OPTIMIZING SECTOR INDEX ROTATION AND REBALANCING FREQUENCY WITH DATA MINING: A CASE STUDY ON INDIAN NATIONAL STOCK EXCHANGE

Tanvi Sharma, Akarsh Srivastava, and Eugene Pinsky

Computer Science, Metropolitan College, Boston University, Boston, MA 02215

ABSTRACT

This paper introduces a data-driven investment strategy that leverages data mining techniques to streamline portfolio allocation. Using historical performance data from 15 sectoral indices of the National Stock Exchange of India, the study applies periodic ranking and clustering methods to identify high-performing indices. At predefined intervals—annually, semiannually, quarterly, and monthly—indexes are re-ranked based on historical returns and reassigned to new groups using pattern recognition techniques. An initial investment of $100 is distributed in three dynamically formed groups, each comprising five indices. Returns within each group are reinvested in the same group for subsequent periods, ensuring systematic portfolio evolution. By integrating data mining principles such as ranking algorithms and periodic reassignment, this strategy offers an intuitive yet computationally efficient approach to portfolio management, demonstrating how financial decision making can be optimized through data-driven insights.

KEYWORDS

sector rotation, trading strategy, financial data mining

1. INTRODUCTION

The dynamic nature of financial markets necessitates investment strategies that are both adaptive and resilient to changing conditions. Traditional approaches, such as buy-and-hold or static allocation models, often fail to capitalize on evolving market trends and sector-specific performance fluctuations. Research has shown that these conventional methods tend to underperform during periods of high volatility or when market dynamics shift [1]. As a result, there is growing interest in alternative data-driven approaches that adapt to changing conditions, making use of historical data and systematic modeling [2].

This study explores a systematic investment strategy centered on ranking and reallocating investments across sectoral indexes in the Indian equity market. India's stock market is characterized by its diversity, comprising sectoral indexes such as consumer durables, auto, pharmaceuticals, financials, and technology. These sectors exhibit distinct performance patterns driven by macroeconomic factors, policy changes, and global trends [3]. Research by Ramachandran [4] highlights the importance of sectoral performance in India, where shifting economic trends directly impact the returns of different sectors. By leveraging historical returns, this research aims to develop a strategy that dynamically adjusts investments to optimize returns while managing risk.

The proposed strategy ranks the returns of sectoral indexes over varying time frames: annually, semi-annually, quarterly, monthly, and groups them into three categories: top performing, middle performing, and bottom performing groups. Investments are allocated equally within these groups, and returns are recalculated at the end of each period to inform re-ranking and reinvestment. This dynamic reallocation process is grounded in modern portfolio theory and is designed to maximize risk-adjusted returns, similar to the approaches used by Jegadeesh and Titman [5] in their momentum strategies. This method ensures diversification, promotes disciplined reinvestment, and makes the strategy adaptable to market cycles. [6]

To evaluate its performance, the strategy is compared with the Nifty 50 index, a key indicator of market performance in India. Financial metrics, including annualized returns, volatility, and the Sharpe ratio, are used to assess the effectiveness of the strategy. Volatility and Sharpe ratio calculations are consistent with the methods used in risk-return analysis [7]. Additionally, this study investigates the trade-offs associated with varying reallocation frequencies, providing insights into the impact of periodicity on transaction costs and overall returns, similar to the work of Fama and French [8] on the impact of transaction costs in tactical asset allocation. The findings of this research contribute to the growing body of work on systematic investment strategies, offering a practical and adaptable framework for investors looking to navigate the complexities of the Indian equity market. It aligns with modern asset management techniques and offers valuable insights into optimizing sector-based investing in a volatile market environment.

2. METHODOLOGY

The proposed investment strategy involves three key steps, applied at varying time frames such as annually, semi-annually, quarterly, and monthly:

2.1. Ranking of Returns

- **Calculation of Historical Returns**: For each period, the historical returns of sectoral indexes are calculated using their returns from the previous interval. This approach aligns with methodologies used in sector rotation strategies, where past performance is analyzed to inform future allocations [9].

- **Ranking of Indexes**: The indexes are ranked in descending order of performance.

2.2. Grouping

- **Division into Groups**: The ranked indexes are divided into three groups:

  - Top-performing
  - Middle-performing
  - Bottom-performing

- **Ensuring Diversification**: Each group contains an equal number of indexes, ensuring diversification.

2.3. Investment Allocation and Re-balancing:

- **Initial Investment**: An initial investment is distributed equally across the three groups.

- **Periodic Re-ranking and Reinvestment**: At the end of each period, returns are recalculated, the indexes are re-ranked, and the strategy is reapplied, reinvesting earnings within the respective groups. This dynamic reallocation process is designed to capitalize on changing market trends, as discussed in systematic sector rotation methodologies [10].

This methodology allows for dynamic capital reallocation, leveraging the varying performance of market segments. Additionally, the strategy's application across different time frames provides insights into the trade-offs between frequent rebalancing and transaction costs, as well as its adaptability to market cycles. The effectiveness of such dynamic strategies has been explored in studies focusing on asset allocation and sector rotation [1].

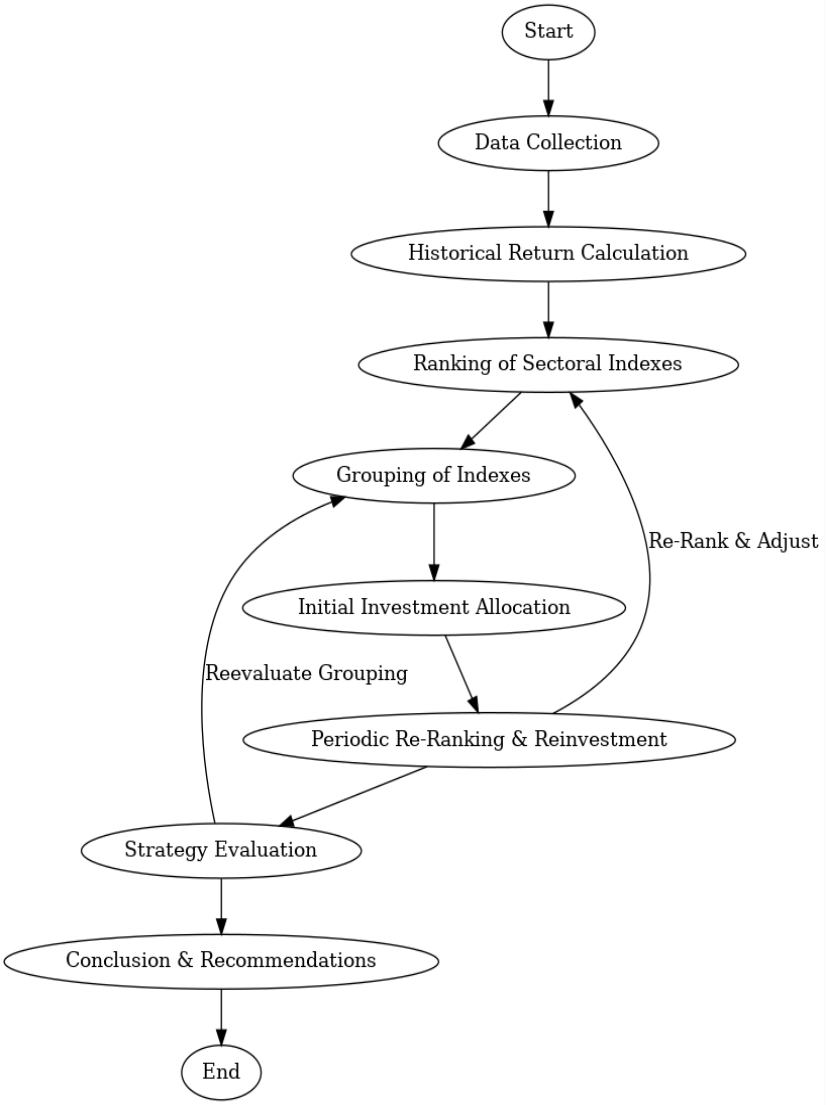

Figure 1: Methodology for the Analysis

3. DATASET INTRODUCTION

This study utilizes historical data from 15 sectoral indices and the benchmark Nifty 50 index, representing the Indian equity market. These indices provide a comprehensive view of sectoral performance and market dynamics, serving as the foundation for the proposed investment strategy. The sectoral indices included in the analysis are as follows:

1. **Auto** (NIFTYAUTO): Captures the performance of companies in the automobile sector, including manufacturers of two-wheelers, four-wheelers, and commercial vehicles.
2. **Bank** (NIFTYBANK): Represents the banking industry, comprising public and private sector banks.
3. **Consumer Durables** (NIFTYCD): Tracks companies producing consumer goods with a long life, such as appliances and electronics.
4. **Financial Services** (NIFTYFINSERV): Includes entities engaged in financial services, such as non-banking financial companies (NBFCs) and asset management firms.
5. **Energy** (NIFTYENERGY): Covers companies in power generation, oil and gas, and other energy-related industries.
6. **FMCG** (NIFTYFMCG): Focuses on the fast-moving consumer goods sector, including food, beverages, and household products.
7. **Healthcare** (NIFTYHEALTH): Encompasses pharmaceutical companies, hospitals, and healthcare providers.
8. **Housing** (NIFTYHOUSING): Represents the housing and construction sector, including real estate and infrastructure companies.
9. **Information Technology** (NIFTYIT): Tracks companies in the information technology sector, including software services and IT consulting.
10. **Metal** (NIFTYMETAL): Covers companies engaged in metal and mining activities.
11. **Oil and Gas** (NIFTYOILGAS): Represents companies in the exploration, production, and distribution of oil and gas.
12. **Pharma** (NIFTYPHARMA): Focuses specifically on pharmaceutical companies.
13. **Private Bank** (NIFTYPVTBANK): Tracks the performance of privately owned banking institutions.
14. **Public Sector Enterprises** (NIFTYPSE): Includes public sector undertakings across various industries.
15. **Realty** (NIFTYREALTY): Captures the performance of companies in the real estate sector.

In addition to these sectoral indices, the **Nifty 50** index [11], representing the top 50 companies listed on the NSE, is included as a benchmark. It serves as a standard for evaluating the performance of the proposed strategy.
The historical data for these indices spans from 2012 to 2023, providing sufficient granularity for analyzing annual, semi-annual, and quarterly trends. Each dataset includes attributes such as daily closing prices, which are used to calculate returns, volatility, and other financial metrics necessary for the study.

These datasets are sourced from the National Stock Exchange of India's official website. The NSE provides historical index data through Historical Index Data [12] page, where users can select and download data for specific indices. Additionally, detailed information about sectoral indices is available on the Sectoral Indices [13] page.
This selection of indices ensures broad coverage of the Indian equity market, capturing diverse sectoral trends and offering a robust foundation for testing the investment strategy across varying market conditions.

4. WINNERS, MEDIAN AND LOSERS STRATEGIES

The investment strategy follows a systematic approach to capital allocation, leveraging historical performance data to rank sectoral indexes, allocate investments, and periodically reinvest earnings. This methodology aligns with sector momentum strategies, where assets exhibiting strong shortterm performance tend to persist in their trends, leading to superior returns [14]. This section outlines the key conceptual steps involved, with detailed calculations provided in Section 4.

4.1. Initial Investment and Allocation

The total initial investment amount is divided equally among three groups: top-performing, middle performing, and bottom-performing indexes. Each group contains five indexes, and the investment is distributed equally within each group. This equal-weighted allocation approach mitigates concentration risk and ensures diversification, which has been shown to improve long-term portfolio stability [15]. The allocation formula is detailed in Section 4.3.

4.2. Ranking and Grouping

Sectoral indexes are ranked based on their returns for the selected timeframe (annual, semi-annual, or quarterly). The indexes are then grouped as follows:

- **Top-performing group (”Winners”):** Ranks 1 to 5.
- **Middle-performing group (”Median”):** Ranks 6 to 10.
- **Bottom-performing group (”Losers”):** Ranks 11 to 15.

Momentum-based ranking methodologies have been widely adopted in systematic investing, with research showing that rotating into sectors with the highest recent returns can yield superior performance over time [16].

4.3. Reinvestment and Compounding

At the end of each period, the returns generated within each group are reinvested back into the same group. The reinvestment process ensures that each group grows based on its performance while maintaining the initial allocation structure. The compounding effect is particularly beneficial in momentum strategies, as it allows winners to continue outperforming, a key principle found in momentum-based investment approaches [17].

4.4. Periodic Re-Ranking and Reallocation

At the start of each new period, the strategy recalculates returns, re-ranks the indexes, and updates the group composition. This dynamic process ensures that the strategy adapts to changing market conditions. Empirical research has shown that sector momentum strategies outperform traditional static allocations, as they allow for continuous capital reallocation to the strongest-performing sectors. The reinvested amounts for each group are adjusted based on the updated rankings, ensuring that capital is consistently allocated to the best-performing sectors.

4.5. Benchmarking and Evaluation

The cumulative and risk-adjusted returns of the strategy are bench marked against the Nifty 50 index, which serves as a standard reference for evaluating performance in the Indian equity

market [11]. Key metrics, including annualized returns, volatility, and the Sharpe ratio, are used for evaluation. Research suggests that sector rotation strategies provide risk-adjusted returns that often exceed market benchmarks, supporting the effectiveness of such approaches [15].

4.6. Adaptability Across Time frames

The strategy is implemented across different timeframes (annual, semi-annual, and quarterly) to assess its adaptability to varying market cycles. Studies have highlighted that sector momentum strategies exhibit different performance characteristics depending on the chosen time frame, with shorter rebalancing periods potentially yielding higher alpha at the cost of increased transaction costs [16]. This approach allows for a comparative analysis of performance, transaction costs, and risk adjusted returns across frequencies.

4.7. Limitations and Assumptions

The strategy operates under the following simplifying assumptions:

- Transaction costs and taxes are not included in the analysis.
- The risk-free rate is assumed to be zero for calculating the Sharpe ratio.
- Historical returns are used as a proxy for future performance, acknowledging inherent limitations in predictability.

These assumptions, while common in academic research, may affect real-world implementation, particularly when transaction costs impact frequent reallocation [17]. Despite these limitations, momentum-based sector strategies have been shown to be effective in generating excess returns over benchmarks in multiple markets.

5. RESULTS AND ANALYSIS

5.1. Evaluating Different Re-Balancing Frequencies Across All Groups

To determine the optimal rebalancing frequency, we compare four different strategies: annual, semi annual, quarterly, and monthly. The evaluation is based on key performance metrics: **Sharpe ratio**, **volatility**, **maximum drawdowns**, and **final valuation**. Table 1 presents a summary of key metrics across different groups and rebalancing frequencies.

Table 1: Comparison of Strategies' Final Balances for Different Rotation Frequencies (Best in Green, Worst in Red)

Strategy	Annual	Semi-Annual	Quarterly	Monthly
Winners	360	426	307	453
Median	546	502	519	371
Losers	487	454	523	484
Buy & Hold	388.96			

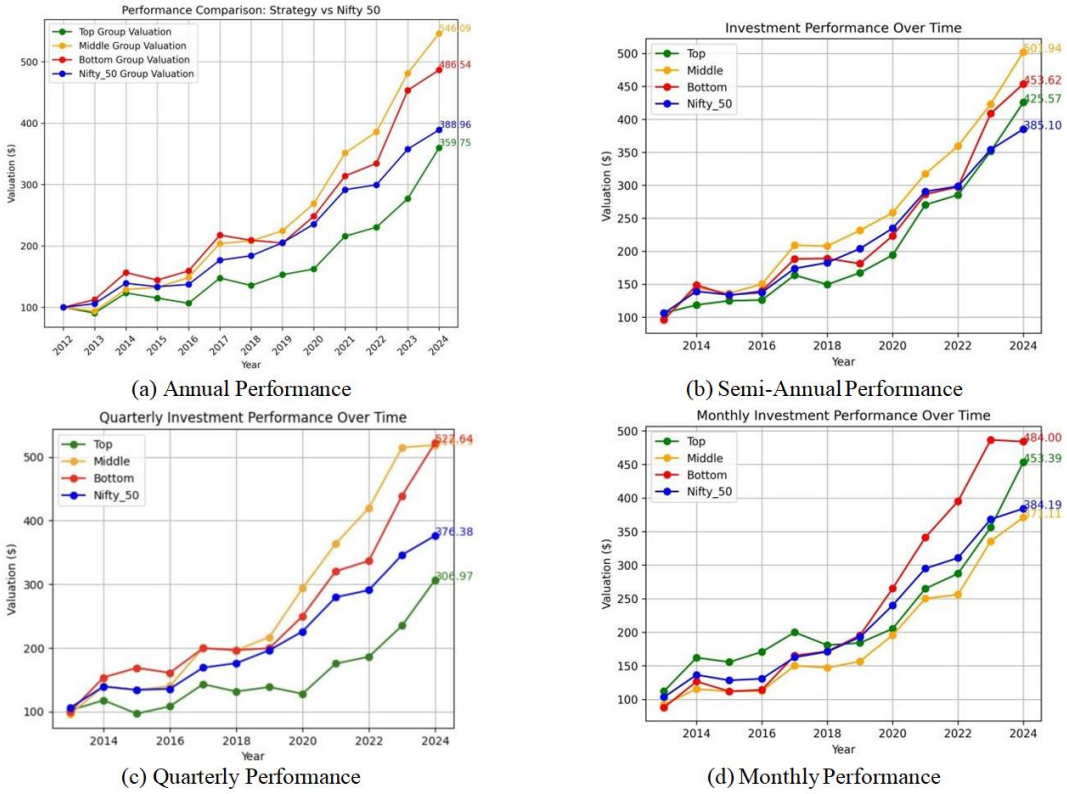

Figure 2: Comparison of Portfolio Growth Across Different Rebalancing Frequencies

5.2. Sharpe Ratio, Volatility, and Drawdown Analysis

To further evaluate the strategy, we analyze key risk-return metrics: Sharpe ratio (risk-adjusted returns), volatility (risk), and maximum drawdown (downside risk). Table 2 summarizes these values for different rebalancing frequencies.

Table 2: Risk-Return Metrics Across Different Frequencies

Metric	Annual	Semi-Annual	Quarterly	Monthly
Sharpe Ratio (Middle Group)	1.17	0.66	0.40	0.21
Volatility (Middle Group)	0.14	0.12	0.10	0.04
% Max Drawdown (Middle Group)	−6.43	−18.41	−28.91	−27.90

The key takeaways from this analysis are:

- **Annual rebalancing provides the best Sharpe ratio (1.17)**, indicating the highest risk adjusted return.
- **Annual rebalancing has the lowest drawdown (-6.43%)**, making it the safest option in terms of downside risk.
- **Final valuation is highest for annual rebalancing**, making it the most profitable strategy for the Middle Group.
- **Quarterly and Monthly rebalancing introduce more volatility and larger drawdowns**, reducing overall performance stability.

Table 3: Risk-Return Metrics Across Different Frequencies

Groups	Annual	Semi-Annual	Quarterly	Monthly
Top Performing Sectors	44.32	16.81	7.18	1.18
Middle Performing Sectors	34.14	15.28	6.59	1.01
Bottom Performing Sectors	39.40	17.42	6.46	1.26

5.3. Why the Middle Group is the Best Investment Choice

The Middle Group consistently outperforms the Top and Bottom Groups across multiple risk-return metrics. Unlike the Top Group, which tends to revert to the mean, or the Bottom Group, which is riskier and more volatile, the Middle Group provides a **balanced approach to sectoral rotation**. **Key reasons why the Middle Group is the best choice:**

- **Best Risk-Adjusted Returns**: The Middle Group achieves the highest Sharpe ratio (1.17) under annual rebalancing, meaning it offers the best return per unit of risk.
- **Lowest Drawdowns**: Even at higher rebalancing frequencies, the Middle Group remains more stable than the Top and Bottom Groups.
- **Consistent Performance**: The Middle Group ensures steady capital growth while minimizing losses during downturns.

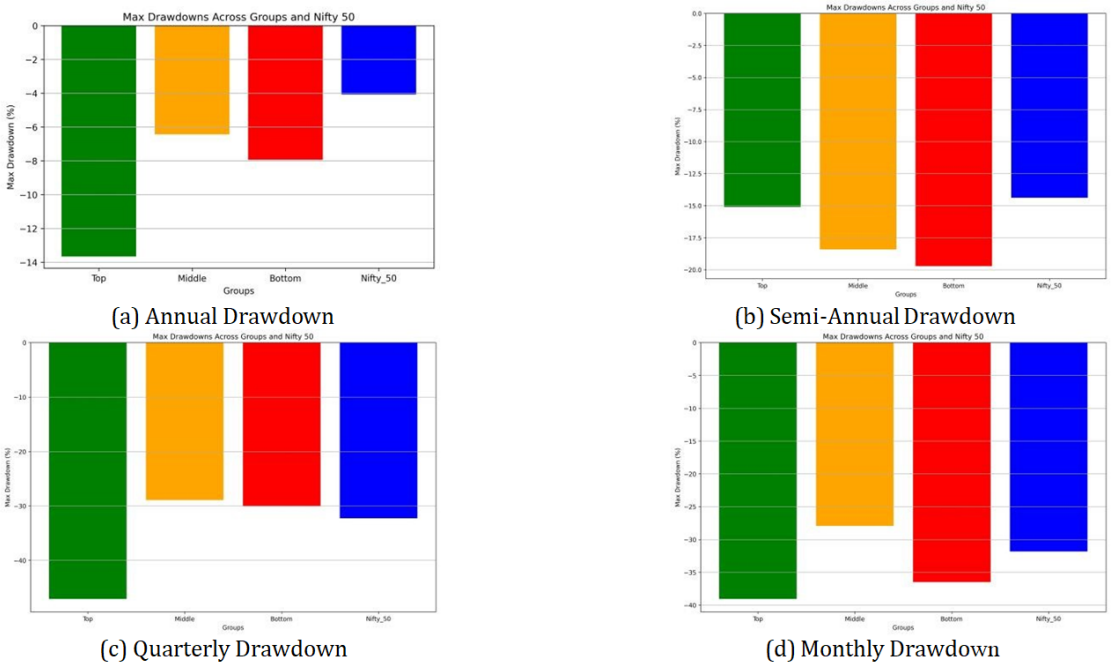

Figure 3: Comparison of Maximum Drawdowns Across Different Rebalancing Frequencies

5.4. Trade-Offs Between Frequencies and Risk

While annual rebalancing appears to be the best, other frequencies offer different advantages:

- **Semi-Annual and Quarterly Rebalancing** allow for better sector rotation but introduce slightly higher volatility and drawdowns.

- **Monthly Rebalancing leads to excessive trading costs and increased volatility**, making it less effective for long-term stability.
- **Annual Rebalancing minimizes transaction costs while maintaining strong returns**, making it ideal for long-term investors.

Figure 4: Growth vs Drawdown Across Re-Balancing Frequencies

As shown in Figure 4, the trade-off between portfolio growth and maximum drawdowns becomes evident. Annual rebalancing maintains the highest Sharpe ratio and lowest drawdowns, indicating a more stable and efficient investment strategy. However, quarterly and monthly rebalancing introduce greater fluctuations, making them less suitable for long-term capital preservation.

5.5. Final Recommendation

The findings confirm that the **annual rebalancing strategy with the Middle Group is the best performing investment approach**. However, for investors willing to take on slightly more risk for better responsiveness, **semi-annual or quarterly rebalancing** may also be viable. **Key Takeaways:**

- Annual rebalancing remains the best strategy, maximizing returns while controlling risk.
- The Middle Group consistently outperforms both the Top and Bottom Groups in terms of Sharpe ratio, stability, and long-term valuation.
- For investors seeking shorter-term adaptability, quarterly or semi-annual rebalancing can be considered, though they come with slightly higher volatility.
- Even in weaker years, the Middle Group remains resilient, managing risk effectively with lower volatility and drawdowns.
- This makes it the most efficient and practical strategy for investors aiming for consistent, longterm portfolio growth.

6. CONCLUSION

The analysis of rebalancing frequencies across sectoral indexes in the Indian equity market highlights the significance of a structured investment strategy. By systematically ranking indexes and reallocating investments at periodic intervals, we demonstrate how different rebalancing frequencies impact portfolio growth, risk, and overall performance.

Among the various strategies, annual rebalancing emerges as the most effective approach, achieving the highest Sharpe ratio (1.17), lowest drawdowns (-6.43%), and strong final valuation in the Middle Group. This suggests that a longer rebalancing provides stability, minimizes transaction costs, and delivers superior risk-adjusted returns. In contrast, quarterly and monthly rebalancing introduce higher volatility and excessive drawdowns, making them less optimal for long-term investors. A key takeaway from this study is that the Middle Group consistently outperforms both the Top and Bottom Groups, striking a balance between momentum and mean-reversion effects. Unlike the Top Group, which exhibits signs of performance reversal, and the Bottom Group, which carries excessive risk, the Middle Group provides a resilient and stable investment framework. While annual rebalancing is the preferred strategy for longterm capital growth, investors seeking higher responsiveness to market trends might consider semi-annual or quarterly rebalancing, albeit with a higher tolerance for risk. Monthly rebalancing, while maintaining exposure to dynamic market shifts, appears to be the least effective due to increased transaction costs and amplified volatility. This study reinforces the importance of systematic portfolio reallocation and the role of periodic re-ranking in enhancing returns while controlling risk. Future research could extend this framework by incorporating transaction costs, alternative weighting methods, or leveraging machine learning techniques for predictive rebalancing. Nonetheless, the proposed annual rebalancing strategy with the Middle Group provides a robust, data-driven approach to navigating sectoral trends and maximizing longterm portfolio performance.

DECLARATIONS

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Data Availability (including Appendices): All the relevant data, Python code for analysis, detailed annual tables and graphs are available via: ***https://github.com/ResearchFiles16/NSE_Files***

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