Risk – Return Computation of and Computation of the Optimal Portfolio of the Chosen Metal Sector Stocks from NSE

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Abstract: In the current era of heightened market volatility, it is crucial for investors to adopt analytical methods for sound investment decisions. With increased millennial participation in equity markets, tools like beta, alpha, standard deviation, and Sharpe's Single Index Model become essential. This study focuses on evaluating risk and return for five major metal sector stocks listed on the NSE, comparing them with both the Nifty 50 and Nifty Metal indices. The analysis incorporates monthly data from April 2019 to March 2024 and applies traditional risk-return metrics as well as advanced portfolio construction techniques. The goal is to identify the most efficient investment combinations for risk-adjusted returns.

Keywords: Risk and Return, Standard Deviation, Beta, Sharpe Index, Optimal Portfolio, Nifty Metal, NSE.

1 Introduction

This study undertakes a thorough examination of the intricate relationship between risk and return among selected companies listed on the National Stock Exchange (NSE), with a comparison to the market and sectoral benchmark indices. In the world of finance, understanding this relationship is crucial for investors looking to make informed decisions. By analysing companies from the same sector, the research aims to uncover the subtle aspects of their performance in relation to broader market trends, as represented by the benchmark index. Using statistical tools and financial models, the study assesses each company's volatility, return patterns, and correlation with market fluctuations. This analysis not only seeks to offer detailed insights into the risk-return dynamics of these companies but also aims to enhance both academic and practical knowledge of market behaviour within the NSE context. Through this comparative approach, the study aims to provide valuable insights for investors, analysts, and policymakers, assisting in the strategic allocation of resources and the refinement of investment strategies within the ever-changing dynamics of the stock market. The stock market offers immense potential for wealth creation, especially for investors capable of balancing risk and return. This study examines five prominent metal sector stocks—Tata Steel, Vedanta, Hindustan Copper, NMDC, and SAIL—against the backdrop of both market and sectoral indices. It aims to quantify their performance using various financial and statistical measures and ultimately construct an optimal portfolio using Sharpe's Single Index Model.

2 Need for the Study

1. To conduct the risk and return analysis of Metal sector and Metal Sector stocks.
2. To give assistance to the investor to manage risk-return trade off.
3. To help the investors to improve and optimize their investment.

3 Objectives of the Study

1. To analyze Risk and Return of selected stocks from Metal Sector.
2. To compare the Risk and Return of Stocks with Nifty Metal and Nifty 50 Risk and Return.
3. To construct and evaluate an optimal portfolio using Sharpe's model.

4 Literature Reviews:

1. Karthika Palanisamy, Karthikeyan Parthasarathy (2020): **A study on Comparative Analysis of Risk and Return with reference to Selected stocks of BSE Sensex Index**, India studies the risk & return associated with the 10 selected stocks from BSE Sensex India. These stocks are selected from sectors like IT, Auto, Banking, Pharma and Oil sectors. These stocks are taken from Jan-2008 to May-2011 for the study.

P. Kulkarni and S. Sharma (eds.) *Proceedings of the IBA IEA Conference on Economics and Public Policy (Ecofluence 2024)*, Advances in Economics, Business and Management Research 335,
https://doi.org/10.2991/978-94-6463-766-3_17

2. Vaishnavi Patil, Priya Saware (2024): **Analysing the Relationship Between Risk and Return in the Equity Stocks of Ten Selected Companies Over Five years: An In-Depth Study**, aims to identify the relation between the risk – return parameter of 10 selected companies. The stock selected are from various sectors like Banking, Auto, IT, FMCG, Steel etc. The study majorly focuses on Returns, variance and SD of these stocks from the year 2018-19 to 2022-23. It studies risk and returns given by stocks with each other's returns and SDs.

3. Basavaraja T, Siddharameshwar (2024): **A Comparative Analysis of Risk and Return Among Chosen Companies Against the Benchmark Index in NSE**, studies the risk and return associated with Auto, Banking, Finance, FMCG, and IT sector stocks from 2019-2023. Study is conducted on the basis of daily return given by the stocks. These selected stocks are later compared with their respective sectoral benchmarks from NSE.

4. Ibrahim Patel, Azharuddin (2024): **Comparative Analysis of Returns and Standard Deviations of Companies' Stocks: A Five-Year Study (2019-2023)**, emphasis on five banking stocks from NSE, comparing its returns and standard deviations with Bank Nifty. The study aims to give a deep understanding of different types of risks which affects the returns given by the script on five-yearly basis.

5. Shashwata Kulkarni, Mallikarjun (2024): **Exploring Risk and Return Dynamics in Equity Stocks of Chosen 10 Companies: A Five-Year Investigation,** devolves into the complex study of risk and return of Ten stocks. The stocks are chosen for the period of five years from 2019-2024. This study majorly focuses on stocks chosen from NSE. The focus of the study were companies from Finance, Infra, IT, Auto and Pharma sector.

6. Mohammed Abdul Jaleel Kamran, Vishal, (2024): **Risk and Return Analysis on Selected 10 Companies: A Five-Year Study (2018-2022)**, studies the relation between the 10 selected stocks from NSE. Companies selected are from different sectors like FMCG, Banking, Entertainment, etc. The research tries to give practical insights for optimal investment strategies to balance the risk and return and helps to build an optimal portfolio.

7. Bhavani, Ramesh Police Patil (2024): **Comparative Analysis of Returns and Standard Deviations of Services Companies Stocks: A Five-Year Study (2019-2023)**, compares the returns and SD of the selected stocks of service companies. For this study stocks are taken from NSE. Such companies are from different sectors like IT, banking, telecommunication and FMCG. Returns and SD are compared between themselves.

8. Priscilla Ben, Jyoti Jamadar, Nandini B.S (2024): **Investigating Risk and Return Dynamics in Equities of Selected 10 Firms: A Five-Year Study (2019-2023),** this study focuses on risk and return associated with the Ten, systematically selected stocks. This study helps to empower shareholders with the information which would help them to negate unnecessary risk and gain more returns on their investments. For this study 10 companies from IT, Metal and Mining, Finance and banking and Auto sectors are taken from NSE from year 2019-2023.

9. Dr Kavitha Lal, Dr S. R. Subba Rao (2016): **Selecting an Optimal Portfolio for Investment in Stocks in India: A Sectoral Approach**, majorly focuses on selection of appropriate stocks from Indian Economy. Its emphasis on the choice of individual stocks within selected sectors to construct an optimal portfolio. For this study sectors like Auto, Bank, Energy, Finance, FMCG, IT, Media, Metal, Pharma, PSU Banks and Realty from NSE. The data selected are from 1st April 2014 to 31st March 2015.

10. Sathyanarayana K, Dr R. Satheeshkumar, Raghunandan N K (2019): **A Study on Expected Risk-Return of Selected Stock with Respect to Growth Industries**, majorly focuses on investor's investment decisions which revolves around high-growth industries. It helps the investors to take advantage of abnormal growth. For this study seven Indian sectors like Realty, Auto, Banking, Financial Services, IT and ITeS, Pharma and Media and 5 stocks from these respective sectors. The period chosen for the research is from 2015-2019.

11. Nandan, T., & Srivastava, N. (2024): **Construction of Optimal Portfolio Using Sharpe's Single Index Model: An Empirical Study on Nifty 50 Stocks.** This study applies SIM to Nifty 50 stocks, focusing on optimal portfolio construction. However, it does not delve into sector-specific analyses or provide a detailed risk-return assessment.

12. Kumar, U., & Chandrashekara, N. (2023): **An Empirical Study on Construction of Optimal Portfolio Using Sharpe's Single Index Model for Nifty 50 Stocks.** The research utilizes Sharpe's SIM to construct an optimal portfolio from Nifty 50 stocks, identifying eight suitable companies. While comprehensive, the study does not focus on sector-specific portfolios or delve into detailed risk-return analyses.

13. Suriyanarayanan, M., & Santhosh, D. (2024): **Construction of Optimal Portfolio Using Sharpe Single Index Model on Nifty Fifty Stocks.** This paper applies SIM to Nifty 50 stocks but does not explore sector-specific applications or provide an in-depth risk-return computation.

14. Bagrecha, C., & Guru, B. P. C. S. (2022): **Building an Optimal Portfolio Using Sharpe's Single Index Model: A Study of BSE Sensex Constituent Companies.** The study constructs an optimal portfolio using SIM for BSE Sensex stocks but does not focus on the metal sector or provide a detailed risk-return analysis.

15. Mistry, J., & Khatwani, R. (2023): **An Empirical Study on the Utility of Sharpe's Single Index Model in Optimal Portfolio Construction.** This study applies Sharpe's Single Index Model to construct an optimal portfolio from the Nifty Midcap 100 index. The findings suggest that the SIM-based portfolio outperformed the benchmark in terms of returns and risk. However, the study is limited to mid-cap stocks and does not explore sector-specific applications.

16. Sharma, S., & Yadav, M. P. (2023): **Robustness of Sharpe Single Index Model in Indian Market: A Unique Approach to Identify Gems.** This paper evaluates the robustness of Sharpe's SIM in the Indian market, incorporating fundamental analysis. However, it does not focus on sector-specific applications or provide a comprehensive risk-return computation.

17. Ashwini, R., & Reddy, G. S. (2022): **Construction of Optimal Portfolio Using Sharpe's Single Index Model.** The study constructs an optimal portfolio using Sharpe's SIM on 15 randomly selected BSE stocks. While methodologically sound, it lacks a focus on specific sectors like metals and does not incorporate a detailed risk-return analysis.

18. Senthilkumar, K., & Rajendran, R. (2022): **Does Portfolio Optimization Favor Sector or Broad Market Investments?** This research applies Sharpe's SIM and Markowitz Portfolio Theory to optimize intra and inter-sectoral equity portfolios in India. It finds that inter-sector portfolios perform better than some intra-sector portfolios. However, it does not specifically apply Sharpe's SIM to the metal sector.

19. Sen, J., Jaiswal, A., Pathak, A., Majee, A. K., Kumar, K., Sarkar, M. K., & Maji, S. (2023): **A Comparative Analysis of Portfolio Optimization Using Mean-Variance, Hierarchical Risk Parity, and Reinforcement Learning Approaches on the Indian Stock Market.** The paper evaluates three portfolio optimization methods on Indian stocks, including NIFTY50 and sectoral stocks. While comprehensive, it does not specifically apply Sharpe's SIM or focus on the metal sector.

20. Nandan, T., & Srivastava, N. (2017): **Construction of Optimal Portfolio Using Sharpe's Single Index Model: An Empirical Study on Nifty 50 Stocks.** This study constructs an optimal portfolio using Sharpe's SIM on Nifty 50 stocks but does not delve into sector-specific analyses or detailed risk-return assessments.

5 Conceptual Background:

5.1 Returns:

The Returns can be defined as the profit or loss generated by an investment over the certain period of time. Returns are usually presented in Percentage. It is calculated by dividing the difference between current price and previous price by previous price. Incomes earned from dividends are also added for calculate total returns.

Formula:

$$Stock's\ Returns = \frac{Today's\ Stock\ Price - Yesterday's\ Stock\ Price}{Yesterday's\ Stock\ Price}\ x100$$

$$Benchmark's\ Returns = \frac{Today's\ index\ Price - Yesterday's\ index\ Price}{Yesterday's\ index\ Price}\ x100$$

5.2 Variation:

Variation in Stock's Returns refers to the degree of change in a stock's return over the certain period of time. It is a statistical measure that shows the volatility or the risk associated with the stock's performance. It indicates how much the returns differ from the average return given by the stock for that period. High variation shows the returns can significantly spread from the average, showing higher risk and potential for more gains or losses. Low variation shows that the returns are more consistent and closer to the average, indicating lower risk.

Formula:

Variance (Σ^2):

$$Variance = \frac{\sum (xi - \bar{x})2}{N}$$

Standard Deviation (*Σ*):

$$SD = \sqrt{\frac{\sum (xi - \bar{x})2}{N}}$$

5.3 Covariance and Correlation:

Covariance: Covariance shows the directional relationship between the returns of two assets. In this instance we can show the direction of movement of stock's returns with respect to their respective benchmarks and market benchmark. A positive covariance indicates that when the benchmark's returns are above its average, stock's returns tend to be above its average as well. A negative covariance indicates an inverse relationship: when benchmark's returns are above its average, the stock's returns tend to be below its average.

Formula:

$$Covariance = \frac{\sum (xi - \bar{x})(yi - \bar{y})}{N}$$

Correlation: Correlation analysis shows relationship between two assets; in this case it's the stock and its sectoral benchmark and the market benchmark. It is also called as correlation coefficient. It shows the changes in independent variables results in changes in another variable. The aim is to see it how vary with respect to the independent variable will bring changes in dependent variable. Correlation coefficient will range between +1 and -1 (plus and minus one).

Formula:

$$Correlation = \frac{Cov\ (x,y)}{\sigma x * \sigma y}$$

Interpretation: Based on Correlation

-1 = perfect negative linear relationship
-0.50 = moderate negative linear relationship
0 = no linear relationship
0.50 = moderate positive linear relationship
1 = perfect positive linear relationship

5.4 Beta:

Beta measures the volatility of a stock with its sectoral benchmark or market benchmark. It is used to assess the risk-level associated with that particular security. It measures the sensitivity of the investment's returns. Beta is majorly used for Portfolio Management, Risk Assessment and Portfolio Benchmarking.

Formula:

$$Beta\ (\beta) = \frac{Cov\ (x,y)}{Var\ (y)}$$

Decisions:

1 = stocks equally respond to market risk

>1 = more responsive to market risk

<1 = less responsive to market risk

5.5 Alpha:

Alpha measures the investment's performance relative to the benchmark's performance. A positive alpha indicates that the investment has outperformed the benchmark index, while a negative alpha indicates underperformance of investment. Basically, alpha is used to understand whether the investment has provided excess returns relative to its risk-adjusted benchmark. It is the difference between the actual return of the investment and the expected return based on the benchmark performance.

Formula:

$$Alpha\ (\alpha) = \bar{Y} - (\beta * \bar{X})$$

5.6 Limitations of Markowitz Model:

While the Markowitz Model offers a comprehensive foundation for portfolio optimization, its practical application within this study was found to be limited. Markowitz Model talks about diversification. The model requires calculating a full variance-covariance matrix, which becomes increasingly complex and data-intensive when applied to even a small set of stocks—like the five metal sector companies in this research. This complexity is compounded by the fact that monthly data over a five-year period was used, increasing the risk of estimation errors. Moreover, the Markowitz approach does not efficiently separate systematic (market-related) and unsystematic (stock-specific) risks, which is a critical factor in analysing stocks from a sector as volatile and cyclical as metals. Additionally, the model does not inherently align portfolio risk with any benchmark index, making it less effective in assessing performance against sector-specific indices like Nifty Metal. Given these constraints, Sharpe's Single Index Model was adopted in this study as it simplifies the optimization process by relating stock returns to a single index, reduces computational complexity, and more effectively captures sector-level dynamics.

5.7 Sharpe's Single Index Model:

Sharpe's Single Index Model is a simplified version of modern portfolio theory. It assumes that the return on a security is linearly related to the return on a market index. This model greatly reduces the complexity involved in calculating the covariance between every pair of securities in a portfolio.

The fundamental idea is that the movement of a stock is influenced by:

- Market movements (systematic risk)
- Company-specific factors (unsystematic risk)

Formula:

$$Ri=\alpha i+\beta iRm+ei$$

Where:

Ri: Return on the stock

αi: Stock's alpha (return independent of the market)

βi: Stock's beta (sensitivity to the market)

Rm: Return on the market index

ei: Unsystematic (firm-specific) component

The **total risk** (variance) of a security under SIM is given by:

Formula:

$$\sigma i2=\beta i2\sigma m2+\sigma ei2$$

Where:

σi2: Market variance

σei2: Unsystematic risk (residual variance)

5.8 Sharpe's Optimal Portfolio Construction:

Sharpe's model can be extended to construct an optimal portfolio that maximizes excess return per unit of risk. The model uses a cut-off rate (C*) to filter stocks and allocate weights based on their risk-adjusted performance.

Step 1: Excess Return-to-Beta Ratio:

This is the measure of return per unit of systematic risk.

Formula:

$$(Ri - Rf) / \beta i$$

Where:

Rf: Risk-free rate of return

Ri: Expected return of the stock

βi: Beta of the stock

Step 2: Cut-Off Rate (C*)

To determine which stocks should be included in the portfolio, a cut-off point is computed

Formula:

$$C^* = [\ \sigma m^2 \times \Sigma\ \{[(Ri - Rf) / \beta i] \times (\beta i / \sigma ei^2)\}] / [\ 1 + \sigma m^2 \times \Sigma\ \{\beta i^2 / \sigma ei^2\}]$$

Only stocks with: $((Ri - Rf) / \beta i) > C^*$ are included in the optimal portfolio.

Step 3: Weight Assignment for Selected Stocks

For stocks satisfying the cut-off condition, weights are assigned as.

Formula:

$$Xi = (\beta i / \sigma ei^2) / \Sigma\ (\beta i / \sigma ei^2)$$

Where:

Xi: Weight of stock iii in the optimal portfolio.

σei2: Unsystematic variance of stock.

Step 4: Portfolio Metrics

Once weights are determined, the overall **portfolio return**, **beta**, **variance**, and **risk** are computed using:

Formulae:

Portfolio Return: $Rp = \Sigma(Xi \times Ri)$

Portfolio Beta: $\beta p = \Sigma(Xi \times \beta i)$

Portfolio Variance: $\sigma p^2 = \beta p^2 \times \sigma m^2$

Portfolio Risk (Standard Deviation): $\sigma p = \sqrt{\sigma p^2}$

6 Research Methodology:

The study is based on historical data collected from various sources like NSE website, publications, magazines and other relevant reports. A descriptive research method is adopted for this research. The study covers a period of Five Years or 60 months, i.e. from 1st April 2019-31st March 2024. The study taken into consideration the monthly closing returns of each security and their respective benchmarks from the year 2019-2024 for the purpose of the analysis.

7 Data Processing and Analysis:

1. **Sample Size:** Five Stocks are selected from the Metal sector based on Market Capitalization.
2. **Technique:**

- Calculation of Returns of each stock, sectoral benchmark (NIFTY METAL) and market index (Nifty 50) on monthly basis.
- Calculation of Standard Deviation and Variance of stocks, sectoral benchmark and market index, Beta and Alpha, Correlation and Covariance of the selected stock.
- Calculation of Sharpe's Single Index Model and Sharpe's Optimal Portfolio Construction.

8 Data Analysis and Interpretation:

Table 1: Risk and Return Related with Nifty Metal Stocks (Data from April 2019 to March 2024):

Computation\Stock	Nifty Metal	Nifty50	Tata Steel	Vedanta Ltd	Hindustan Copper	NMDC	SAIL
Return	129.21%	73.43%	37.61%	112.06%	312.8%	112.98%	166.22%
Variance	0.9847%	0.2838%	2.7713%	1.9721%	6.1526%	1.4246%	2.7976%
SD	9.9234%	5.3275%	16.6472%	14.0432%	24.8044%	11.9357%	16.7259%
Covariance (Metal)	-	-	0.0083	0.0110	0.0162	0.0077	0.0139
Covariance (Nifty50)	-	-	.00030	0.0051	0.0066	0.0024	0.0059
Beta (Metal)	-	-	0.8415	1.1141	1.6429	0.7827	1.4159
Beta (Nifty50)	-	-	1.0519	1.7870	2.3396	0.8529	2.0680
Alpha (Metal)	-	-	-0.0121	-0.0054	0.0170	0.0020	-0.0028
Alpha (Nifty50)	-	-	-0.0067	-0.0032	0.0239	0.0085	0.0024
Correlation (Metal)	-	-	0.5016	0.7872	0.6573	0.6507	0.8400
Correlation (Nifty50)	-	-	0.3366	0.6779	0.5025	0.3807	0.6587

The data provided offers insights into the performance, risk (measured by standard deviation and variance), and correlation of stocks in the metal sector compared to broader benchmarks such as Nifty Metal and Nifty50.

8.1 Returns:

- **Highest Returns**: Hindustan Copper has the highest return of 312.8%, indicating that it has been the most profitable stock over the period in the metal sector.
- **Lowest Returns**: Tata Steel, with a return of 37.61%, is the lowest-performing stock among the listed ones.
- **Benchmark Comparison**: Nifty Metal delivered a 129.21% return, which is significantly higher than the broader Nifty50 index (73.43%). This suggests that, overall, the metal sector has outperformed the broader market.

8.2 Variance & Standard Deviation (SD):

Variance measures the dispersion of returns, while Standard Deviation (SD) gives a clearer picture of the stock's volatility. Higher values suggest greater risk.

- Hindustan Copper has the highest variance (6.1526%) and SD (24.8044%), making it the most volatile stock, which aligns with its high return.
- NMDC has the lowest variance (1.4246%) and SD (11.9357%), indicating it is the least volatile among the chosen stocks, making it a safer bet.
- Tata Steel has a relatively high SD (16.6472%) and variance (2.7713%) but has delivered the lowest return (37.61%). This suggests a relatively poor risk-return trade-off.

8.3 Covariance:

Covariance measures how the stock returns move with the returns of either Nifty Metal or Nifty50.

- Tata Steel, Vedanta, Hindustan Copper, NMDC, and SAIL have higher covariance with Nifty Metal than with Nifty50, implying they are more aligned with the metal sector's movements than with the broader market.
- Hindustan Copper has the highest covariance with both indices, showing a strong relationship with sector trends.

8.4 Beta:

Beta measures the sensitivity of a stock's returns to the market (Nifty Metal or Nifty50). A beta > 1 suggests that the stock is more volatile than the market, while a beta < 1 means it is less volatile.

- Hindustan Copper has the highest beta with both Nifty Metal (1.6429) and Nifty50 (2.2296), indicating that it is highly sensitive to market fluctuations, which explains its high volatility.
- NMDC has the lowest beta with both indices, indicating it is relatively less sensitive to market movements and may provide stability compared to the others.

8.5 Alpha:

Alpha measures a stock's performance relative to the market. A positive alpha means the stock outperformed its benchmark, while a negative alpha indicates underperformance.

- Hindustan Copper has a positive alpha with both Nifty Metal (0.0170) and Nifty50 (0.0239), suggesting it outperformed both benchmarks.
- Tata Steel has a negative alpha with both indices -0.0121 for Nifty Metal and -0.0067 for Nifty50, indicating it underperformed relative to its risk level.
- Vedanta also underperformed relative to Nifty50 (-0.0032), suggesting that its moderate returns came with greater risk, and it did not compensate for this risk adequately.

8.6 Correlation:

Correlation indicates the strength and direction of the relationship between the stock's returns and the returns of the benchmarks.

- SAIL has the highest correlation with Nifty Metal (0.84), indicating its returns move very closely with the metal sector.
- Hindustan Copper also shows a high correlation with Nifty Metal (0.6573), meaning it behaves similarly to other stocks in the metal sector.
- Tata Steel has a weaker correlation with both Nifty Metal (0.5016) and Nifty50 (0.3366), suggesting its returns do not follow the market trends as closely, making it potentially more diversified in risk.

8.7 Analysis & Insights:

1. **Risk-Return Trade-off**: Hindustan Copper delivers the highest returns, but also comes with the highest volatility and risk (highest SD and Beta). Investors seeking high returns must be willing to tolerate its substantial risk.
2. **Stable Performers**: NMDC appears to be the least volatile, with low beta and SD values, making it more attractive for risk-averse investors. However, its returns are moderate compared to high-risk stocks like Hindustan Copper and SAIL.
3. **Sector Performance**: The metal sector as represented by Nifty Metal has outperformed the broader market (Nifty50). Stocks like Vedanta, Hindustan Copper, and SAIL have benefited from this trend, but with higher risk.
4. **Diversification**: Tata Steel offers moderate risk and returns, showing weaker correlation with both Nifty Metal and Nifty50. This could make it a good candidate for diversification within a metal-heavy portfolio.

8.8 Sharpe's Single Index Model:

8.8.1 Compared with Nifty50:

Parameters	Tata Steel	Vedanta Ltd	Hindustan Copper	NMDC	SAIL	Nifty 50
Average Returns (5 Yearly)	0.64	1.9	5.3	1.91	2.82	1.24
Variance of Stock	2.7713	1.9721	6.1525	1.4246	2.7975	0.2838
Beta	1.0519	1.7870	2.3396	0.8529	2.0680	
Correlation	0.3366	0.6779	0.5025	0.3807	0.6587	
Coefficient	0.1133	0.4596	0.2525	0.1449	0.4339	
Explained by the Index	0.3140	0.9064	1.5535	0.2064	1.2138	
Unexplained by the Index	2.4573	1.0657	4.5990	1.2182	1.5837	
Systematic Risk	0.3140	0.9063	1.5534	0.2064	1.2137	
Unsystematic Risk	2.4573	1.0658	4.5991	1.2182	1.5838	
Total Risk	2.7713	1.9721	6.1525	1.4246	2.7975	

Portfolio Risk	1.1819

8.8.2 Compared with Nifty Metal:

Parameters	Tata Steel	Vedanta Ltd	Hindustan Copper	NMDC	SAIL	Nifty Metal
Average Returns (5 Yearly)	0.64	1.9	5.3	1.91	2.82	2.19
Variance of Stock	2.7713	1.9721	6.1525	1.4246	2.7975	0.9847
Beta	0.8415	1.1141	1.6429	0.7827	1.4159	
Correlation	0.3366	0.6779	0.5025	0.3807	0.6587	
Coefficient	0.1133	0.4596	0.2525	0.1449	0.4339	
Explained by the Index	0.3140	0.9064	1.5535	0.2064	1.2138	
Unexplained by the Index	2.4573	1.0657	4.5990	1.2182	1.5837	
Systematic Risk	0.6973	1.2222	2.6578	0.6032	1.9741	
Unsystematic Risk	2.0740	0.7499	3.4947	0.8214	0.8234	
Total Risk	2.7713	1.9721	6.1525	1.4246	2.7975	

Portfolio Risk	1.2814

To understand how benchmark choice affects risk evaluation, the total portfolio risk was calculated using both: Nifty 50 (broad market index) and Nifty Metal (sectoral index). This clearly indicates that when compared against the sectoral benchmark (Nifty Metal), the portfolio appears slightly riskier due to its closer correlation with sector-specific movements.

8.9 Sharpe's Optimal Portfolio Construction:

To construct a statistically optimal portfolio, Sharpe's Single Index Model was used. This model prioritizes stocks offering the best risk-adjusted returns compared to a single index — in this case, **Nifty 50**.

Stock	**Tata Steel**	**Vedanta Ltd**	**Hindustan Copper**	**NMDC**	**SAIL**
Average Return	0.64%	1.90%	5.30%	1.91%	2.82%
Risk Free Rate	6.25%	6.25%	6.25%	6.25%	6.25%
Beta	1.0519	1.787	2.3396	0.8529	2.068
Excess Return-Beta Ratio	-0.0534	-0.0243	-0.0041	-0.0509	-0.0166
Unsystematic Risk	2.4573	1.0658	4.5991	1.2182	1.5838
Market Variance	0.2838%	0.2838%	0.2838%	0.2838%	0.2838%
Risk Criteria	-0.0228	-0.0408	-0.0021	-0.0356	-0.0217
Beta/Unsystematic Risk	0.4281	1.6766	0.5087	0.7002	1.3057

Stock	**Cut Off**		
	Ri-Rf	**(Ri-Rf) *(B/UR)**	**(B^2)/UR**
Tata Steel	-5.6130%	-2.4028%	0.4503
Vedanta Ltd	-4.3500%	-7.2934%	2.9962
Hindustan Copper	-0.9500%	-0.4833%	1.1902
NMDC	-4.3400%	-3.0387%	0.5972
SAIL	-3.4300%	-4.4786%	2.7002
Total		**-17.70%**	**7.93**

Cut Off	**0.0491**

Parameters	Excess Return-Beta Ratio	B/UR	Weights	Portfolio Return	Portfolio Beta
Tata Steel	-0.0534				
Vedanta Ltd	-0.0243	1.6769	48.03%	0.9126%	0.8583
Hindustan Copper	-0.0041	0.5087	14.57%	0.7723%	0.3409
NMDC	-0.0509				
SAIL	-0.0166	1.3056	37.40%	1.0546%	0.7734
Total		3.4912		2.7395%	1.9726

Tata Steel and NMDC were excluded from the optimal portfolio because their excess return-to-beta ratios (–0.0534 and –0.0509 respectively) were lower than the calculated cut-off rate (–0.0491), indicating that they underperformed on a risk-adjusted basis and did not contribute efficiently to the portfolio's return relative to their risk.

Selected Stock	Vedanta Ltd, SAIL & Hindustan Copper
Portfolio Return	2.74%
Portfolio Beta	1.9726
Portfolio Variance	0.0110
Portfolio Risk	11%

9 Findings:

The performance of equity investments is influenced not only by company fundamentals but also by broader economic conditions and sector-specific dynamics. The EIC (Economic, Industry, Company) framework offers a structured approach to assess these layers of influence. In the context of the Indian metal sector, stock behaviour during the period from 2019 to 2024 was heavily shaped by macroeconomic disruptions such as the COVID-19 pandemic, recovery-led infrastructure spending, and global commodity price cycles. These economic shifts affected each company's revenue stability, cost structures, and investor sentiment, making EIC analysis essential to understanding return fluctuations and risk behaviour.

Within the metal sector, while some companies capitalized on commodity price surges and policy support, others lagged due to operational inefficiencies, high leverage, or weak sector alignment. The industry as a whole faced cyclical pressure but also showed periods of strong recovery, particularly in steel and copper segments. At the company level, differences in management strategy, diversification, and responsiveness to market shifts explained variations in stock returns and volatility. The EIC-based evaluation revealed that not all metal stocks move uniformly; rather, those that aligned better with favourable economic and industry trends, and maintained operational strength, emerged as superior candidates for portfolio inclusion.

Sr. No	Stock	Findings
1.	Tata Steel	Tata Steel delivered the lowest return among the selected stocks, largely due to global steel demand slowdowns and pricing pressure during the pre- and post-COVID periods. The pandemic disrupted key consumer sectors like automotive and construction, weakening economic demand. Industry-wise, global overcapacity and falling prices hurt performance. Company-specific challenges included high operational leverage and late recovery in investor confidence. With a weak correlation to the sector index and low alpha, Tata Steel underperformed on a risk-adjusted basis and was thus excluded from the optimal portfolio.
2.	Vedanta Ltd	Vedanta showed moderate to strong returns with balanced risk, reacting initially to COVID-induced commodity demand disruptions but rebounding steadily post-2020. The economic recovery and revival in metal consumption globally, particularly aluminium and zinc, aided its growth. Industry fluctuations were navigated well through Vedanta's diversified operations and cost efficiencies. Its relatively high beta and consistent performance positioned it as a stable contributor to the optimal portfolio, especially for moderate-risk investors.

3.	Hindustan Copper	Hindustan Copper posted the highest return (312.8%) among the selected stocks, driven by a global copper rally and strong domestic policy support for mining. Economically, the surge in green energy and electric vehicle adoption fuelled copper demand. At the industry level, tight global supply and rising prices boosted profitability. The company capitalized on this momentum through production expansions. Despite its high volatility, Hindustan Copper's strong alpha and sector alignment made it an attractive choice for aggressive portfolios.
4.	NMDC	NMDC offered modest but stable returns with the lowest standard deviation, making it the least volatile among the group. It benefited from infrastructure-driven demand and steady iron ore prices at the economic and industry levels. As a government-backed entity, NMDC maintained operational stability and low leverage. However, its conservative risk-return profile and lower-than-cutoff excess return-to-beta ratio led to its exclusion from the optimal portfolio despite being ideal for risk-averse investors.
5.	SAIL	SAIL delivered one of the highest returns among the stocks, showing a strong recovery post-pandemic as steel demand surged domestically. Economically, it gained from government-led infrastructure development. The steel industry's price rebound post-2020 further supported its growth. On the company level, improved capacity utilization and financial performance elevated investor sentiment. With a strong correlation to the Nifty Metal index and high risk-adjusted return, SAIL emerged as a core component of the optimal portfolio.

9.1 Investment Recommendation:

- **Risk-seeking investors** may find Hindustan Copper and SAIL appealing, given their high returns, but they should be prepared for significant volatility.
- **Conservative investors** might prefer Vedanta Ltd more balanced risk-return profiles.
- **Sector-focused investors** would benefit from tracking Nifty Metal closely, as the overall sector shows strong performance, with stocks generally outperforming the broader market. However, attention to stock-specific risks is essential.

10 Conclusion:

This comparative analysis of risk and return for selected metal sector companies—benchmarked against both sectoral (Nifty Metal) and market-wide (Nifty 50) indices—has yielded important insights into how macroeconomic, industry, and company-specific factors influence stock performance. Through a structured EIC framework and quantitative evaluation, it was found that while some metal companies demonstrated strong alignment with market and sector trends, others deviated due to operational limitations, commodity price exposure, or regulatory influences.

The findings highlight that volatility and return potential vary significantly across stocks within the same sector. Companies like NMDC offered stable returns with lower risk, making them suitable for risk-averse investors, whereas Hindustan Copper delivered exceptionally high returns with significant volatility, appealing to aggressive risk-seeking investors. This variability underscores the importance of selective stock picking and tailored portfolio construction.

The application of Sharpe's Single Index Model provided a more focused and efficient portfolio optimization strategy. Based on excess return-to-beta analysis and cut-off rate filtering, Vedanta, SAIL, and Hindustan Copper emerged as the optimal stock combination. This portfolio not only balanced return and risk effectively but also demonstrated higher relevance when aligned with the sectoral index (Nifty Metal), as compared to the broader market index.

In conclusion, the NSE metal sector presents a diverse set of investment opportunities suited to different investor risk profiles. Strategic portfolio construction—grounded in sector-specific analysis and quantitative models like SIM—can significantly enhance decision-making. Future research could expand this work by incorporating global variables such as trade policy shifts, interest rate changes, and geopolitical developments, to further contextualize risk and return in this globally integrated sector.

REFERENCES:

1. Palanisamy, K., & Parthasarathy, K. (2011). A study on comparative analysis of risk and return with reference to selected stocks of BSE Sensex index, India. *The International Journal's Research Journal of Social Science & Management*, 1(4), 101–110.

2. Patil, V., & Saware, P. (2024). Analysing the relationship between risk and return in the equity stocks of ten selected companies over five years: An in-depth study. *International Journal for Multidisciplinary Research (IJFMR)*, 6(2).
3. Basavaraja, T., & Siddharameshwar. (2024). A comparative analysis of risk and return among chosen companies against the benchmark index in NSE. *International Journal for Multidisciplinary Research (IJFMR)*, 6(2).
4. Patel, I., & Azharuddin. (2024). Comparative analysis of returns and standard deviations of companies' stocks: A five-year study (2019–2023). *International Journal for Multidisciplinary Research (IJFMR)*, 6(2)
5. Kulkarni, S., & Mallikarjun. (2024). Exploring risk and return dynamics in equity stocks of chosen 10 companies: A five-year investigation. *International Journal for Multidisciplinary Research (IJFMR)*, 6(2).
6. Kamran, M. A. J., & Vishal. (2024)). Risk and return analysis on selected 10 companies: A five-year study (2018–2022). *International Journal for Multidisciplinary Research (IJFMR)*, 6(2).
7. Bhavani, & Patil, R. P. (2024): Comparative analysis of returns and standard deviations of services companies' stocks: A five-year study (2019–2023). *International Journal for Multidisciplinary Research (IJFMR)*, 6(2).
8. Ben, P., Jamadar, J., & Nandini, B. S. (2024). Investigating risk and return dynamics in equities of selected 10 firms: A five-year study (2019–2023). *International Journal for Multidisciplinary Research (IJFMR)*, 6(2).
9. Lal, K., & Rao, S. R. S. (2016). Selecting an optimal portfolio for investment in stocks in India: A sectoral approach. *Pacific Business Review International*, 8(9), 78–85.
10. Sathyanarayana, K., Satheeshkumar, R., & Raghunandan, N. K. (2019). A study on expected risk-return of selected stock with respect to growth industries. *Journal of Management (JOM)*, 6(3), 124–133.
11. Nandan, T., & Srivastava, N. (2024). Construction of optimal portfolio using Sharpe's single index model: An empirical study on Nifty 50 stocks. *Journal of Management Research and Analysis*, 11(3), 74–83.
12. Kumar, U., & Chandrashekara, N. (2023). An empirical study on construction of optimal portfolio using Sharpe's single index model for Nifty 50 stocks. *Rabindra Bharati Journal of Philosophy*, 23(24), 63.
13. Suriyanarayanan, M., & Santhosh, D. (2024). Construction of optimal portfolio using Sharpe single index model on Nifty Fifty stocks. *Journal of Management Research and Analysis*, 11(3), 84–92.
14. Bagrecha, C., & Guru, B. P. C. S. (2022). Building an optimal portfolio using Sharpe's single index model: A study of BSE Sensex constituent companies. *Journal of Management Research and Analysis*, 10(2), 45–52.
15. Mistry, J., & Khatwani, R. (2023). An empirical study on the utility of Sharpe's single index model in optimal portfolio construction. *Journal of Public Affairs*, 23(3), e2752.
16. Sharma, S., & Yadav, M. P. (2023). Robustness of Sharpe single index model in Indian market: A unique approach to identify gems. *International Journal of Public Sector Performance Management*, 9(5), 584–601.
17. Ashwini, R., & Reddy, G. S. (2022). Construction of optimal portfolio using Sharpe's single index model. *Journal of Management Research and Analysis*, 9(3), 194–167.
18. Senthilkumar, K., & Rajendran, R. (2022). Does portfolio optimization favor sector or broad market investments? *Journal of Public Affairs*, 22(3), e2752.
19. Sen, J., Jaiswal, A., Pathak, A., Majee, A. K., Kumar, K., Sarkar, M. K., & Maji, S. (2023). A comparative analysis of portfolio optimization using mean-variance, hierarchical risk parity, and reinforcement learning approaches on the Indian stock market. *arXiv preprint arXiv:2305.17523*.
20. Nandan, T., & Srivastava, N. (2017). Construction of optimal portfolio using Sharpe's single index model: An empirical study on Nifty 50 stocks. *Journal of Management Research and Analysis*, 4(2), 74–83.