BEYOND WINNERS AND LOSERS: MEDIAN SECTOR ROTATION IN THE JAPANESE EQUITY MARKET

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ABSTRACT

This study evaluates the effectiveness of a median sector rotation strategy within the Nikkei 500 component sectors, building on prior research that demonstrated superior risk-adjusted returns by selecting mid-performing assets. Unlike traditional momentum-based investing, which focuses on winners or losers, the median strategy systematically reallocates capital to sectors with moderate past performance, reducing volatility while maintaining steady growth. Our findings reveal that quarterly and semi-annual rebalancing optimize returns in Japan, differing from U.S.-based studies where monthly rebalancing was more effective. Unlike buy-and-hold investing, the median strategy tends to outperforms total return and drawdown reduction, making it a viable alternative for public investors. By applying structured sector rotation rather than passive indexing, investors gain exposure to Japan's strongest industries while mitigating downside risk. The results highlight the strategy's adaptability across markets and suggest broader applications in global equities, fixed income, and multi-asset portfolios for enhanced portfolio resilience.

KEYWORDS

median sector rotation, Nikkei 500, risk-adjusted returns, portfolio rebalancing, sector investing, asset allocation, market volatility, public investment strategy.
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1. INTRODUCTION

Public investors find complex investment strategies unattractive due to their limited resource in time, research resources, and expertise. As a result, many defaults to passive investing in broad market indices such as the S&P 500, prioritizing ease and diversification over-optimization. While index investing provides stability, it also limits the potential for excess returns and fully exposes investors to market-wide downturns. A simple, rule-based strategy that adapts systematically to changing conditions could offer a superior alternative—one that balances return and risk while remaining accessible to the average investor ([1], [2], [3], [4]).

In this context, our paper extends the "median" sector rotation strategy to the Japanese equity market, specifically using top component sectors within the Nikkei 500. The foundational strategy was introduced by Yang and Pinsky, who applied it to U.S. sector ETFs and showed that selecting the middle-performing sectors — rather than the best or worst from the previous month consistently outperformed the S&P 500 and equal-weighted strategies in terms of risk-adjusted returns [5]. Follow-up work recent work by Kumar and Pinsky validated the same principle in the Dow Jones Industrial Average, further demonstrating that avoiding extremes in asset selection provides stability and performance enhancement [6].

Adding to this growing body of evidence, a recent study by Sharma, Srivastava, and Pinsky (2025) applied a data-driven strategy variation to the Indian National Stock Exchange [7]. Their

research employed clustering and re-ranking of sector indices at different time intervals and concluded that the middle-performing group yielded the best balance of return and risk— particularly under annual rebalancing ([2], [3], [4]). Together, these studies underscore the cross-market robustness of the median rotation strategy.

The rationale behind this approach is straightforward: rather than chase recent winners or hold onto laggards, the strategy systematically selects assets with moderate past performance. These mid-tier assets are usually less volatile than top performers and more stable than the bottom ones, providing a smoother return profile. Unlike broad index investing, which remains fully exposed to macro-level shocks, median-based rotation offers a more adaptive and risk-conscious alternative — one that does not require forecasting or deep technical expertise as with other sector rotation methods ([8]–[10]).

In this study, we test the applicability of this strategy to Japanese component sectors, examining whether its effectiveness holds in a new market context. By extending prior U.S. and Indian applications to Japan, we assess the universality of this strategy as a practical alternative to passive investing — one capable of delivering better long-term resilience and risk-adjusted returns.

The Related Work section follows this introduction and provides a review of existing research on sector rotation strategies. The Background section provides further context focusing on the characteristics of the Japanese equity market. We then outline our Methodology and Dataset details, followed by the Results and Discussion section, where we evaluate the effectiveness of the median sector rotation strategy in Japan. Finally, in the Conclusion section, we present a summary of our findings.

2. RELATED WORK

In this section, we review several similar studies that are closely related to our work. Sector rotation strategies, which involve selecting sectors based on their past performance to guide future investments, have been studied in different markets. In [5], the median sector rotation strategy was introduced as a possible alternative to traditional investing strategies. Rather than focusing on the top or bottom performers, the strategy focuses on the middle-performing sectors. Their study utilized sector ETFs in the US market, ranking sectors by their past performance and rebalancing them monthly. This study revealed that the middle-based strategies resulted in better performance compared to both the S&P 500 and equal-weight benchmarks.

In [6], the median sector rotation strategy was further explored. The study applied this strategy to the Dow Jones Industrial Average (DJIA) and the results were documented. The study found that the median sector rotation strategy consistently outperforms other strategies such as the Dogs of the Dow strategy which focuses on stocks with the highest dividend yields. The results also showed that the median sector rotation strategy not only provided higher returns but also reduced drawdowns.

The application of the median sector rotation strategy was further expanded in [7] where the strategy was applied to the Indian National Stock Exchange (NSE). In their study, they utilized data mining techniques to rank sectors at different time frequencies. Their paper concluded that selecting the middle performing sectors resulted in the best balance of return and risk, particularly with annual rebalancing.

While these studies show the effectiveness of the median sector rotation in markets like the US and India, there is limited research on its application in Japan. The study aims to fill that gap by

testing the median sector rotation strategy with Nikkei 500 and evaluating whether the strategy is just as effective in Japan.

3. BACKGROUND

3.1. Overview of the Japanese Equity Market

The Japanese stock market offers investors exposure to various industries advanced technology, automotive manufacturing, financial services, consumer goods, and 32 other sectors. The market has historically exhibited distinct economic cycles and structural inefficiencies that differentiate it from other major global equity markets. These characteristics have made investing in Japanese equities an opportunity and a challenge for institutional and retail investors alike [11].

Since Japan's asset bubble collapse in the early 1990s, the Japanese market has experienced prolonged periods of stagnation, mixed with phases of strong economic growth and policy-driven market rallies. The Bank of Japan (BOJ) monetary easing policies and corporate governance reforms have contributed to recent improvements in capital efficiency and shareholder returns. Yet, volatility remains a persistent feature of the market. Unlike the steady expansion seen in the U.S. equity market, Japanese stocks tend to move in response to global economic cycles, changes in domestic policy, and investor sentiment. These factors attribute to the fluctuations in sector performance [12].

3.2. Volatility and Sector Dynamics in Japan's Stock Market

Despite the seemingly stable market, the Japan's equity market is highly sensitive to external economic shocks, currency fluctuations, and domestic policy changes. Using studies on market sentiment, findings suggest that negative news has a disproportionately strong impact on Japanese equities [13]. This contributed to pronounced price fluctuations, particularly in small-cap and mid-cap stocks [12], leading investors to seek strategies that mitigate exposure to high-volatility stocks while still capturing market trends.

One popular approach in the Japanese market is sector-based investing. This strategy allows investors to invest in industries that align with different phases of the economic cycle. While the typical broad market index investing (e.g., Nikkei 225, TOPIX) remains widely used, sector-based strategies have gained traction as they offer greater flexibility in navigating market inefficiencies [11] with a basic understanding of current sector performance.

3.3. The Nikkei 500 Index and Its Components

The Nikkei 500 comprises 500 companies across multiple market sectors. Unlike the Nikkei 225, which is based on stock prices that can be heavily influenced by an outlier of high-priced stocks, the Nikkei 500 offers a more balanced sector-based distribution. This makes the index more useful as a benchmark for structured investment strategies [11].

Some of the top sectors represented by the Nikkei 500 include:

- Marine Transport: – This sector includes companies engaged in maritime logistics and cargo shipping, which are critical to Japan's export-drive economy and global trade networks
- Insurance: – This sector includes firms that offer life and non-life insurance to individuals and businesses.

- Shipbuilding: – This sector includes companies that design and build ships for commercial and industrial use.

Given the broader coverage of mid-cap and large-cap stocks, the Nikkei 500, is better suited for sector rotation strategies compared to the more concentrated Nikkei 225 [11]. Sector rotation withing the Nikkei 500 offers an alternative to passive market investing.

Given the volatility in sector performance, focusing on middle-performing sectors may provide a better risk-return balance [14]. By rebalancing towards these sectors, investors can potentially achieve better long-term returns while minimizing downside risk [11].

This study builds on this concept by applying the median sector rotation strategy to the Nikkei 500, focusing on middle-performing sectors as an alternative to broad market index investing and momentum-driven sector selection. The next sections will detail the methodology and present the empirical results.

4. METHODOLOGY AND DATASET

4.1. Data Selection and Sector Composition

To evaluate the effectiveness of a sector-based rotation strategy within the Japanese stock market, we constructed a portfolio using components from the Nikkei 500 Index. Due to the unbalanced distribution of companies within the index, we limited our selection to the top 9 sectors by market capitalization. This ensures the sector rotation strategy is applied to a representative, liquid subset of the market, avoiding biases from underrepresented sectors.

The selected sectors (with daily data on the corresponding tickers from *Yahoo Finance*) are:

- Marine Transport: ^NG30.OS
- Precision Instrument: ^NG19.OS
- Insurance: ^NG26.OS
- Mining: ^NG02.OS
- Shipbuilding: ^NG16.OS
- Petroleum: ^NG09.OS
- Communications: ^NG33.OS
- Other Manufacturing: ^NG20.OS
- Electric Machinery: ^NG15.OS

These sectors collectively represent the dominant industries within the Japanese equity market and capture a broad spectrum of economic cycles. The selection approach is consistent with prior research that has demonstrated the effectiveness of mid-performance rotation strategies across diversified sector groups [5].

4.1.1. Data Limitation

One of the primary limitations of this study is the limited timeframe of data. The dataset used in this analysis spans from 2018 to 2024 as these were the only years publicly accessible. While this timeframe does capture a range of economic cycles and market conditions, it is possible that a longer time series could have given a more comprehensive look into the performance of the median sector rotation strategy across different market phases.

4.2. Portfolio Construction and Rotation Strategy

Following the methodology outlined in the previous studies [6] on medianbased sector rotation, we implemented a systematic ranking and rebalancing approach:

1. Sector Performance Ranking

   - At the end of each rebalance period, we rank the 9 sectors based on their total return over the previous period [15].
   - Sectors are then categorized into Winners (Top 3), Losers (Bottom 3), and Median (Middle 3) performers.

2. Portfolio Allocation

   - Equal-weighted portfolios are constructed for each of the three groups [16].
   - The Median Portfolio comprises the three middle-performing sectors, following prior research showing that mid-tier assets often provide better risk-adjusted returns compared to extreme performers.
   - The Winner Portfolio consists of the top three best-performing sectors.
   - The Loser Portfolio consists of the three worst-performing sectors. • A benchmark Buy-and-Hold Portfolio (B&H), consisting of all 9 sectors equally weighted without rotation, is used for comparison.

3. Rebalancing Frequencies

   - We tested five rebalancing intervals to evaluate their impact on strategy performance

     – Weekly
     – Monthly
     – Quarterly
     – Semi-Annual
     – Annual
   - These variations allow us to assess the sensitivity of the strategy to different time horizons.

4.3. Performance Metrics and Risk Measures

To evaluate the effectiveness of each portfolio strategy, we measured

1. **Final Portfolio Value** – The total value of each portfolio at the end of the evaluation period.
2. **Annualized Returns** – The compounded annual growth rate (CAGR) of each portfolio
3. **Annualized Volatility** – The standard deviation of returns, reflecting portfolio risk.
4. **Tracking Error** – Deviation from the benchmark performance (B&H portfolio).
5. **Sharpe Ratio** – A risk-adjusted performance measure.
6. **Maximum Drawdown (MDD)** – The largest peak-to-trough loss during the investment period using the "Empyrical" Python library (https://pypi.org/project/empyrical/) to calculate.

4.4. Evaluation and Interpretation of Results

The results were analysed to determine:

- Whether the median rotation strategy provides superior risk-adjusted returns compared to the winner- and loser-based rotations.
- The effectiveness of different re-balancing periods in optimizing returns while minimizing risk.
- The relative performance of sector-based investing versus buy-and-hold index investing in the Nikkei 500.

By systematically assessing these metrics across different re-balancing frequencies, we provide an empirical basis for determining the optimal strategy for sector rotation in the Japanese stock market. The next section presents our findings and their implications for portfolio construction.

5. RESULTS AND FINDINGS

5.1. Portfolio Growth and Performance Across Re-balancing Frequencies

The final portfolio values indicate that the Winner strategy consistently outperforms the other strategies, particularly at longer re-balancing intervals. The Median strategy, which selects the mid-performing sectors, exhibits steady growth with lower risk exposure than both the Winner and Loser portfolios.

- Winner Strategy: Generates the highest final portfolio value, particularly with annual re-balancing.
- Median Strategy: Demonstrates moderate but stable growth, positioning itself as a balanced investment strategy.
- Loser Strategy: Under-performs across all re-balancing periods, reinforcing the persistence of downward momentum in weak-performing sectors.
- Buy-and-Hold (B&H) Strategy: Lags behind active strategies but provides lower volatility and stability over time.
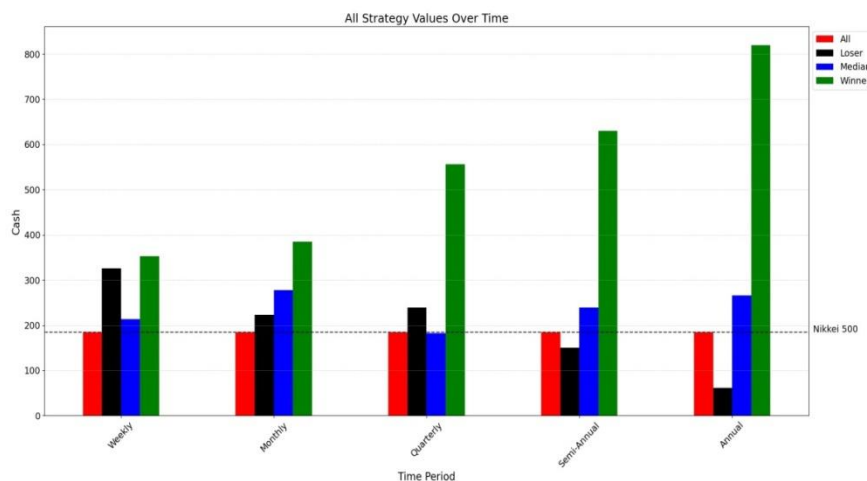

Figure 1: Rotation strategy values across different re-balancing frequencies

These findings indicate that shorter re-balancing periods (for weekly and monthly) will lead to reduced performance across all strategies, likely due to increased transaction costs and excessive portfolio churn. Quarterly and semi-annual re-balancing can optimize the Median strategy's risk-adjusted returns, while annual re-balancing yields the highest total returns for the Winner strategy.

5.2. Growth and Annualized Returns

Comparing cumulative growth and annualized returns across different strategies and re-balancing periods:

- The Winner strategy achieves the highest growth over long-term horizons but suffers from high volatility and drawdowns.
- The Median strategy outperforms the Buy-and-Hold strategy while maintaining lower risk exposure than the Winner strategy.
- The Loser strategy fails to recover from underperformance, making it an inefficient investment approach.

5.3. Risk Analysis: Maximum Drawdowns and Volatility

Maximum drawdown (MDD) values highlight the risk associated with each strategy.

- The Loser strategy experiences the largest drawdowns, supporting the hypothesis that underperforming sectors continue to decline rather than revert.
- The Winner strategy, despite achieving the highest returns, exhibits significant drawdowns, suggesting that top-performing sectors are prone to high volatility.
- The Median strategy has the lowest drawdowns across most rebalancing periods, demonstrating its ability to mitigate downside risk while maintaining long-term stability.
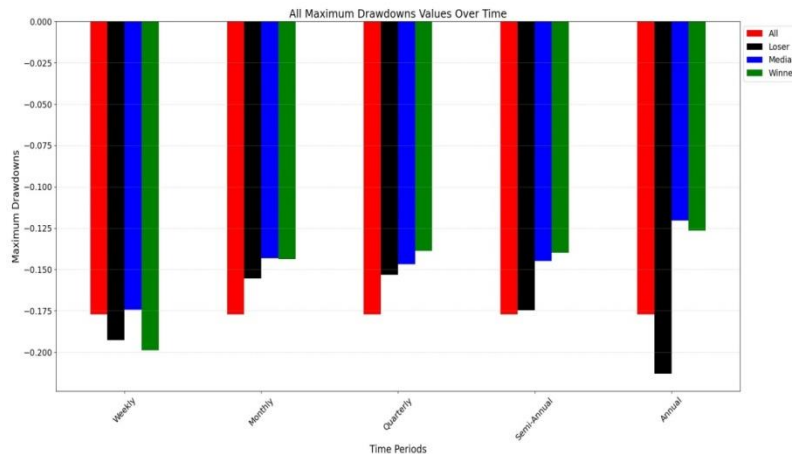

Figure 2: Rotation Strategy Max Drawdowns across different rotational time periods

Volatility measures reinforce these findings:

- Winner and Loser portfolios exhibit the highest volatility, confirming that extreme sector performance leads to higher risk.
- The Median strategy maintains moderate volatility, reinforcing its potential for stability and risk-adjusted return optimization.
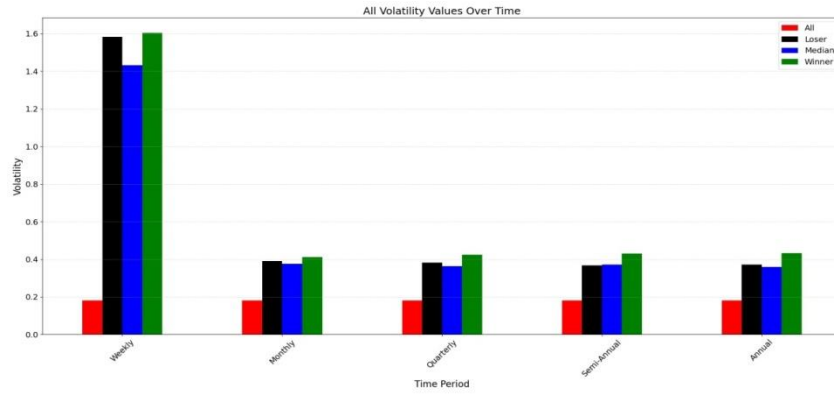
Figure 3: Rotation Strategy volatility across different rotational periods

5.4. Annualized Volatility and Tracking Errors

Annualized volatility and tracking errors demonstrate that:

- Winner and Loser strategies have the highest tracking errors relative to the benchmark (B&H), particularly in short-term re-balancing periods
- The Median strategy maintains moderate tracking errors, making it an attractive option for investors seeking consistency with reduced deviation from index performance.
- Short-term rebalancing increases volatility across all strategies, reinforcing the inefficiency of high-frequency portfolio adjustments.

5.5. Risk-Adjusted Performance: Sharpe Ratio Analysis

The Sharpe Ratio, a tool that measures risk-adjusted returns, indicates that:

- The Winner strategy has the highest Sharpe Ratio in longer rebalancing periods, benefiting from sustained sector momentum.
- The Median strategy consistently achieves competitive Sharpe ratios, particularly with quarterly and semi-annual re-balancing, suggesting it effectively balances return and risk.
- The Loser strategy underperforms in Sharpe Ratios, confirming that weak-performing sectors tend to remain weak.
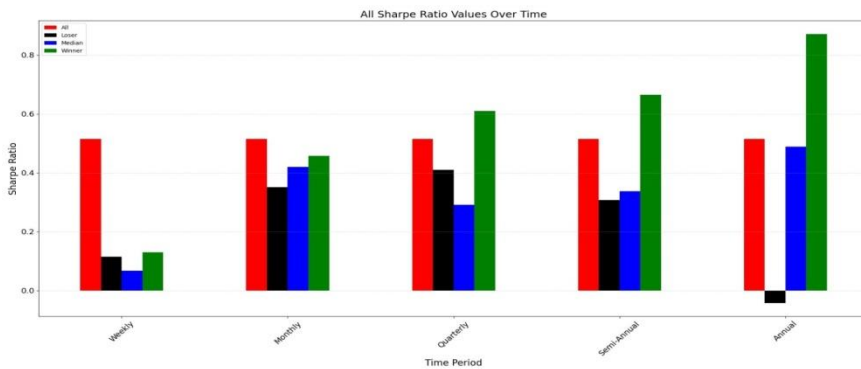- Buy-and-Hold provides stable but lower Sharpe Ratios, reflecting its lower-risk but lower-return nature.

Figure 4: Comparison of Average Sharpe Ratios

5.6. Key Findings

The Median strategy provides the best balance between return and risk, outperforming Buy-and-Hold while maintaining lower volatility and drawdowns.

- The Winner strategy achieves the highest absolute returns but at the cost of increased risk, making it suitable for aggressive investors [17].
- The Loser strategy consistently underperforms, reinforcing that weak sectors do not recover quickly [17].
- Quarterly and semi-annual re-balancing optimizes risk-adjusted performance, particularly for the Median strategy.
- Annual re-balancing is most effective for maximizing returns in the Winner strategy but exposes investors to greater drawdowns.
- Frequent re-balancing (weekly, monthly) negatively impacts performance across all strategies, likely due to excessive turnover and transaction costs.

The results suggest that a sector rotation strategy focused on middle-performing sectors provides a compelling alternative to both passive index investing and momentum-based approaches. The following section will discuss the broader implications of these findings for portfolio construction and market application.

6. DISCUSSION AND FUTURE STUDIES

6.1. Comparison with Previous Studies

The results of our study closely align with prior research on median-based sector rotation strategies, reinforcing the conclusion that investing in midperforming assets yields an optimal balance between return and risk. This strategy consistently outperforms both winner- and loser-focused approaches, offering lower volatility and more stable growth across multiple markets.

Building on Yang and Pinsky (2022), which applied the median strategy to U.S. S&P 500 sector ETFs, our study confirms its cross-market applicability. While the U.S. study favoured monthly re-balancing, quarterly and semi-annual rebalancing is more effective in Japan, highlighting how optimal timing may depend on the underlying market structure.

Our findings also extend the results of Kumar, Valath, and Pinsky (2025), who implemented the strategy within the Dow Jones Industrial Average (DJIA) [6]. Their work showed that median-slice rebalancing outperformed both buy-and-hold and winner-focused strategies, a similar pattern in our Nikkei 500 application.

New evidence from Sharma, Srivastava, and Pinsky further validates these results in the Indian National Stock Exchange, using 15 sector indices and data mining techniques [7] . Their findings echoed the same pattern: median groups achieved the highest Sharpe ratios and lowest drawdowns, with annual re-balancing emerging as the most stable configuration. These three studies demonstrate that median rotation is robust across developed and emerging markets, individual stocks and sector indices, and multiple geographic and economic contexts.

A key structural difference lies in the sector composition of the Nikkei 500, which is more imbalanced than the DJIA or S&P 500, requiring us to focus on the top nine component sectors. Despite this adjustment, the strategy's effectiveness remains consistent, demonstrating the adaptability and resilience of the median rotation framework across diverse index compositions.

6.2. Implications for Investors and Portfolio Management

Our findings prove that the median sector rotation strategy offers a viable alternative to passive index investing and traditional momentum-based strategies. By systematically selecting mid-performing sectors, investors can:

1. Reduce downside risk while still capturing positive market trends.
2. Avoid overexposure to extreme volatility, which often presents itself in winner and loser-focused strategies.
3. Adapt to market fluctuations without requiring complex investing models or predictive analytics.

The study also highlights the importance of re-balancing frequency in optimizing portfolio performance. While the monthly re-balancing strategy was optimal in previous studies using U.S. sector ETFs, we find that quarterly and semi-annual re-balancing strategies produce better outcomes in the Nikkei 500 component sector rotation. This suggests that investors should tailor their re-balancing their frequency based on market structure and sector behaviour rather than applying a one-size-fits-all approach. Although this requires public investors to put in more time and research to execute, this action does not require investors to have complex understanding and expertise in market knowledge and investment theories to excel.

6.3. Future Research and Potential Improvements

While the median rotation strategy has shown robustness in multiple markets, several opportunities exist to enhance the current system and extend its application:

1. Application to Other Markets and Asset Classes

   - Testing the median rotation strategy in European indices, such as the FTSE 100, DAX, or CAC 40, would help assess its effectiveness in different regulatory and economic environments.
   - Expanding to emerging markets, such as the Shanghai Composite or BSE Sensex, could provide insights into how sector-based rotation performs in higher-growth, higher-volatility economies.
   - Applying median rotation to bond ETFs could determine whether interest rate sensitivity and credit spreads follow similar mid-tier performance patterns.
   - Investigating the median strategy in commodity futures (e.g., oil, gold, and agricultural products) could reveal whether momentum and mean-reversion effects operate in a similar manner to equity markets.

2. Data Handling

   - A longer time series data would be beneficial for this research in order to ensure that more market cycles are included, this would improve the robustness of the results
   - Future studies could incorporate real time data which would allow dynamic rebalancing based on real time market performance

3. Multi-Asset Portfolios and Cross-Asset Strategy

- Future research could examine whether a median-based allocation strategy within a balanced portfolio (stocks, bonds, real estate, and commodities) outperforms traditional risk-parity and targetvolatility strategies.

4. Incorporating Machine Learning and Advanced Analytics

- Incorporating factor-based enhancements such as Fama-French factors or macroeconomic indicators could refine the strategy by adjusting for sector-specific economic conditions [14] .
- Using machine learning algorithms ([18], [19]) to dynamically adjust the definition of "median" based on changing market conditions could further improve long-term results.

5. Sector Rotation During Market Crises
- While our study shows that the median strategy performs well during normal market conditions, future research could analyse its resilience during major economic downturns (e.g., 2008 financial crisis).

6. Future Expansion

- We understand that we have not covered all aspects of the studies, particularly on statistical significance testing, transaction cost accounting, and survivorship bias mitigation. However, we intend to expand on the rotational study series further and will use future papers to address these concerns

7. CONCLUSION

This study highlights the effectiveness of the median sector rotation strategy in the Nikkei 500 component sectors, reinforcing the allure of Nikkei 500's ability to balance risk and return better than winner- or loser-focused strategies. Compared to buy-and-hold investing, the median approach reduces volatility while maintaining steady long-term growth. Making the median sector rotation strategy a compelling alternative for public investors.

For public investors, investing in the Japanese sector market via the Nikkei 500 means gaining exposure to Japan's most dominant industries while mitigating risk through sector rotation instead of passive indexing. Our results strongly suggest that the best way to implement this strategy is through an equal-weighted portfolio of mid-performing sectors, re-balancing the portfolio quarterly or semi-annually, to optimize risk-adjusted returns.

The strength of the median strategy lies in its simplicity and adaptability, proving that structured, rule-based investing can have the potential to outperform conventional market approaches. As the global markets evolve, the ability to strategically rotate between market sectors rather than passively following an index may become an essential and easy-to-use tool for investors seeking resilience and long-term performance.

DECLARATIONS

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Author Contributions: All the authors contributed equally to the effort.

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APPENDIX A: GROWTH COMPARISON FOR DIFFERENT ROTATION FREQUENCIES

Figure 5: Growth Comparison with Weekly Re-balancing
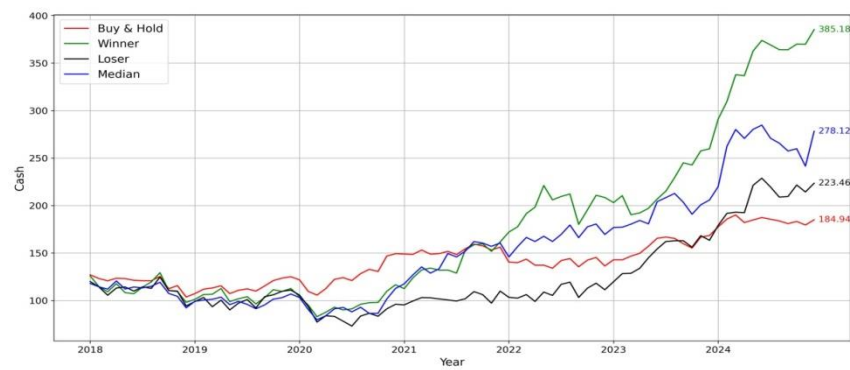

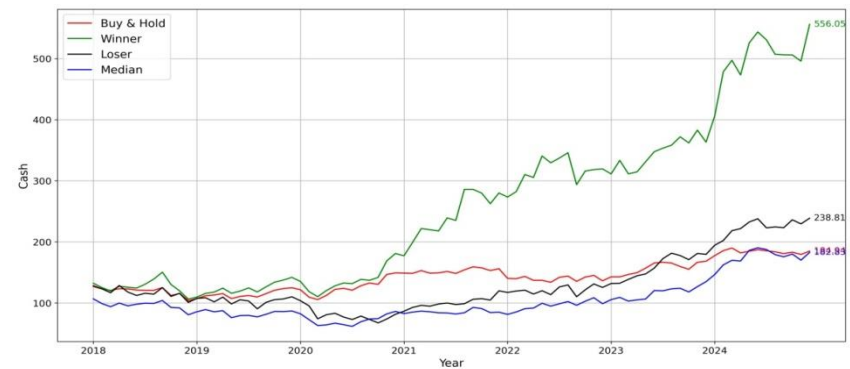Figure 6: Growth Comparison with Monthly Re-balancing

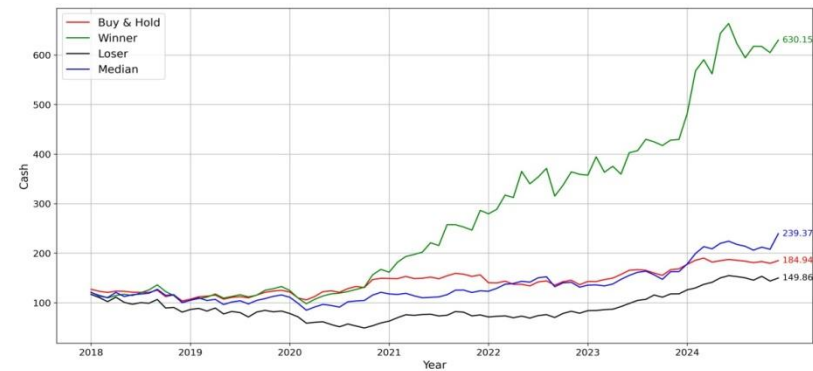Figure 7: Growth Comparison with Quarterly Re-balancing
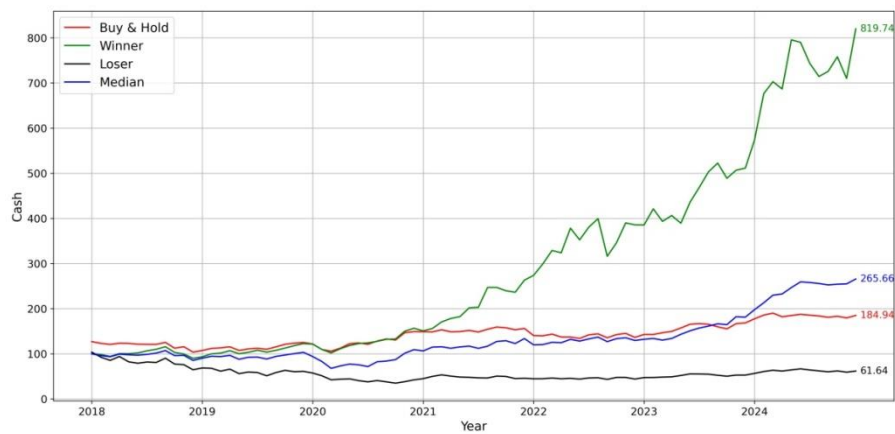

Figure 8: Growth Comparison with Half-Year Strategy

Figure 9: Growth Comparison with Annual Re-balancing