valued at around 2376 Credits.

AIS has divided its operations into three Strategic Business Units in order to better focus on certain market areas and better serve clients (SBUs)

- **Automotive Glass (77% market share)**
- **Architectural glass**
- **Tempered glass**

RAYMOND



Raymond Corporation, founded in 1925, is an Indian supplier of designer apparel and textiles. It produces tailoring textiles and has a capacity of 31 million meters of wool and mixes.

Raymond, Raymond Premium Apparel, Raymond Made to Measure, Ethnix, Park Avenue, and Park Avenue Woman ColorPlus are among the apparel brands owned by the firm. All products are sold through 'The Raymond Shop' (TRS), which has over 700 retail locations in India and overseas in over 200 cities. Furthermore, the firm has a presence in ready-to-wear, designer apparel, cosmetics and toiletries, tools and technical records, redundancies, and airplane charter operations. Raymonds launched a real estate joint venture called Raymond Realty in 2019. Their revenue in 2022 is estimated to be 50,000Cr. Raymond's market capitalization is Rs 4,883.52 Cr.

SUNDRAM FASTENERS



Sundram Fasteners Ltd is one of India's top auto component manufacturers and is part of the \$8.5 billion TVS Group. Fasteners, powertrain parts, sintered metal parts, powdered iron parts, iron cold extrusions, cold extrusions, radiator caps, and power components are all manufactured by the firm. The amount of wind The corporation has six local subsidiaries and five foreign subsidiaries. Sundram Fasteners Ltd was formed as a limited liability business on 10 December 1962 under the name Kasjax Engineering Ancillaries Pvt Ltd, and the name was changed to Sundram Fasteners (P) Ltd on 3 July 1965.

Sundram Fasteners has a market capitalization of Rs 17,905.04. Operating income was Rs 1,024.25 crore for the quarter ending December 31, 2021, up 8.7 percent from Rs 942.20 crore in the same period previous year.

JK PAPER



The firm is India's largest branded paper maker and a prominent participant in luxury packaging paper and board. In 1992, JK Corp Ltd, a subsidiary of HS Group Singhania, took over the failing firm known as BIFR. As of November 6, 2003, JK Corp. owned 44.76 percent of the company's stock. JK Paper now has a total installed capacity of 150,000 tpa, with two integrated paper mills in Orissa (Inst. Cap 100,000 tpa) and Gujarat (Central Pulp Mills) (Inst. Cap 50,000 tpa). The paper mills of the corporation have a capacity utilization efficiency of 115 percent on average. In addition, the corporation changed its FCCB (series 3) into Rs 7,428,240 equity shares. JK Paper stock has a market capitalization of 1. JK Paper has a market capitalization of Rs 3,798.00 Cr.

CG CONSUMER



CG Power and Industrial Solutions Limited, formerly known as Crompton Greaves Limited, is an Indian multinational corporation engaged in the design, manufacture and marketing of products related to electricity generation, transmission and distribution. Crompton is one of the leading manufacturers of consumer products ranging from fans, light sources and luminaires, pumps, and household appliances.

MONTE CARLO



Monte Carlo Fashions Ltd was founded in 1984 by Oswal Woolen Mills Ltd, the Nahar group's main firm. ISO 9001: 2000 accreditation has been obtained by the firm. In a summer 2009 research conducted by Images-ORG-MARG, it was also ranked the No. 1 brand in the men's

clothes category. Monte Carlo has been voted one of Asia's greatest marketing brands. It has a market value of Rs. 1020.54 Crs. and is a small cap business.

MM FORGINGS



In 1946, Madras Motors Pvt Ltd was established. In 1975, it became a publicly traded firm. The firm began by dealing in imported two-wheelers and eventually grew to incorporate steel forging activities. On April 1, 1993, the company's name was changed to M M Forgings. The firm produces carbon and alloy steel forgings with individual forging pieces weighing between 15 kg and 60 kg at its two forging facilities in Tamilnadu, Singampunari Madurai district and Viralimalai Trichy district (combined capacity: 15000 tpa). It is a small-cap firm having a market valuation of Rs. 1951.30 Crs.

ANDHRA PAPER LTD.



In 1964, the firm was founded as Andhra Pradesh Paper Mills. International Paper (IP) purchased the firm in 2011, and the company was renamed "International Paper APPM Limited" in 2013.

West Coast Paper Mills Ltd purchased the bulk of the company's stock in 2019. (WCPM).

WCPM is one of India's largest makers of printing and publishing paper. Andhra Paper Ltd was acquired by WCPM. It is a small cap business having a market cap of Rs. 850.48 Crs. The firm recorded a total income of Rs. 353.85 Crs for the past quarter, a 1.34 percent decline from the previous quarter and a 40.13 percent rise from the same quarter last year.

GOLD



Gold has always been seen as a safe haven asset during times of financial instability. Many investors have been acquainted with gold through acquiring equities in exploration and mining firms. Gold has captivated human populations more than any other commodity from the beginning of recorded history. Gold became widely recognised as a suitable form of payment as cultures matured. Even if the metal's demand declines, supply will ultimately grow. Because gold has non-monetary applications such as jewelry, electronics, and dentistry, it should always have a minimum level of genuine demand. It may be divided evenly and correctly without losing value, unlike diamonds, and it does not splinter.

ETHEREUM



Ethereum is a cryptocurrency-transfer system that allows you to transmit money to others for a small cost. It also runs open-source programmes that no one can disable.

It is the world's first programmable blockchain, and it builds on Bitcoin's achievements, but with significant changes. Both allow you to utilize digital money in the absence of payment providers or banks. Because it is programmable, Ethereum, on the other hand, may be used to create a variety of digital assets, including Bitcoin. This implies that Ethereum may be used for purposes other than payments. It is appropriate for a wide range of applications, such as financial services, gaming, and software, and it will not censor or steal user information. Ethereum may be used by anybody to gain access to digital money.

Markowitz Portfolio

Modern portfolio theory (MPT) is a technique for risk-averse investors to build diversified portfolios that maximize returns while avoiding unacceptable levels of risk. Modern portfolio theory can help investors who wish to use ETFs to develop efficient and diverse portfolios.

Problems can be generalized to a variety of risky securities as well as a risk-free asset. The problem may be handled using two risky securities as an example:

We begin by determining the risk–return combinations accessible from the collection of risky assets; subsequently, we uncover the optimal risky asset portfolio by maximizing our portfolio's Sharpe Ratio by discovering the portfolio weights that result in the steepest CAL. Finally, we pick a suitable full portfolio by combining the risk-free and risky assets by maximizing the utility function based on risk aversion.

- When short selling is allowed

$$\text{Min } \sigma_p^2 = \mathbf{w}' \boldsymbol{\Sigma} \mathbf{w}$$

Constraint: $\mathbf{w}' \mathbf{1} = 1$

w - vector of asset weights

$\boldsymbol{\Sigma}$ - variance-covariance matrix

- When short selling is banned

$$\text{Min } \sigma_p^2 = \mathbf{w}' \boldsymbol{\Sigma} \mathbf{w}$$

Constraint: $\mathbf{w}' \mathbf{1} = 1, \mathbf{w} > 0$

w - vector of asset weights

$\boldsymbol{\Sigma}$ - variance-covariance matrix

Inputs For Markowitz model

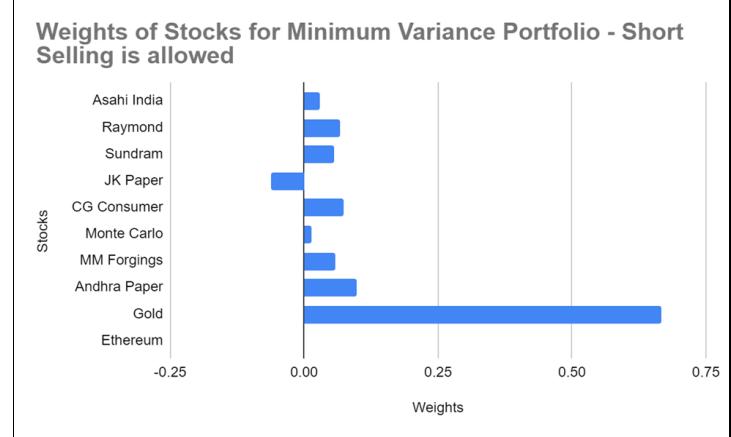
Stocks	Variance	Annualized Variance	Mean	Annualized return
Asahi India	0.000736	0.185401	0.002574	0.911592
Raymond	0.000622	0.156806	0.00261	0.928537
Sundram	0.000488	0.123066	0.002455	0.854852
JK Paper	0.001018	0.256645	0.00292	1.084861
CG Consumer	0.000399	0.100484	0.000787	0.219415
Monte Carlo	0.001001	0.252359	0.004168	1.852091
MM Forgings	0.000684	0.172403	0.00262	0.933467
Andhra Paper	0.000448	0.112851	0.000284	0.07416
Gold	7.01E-05	0.017665	-0.00016	-0.03961
Ethereum	0.004715	1.188283	0.009014	8.597229

Variance and Co-Variance Matrix										
index	Asahi India	Raymond	Sundram	JK Paper	CG Consumer	Monte Carlo	MM Forgings	Andhra Paper	Gold	Ethereum
Asahi India	0.1854007	0.0355401	0.0351774	0.0543537	0.0322142	0.063937	0.0232816	0.016126	-0.001728	0.0675579
Raymond	0.0355401	0.1568056	0.0342913	0.0646832	0.0197648	0.0385654	0.0177982	0.026689	-0.005486	0.0317134
Sundram	0.0351774	0.0342913	0.1230656	0.0439628	0.0192041	0.0077291	0.0268392	0.0108487	-0.0004	0.0206995
JK Paper	0.0543537	0.0646832	0.0439628	0.2566451	0.0370081	0.0354301	0.0665551	0.0985942	0.0030337	0.0310219
CG Consumer	0.0322142	0.0197648	0.0192041	0.0370081	0.1004842	0.015728	0.0031393	0.0165497	0.001381	0.0116338
Monte Carlo	0.063937	0.0385654	0.0077291	0.0354301	0.015728	0.2523589	0.0201167	0.018422	0.0017811	0.0612375
MM Forgings	0.0232816	0.0177982	0.0268392	0.0665551	0.0031393	0.0201167	0.1724034	0.0258519	-0.001562	-0.025051
Andhra Paper	0.016126	0.026689	0.0108487	0.0985942	0.0165497	0.018422	0.0258519	0.1128506	0.0007352	0.0216604
Gold	-0.001728	-0.005486	-0.0004	0.0030337	0.001381	0.0017811	-0.001562	0.0007352	0.0176649	0.0063208
Ethereum	0.0675579	0.0317134	0.0206995	0.0310219	0.0116338	0.0612375	-0.025051	0.0216604	0.0063208	1.1882826

Results

Minimum Variance Portfolio - When Short Selling is allowed

Stocks	Weights
Asahi India	0.02844
Raymond	0.06615
Sundram	0.05543
JK Paper	-0.06128
CG Consumer	0.07291
Monte Carlo	0.01296
MM Forgings	0.05858
Andhra Paper	0.09772
Gold	0.66781
Ethereum	0.00128



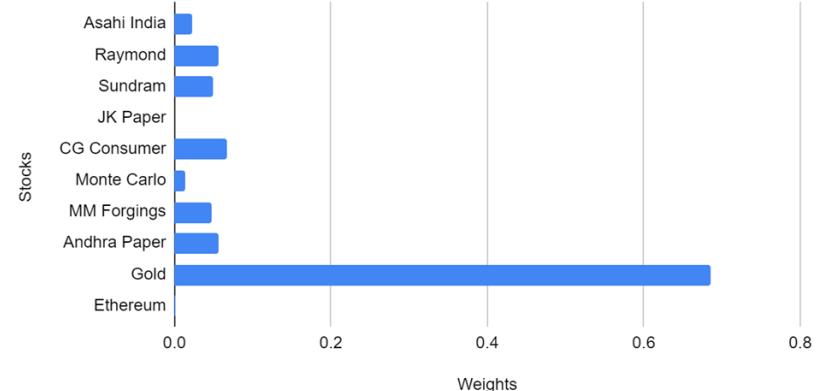
Portfolio_Return	0.1547
Constraint	1
Portfolio_Variance	0.01129
Portfolio Risk	0.10625
Rf	0.03396
Sharpe Ratio	1.13638

We obtained an Expected Returns of 15.47% with a Standard Deviation of 10.6% for the portfolio made by minimizing variance and when short selling is allowed. The portfolio then suggests investing(long position) more in Gold (66.781% of the Investable sum in Risky Assets) and Short Sell JK paper equity.

Minimum Variance Portfolio-short selling not allowed

Stocks	Weights
Asahi India	0.02218
Raymond	0.05662
Sundram	0.04942
JK Paper	0
CG Consumer	0.06774
Monte Carlo	0.0139
MM Forgings	0.04726
Andhra Paper	0.05586
Gold	0.68574
Ethereum	0.00128

Weights for Minimum Variance Portfolio-short selling not allowed

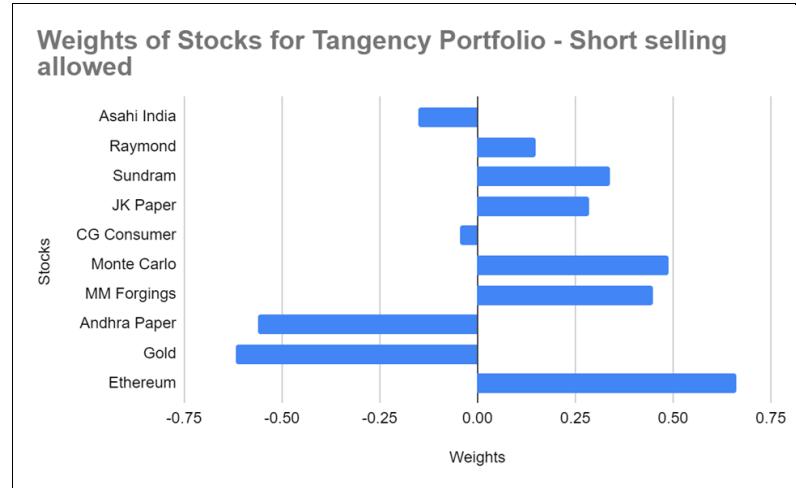


Portfolio_Return	0.18773
Constraint	1
Portfolio_Variance	0.01184
Portfolio Risk	0.10881
Rf	0.03396
Sharpe Ratio	1.41322

We obtained an Expected Returns of 18.773% with a Standard Deviation of 10.881% for the portfolio made by minimizing variance and when short selling is not allowed. The portfolio then suggests investing(long position) more in Gold (68.574% of the Investable sum in Risky Assets) and avoiding JK paper equity.

Tangency Portfolio - When Short selling allowed

Stocks	Weights
Asahi India	-0.14963
Raymond	0.15041
Sundram	0.33742
JK Paper	0.28395
CG Consumer	-0.04468
Monte Carlo	0.48987
MM Forgings	0.44906
Andhra Paper	-0.56097
Gold	-0.6188
Ethereum	0.66337



Portfolio_Return	7.60248
Constraint	1
Portfolio_Variance	0.70786
Portfolio Risk	0.84134
Rf	0.03396
Sharpe Ratio	8.99576

We obtained an Expected Return of 760.248% with a Risk of 84.134% with a tangency portfolio with short selling allowed. This portfolio suggests to invest more in Ethereum (66.337% of Investable sum in risky assets) and short sell Equities of Asahi India, CG Consumer, Andhra Paper and Gold. This Portfolio seems to be more aggressive and the sharpe ratio is steeper compared to minimum variance portfolio. The Increased sharpe ratio is attributed to the Increased Risk adjusted returns.

Tangency Portfolio -When Short selling not allowed

Stocks	Weights
Asahi India	0
Raymond	0.07607
Sundram	0.16188
JK Paper	0.01435
CG Consumer	0
Monte Carlo	0.21407
MM Forgings	0.21866
Andhra Paper	0
Gold	0
Ethereum	0.31497



Portfolio_Return	3.53306
Constraint	1
Portfolio_Variance	0.15859
Portfolio Risk	0.39823
Rf	0.03396
Sharpe Ratio	8.78656

We obtained an Expected Return of 353.306% with a Risk of 39.823% with a tangency portfolio with short selling is not allowed. This portfolio suggests to invest more in Ethereum (31.49% of Investable sum in risky assets) and invest nothing in Equities of Asahi India, CG Consumer, Andhra Paper and Gold. This portfolio is less aggressive (Lower risk) compared to the portfolio with short selling.

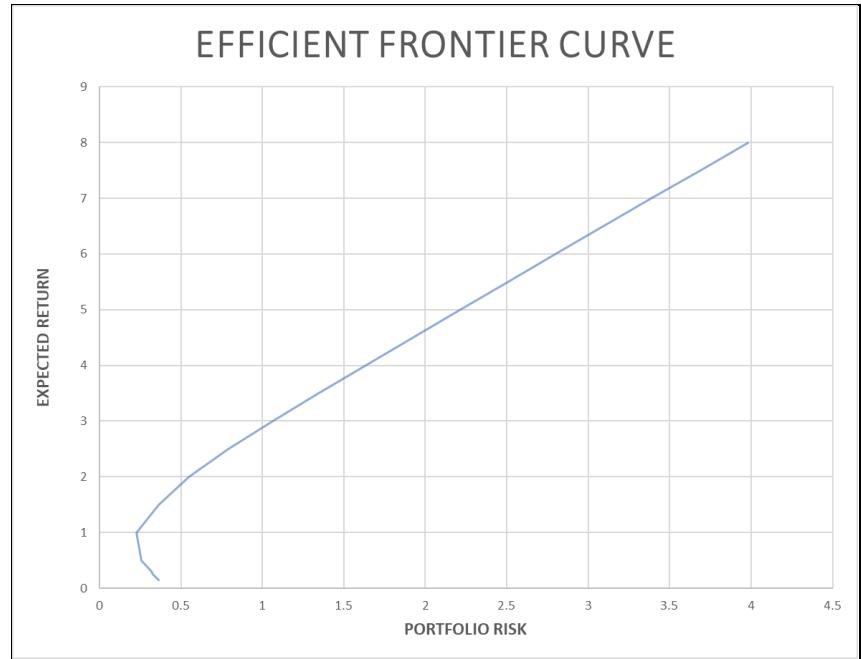
Efficient Frontier

The region on the curve between Expected return and Risk where we obtain the optimum portfolio of Maximum Expected returns for a specific risk or Lowest risk portfolio for a specified Expected return. We obtained the Efficient frontier curve specifying the expected returns and calculating the risk.

The efficient frontier is the curve above 15.47%. i.e(0.1547) of Expected return.

The curve below that point is not part of the efficient frontier.

Portfolio Risk	E(r)
0.36365184	0.15
0.346028064	0.2
0.329274506	0.25
0.318390375	0.3
0.258724097	0.5
0.228189911	1
0.364069984	1.5
0.549574634	2
0.791453015	2.5
1.063510564	3
1.346334351	3.5



1.634016537	4
1.924288349	4.5
2.216100228	5
2.50890133	5.5
2.802371975	6
3.096323539	6.5
3.390626885	7
3.685146289	7.5
3.97994845	8

LIMITATIONS OF MARKOWITZ PORTFOLIO MODEL

- The model is based on previous performance of securities. Past results are simply indicators of probable future outcomes and are not always correct. Considering merely previous performance may lead to overlooking newer variables that may not be discovered when using historical data. These decisions will occasionally play a significant part in decision making.
- This Model is based on the assumption that security returns are normally distributed. However, they are not normally dispersed. Non-Normality can arise during unanticipated economic shocks or crises, resulting in an incorrect portfolio risk.
- As the size of the portfolio increases Input list explodes which becomes computationally expensive.

- Correlations are supposed to be constant, which is incorrect for equities because they change over time. Also Industry specialization makes it harder to estimate correlations
- The Markowitz Model considers only a single objective i.e., either risk minimization or utility maximization whereas in the real world we need to satisfy both contradicting objectives simultaneously with some more constraints.
- The assumption that securities of any size can be traded is not true in real markets as some of the securities have minimum order sizes.
- The cost pertaining to taxes and trading is not considered in the model whereas that makes the difference when the volumes being traded are different for every security while making decisions.
- All the investors will have the same view on the Expected rate of return. But there is behavioral economics where that isn't considered.

Conclusion

Markowitz's modeling of the 10 securities, we now have an efficient frontier from which every investor may pick their level of risk. There is an ideal return that the investor would receive in exchange for that level of risk. One of the best portfolios for maximizing the Sharpe ratio with portfolio variance is the tangency portfolio. Markowitz modeling is used to determine the weights of the securities, which usually results in negative weights. Negative weights indicate that the investor should short-sell the provided security and invest the proceeds in positive-weighted assets.

We found that when the return climbed, so did the risk in all of the portfolios we looked at, which is consistent with the risk-return trade-off notion.

This portfolio has a reasonable level of diversity because it comprises assets from three distinct asset groups. We may diversify this portfolio further by including risk-free assets such as government bonds.

References

- <https://www.moneycontrol.com/india/stockmarket/sector-classification/marketstatistics/nse/manufacturing.html?classic=true>
- <https://www.ibef.org/industry/manufacturing-sector-india.aspx>
- [Crompton Greaves - TradingView India](#)
- https://www.gold.org/goldhub/data/gold-prices?gclid=EAIalQobChMIxK7-zuPM8wlViwkrCh2CsQh5FAAYASAAEgKcpPD_BwE
- https://en.wikipedia.org/wiki/Asahi_India_Glass_Limited
- https://en.wikipedia.org/wiki/Raymond_Group
- <https://www.sundram.com/>
- <https://www.jkpaper.com/>
- <https://www.andhrapaper.com/>
- https://en.wikipedia.org/wiki/CG_Power_and_Industrial_Solutions
- https://en.wikipedia.org/wiki/Monte_Carlo_Fashions_Limited
- <https://en.wikipedia.org/wiki/Ethereum>
- <https://finance.yahoo.com/>
- https://www1.nseindia.com/index_nse.htm
- <https://www.investing.com/>