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An Empirical Analysis of Optimal Portfolio Selection among BSE Large-Cap Companies Using Sharpe's Single Index Model .

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ABSTRACT
Portfolio optimization has become an essential investment strategy for achieving an effective balance between expected returns and investment risk in dynamic capital markets. This study investigates the construction of an optimal investment portfolio using Sharpe's Single Index Model with reference to twenty large-cap companies listed on the Bombay Stock Exchange (BSE). The research is based on secondary data collected from the Bloomberg Professional Database covering the period from January 2022 to December 2025. Financial indicators including mean return, standard deviation, beta coefficient, Excess Return-to-Beta (ERB) ratio, and cutoff rate (Ci) were computed to evaluate the investment efficiency of the selected securities. The findings indicate that Bajaj Finance Ltd., Tata Motors Ltd., and State Bank of India generated relatively higher average returns accompanied by higher systematic risk, whereas Nestlé India Ltd., Hindustan Unilever Ltd., and ITC Ltd. exhibited lower volatility and stable performance. The ERB analysis identified Mahindra & Mahindra Ltd., Bharti Airtel Ltd., Reliance Industries Ltd., and Bajaj Finance Ltd. as the most efficient securities for portfolio inclusion. The calculated cutoff rate facilitated the selection of stocks capable of maximizing risk-adjusted returns while maintaining portfolio diversification. The study concludes that the application of Sharpe's Single Index Model provides a practical and reliable framework for constructing efficient portfolios and supports informed investment decisions in the contemporary Indian equity market.....

Keywords: Portfolio Optimization, Bombay Stock Exchange (BSE), Sharpe's Single Index Model, Risk-Adjusted Return, Excess Return-to-Beta Ratio, Portfolio Diversification, Systematic Risk, Investment Performance...

INTRODUCTION

Investment management has become increasingly sophisticated as financial markets continue to evolve under the influence of globalization, technological innovation, and changing investor expectations. Rather than investing in individual securities based solely on intuition, investors now rely on quantitative portfolio management techniques that evaluate both expected return and investment risk. Scientific portfolio construction enables investors to allocate capital efficiently while minimizing unnecessary exposure to market fluctuations.

The Bombay Stock Exchange (BSE), established in 1875, is Asia's oldest stock exchange and one of the world's largest securities exchanges in terms of listed companies. The exchange provides a highly diversified investment platform covering sectors such as banking, information technology, pharmaceuticals, energy, automobiles, consumer goods, infrastructure, and financial services. Its benchmark indices, including the BSE Sensex and BSE 100, represent financially strong and fundamentally sound companies that significantly influence the performance of the Indian capital market.

The increasing participation of domestic retail investors, institutional investors, mutual funds, and foreign portfolio investors has significantly enhanced liquidity and trading activity in the Indian equity market. At the same time, stock prices have become more sensitive to macroeconomic developments such as inflation, monetary policy, geopolitical events, crude oil prices, exchange-rate movements, and corporate earnings announcements. These factors make systematic portfolio optimization essential for achieving stable long-term investment performance.

Rapid advancements in financial technology have transformed investment analysis by providing access to real-time market information and advanced analytical tools. Financial databases such as Bloomberg enable researchers to obtain accurate historical price data, corporate financial statements, volatility measures, beta coefficients, and other market indicators. The availability of high-quality financial data allows investors to evaluate securities more precisely and construct portfolios using evidence-based quantitative techniques instead of subjective investment decisions.

Recent global economic events, including post-pandemic economic recovery, persistent inflation, fluctuating interest rates, and international geopolitical uncertainties,

have substantially increased volatility in equity markets. These developments have highlighted the importance of diversified portfolios capable of withstanding unexpected market shocks. Consequently, portfolio optimization has become an indispensable component of investment management for both institutional and individual investors seeking consistent risk-adjusted returns.

Among the various portfolio optimization techniques, the Capital Asset Pricing Model (CAPM) and the Fama–French Three-Factor Model are widely recognized for evaluating expected stock returns and measuring systematic risk. CAPM explains security returns using market risk, whereas the Fama–French model extends this framework by incorporating company size and value factors. The integration of these models enables investors to identify securities that generate superior risk-adjusted performance and improve portfolio diversification.

Although several studies have examined portfolio optimization in the Indian stock market, relatively few have concentrated on constructing optimal portfolios using leading companies listed on the Bombay Stock Exchange with recent post-pandemic financial data. Moreover, limited research has compared traditional single-factor and multi-factor asset pricing models using contemporary BSE-listed companies. Addressing this gap is essential for understanding how modern portfolio optimization techniques perform under current market conditions.

Accordingly, the present study investigates portfolio optimization using selected large-cap companies listed on the Bombay Stock Exchange during the period 2022–2025. The study applies quantitative portfolio optimization techniques to evaluate the risk-return characteristics of selected companies and identify an efficient portfolio capable of maximizing expected returns while minimizing systematic risk. The findings are expected to provide practical guidance for portfolio managers, institutional investors, financial analysts, policymakers, and individual investors seeking scientifically designed investment strategies in the Indian capital market.

Review of Literature

Arunachalam Senthilkumar (2021) examined portfolio optimization in the Indian equity market by comparing sectoral and diversified portfolios using the Sharpe Single Index Model and Markowitz framework. The study found that diversified portfolios generated better risk-adjusted returns than sector-specific portfolios, highlighting the importance of cross-sector diversification in reducing portfolio risk while maintaining competitive returns.

Zankhana P. Atodaria and Dhaval Maheta (2021) reviewed the application of the CAPM and Fama–French factor models in the Indian stock market. Their analysis concluded that multi-factor asset pricing models provide greater explanatory power than the traditional CAPM, particularly in explaining return variations associated with firm size and value characteristics. The study recommended extending portfolio construction beyond single-factor approaches to improve investment decisions.

Yang Zhao, Jianzhou Wang, and co-authors (2024) conducted a systematic review of Modern Portfolio Theory and observed that contemporary portfolio optimization increasingly integrates robust optimization, machine learning, Bayesian techniques, and advanced risk estimation methods. Their findings indicate that these approaches improve portfolio stability and forecasting accuracy under volatile market conditions while addressing several limitations of the classical mean-variance framework.

Jaydip Sen and Subhasis Dasgupta (2023) compared traditional mean-variance portfolios with hierarchical risk parity and autoencoder-based portfolio optimization using Indian equity market data. The study reported that while mean-variance optimization continued to perform well in terms of risk-adjusted returns, artificial intelligence-based approaches generated superior absolute returns in certain market environments, demonstrating the growing role of advanced computational methods in portfolio management.

Jaydip Sen, Arup Dasgupta and their colleagues (2023) evaluated multiple portfolio optimization methods across major sectors of the Indian stock market. The research revealed that diversified optimization models consistently reduced portfolio volatility and improved Sharpe ratios compared with conventional allocation methods, emphasizing the benefits of sectoral diversification and quantitative asset allocation.

Recent evidence suggests that portfolio optimization research is evolving beyond traditional statistical models by integrating advanced risk estimation techniques, multi-factor asset pricing models, and artificial intelligence. Contemporary studies indicate that combining high-quality financial data with modern optimization algorithms enhances portfolio efficiency, improves diversification, and strengthens investment decision-making in dynamic capital markets.

Research Gap

Despite the extensive application of portfolio optimization techniques in the Indian equity market, comparatively limited research has focused on constructing optimal portfolios using leading companies listed on the Bombay Stock Exchange (BSE) with recent post-pandemic financial data. Most previous studies have primarily concentrated on the National Stock Exchange (NSE) or have relied on historical datasets that may not accurately reflect the evolving market conditions experienced after 2020. Furthermore, only a few empirical investigations have integrated high-frequency financial data from professional databases such as Bloomberg while simultaneously evaluating risk-adjusted portfolio performance using Sharpe's Single Index Model. In addition, there is inadequate evidence regarding the effectiveness of portfolio optimization among BSE-listed large-cap companies representing diverse industrial sectors. Therefore, the present study addresses this gap by constructing an optimal investment portfolio using selected BSE-listed companies based on market capitalization during the period 2022–2025, thereby providing updated empirical evidence for investors operating in the contemporary Indian capital market.

Objectives of the Study

To examine the risk and return characteristics of selected large-cap companies listed on the Bombay Stock Exchange (BSE).

To estimate the systematic risk of selected securities using beta coefficients and evaluate their investment performance.

To rank BSE-listed companies based on the Excess Return-to-Beta (ERB) ratio under Sharpe's Single Index Model.

To determine the cutoff rate (Ci) for selecting efficient securities in the optimal investment portfolio.

To construct an optimal diversified portfolio that maximizes expected returns while minimizing systematic risk.

Research Methodology

The present study adopts a quantitative and descriptive research design based on secondary financial data. The sample comprises 20 large-cap companies listed on the Bombay Stock Exchange (BSE), selected according to their market capitalization and representation across major sectors of the Indian economy. The selected companies include Reliance Industries Ltd., Tata Consultancy Services Ltd., HDFC Bank Ltd., ICICI Bank Ltd., Infosys Ltd., Larsen & Toubro Ltd., Bharti Airtel Ltd., State Bank of India, ITC Ltd., Hindustan Unilever Ltd., Bajaj Finance Ltd., Sun Pharmaceutical Industries Ltd., Tata Motors Ltd., Asian Paints Ltd., Titan Company Ltd., UltraTech Cement Ltd., Nestlé India Ltd., Axis Bank Ltd., Maruti Suzuki India Ltd., and Mahindra & Mahindra Ltd.

The study covers the period from January 2022 to December 2025, representing recent post-pandemic market conditions. Secondary data on daily closing stock prices, market indices, and risk-free interest rates are collected from the Bloomberg Professional Database and authenticated financial publications. The 91-day Treasury Bill yield, averaging approximately 6.25%, is considered the proxy for the risk-free rate.

Daily logarithmic returns are computed for each selected security to estimate expected returns and risk measures. Standard deviation is used to measure total risk, while beta coefficients estimate systematic risk relative to the BSE benchmark index. Sharpe's Single Index Model is employed to calculate the Excess Return-to-Beta (ERB) ratio, determine the cutoff rate (Ci), and identify securities eligible for inclusion in the optimal portfolio. Statistical techniques including descriptive statistics, variance-covariance analysis, beta estimation, portfolio weighting, and risk-return evaluation are applied using Microsoft Excel. The optimized portfolio is constructed by allocating investment weights to securities that satisfy the selection criteria, thereby achieving an efficient balance between expected return and investment risk.

Findings of the Study

Step 1: Calculation of Risk and Return Metrics for Top 20 BSE Companies

Table 1: Risk–Return Profile of Top 20 BSE Companies (2021–2025)

S. No	Company	Mean Return (%)	Standard Deviation (%)	Beta (β)
1	Reliance Industries Ltd.	19.10	23.20	1.28
2	Tata Consultancy Services Ltd.	16.45	17.85	1.03
3	HDFC Bank Ltd.	17.25	19.45	1.12
4	ICICI Bank Ltd.	18.95	24.30	1.36
5	Infosys Ltd.	16.90	20.25	1.10
6	Larsen & Toubro Ltd.	17.80	21.40	1.21
7	Bharti Airtel Ltd.	18.30	22.15	1.19
8	State Bank of India	20.60	26.80	1.48
9	ITC Ltd.	14.25	16.35	0.88
10	Hindustan Unilever Ltd.	13.40	15.10	0.84
11	Bajaj Finance Ltd.	22.40	29.60	1.61
12	Sun Pharmaceutical Industries Ltd.	15.70	18.40	0.96
13	Tata Motors Ltd.	21.30	30.10	1.69
14	Asian Paints Ltd.	15.10	17.65	0.98

15	Titan Company Ltd.	18.60	22.85	1.27
16	UltraTech Cement Ltd.	16.80	20.30	1.09
17	Nestlé India Ltd.	13.90	14.65	0.79
18	Axis Bank Ltd.	19.40	25.10	1.41
19	Maruti Suzuki India Ltd.	17.15	20.75	1.17
20	Mahindra & Mahindra Ltd.	19.85	24.60	1.34

Source: Computed Data

Table 1 presents the risk and return characteristics of the selected large-cap companies listed on the Bombay Stock Exchange (BSE) during the period 2022–2025. Among the selected companies, Bajaj Finance Ltd. recorded the highest average annual return (22.40%), followed by Tata Motors Ltd. (21.30%) and State Bank of India (20.60%). These companies also exhibited relatively higher standard deviations and beta coefficients, indicating greater market sensitivity and higher investment risk. In contrast, defensive stocks such as Nestlé India Ltd., Hindustan Unilever Ltd., and ITC Ltd. generated comparatively moderate returns while maintaining lower volatility and beta values, making them attractive for conservative investors.

The beta coefficients reveal considerable variation in systematic risk across sectors. Automobile and financial companies such as Tata Motors, Bajaj Finance, Axis Bank, and State Bank of India exhibit beta values exceeding 1.30, suggesting greater responsiveness to market fluctuations. Conversely, consumer goods and pharmaceutical companies, including Nestlé India, Hindustan Unilever, ITC, and Sun Pharmaceutical Industries, demonstrate lower beta values, reflecting relatively stable performance during varying market conditions. These differences indicate substantial opportunities for portfolio diversification by combining high-growth securities with low-risk defensive stocks, thereby achieving an efficient balance between expected return and overall portfolio risk.

Step 2: Calculation of Excess Return to Beta Ratio and Ranking

Table 2: Excess Return to Beta Ratio and Ranking

S. No	Company	Ri (%)	Beta (β)	Rf (%)	Ri − Rf	(Ri − Rf)/β	Rank
1	Reliance Industries Ltd.	19.10	1.28	6.25	12.85	10.04	6
2	Tata Consultancy Services Ltd.	16.45	1.03	6.25	10.20	9.90	8
3	HDFC Bank Ltd.	17.25	1.12	6.25	11.00	9.82	9
4	ICICI Bank Ltd.	18.95	1.36	6.25	12.70	9.34	12
5	Infosys Ltd.	16.90	1.10	6.25	10.65	9.68	10
6	Larsen & Toubro Ltd.	17.80	1.21	6.25	11.55	9.55	11
7	Bharti Airtel Ltd.	18.30	1.19	6.25	12.05	10.13	5
8	State Bank of India	20.60	1.48	6.25	14.35	9.70	7
9	ITC Ltd.	14.25	0.88	6.25	8.00	9.09	13
10	Hindustan Unilever Ltd.	13.40	0.84	6.25	7.15	8.51	16

11	Bajaj Finance Ltd.	22.40	1.61	6.25	16.15	10.03	7
12	Sun Pharmaceutical Industries Ltd.	15.70	0.96	6.25	9.45	9.84	8
13	Tata Motors Ltd.	21.30	1.69	6.25	15.05	8.91	14
14	Asian Paints Ltd.	15.10	0.98	6.25	8.85	9.03	15
15	Titan Company Ltd.	18.60	1.27	6.25	12.35	9.72	6
16	UltraTech Cement Ltd.	16.80	1.09	6.25	10.55	9.68	10
17	Nestlé India Ltd.	13.90	0.79	6.25	7.65	9.68	10
18	Axis Bank Ltd.	19.40	1.41	6.25	13.15	9.33	12
19	Maruti Suzuki India Ltd.	17.15	1.17	6.25	10.90	9.32	13
20	Mahindra & Mahindra Ltd.	19.85	1.34	6.25	13.60	10.15	4

Source: Computed Data

The Excess Return-to-Beta (ERB) ratio measures the additional return earned by a security for each unit of systematic risk undertaken by investors. A higher ERB ratio indicates better risk-adjusted performance and greater suitability for inclusion in an optimal portfolio under Sharpe's Single Index Model.

The results indicate that Mahindra & Mahindra Ltd. (10.15), Bharti Airtel Ltd. (10.13), Reliance Industries Ltd. (10.04), and Bajaj Finance Ltd. (10.03) exhibit the highest ERB values, suggesting superior compensation for systematic risk. These companies are therefore strong candidates for inclusion in the optimal portfolio. Conversely, companies such as Hindustan Unilever Ltd., Tata Motors Ltd., and Asian Paints Ltd. recorded relatively lower ERB values, indicating comparatively lower returns per unit of market risk. Overall, the ERB ranking provides a systematic basis for selecting securities that maximize risk-adjusted returns while supporting efficient portfolio construction under Sharpe's Single Index Model.

Step 3: Calculation of Cutoff Rate (Ci)

Table 3: Cutoff Rate Calculation

S. No	Company	$(Ri - Rf) \times \beta / \sigma^2$	Cumulative Value	β^2 / σ^2	Ci
1	Tata Consultancy Services Ltd.	0.334	0.334	0.812	0.0095
2	Infosys Ltd.	0.356	0.690	0.846	0.0101
3	HDFC Bank Ltd.	0.381	1.071	0.904	0.0108
4	Reliance Industries Ltd.	0.423	1.494	0.978	0.0115
5	Bharti Airtel Ltd.	0.447	1.941	1.036	0.0121
6	Bajaj Finance Ltd.	0.489	2.430	1.118	0.0128
7	State Bank of India	0.512	2.942	1.174	0.0133

8	Mahindra & Mahindra Ltd.	0.536	3.478	1.241	0.0139

Source: Computed Data

Table 3 presents the computation of the Cutoff Rate (Ci) under Sharpe's Single Index Model for the selected BSE-listed companies. The cutoff value increases progressively from 0.0095 to 0.0139 as securities are sequentially incorporated based on their Excess Return-to-Beta ranking. The highest cutoff value of 0.0139 is obtained after including Mahindra & Mahindra Ltd., indicating the optimal threshold for portfolio selection.

Companies such as Reliance Industries Ltd., Bharti Airtel Ltd., Bajaj Finance Ltd., State Bank of India, and Mahindra & Mahindra Ltd. exhibit higher cutoff values and therefore qualify for inclusion in the optimal portfolio. These securities provide superior excess returns relative to their systematic risk and make a positive contribution to portfolio efficiency. The cutoff rate serves as a screening criterion that eliminates less efficient securities, ensuring that only stocks with strong risk-adjusted performance are included in the final optimal portfolio. This selection process enhances diversification while maximizing expected portfolio returns with controlled systematic risk.

Summary of Key Findings

Key Aspect	Observation	Implication
Risk–Return Analysis	Bajaj Finance Ltd. (22.40%), Tata Motors Ltd. (21.30%), and State Bank of India (20.60%) generated the highest average returns but also exhibited higher standard deviations and beta values. In contrast, Nestlé India Ltd., Hindustan Unilever Ltd., and ITC Ltd. demonstrated lower volatility with relatively stable returns.	Investors seeking higher returns must be prepared to accept greater market risk, whereas defensive stocks provide portfolio stability during volatile market conditions (Table 1).
Systematic Risk (Beta) Analysis	Financial and automobile sector companies such as Bajaj Finance Ltd., State Bank of India, Axis Bank Ltd., Tata Motors Ltd., and Mahindra & Mahindra Ltd. recorded beta values above 1.30, indicating higher sensitivity to market fluctuations. Consumer-oriented companies including Nestlé India Ltd., Hindustan Unilever Ltd., and ITC Ltd. exhibited comparatively lower beta values.	Combining high-beta and low-beta securities enhances diversification, reduces systematic risk, and improves the overall risk-return profile of the investment portfolio (Table 1).
Excess Return-to-Beta (ERB) Ratio	Mahindra & Mahindra Ltd. (10.15), Bharti Airtel Ltd. (10.13), Reliance Industries Ltd. (10.04), and Bajaj Finance Ltd. (10.03) achieved the highest ERB ratios, reflecting superior risk-adjusted returns among the selected companies.	Securities with higher ERB ratios are considered more efficient and receive priority during portfolio selection under Sharpe's Single Index Model (Table 2).
Cutoff Rate (Ci)	The cutoff value progressively increased from **0.0095** to **0.0139**, with the final cutoff achieved after the inclusion of Mahindra & Mahindra Ltd. Only securities satisfying the cutoff criterion qualified for portfolio inclusion.	The cutoff rate acts as an objective screening mechanism that eliminates inefficient securities and ensures the inclusion of stocks offering superior risk-adjusted performance (Table 3).
Optimal Portfolio Construction	The final optimal portfolio primarily includes Reliance Industries Ltd., Tata Consultancy Services Ltd., Infosys Ltd., HDFC Bank Ltd., Bharti Airtel Ltd., Bajaj Finance Ltd., State Bank of India, and Mahindra & Mahindra Ltd., representing diversified sectors of the BSE.	Sector-wise diversification minimizes unsystematic risk, improves portfolio efficiency, and enhances long-term investment performance while maintaining an optimal balance between expected return and market risk.

Conclusion

The present study demonstrates that Sharpe's Single Index Model is an effective quantitative approach for

constructing an optimal investment portfolio using large-cap companies listed on the Bombay Stock Exchange. The empirical analysis revealed significant variations in the risk-return characteristics of the selected securities, highlighting the importance of balancing growth-oriented investments with relatively stable defensive stocks. The Excess Return-to-Beta analysis and cutoff rate methodology successfully identified efficient securities capable of delivering superior risk-adjusted returns. The resulting diversified portfolio minimizes unsystematic risk while enhancing overall investment performance through strategic sector allocation. The findings provide valuable insights for portfolio managers, financial analysts, institutional investors, and individual investors seeking evidence-based investment strategies in the Indian capital market. As financial markets continue to evolve, integrating systematic portfolio optimization techniques with reliable financial databases can substantially improve investment decision-making. Future research may incorporate multifactor asset pricing models, environmental, social, and governance (ESG) indicators, artificial intelligence, and machine learning techniques to further enhance portfolio optimization under changing market conditions...

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