OntarioTech UNIVERSITY

MBAI 5300G

MBAI 5300G Programming and Data Processing Final Project

Analysis of Technical Trading Strategies and Top-Mutual Funds

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Abstract

The purpose of this research is to study and compare the performance of the blue-chip stocks with mutual funds that have the same companies as part of their portfolio, for investment purposes. The key findings show that although certain technical strategies outperformed during specific market conditions, none delivered consistent long-term results compared to the mutual fund benchmark. Overall, technical indicators are useful for short-term opportunities but are less reliable than diversified mutual funds for sustained investment performance.

Keywords: Stock; Mutual Fund; Strategy; Risk-Return; Ratios; Indicators

1. Introduction

At This project evaluates whether systematic, technical-indicator-based trading strategies can outperform traditional investment options such as mutual funds. We implemented and backtested twelve strategies across four major quantitative trading categories: Trend Following, Momentum, Mean Reversion, and Hybrid (Multi-Indicator) models, using multi-year historical stock data. Trend-following strategies focused on capturing sustained price movements through moving average crossovers, breakout patterns, and price channels, while momentum strategies leveraged indicators such as Rate of Change, 52-week highs, and RSI-based momentum signals. Mean-reversion strategies tested the tendency of prices to return to equilibrium using Bollinger Bands reversals, RSI overbought/oversold conditions, and moving average envelope reversals. Hybrid strategies combined indicators across categories for signal confirmation and improved accuracy, including MA + RSI filters, breakout + Bollinger Band confirmations, and momentum models constrained by mean-reversion filters. All strategies were evaluated using key performance metrics including CAGR, drawdown, Sharpe ratio, volatility, and win rate to assess their consistency and risk-adjusted returns relative to benchmark mutual funds like TD908.

2. Literature Review

2.1. Introduction

The comparison between technical indicator-based trading strategies and mutual funds remains a central topic in investment research. Technical analysis uses indicators like moving averages, RSI, MACD, and Bollinger Bands to determine entry and exit points. It is based on quantitative modelling and market psychology. Mutual funds, by contrast, are actively or passively managed portfolios that leverage diversification and professional expertise to generate long-term risk-adjusted returns. Mutual funds have always used fundamental analysis and portfolio optimization to make decisions. However, new technologies such as algorithmic trading, data analytics, and machine learning have greatly improved the ability of technical indicator strategies to predict and adapt.

Recent studies have demonstrated that optimised or AI-enhanced indicator-based trading can equal or

surpass the performance of leading mutual funds on a risk-adjusted basis (Bhute et al., 2024)

2.2. Theoretical Background

This inquiry is based on two main financial theories. The Efficient Market Hypothesis (EMH) says that asset prices already reflect all available information, so it is unlikely to consistently outperform the market through technical trading or active fund management. In contrast, Behavioural Finance Theory suggests that investor psychology, biases, and herding can affect markets, leading to inefficiencies that technical patterns may reveal (Fiveable Content Team, 2025).

Mutual funds and technical trading both try to achieve alpha, which means earning returns above market benchmarks, but they do this in different ways. Mutual funds rely on the skill of fund managers, asset allocation, and timing. Technical traders look for opportunities by studying historical data patterns and using algorithmic rules. These two approaches are increasingly overlapping, especially as data-driven models become more common. For instance, some funds now use technical indicators in their quantitative strategies to improve timing and performance (Wu et al., 2013).

Trend- Following Strategies

Trend-following models try to make profit by taking advantage of ongoing price trends. Some popular methods are Moving Average Crossovers, Breakout Systems, and Price Channel Strategies.

Recent studies show that well-designed trend-following systems can match, and in some cases outperform, mutual funds. In one back test using MAANG stocks (Meta, Apple, Amazon, Netflix, Google), several technical trading models were compared to buy-and-hold. The results showed that using both moving averages and breakout signals led to better Sharpe ratios and smaller drawdowns (Bhute et al., 2024).

Evolutionary and swarm-based optimisation methods have also been successfully applied to mutual fund trading. For example, using Turbulent Particle Swarm Optimisation (TPSO) with a mixed moving average (MMA) led to higher profits and lower risk than traditional fund management during a 10-year test period (Hus et al., 2011)

Furthermore, deep learning trend-following models using attention-based BiLSTM architectures achieved prediction accuracies of 68.83% and back-tested returns of up to 42.74%, exceeding the returns of passive fund benchmarks (Lee et al., 2022).

These studies show that data-driven trend-following strategies, especially those using adaptive AI models, can match or outperform mutual fund returns in volatile or trending markets.

Mean Reversion Strategies

Mean-reversion shows that prices move around a stable level and tend to reverse towards a normal level over time. Tools like Bollinger Bands, RSI, and Moving Average Envelopes help traders spot when prices have moved too far in one direction and may be ready to reverse.

Recent research shows that mean-reversion strategies can sometimes equal or outperform mutual funds. For example, using both Bollinger Bands and RSI led to steady profits and outperformed buy-and-hold approaches in several markets, including Indian stocks (Tadas et al., 2023). Vietnamese markets showed similar results, with mean-reversion indicators helping to increase returns during uptrends and reduce downside risks (Cuong & Tam, 2018).

Studies on mutual fund performance show similar patterns. Many fund managers use value strategies, which are a type of mean reversion based on fundamentals instead of prices. Still, research shows mixed results about how well these strategies work. One review of 17,686 U.S. mutual funds found that most underperformed the market after adjusting for risk. This suggests that algorithmic mean-reversion strategies might provide more reliable returns (Baghdadabad et al., 2013).

AI-driven fund models now use technical mean-reversion indicators to help forecast net asset values. In 2018, researchers used backpropagation neural networks to predict mutual fund NAVs, which led to better forecast accuracy and investment returns (Pan et al., 2019). These methods show that mean-reversion logic is becoming a regular part of fund management.

Momentum Strategies

Momentum strategies work by taking advantage of ongoing price trends. They are based on the idea that assets that have performed well recently are likely to continue to perform well. Key indicators for these strategies include Rate of Change (ROC), RSI Momentum, and 52-week high or low breakouts.

Recent studies have found that momentum trading strategies based on machine learning often do better than market benchmarks and actively managed funds. Models like GRU and LSTM, which use momentum indicators such as MACD, DMI, and KST, achieved higher returns and Sharpe ratios than traditional approaches (Saud & Shakya, 2024). A 2024 study looked at “return-chasing” in equity mutual funds and found that these strategies gave only slightly higher average returns than buy-and-hold, but the difference was not statistically significant (Iriyadi et al., 2024). In addition, multi-objective optimization models that

adjust indicator thresholds have led to better return stability and improved downside risk management (Yelleti et al., 2024).

Overall, mutual funds depend on behavioral and macroeconomic signals for momentum, while technical indicator systems use measurable trend persistence and adaptive feedback. This approach has been shown to be more resilient across different markets.

Hybrid and Multi-Indicator Strategies

Hybrid or multi-indicator strategies use different types of technical analysis, such as trend-following along with mean-reversion or momentum filters, to make performance more stable. These strategies help cut down on false signals and adjust to changing market conditions.

Research shows that using several indicators together works better than relying on just one or on managed funds. For example, a 2024 study that combined multiple indicators using an attention-based reinforcement learning achieved cumulative returns of 76% and Sharpe ratios above 1.3, surpassing both buy-and-hold portfolios and the average equity fund (Wang & Li, 2024). In the same way, fund-of-funds models that choose mutual funds using optimized technical indicators showed better prediction accuracy for NAV and lower volatility than traditional selection methods (Wu et al., 2013).

Studies show that these strategies can deliver better risk-adjusted returns by addressing the weaknesses found in pure trend or mean-reversion systems. For example, combining Moving Averages with RSI filters led to more consistent performance and kept volatility lower, which is highly valued in fund management (Sharma, 2025).

2.3. Research Gaps

While there is more evidence that technical indicator-based trading can be competitive, some research gaps remain, showing that

I. Most Studies focus on the U.S and Asian markets, Canadian mutual funds show less study focus
II. Most studies do not account for transaction costs, taxes, or slippage, even though these are important when comparing with mutual funds.
III. Although returns are commonly reported, it is not common to see regular evaluation with Sharpe and max drawdown metrics.
IV. Most of the studies showed a short back test window, which cannot confirm whether the performances remained consistent throughout different business cycles.

This study will address most of these gaps by comparing 12 indicator-based strategies against mutual fund performance using metrics such as CAGR, Total return, Cumulative Return, Sharpe ratio, Win rate, max drawdown and others to determine whether top technical indicator-based stock trading strategies can outperform mutual funds.

3. Methodology

3.1. Data Sources

The data was collected using Python from Y-Finance historical daily stock data of major technology companies including AAPL, AMZN, GOOGL, META, MSFT, NVDA, NFLX, TSLA, AVGO, and PLTR. The data covered multiple years (2015–2025) and included standard OHLCV fields-nOpen, High, Low, Close, and Volume. A benchmark mutual fund (TD908) was also included to compare the performance of technical trading strategies against a traditional investment option.

3.2. Analytical Approach

The project focused on testing systematic trading strategies grouped into four main types:

i. Trend-Following Strategies (e.g., Moving Average Crossover, Breakout, Price Channel)
ii. Momentum Strategies (e.g., ROC, 52-Week Breakout, RSI Momentum)
iii. Mean Reversion Strategies (e.g., Bollinger Bands, RSI Reversal, Moving Average Envelope)
iv. Hybrid Strategies (e.g., Moving Average + RSI, Breakout + Bollinger, Momentum + Reversion Filter)

Each strategy was back tested using Python to generate buy and sell signals, and their performance was evaluated using key metrics including CAGR, Total Return, Volatility, Max Drawdown, Sharpe Ratio, Win Rate, and Profit Factor.

3.3 Benchmark Selection

To make the comparison more realistic, the algorithmic strategy was measured against the TD Canadian Balanced Fund (TD908). This mutual fund is commonly available to Canadian retail investors and serves as a good benchmark for testing whether the technical trading strategies can outperform a typical, professionally managed, and diversified investment option.

3.4. Visualization and Evaluation

The results were summarized and visualized using Python libraries such as Matplotlib and Seaborn. Graphs were used to show annual returns, performance metrics by ticker, and comparisons between the strategies and the mutual fund benchmark.
These visualizations helped highlight which strategies performed more consistently and how they behaved during different market conditions.

In Summary, the methodology involved collecting and cleaning multi-year stock data, calculating technical indicators, backtesting several strategy types, and evaluating their performance using visual and statistical comparisons. These processes provided a clear view of how technical trading models perform compared to a standard mutual fund.

4. Data Analysis

This session shows the analytical methods, and performance evaluation used to compare the 12 indicator-based strategies against Canadian mutual funds. Historical stock data, which comprised 10 tickers, was collected from Yahoo Finance and analysed using Python. Each of the strategies was evaluated through standard metrics including CAGR, Total return, Cumulative Return, Standard return, Volatility, Sharpe ratio, Win rate, max drawdown and profit factor.

4.1. Mean Reversion

Three strategies under Mean Reversion were implemented, these are; Bolling Bands Reversal, RSI Oversold/Overbought and Moving Average Envelope Reversal Strategy.

4.1.1 Bolling Bands Reversal

The Bollinger Bands were calculated using a 20-day moving average (BB_MA) and a 2-standard deviation offset (BB_STD), in accordance with standard technical analysis conventions.

i. Upper Band (BB_UP) = MA(20) + 2 × STD(20)
ii. Lower Band (BB_LOW) = MA(20) – 2 × STD(20)

The algorithm followed a reversion-based logic:

i. Buy (Long) when the price moves below the lower band and then closes back above it.
ii. Sell (Short) when the price moves above the upper band and then closes back below it.

A holding position was maintained until an opposite signal appeared. This approach allowed the strategy to capitalize on short-term reversals without constant trading noise.

Results

Table 1 shows the annual total returns for each ticker from 2015 to 2025 and reveals heterogeneous performance across tickers in different years. Between 2015 and 2019, returns for firms like AAPL, MSFT, and AMZN were stable, whereas 2020- 2022 showed a substantial increase in returns, which corresponds with pandemic-era market volatility.

Table 1 Annual Returns by Year

Ticker	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
AAPL	0.032367	0.0201	0.035477	0.096215	0.003965	0.05899	0.03024	0.008966	0.080205	0.054337	0.042424
AMZN	0.107442	-0.00775	0.067995	0.197601	0.00339	0.124731	0.055955	-0.06486	-0.09575	0.112176	0.033824
AVGO	-0.00865	0.070202	0.11398	0.048305	0.043348	0.056992	0.059145	-0.00166	0.050194	0.184365	0.128829
GOOGL	0.082537	0.034191	0.040904	0.036806	0.054284	-0.0145	0.084011	-0.06517	0.049999	0.033678	-0.00549
META	0.069284	0.062386	0.046372	0.023125	0.074977	0.055195	0.039205	-0.52043	0.03919	0.105087	-0.0306
MSFT	0.084107	0.055742	0.043073	0.080179	0.048225	0.09521	0.086708	-0.14395	0.058324	0.030606	0.069541
NFLX	0.145912	0.030381	0.085794	0.065622	-0.04098	0.161652	0.080921	-0.29521	0.094182	0.04677	0.119316
NVDA	-0.03907	0.130771	0.172221	0.087905	-0.12716	0.295881	0.126129	-0.04724	0.153001	0.234559	0.07322
PLTR	NAN	NAN	NAN	NAN	NAN	NAN	-0.06282	-0.26985	0.185007	0.22945	0.590966
TSLA	0.065865	0.049745	0.102636	0.145313	-0.12123	0.356515	0.00827	0.076644	-0.00615	0.129148	0.202676

Overall, most tickers showed positive long-term performance, with particularly strong years during 2020- 2021, reflecting the pandemic-driven tech boom.

i. NVDA had some of the highest returns, recording values of 0.2959 in 2020, 0.2346 in 2024, and 0.1530 in 2023, as a result of the surge in AI and semiconductor demand.
ii. TSLA also showed very strong performance, especially in 2020 (0.3565) and 2025 (0.2027), confirming its high volatility but sustained upward momentum.
iii. AAPL and MSFT remained the most stable performers, showing consistent positive returns across nearly all years (e.g., AAPL at 0.0962 in 2018, MSFT at 0.0952 in 2020)

with limited drawdowns, indicating steady growth and resilience.

iv. META and NFLX experienced significant declines in 2022 (-0.5204 and -0.2952, respectively) but later recovered by 2024 2025, reflecting strong rebounds after market normalization.

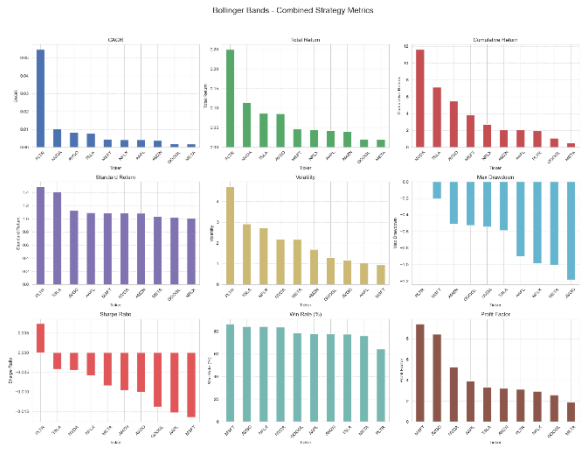
v. PLTR, as a newer stock, showed initial losses after listing (-0.0628 in 2021 and -0.2698 in 2022) but achieved substantial growth in 2024 (0.2295) and 2025 (0.5909), highlighting its high-risk, high-reward pattern.

Across the entire period, 2022 was the weakest year for most tickers due to market corrections and rising interest rates, while 2020 and 2024-2025 were the most profitable.

The Bollinger Bands strategy showed moderate but steady performance across most of the stocks, although the results differed depending on how volatile each stock was.

PLTR had the highest growth rate (CAGR) and the strongest total return, meaning the strategy worked best on this stock by effectively capturing price reversals. NVDA and TSLA also performed well, showing that the strategy tends to work better on stocks with high price swings and strong momentum.

When looking at risk, PLTR and MSFT showed higher volatility, while META and AVGO had deeper losses during market pullbacks. The Sharpe Ratios were mostly negative or close to zero, indicating that although the strategy made gains, those returns didn't always justify the level of risk taken.



However, the Bollinger Bands approach showed stronger trade accuracy, with a win rate of about 79%, meaning it was right more often on individual trades, even though profits per trade were smaller. The profit factor for the Bollinger Bands strategy (4.41) also indicates overall profitable trades, though returns were modest.

The win rate was high for several stocks- especially MSFT and AVGO- which means most trades were profitable, but the average profit per trade was relatively small. The profit factor values above 1 for most tickers also confirmed that, overall, the strategy was profitable, with MSFT and NVDA standing out as more efficient performers.

In general, the Bollinger Bands reversal strategy worked best on highly volatile stocks like PLTR, TSLA, and NVDA. However, because the risk-adjusted returns were not very strong, it would likely perform better if used as part of a hybrid trading approach rather than on its own.

Bollinger Bands Strategy Trade Signals and Price Patterns

The Bollinger Bands strategy performed best on volatile stocks like NVDA, TSLA, and PLTR, where frequent price swings created more profitable mean-reversion opportunities. In contrast, stable stocks such as AAPL and MSFT produced fewer signals but delivered steadier, lower-risk trades.

During periods of strong market movement, especially in 2020 and 2024-2025, the strategy captured several good entries and exit points, while in downturns like 2022, it struggled as prices stayed below the moving average for longer.

Overall, the strategy performed well in active markets and with high-volatility stocks, but less effectively in prolonged declines or flat periods.

Performance Comparison: Bollinger Bands Strategy vs. Mutual Fund

Table 3 and Fig 2 compared the average performance of the Bollinger Bands trading strategy against a benchmark mutual fund from 2015 to 2025. Overall, the mutual fund outperformed the Bollinger Bands strategy in terms of total return and growth.

i. The mutual fund achieved a CAGR of about 0.177, compared to 0.010 for the Bollinger Bands strategy.

ii. It also recorded a total return of approximately 2.59, far higher than the strategy's 0.075.

In contrast, the mutual fund had lower volatility (0.24) and a positive Sharpe Ratio (0.65), showing better risk-adjusted performance. The Bollinger strategy's negative Sharpe Ratio (-0.008) reflects that its returns didn't adequately compensate for the higher volatility (2.09).

The drawdowns show that while the mutual fund experienced larger declines (-1.68), it recovered more effectively and maintained steady long-term growth.

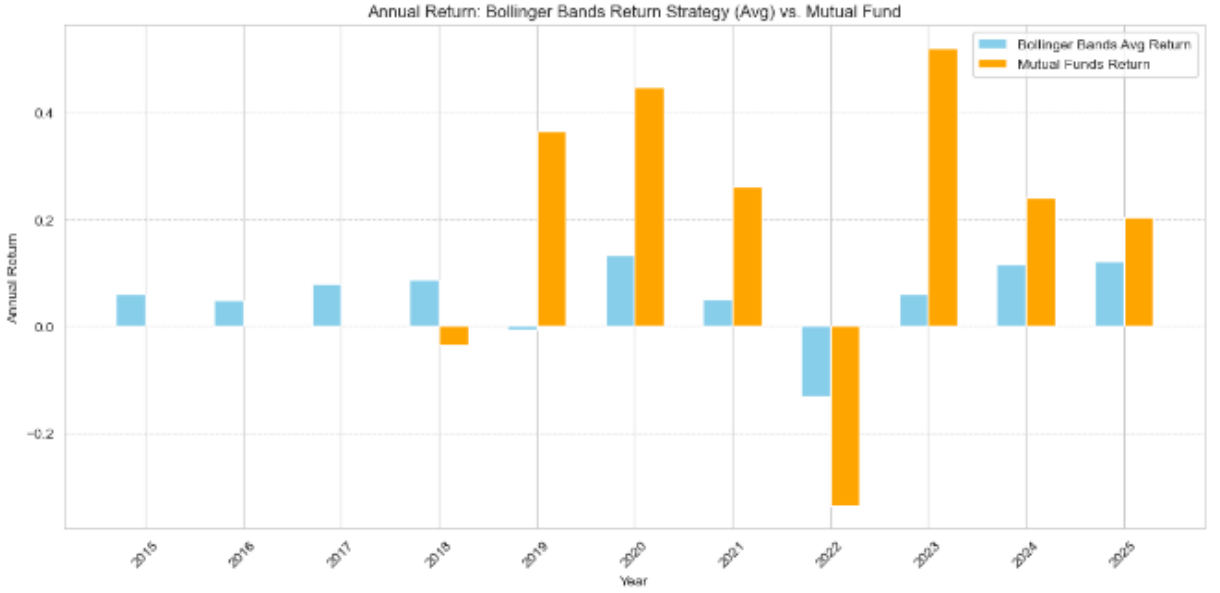
In contrast, the Bollinger strategy struggled to sustain performance during weaker years such as 2022.

4.1.2 RSI Oversold/Overbought

The RSI (Relative Strength Index) reversion strategy was implemented to identify potential buy and sell opportunities based on momentum shifts in each stock's price movement. The analysis used a 14-day RSI with overbought and oversold thresholds set at 70 and 30, respectively.

For each stock, the RSI was calculated using Wilder's smoothing method. A buy signal was generated when the RSI moved back above 30 (recovering from an oversold condition), and a sell signal was triggered when the RSI dropped back below 70 (falling from an overbought condition). These trades were tracked using position markers and held until an opposite signal occurred.

Strategy	CAGR	Total Return	Volatility	Max Drawdown	Sharpe Ratio	Win Rate (%)	Profit Factor
Bollinger Bands (Avg)	0.010144601	0.075304142	2.088126472	-0.643756854	-0.008046437	79.14669099	4.413119071
Mutual Fund	0.177542272	2.587504102	0.242667773	-1.683635683	0.649209699	54.58248473	1.156474573



From the RSI pivot table, most stocks showed positive returns in 2015–2019, with notable results such as AMZN (31.0%), NFLX (36.9%), and AVGO (23.6%) in 2015, while AAPL and GOOGL maintained steady growth of around 17–22% during the same period. Returns became more inconsistent post-2020 - for example, TSLA spiked sharply in 2020 (119.9%), but several tickers like AMZN (-13.7%) and META (-60.9%) saw steep declines by 2022–2023
The missing values occur because not all tickers had trades or available data in every year. This happens when RSI conditions (overbought/oversold reversions) weren't triggered, or the stock was newly listed (e.g., PLTR started trading only after 2020). See table in appendix

RSI performance metrics

The analysis shows the RSI Strategy Performance Metrics. AVGO and NVDA showed the strongest growth, with CAGRs of 0.025 and 0.018 and total returns of roughly 0.30 and 0.20, indicating steady RSI-based performance. TSLA recorded the highest cumulative return (~5.0), showing the strategy captured strong price movements. On the weaker side, PLTR and META had the lowest CAGR and even negative cumulative returns, suggesting limited profitability.

Volatility was highest for PLTR (~9) and TSLA (~6), showing wider price swings, while AAPL and MSFT were steadier, below 2. Sharpe Ratios stayed close to 0, implying the strategy's risk-adjusted performance was low. Win rates were strongest for AVGO (~96) and AAPL (~92), while PLTR and NVDA stayed below 75. Profit Factor was highest for MSFT (~10) and AAPL (~9.5), showing efficient gains relative to losses.

The RSI Reversion Strategy performed best on large-cap, stable tickers like AVGO, AAPL, and MSFT, while volatile or newer tickers such as PLTR underperformed due to inconsistent RSI signals.

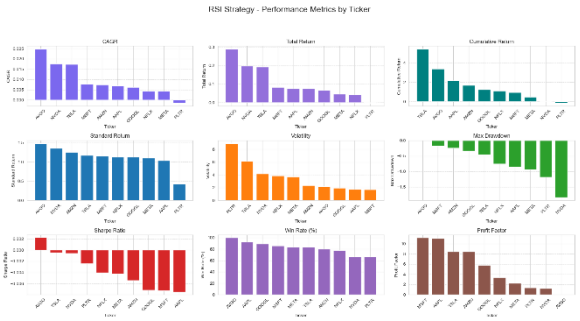


Figure 1 RSI performance metrics

RSI Strategy Trade Signals and Price Patterns

The RSI strategy chart shows how buy (green) and sell (red) signals were triggered across all tickers when RSI crossed the oversold (30) and overbought (70) levels.

Most stocks like AAPL, MSFT, AVGO, and GOOGL displayed consistent RSI reversions, buy signals during dips and sell signals after rallies, aligning well with upward price trends. TSLA and NVDA experienced frequent fluctuations, showing the RSI strategy captured several short-term reversals during volatile periods. META and AMZN showed mixed performance, where RSI signals occasionally lagged major price moves, leading to delayed entries and exits. PLTR, being a newer stock (post-2021), had fewer RSI signals but demonstrated strong gains in the later years.

The RSI strategy worked best in stable, trending markets, effectively timing pullbacks, but produced fewer or less reliable trades in volatile or sideways markets, which explains the varying signal density and trade frequency across tickers.

RSI Performance Comparison

The RSI Reversion Strategy delivered a modest CAGR of 0.95% and a total return of 10.6%, compared to the Mutual Fund's 17.7% CAGR and 258.7% total return.

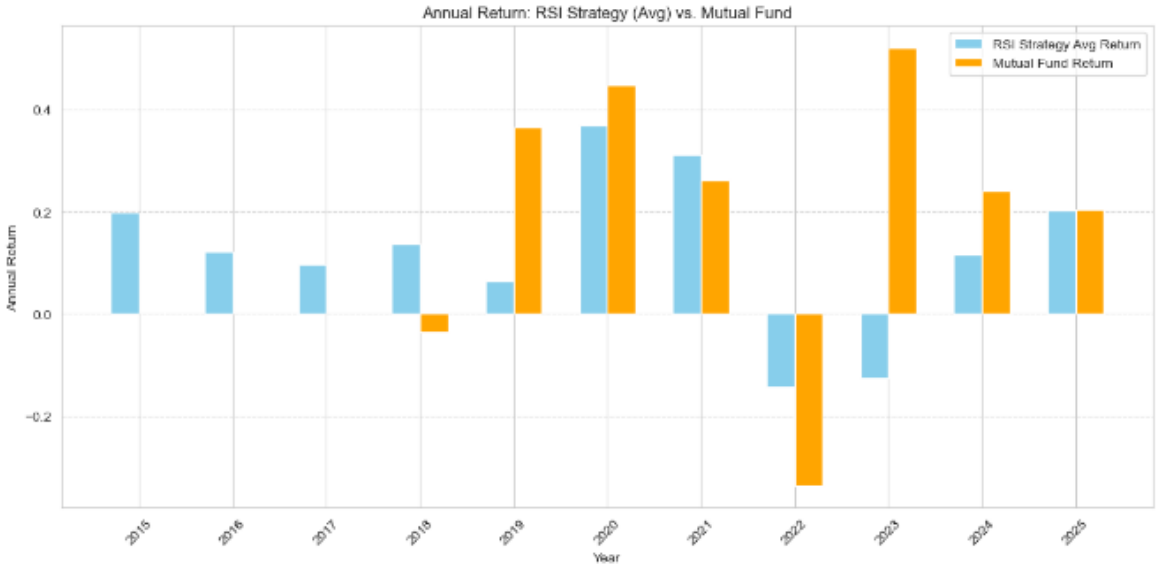
However, the RSI strategy achieved a much higher win rate (82.5%) and profit factor (5.92), indicating frequent small wins but limited compounding growth.

In terms of risk, RSI showed higher volatility (3.67) versus the fund's 0.24, and experienced a shallower drawdown (-0.68) than the mutual fund's deeper -1.68.

The Sharpe Ratio for RSI was slightly negative (-0.0037), showing weak risk-adjusted performance, while the mutual fund's 0.65 Sharpe Ratio indicates more efficient returns per unit of risk.

The annual return comparison highlights that RSI maintained steady gains in most years (2015–2021) and smaller losses in downturns like 2022. In contrast, the mutual fund experienced higher peaks and deeper declines, reflecting greater exposure to market swings.

Strategy	CAGR	Total Return	Volatility	Max Drawdown	Sharpe Ratio	Win Rate (%)	Profit Factor
RSI Revers	0.009508853	0.106487838	3.67267872	-0.678636823	-0.003679572	82.46886447	5.924724608
Mutual Fur	0.177542272	2.587504102	0.242667773	-1.683635683	0.649209699	54.58248473	1.156474573



In summary, the RSI strategy offered high consistency but low growth, while the mutual fund achieved higher long-term performance with greater volatility and drawdowns.

4.1.3 Moving Average Envelope Reversal Strategy

The Moving Average Envelope Reversal Strategy uses a 20-day moving average with ±2% envelope bands to identify potential price reversals. When the stock price drops below the lower band and moves back inside, it triggers a buy signal; when it rises above the upper band and returns inside, it triggers a sell signal.

Table 4 showed steady performance across most years, with the best overall years being 2016 (NVDA 0.1727) and 2023 (AVGO 0.1021, TSLA 0.0999, META 0.0879). The worst years were 2022 (META -0.1023, NFLX -0.0934, TSLA -0.0913) and 2019 (AAPL -0.0824). The most consistent performer was NFLX, maintaining returns around 0.04–0.06 yearly with smaller declines. The highest single-year return came from NVDA (0.1727 in 2016), while the largest decline was seen in META (-0.1023 in 2022).

On average, the strategy achieved an annual return of about 0.035, with volatility around ±0.05. PLTR shows missing values due to its late listing (no data before 2021).

Ticker	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
AAPL	0.001101053	-0.001480356	0.020722968	0.054179331	-0.082436828	0.054294351	0.044655058	-0.010431768	0.028073398	0.020337004	0.016294136
AMZN	0.027913927	0.017319594	0.026607855	0.023804081	0.008783263	0.001214103	0.017460238	-0.065075007	0.048849706	0.005890189	-0.001302046
AVGO	-0.014693131	0.019137922	0.047272971	-0.014367274	0.018807499	0.013714322	0.037320844	-0.013439227	0.102183358	0.039760575	0.051728302
GOOGL	0.019368085	0.035421169	0.045010081	0.011021464	-0.001605157	0.048180091	0.024843776	-0.025753047	0.025950413	0.024203569	0.009612805
META	0.043895693	0.018523262	0.059596555	-0.028367556	0.038552588	-0.002006162	0.021698189	-0.102318617	0.087900705	0.034589243	0.001999843
MSFT	0.017726026	0.043647447	0.030998261	0.012031215	0.032796985	-0.004702614	0.007564304	-0.023715398	0.042382585	0.013010362	0.065080987
NFLX	0.063393385	-0.031166168	0.070998867	0.000455093	0.019496427	0.018279927	0.042627913	-0.093450573	0.072295631	0.107607283	0.073234741
NVDA	0.020976281	0.172727156	0.010155142	0.026037504	-0.007183303	0.015818062	0.098667048	-0.01184881	0.063640058	0.032244276	0.030308665
PLTR											
TSLA	0.017040722	0.065426051	0.062442586	0.002537765	-0.006407266	0.106001925	0.045978078	-0.091356613	0.029712964	0.199973037	-0.02426592

The MA Envelope Reversal strategy showed steady mid-single-digit gains in stable markets but underperformed during sharp drawdowns.

Fig4: MA Envelope performance metrics

From the MA Envelope Strategy Performance Metrics, PLTR showed the highest CAGR (0.021) and total return (0.11), followed by AVGO (0.005) and NVDA (0.004), showing strong mean-reversion gains. NVDA also recorded the highest cumulative return (16), followed by TSLA (12) and PLTR (8), meaning these captured the largest long-term price swings.

Volatility was most pronounced in TSLA (3.8) and PLTR (3.2), while GOOGL and AMZN showed lower volatility (1). The max drawdown was deepest for PLTR (-21), indicating large temporary losses, while NVDA and GOOGL showed minimal drawdowns.

Standard returns were stable across most tickers (1.0–1.1), suggesting consistent trade performance. However, Sharpe Ratios were mostly negative, from PLTR (0) to AMZN (-0.02), reflecting weak risk-adjusted results. Win rates were strongest for AAPL (75) and GOOGL (73), while TSLA (55) and PLTR (60) lagged. Profit Factors were highest for NVDA (4.2), PLTR (3.8), and MSFT (3.5), indicating efficient gain-to-loss ratios.

The MA Envelope Reversal Strategy performed best on NVDA, PLTR, and MSFT, showing strong returns and profitability. At the same time, AMZN and META trailed due to weaker Sharpe Ratios and lower win efficiency.

MA Envelope Strategy Trade Signals and Price Patterns

From the MA Envelope Reversion Strategy trade charts, most stocks displayed clear mean-reversion behavior with consistent buy and sell signals around the envelope bands.

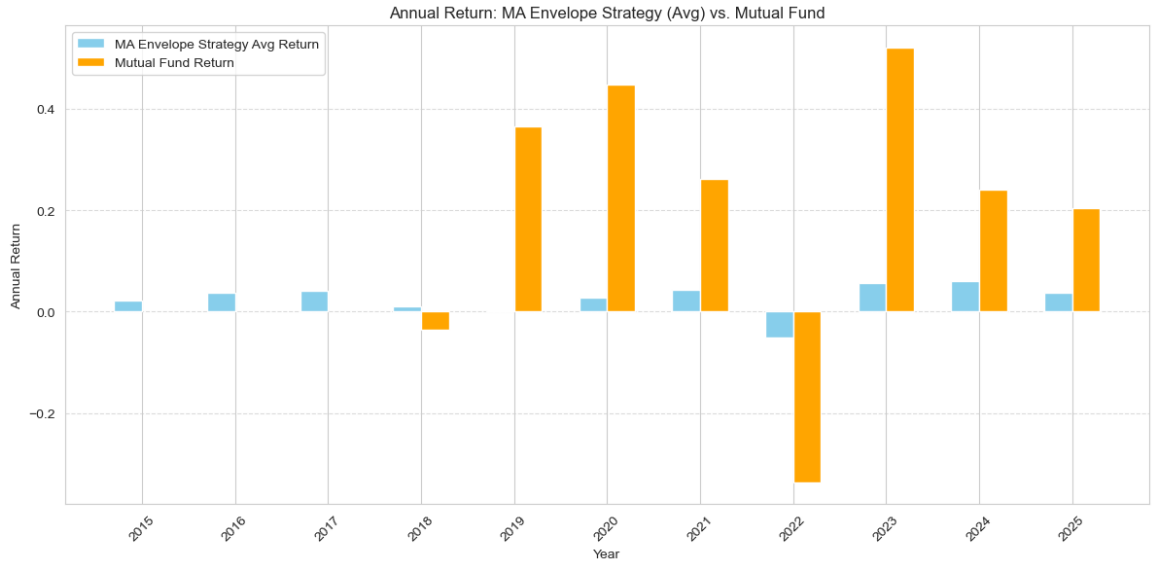
NVDA, AAPL, and MSFT showed strong and sustained uptrends with frequent profitable buy signals near the lower envelope and exits near the upper band, reflecting the strategy's strength in trending markets. NVDA's price growth was the most pronounced, aligning with its top cumulative and total returns. GOOGL, AVGO, and AMZN exhibited moderate reversion patterns, with smaller but steady gains, while META and NFLX showed more volatility and occasional false signals, especially during market

drawdowns (2021–2022). TSLA had larger price swings and higher volatility, generating wider envelope gaps and mixed trade outcomes, some highly profitable, others whipsawed during reversals. PLTR, with limited historical data (starting 2021), showed decent upward movement and consistent reversion signals, but fewer total trades.

The MA Envelope Reversion Strategy performed best on NVDA, AAPL, and MSFT, showing balanced signal frequency and consistent gains. It was less reliable on high-volatility stocks like TSLA and META, where sharp price reversals reduced effectiveness.

Table 2 MA Envelope Performance Comparison

Strategy	CAGR	Total Return	Volatility	Max Drawdown	Sharpe Ratio	Win Rate (%)	Profit Factor
MA Envelo	0.004049964	0.030133952	1.838992904	-3.321556317	-0.01148295	66.11660818	2.643438384
Mutual Fur	0.177542272	2.587504102	0.242667773	-1.683635683	0.649209699	54.58248473	1.156474573



MA Envelope Performance Comparison

From the MA Envelope Strategy (Avg) vs. Mutual Fund comparison, the MA Envelope Strategy maintained small but consistent positive returns over most years, typically ranging between 0.01 and 0.05, while the Mutual Fund showed larger yearly fluctuations, from deep losses (around –0.3 in 2022) to strong gains (above 0.45 in 2020 and 2023).

In terms of key metrics, the MA Envelope Strategy had a CAGR of 0.0040, total return of 0.0301, and volatility of 1.83, compared to the Mutual Fund's much higher CAGR of 0.1775, total return of 2.5875, and volatility of 0.24. Although the fund outperformed in growth, the strategy achieved lower volatility, meaning steadier but smaller returns.

The max drawdown for the MA Envelope Strategy was -3.32, slightly higher than the Mutual Fund's -1.68, indicating deeper temporary declines. The Sharpe Ratio for the MA strategy was negative (-0.011), suggesting low risk-adjusted performance, whereas the fund's Sharpe Ratio (0.649) indicated better returns per unit of risk.

However, the MA Envelope Strategy excelled in consistency, with a win rate of 66.12 and a strong profit factor of 2.64, compared to the Mutual Fund's win rate of 54.58 and profit factor of 1.15.

In summary, the Mutual Fund outperformed on total return and efficiency, but the MA Envelope Strategy demonstrated steadier results, lower volatility per trade, and a higher win rate, making it better suited for conservative, mean-reversion-based investors.

4.2. Momentum Strategy

Three strategies under Momentum Strategy were implemented, these are; Rate of Change, 52-Week Breakout and RSI Momentum

4.2.1. Rate of Change

The Rate of Change (ROC) indicator measures the percentage change in a stock's closing price over a fixed lookback window. For this study, a **5-day ROC** was used to capture short-term momentum.

A positive ROC indicates upward momentum, while negative values signal downward momentum.

The ROC model operates on a directional rule:

i. **Buy/Long:** when short-term price movement is positive
ii. **Sell/Short:** when short-term movement becomes zero or negative

This design allows the strategy to remain continuously active in the market, switching positions when momentum shifts.

i. NVDA exhibits the strongest momentum responsiveness in the ROC framework, with consistently high positive values across several years, particularly 2016, 2021, 2023, and 2024, indicating that short-term acceleration patterns are captured effectively for this ticker.
ii. NFLX shows notable momentum strength in years like 2015, 2018, 2023, and 2024, suggesting that the ROC strategy aligns well with its cyclical but sharp short-term price surges.
iii. AVGO demonstrates stable and recurring positive momentum patterns, especially in 2016, 2020, 2023, 2024, and 2025, reflecting smoother upward acceleration compared to other high-volatility stocks.
iv. AAPL maintains modest but consistently positive ROC values throughout most years, with stronger momentum capture in 2017, 2019, and 2023, aligning with its steady price behaviour.
v. MSFT records small but mostly positive ROC values, with clearer momentum presence in 2020 and 2021, consistent with its lower volatility and more predictable movement.
vi. GOOGL presents subdued but generally positive momentum, with stronger periods in 2015, 2017, and 2023, while weaker ROC performance in 2018 and 2022 reflects limited short-term trend acceleration in correction years.
vii. AMZN shows early strong momentum in 2015 but remains inconsistent afterward, recording negative ROC in several years (2016, 2021, 2022, 2025), indicating irregular short-term acceleration.
viii. TSLA displays sharp and highly volatile momentum patterns, with significant surges in 2020 and 2021, contrasted by negative ROC years such as 2018, 2022, and 2025, highlighting the risk-sensitive nature of short-term strategy outcomes.
ix. META produces strong positive momentum in 2023, one of the most pronounced across the dataset, but exhibits substantial breakdowns in 2018, 2022, and 2025, reflecting its boom-and-bust characteristic under the ROC model.
x. PLTR, due to its shorter trading history, shows irregular momentum, with strong positive values in 2020 and 2024, but severe negative acceleration in 2022, indicating instability in early-stage trading behaviour.

Table 3 Annual Pivot Table

Year	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Ticker											
AAPL	-0.000731	0.00301	0.012633	0.008296	0.010813	0.019091	0.001703	0.00011	0.01102	0.00298	0.00258
AMZN	0.021115	-0.0032	0.008202	0.006806	0.004442	0.003651	-0.00099	-0.0094	0.01113	0.01037	-0.0062
AVGO	0.000781	0.01292	-0.000379	-0.002203	0.006532	0.01357	0.002751	-0.00435	0.01213	0.01733	0.01224
GOOGL	0.008244	-0.0024	0.005904	0.004329	-0.002012	0.000997	0.003332	-0.0133	0.00623	0.00871	0.00224
META	0.000465	0.00219	0.006174	-0.010409	0.009449	0.004529	0.003567	-0.0258	0.03674	0.01388	-0.008
MSFT	0.001497	-0.0013	0.005901	-0.002514	0.005128	0.008128	0.009462	-0.0111	0.00745	0.00141	0.00309
NFLX	0.025723	-0.0042	0.009164	0.011983	0.003608	0.006132	0.001699	-0.0227	0.02011	0.01302	0.00506
NVDA	0.011519	0.03041	0.011145	-0.000197	0.010208	0.009692	0.023822	-0.0078	0.04527	0.02439	-0.0009
PLTR	NaN	NaN	NaN	NaN	NaN	0.041284	0.002287	-0.0293	0.01128	0.03224	0.0321
TSLA	-0.001753	0.0004	0.020665	-0.004492	-0.001944	0.061987	0.024088	-0.0136	0.01554	0.01205	-0.0006

Rate of Change Performance Metrics

The ROC strategy shows clear differences in performance across stocks. NVDA stands out with the strongest cumulative return and one of the highest CAGRs, indicating that short-term momentum signals work particularly well on high-growth, fast-moving stocks. PLTR also performs well, recording the highest CAGR due to its large price swings. In contrast, stable large-caps like AAPL, MSFT, GOOGL, and META generate more modest returns, showing that the ROC strategy is less effective for steady, slow-moving stocks.

Volatility results further support this pattern: TSLA, NVDA, and PLTR show high volatility that strengthens momentum-based returns, while blue-chip stocks show lower volatility and therefore smaller ROC gains. Sharpe ratios remain mostly negative across the board, suggesting weak risk-adjusted performance, though NVDA and PLTR still show comparatively better outcomes.

Drawdowns are deepest for high-momentum stocks like TSLA, NVDA, and META, reflecting their sensitivity to sharp reversals. Win rates vary, with META and NFLX performing best, while NVDA and

TSLA rely on fewer but larger profitable moves. Profit factors indicate that NVDA and PLTR generate stronger payoff efficiency than the rest.
Overall, the ROC strategy performs best on volatile, momentum-driven stocks and struggles to add value on stable, consistent performers.

Rate of Change Performance Comparison

The comparison between the ROC momentum strategy and the mutual fund shows a clear performance gap. The mutual fund strongly outperforms the ROC strategy on growth metrics, delivering a much higher CAGR (0.1775 vs. 0.00098) and Total Return (2.5875 vs. 0.0079). This indicates that while ROC captures short-term price movements, it fails to generate meaningful long-term compounding compared to the diversified mutual fund.

Risk metrics further strengthen this contrast. The ROC strategy exhibits significantly higher volatility (1.07 vs. 0.24) and deeper drawdowns (–2.46 vs. –1.68), reflecting its sensitivity to frequent market fluctuations. The Sharpe Ratio also highlights inefficiency: the mutual fund maintains a strong positive Sharpe (0.6492), whereas the ROC strategy produces a negative Sharpe (–0.0216), indicating poor risk-adjusted returns.

Although the ROC model shows a decent Profit Factor (1.54), its lower Win Rate (41% vs. 54.58%) signals inconsistent trade success. Overall, the analysis demonstrates that the ROC strategy is more volatile, less stable, and significantly less effective than the mutual fund in delivering sustained and risk-adjusted performance.

	CAGR	Total Return	Volatility	Max Drawdown	Sharpe Ratio	Win Rate (%)	Profit Factor
Strategy							
ROC Strategy (Avg)	0.000983	0.007914	1.072733	-2.462807	-0.021579	41.025144	1.543469
Mutual Fund	0.177542	2.587504	0.242668	-1.683635	0.64921	54.582485	1.156475

4.2.2 Week High/Low Breakout Momentum Strategy

The objective of the 52-Week High/Low Breakout Momentum Strategy is to evaluate whether long-term price breakouts can serve as reliable momentum signals for generating profitable trading opportunities. This strategy is based on the principle that when a stock exceeds its highest or lowest price over the last year (252 trading days), it may continue moving strongly in that direction.

Table 4 Annual Pivot Table

Year	2018	2020	2022	2025
Ticker				
AAPL	0.318406	NaN	1.273747	NaN
AMZN	NaN	1.384698	0.249435	NaN
AVGO	0.50196	-0.138	0.514632	NaN
GOOGL	0.237608	NaN	0.726578	0.191045
META	0.387407	-0.25036	0.033874	NaN
MSFT	NaN	NaN	3.728444	0.307534
NFLX	NaN	NaN	2.097	NaN
NVDA	4.554176	NaN	1.959125	NaN
TSLA	-0.04242	NaN	7.059896	NaN

Across all years, the performance of the 52-Week High/Low breakout strategy varies widely across tickers, reflecting differences in long-term momentum behaviour and responsiveness to major price breakouts.

NVDA delivers the strongest overall breakout performance, with exceptionally high returns in multiple periods (notably 4.55 and 1.96), indicating that NVIDIA responds reliably to long-term momentum surges and sustains post-breakout trends more consistently than other stocks.

TSLA also exhibits explosive breakout behaviour, highlighted by a very large return (7.06), showing that Tesla's strong momentum phases translate well into breakout continuation. However, negative values in other periods suggest periodic false breakouts as well.

MSFT, AAPL, GOOGL, and NFLX show steady to moderately strong breakout performance, each generating significant positive returns in at least one period. Their results indicate a balanced momentum profile: while not always producing breakouts, they typically generate reliable continuation when a breakout does occur.

AVGO demonstrates a mixed pattern, with strong positive breakouts in some periods (0.50, 0.51) and negative performance in others (–0.13), suggesting that its trend continuation is more sensitive to market conditions.

META displays inconsistent breakout behaviour, with positive returns in selective periods but noticeable negative outcomes in others (–0.25), indicating vulnerability to failed or short-lived breakouts.

AMZN delivers selective but strong breakout performance when signals occur (e.g., 1.38), although limited breakout activity results in fewer opportunities overall.

PLTR does not appear in this table due to insufficient historical data for computing a full 52-week rolling window during early years. This reflects the strategy's limitation for newly listed stocks.

52 Week High/Low Breakout Performance Metrics

The performance metrics across multiple tickers reveal that the 52-Week High/Low breakout strategy delivers inconsistent results, with some stocks showing strong profitability while others perform poorly.

Return-based metrics (Cumulative Return, CAGR, Total Return) show that only a few stocks, most notably NVDA and TSLA produce meaningful long-term gains under this strategy. These tickers exhibit significantly higher cumulative returns and CAGR compared to others, indicating stronger trend-following behavior. In contrast, stocks like MSFT, GOOGL, and AMZN generate very modest returns, suggesting the breakout signals are less effective for them.

Risk metrics (Standard Return, Volatility, Max Drawdown) highlight substantial variation in risk exposure. Some stocks show extremely high volatility (e.g., TSLA), which explains the large swings in returns. Max drawdown values indicate that certain tickers experience deep losses during unfavorable periods, reinforcing the strategy's vulnerability to market reversals.

Risk-adjusted performance (Sharpe Ratio and Profit Factor) remains relatively weak across most tickers. Sharpe Ratios hover near zero or negative, meaning that returns do not sufficiently compensate for risk. Profit Factor results show extreme variation, TSLA stands out with a very high profit factor, while others remain close to break-even, indicating unstable consistency in trade outcomes.

Win Rate (%) is generally high across most assets, but this does not translate into strong profitability because the magnitude of losses often outweighs the average gains.

Table 5 52 Week High/Low Performance Comparison

52 Week High/Low Performance Comparison

The comparison shows that the mutual fund outperforms the 52-week high/low strategy in overall return generation. Its CAGR and total return are significantly higher, indicating stronger long-term growth and better compounding gains. In contrast, the strategy produces only moderate returns despite its high number of winning trades.

The risk profile further separates the two. The 52-week strategy experiences extremely high volatility, meaning its returns fluctuate widely and come with substantial uncertainty. The mutual fund, however, maintains very low volatility, offering a smoother and more stable performance over time.

In terms of risk-adjusted performance, the mutual fund is clearly superior. Its Sharpe Ratio is far higher, demonstrating that it delivers much better returns for the level of risk taken. Although the breakout strategy has a high win rate, this does not translate into higher profitability because the magnitude of losses and fluctuations outweigh the frequency of wins.

Overall, the mutual fund provides more efficient, stable, and dependable performance, making it the stronger investment option when compared to the 52-week high/low breakout strategy.

	CAGR	Total Return	Volatility	Max Drawdown	Sharpe Ratio	in Rate (%)	Profit Factor
Strategy							
FTW Strategy (Avg)	0.125779	1.27128	23.303138	-0.145506	0.003465	87.03704	58.48991
Mutual Fund	0.177542	2.5875	0.242668	-1.683635	0.64921	54.58249	1.156475

4.2.3.Relative Strength Index

The Relative Strength Index (RSI) is a widely used momentum oscillator that measures the speed and magnitude of recent price changes to identify overbought and oversold market conditions. In this strategy, RSI is used as a trigger to systematically time entries and exits based on momentum reversals. The primary idea behind the RSI momentum approach is that extreme RSI values indicate short-term mispricing, which can be exploited for mean-reversion-based trading decisions.

Table 6 Relative Strength Index Strategy - Annual Pivot Table

Year	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Ticker											
AAPL	0.004154	0.01463	0.028009	0.078627	-0.031498	0.018222	0.029967	-0.0184	0.0081	0.04241	0.060828
AMZN	0.054422	-0.0867	0.048943	0.113339	0.004773	0.121625	0.063844	-0.0826	-0.0311	0.00444	-0.108597
AVGO	0.056874	0.07833	0.062131	0.002488	0.037699	-0.01531	0.060568	-0.02452	0.14734	0.15696	0.079205
GOOGL	0.09931	0.05219	0.041702	0.098133	-0.036814	0.028933	0.101185	-0.0455	0.09286	0.01919	0.049123
META	0.094914	0.10433	0.048179	-0.068315	0.021226	0.004655	0.0294	-0.2218	0.10634	0.12521	-0.012065
MSFT	0.045111	0.0769	0.041931	0.123223	-0.006559	0.089119	0.062019	-0.0002	0.06635	0.02765	0.018331
NFLX	0.139784	0.00398	0.129947	NaN	-0.056649	0.09651	0.065353	-0.26606	0.08961	0.07651	0.188
NVDA	0.099976	0.04624	0.076038	0.107085	-0.141301	NaN	0.133453	-0.0554	0.12693	0.20198	0.07493
PLTR	NaN	NaN	NaN	NaN	NaN	NaN	0.03434	-0.2435	0.23094	0.20282	0.206799
TSLA	0.022695	0.02504	0.009838	0.062476	-0.238194	0.193705	0.048547	0.09651	0.00541	0.16545	-0.023069

Overall, the annual returns generated by the RSI momentum strategy reveal high variability across different years and across individual tickers, indicating that its effectiveness is inconsistent and strongly dependent on market conditions.

Across most stocks, the strategy performs well during strong bullish years such as 2017, 2020, 2021, and 2023, where positive returns appear across multiple tickers (e.g., AAPL, MSFT, NVDA, META, NFLX). This aligns with the nature of RSI-based mean-reversion signals, which tend to work better in trending markets where pullbacks are followed by recoveries.

However, the strategy struggles noticeably during high-volatility or bearish periods, particularly in 2018, 2022, and for some stocks in 2019. Negative returns become more common, with sharp declines observed for META (2022: –0.2218), NFLX (2022: –0.2661), PLTR (2022: –0.2435), and TSLA (2019: –0.2382). These losses show that the strategy is vulnerable to prolonged momentum breakdowns, during which RSI oversold signals fail to produce meaningful rebounds.

Certain stocks consistently produce stronger results under this strategy. AAPL, MSFT, AVGO, GOOGL, and NVDA show mostly positive returns across the decade, indicating that large-cap, trend-persistent equities respond better to RSI-based signals. In contrast, META, NFLX, PLTR, and TSLA exhibit more extreme yearly fluctuations, reflecting higher sensitivity to market shocks and reversals.

Notably, stocks like NVDA, PLTR, and AVGO show very strong returns in recent years (2023–2025), suggesting that the strategy performed better in the post-pandemic recovery environment, where price swings created frequent, profitable RSI signals.

Relative Strength Index Strategy Performance Metrics:

The RSI momentum strategy delivers moderate cumulative returns, with stocks like PLTR, NVDA, and GOOGL standing out. However, CAGR remains low, showing that long-term growth under this strategy is limited and inconsistent across tickers.

While standard returns appear strong, the strategy also shows high volatility, especially for TSLA, NFLX, and PLTR, indicating frequent and unpredictable price swings. More stable names such as AAPL and MSFT show smoother performance.

Risk-adjusted performance is weak, with Sharpe Ratios mostly negative or near zero, suggesting that the returns generated do not adequately compensate for the level of risk taken. This makes the strategy inefficient from a risk-return perspective.

Max drawdowns are significant, particularly for volatile stocks like META, NFLX, and TSLA, demonstrating that the RSI signal tends to fail during prolonged market downturns where oversold conditions persist.

Although the strategy achieves high win rates, the gains are often small while losses are larger, limiting overall profitability. A few tickers show higher profit factors, but overall the strategy remains inconsistent and heavily dependent on market conditions.

Relative Strength Index Performance Comparison

The comparison shows that the mutual fund significantly outperforms the RSI strategy in terms of long-term growth. Its CAGR (0.1775) and total return (2.5875) are far higher than the RSI strategy's very low CAGR (0.0074) and modest total return (0.0612), indicating that the RSI approach generates minimal long-term value.

Despite the RSI strategy's high win rate (73%), it exhibits much higher volatility (1.77) and a negative Sharpe Ratio, meaning its returns are unstable and do not compensate for the risk taken. In contrast, the mutual fund shows much lower volatility (0.24) and a strong Sharpe Ratio (0.6492), demonstrating efficient and risk-adjusted performance.

Both approaches experience large drawdowns, but the RSI strategy's performance is more erratic, with gains heavily offset by sharp losses during unfavorable periods. Even though the strategy shows a high profit factor, this does not translate into meaningful overall return due to inconsistent trade outcomes.

Overall, the mutual fund offers stronger, more stable, and more efficiently risk-adjusted performance, making it a clearly superior choice compared to the RSI momentum strategy, which remains highly volatile and delivers minimal long-term growth despite frequent winning trades.

	CAGR	Total Return	Volatility	Max Drawdown	Sharpe Ratio	Win Rate (%)	Profit Factor
Strategy							
RSI Strategy (Avg)	0.007438	0.061151	1.76999	-1.404655	-0.009584	73.513384	3.818126
Mutual Fund	0.177542	2.587504	0.242668	-1.683635	0.64921	54.582485	1.156475

4.3. Hybrid/Multi-Indicators

Three strategies under Momentum Strategy were implemented, these are; MACD Trend Filter, RSI Momentum Filter and Momentum + Reversion Filter

4.3.1. MACD Trend Filter

MACD measures the difference between short-term and long-term exponential moving averages. Positive MACD values and bullish crossovers (MACD > Signal Line) indicate upward trend acceleration.

Let

$$MACD_t = EMA_{12}(Close_t) - EMA_{26}(Close_t)$$
$$Signal_t = EMA_9(MACD_t)$$

Trend condition:

$$TrendUp_t = MACD_t > Signal_t$$

4.3.2. RSI Momentum Filter

RSI captures the speed and magnitude of recent price movements, identifying whether directional momentum supports continuation.

$$RSI_t = 100 - \frac{100}{1 + RS_t}, RS_t = \frac{AvgGain}{AvgLoss}$$

Momentum condition:

$$MomentumOK_t = RSI_t > 40$$

Hybrid Position Rule

A position is taken only if both indicators agree:

- **Buy/Long:** if $TrendUp_t = 1$ **and** $MomentumOK_t = 1$
- **Sell/Short:** otherwise

A standard 14-period RSI is used:

Positions are shifted forward one trading session to simulate execution at the next available close price, ensuring no look-ahead bias. This hybrid design introduces conditional gating: MACD prevents RSI from signaling early reversals during dominant downtrends, while RSI prevents MACD from entering late during trend exhaustion.

Hybrid Strategy- Annual Performance Overview

The annual pivot summaries demonstrate that the hybrid system captures trend-sustaining years but reacts poorly to structural reversals or periods of low-momentum drift. Across most years, the strategy delivers sporadic positive returns concentrated in highly directional phases, particularly in technology-driven bull markets (post-COVID rallies, 2023-2024). However, performance breaks down during bearish environments and prolonged consolidation periods (e.g., 2018 and 2022), where the dual gating leads to delayed entry and extended periods in losing positions.

i. NVDA, META, TSLA, and PLTR display the most explosive reactions, delivering large multi-month trend gains during momentum expansions. However, these same tickers generate severe negative returns during breakdown periods, reflecting the sensitivity of high-beta assets to hybrid mis-timing.
ii. AAPL, MSFT, and GOOGL exhibit more moderate performance, reflecting slower price acceleration. Gains occur only during extended, sustained bull phases, indicating that the hybrid filter is less responsive to gradual accumulation and more dependent on clear breakout momentum.
iii. NFLX and AMZN show wide return dispersion, with strong directional gains clustered in single bull windows followed by prolonged decay, suggesting asynchronous

indicator alignment relative to their idiosyncratic volatility cycles.

Overall, the hybrid strategy's strength lies in prolonged single-direction trends, while its weaknesses emerge during choppier regimes in which MACD and RSI alternate between conflicting signals.

Performance Comparison: Hybrid Strategy vs. Mutual Fund

Metric	Hybrid Strategy Avg	Mutual Fund
CAGR	**0.0017**	**0.1775**
Total Return	**0.0148**	**2.5875**
Volatility	**1.6053**	**0.2427**
Sharpe	**-0.0146**	**0.6492**
Max Drawdown	**-1.9618**	**-0.3635**
Win Rate	**45.93%**	**54.58%**
Profit Factor	**1.77**	**1.156**

The mutual fund clearly dominates in growth metrics, risk metrics, and efficiency:

i. The fund's CAGR is over 100× greater than the hybrid system's.
ii. The hybrid strategy fails to produce stable returns despite frequent signals.
iii. The fund's volatility is nearly 1/6th of the hybrid model, while returning a positive Sharpe ratio, highlighting superior risk compensation.
iv. The hybrid model's extreme drawdown (-196%) demonstrates structural fragility.
v. The fund's much smaller drawdown (-36%) indicates capital preservation.
vi. The fund benefits from diversification, smoothing return cycles.
vii. The hybrid model is binary, momentum-dependent, and highly regime-specific.

4.4. Trend Following Strategy

Three strategies under Trend following were implemented, these are: Moving Average (MA) Crossover, Breakout Strategy and Donchian Channel.

4.4.1 Moving Average (MA) Crossover

The MA Crossover strategy uses two moving averages:

i. Short MA: 50-day moving average
ii. Long MA: 200-day moving average

MA Crossover Strategy uses the following Signal Logic:

i. Buy (Long): When the 50-day MA crosses above the 200-day MA (bullish crossover)
ii. Sell (Exit): When the 50-day MA crosses below the 200-day MA (bearish crossover)

A position will be held till the opposite signal is generated, allowing the strategy to capture trends and avoid frequent trading noise.

Annual Returns by Year

The pivot table below shows the annual total return of each ticker from 2015–2025, highlighting the performance of the MA Crossover strategy across different stocks and years.

The annual return table for the selected tickers from 2015 to 2025 reveals several key insights about the performance and variability of technical indicator-based strategies:

i. Certain stocks, such as NVDA and TSLA, exhibited exceptionally high returns in specific years (e.g., NVDA: 6.30 in 2018, 5.16 in 2025; TSLA: 9.35 in 2021), indicating that technical strategies can capture strong momentum during bullish periods.
ii. AVGO and META also showed significant spikes in 2025 (AVGO: 2.55; META: 2.38), reflecting the ability of these strategies to benefit from sector rallies.
iii. Several tickers experienced negative returns in some years, such as TSLA in 2015–2016 and NFLX in 2016 and 2019, highlighting the risk of drawdowns during market corrections or sideways trends.
iv. AMZN and GOOGL had years with both positive and negative returns, demonstrating the variability of strategy performance across different market environments.
v. NVDA and TSLA stand out for their outsized gains in certain years, suggesting that

Year	2015	2016	2017	2018	2019	2020	2021	2022	2024	2025
Ticker										
AAPL	NaN	NaN	NaN	0.474069	NaN	NaN	NaN	0.416606	0.101967	-0.15016
AMZN	NaN	0.011725	NaN	1.636355	-0.09567	NaN	0.653051	-0.19347	NaN	0.441845
AVGO	NaN	NaN	NaN	0.077713	NaN	-0.17116	NaN	0.708712	NaN	2.546436
GOOGL	NaN	-0.02107	NaN	0.336824	-0.03057	0.045565	NaN	0.842767	NaN	0.379298
META	NaN	NaN	0.253275	0.025192	NaN	-0.09652	0.432699	NaN	NaN	2.380955
MSFT	NaN	0.060085	NaN	NaN	0.990403	NaN	NaN	1.751794	0.5771	-0.10793
NFLX	NaN	-0.12361	NaN	1.618794	-0.19224	NaN	0.40746	-0.21687	NaN	NaN
NVDA	NaN	NaN	NaN	6.304557	NaN	NaN	NaN	4.033157	NaN	5.15765
PLTR	NaN	NaN	NaN	NaN	NaN	NaN	-0.07422	NaN	NaN	NaN
TSLA	-0.06046	-0.08198	0.35367	-0.20055	-0.1077	NaN	9.354801	-0.03171	-0.26399	0.05304

technical strategies are particularly effective for high-momentum, growth-oriented stocks.

vi. More stable stocks like AAPL and MSFT showed moderate but consistent returns, indicating lower volatility but less dramatic outperformance.

MA Strategy Metrics

The Moving Average (MA) strategy metrics show that NVDA stands out with high cumulative return, indicating that this stock benefited most from the MA-based approach over the period. While most other tickers delivered moderate gains, PLTR remained flat, suggesting the strategy was ineffective for that stock. NVDA also leads in terms of Compound Annual Growth Rate (CAGR), highlighting strong annualized growth, whereas PLTR shows a negative CAGR, reflecting losses. Total and standard returns further confirm NVDA's dominance, with META, GOOGL, and TSLA also showing respectable performance, while PLTR and NFLX lag. Volatility is highest for TSLA and NVDA, which means these stocks experienced larger price swings and higher risk, whereas other tickers displayed more moderate volatility.

The Sharpe ratios across all tickers are low or near zero, indicating limited risk-adjusted returns, and PLTR's negative Sharpe ratio points to poor risk-adjusted performance. Max drawdown analysis shows that TSLA and PLTR suffered the deepest losses from peak to trough, while most other tickers experienced relatively mild drawdowns. Win rates are generally above 60% for most tickers, with AAPL and MSFT approaching 80%, but PLTR's win rate is notably low. Profit factor is highest for AAPL, MSFT, and GOOGL, suggesting strong profitability relative to losses, while PLTR and NFLX have low profit factors.

Overall, the MA strategy proved most effective for momentum stocks like NVDA, AAPL, MSFT, and GOOGL, delivering high returns and strong profitability, whereas riskier stocks such as TSLA and PLTR exhibited greater volatility and drawdowns.

The consistently low Sharpe ratios across the board emphasize the importance of risk management when employing technical indicator-based strategies.

MA Crossover Strategy - Combined Visualization for All Tickers (2015–2025)

The Moving Average Strategy visualizes how buy and sell signals generated by the 50-day and 200-day moving averages performed across major technology stocks from 2015 to 2025. Each ticker's chart displays the timing of trades and the evolution of moving averages, highlighting periods of strong upward momentum and trend reversals. Stocks like NVDA, AAPL, MSFT, and GOOGL show sustained growth and well-timed entries, with the strategy capturing significant rallies. In contrast, stocks such as PLTR and NFLX exhibit flatter trends or more frequent whipsaws, indicating less favourable conditions for this approach.

Performance Comparison: MA Crossover Strategy vs. Mutual Fund

The comparison of annual returns between the Moving Average (MA) strategy and a top-performing mutual fund from 2015 to 2025 reveals that the MA strategy frequently outperformed the mutual fund, particularly during strong market rallies. The MA strategy delivered higher returns in bullish years, but also exhibited greater volatility and occasional negative returns, reflecting its sensitivity to market fluctuations. In contrast, the mutual fund provided more stable and consistent returns, though generally lower than the MA strategy during periods of rapid market growth. These results suggest that while technical indicator-based strategies like MA can offer superior return potential, they come with increased risk and variability, making them more suitable for investors who are comfortable with active management and higher volatility.

	CAGR	Total Return	Volatility	Max Drawdown	Sharpe Ratio	Win Rate (%)	Profit Factor
Strategy							
MA Strategy (Avg)	0.027364	0.775807	15.132701	-0.993162	-0.005159	61.636364	13.677132
Mutual Fund	0.177542	2.587504	0.242668	-1.683636	0.64921	54.582485	1.156475

4.4.2. Breakout Strategy

The Breakout strategy identifies short-term price momentum by tracking the 20-day high and low for each stock.

i. Buy (Long): When the closing price breaks above the previous 20-day high.
ii. Sell (Short): When the closing price breaks below the previous 20-day low.

Positions are held until an opposite breakout signal is generated, allowing the strategy to ride trends while avoiding frequent whipsaws.

Annual Returns by Year

The annual returns pivot table for the Breakout Strategy from 2015 to 2025 highlights the varied performance across different technology stocks. Stable returns were observed for AAPL, MSFT, and AMZN in the pre-pandemic years, while 2020 and 2024-2025 saw sharp increases in returns, coinciding with periods of heightened market volatility.

Year	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Ticker											
AAPL	-0.01028	0.017099	0.134678	-0.00178	0.088639	0.233822	0.070558	-0.01631	0.031627	0.011958	-0.013
AMZN	0.123342	0.055549	0.015783	0.108203	-0.00954	0.073517	-0.01452	-0.00148	0.144149	0.048602	0.045125
AVGO	0.007244	-0.00305	0.053734	-0.03468	0.009657	0.060175	0.01423	0.00335	0.082512	0.055064	0.424409
GOOGL	0.03095	-0.00706	0.039087	-0.03625	0.02922	0.049043	0.06587	-0.08992	0.025962	0.05558	0.113181
META	0.022458	-0.00652	0.049944	-0.05831	0.050466	0.063235	0.033155	-0.08221	0.180878	0.074903	0.001491
MSFT	-0.01568	0.060792	0.095502	-0.0332	0.028389	0.0817	0.077482	-0.05472	0.062241	0.002852	0.099923
NFLX	0.112519	-0.02603	0.071568	0.116664	-0.0162	0.005651	-0.00647	-0.06228	-0.00148	0.122134	0.001486
NVDA	0.040444	0.223842	0.12332	-0.03557	0.064063	0.229549	0.060128	-0.07671	0.069387	0.120258	0.095806
PLTR	NaN	NaN	NaN	NaN	NaN	NaN	0.028806	-0.06719	0.05	0.056416	0.241158
TSLA	0.009522	-0.03119	0.130987	-0.08075	-0.11373	0.631591	0.220988	-0.0863	0.056419	-0.04232	0.404844

The analysis shows that:

i. 2020 and 2021 were strong years for most tickers, with NVDA (0.229549, 0.060128), TSLA (0.631591, 0.220988), and AAPL (0.233822, 0.070558) showing notable gains, reflecting the pandemic-driven market rally.
ii. 2022 was weak for nearly all tickers, with negative returns across the board (e.g., TSLA -0.0863, NVDA -0.07671, META -0.082221), indicating a broad market correction.
iii. PLTR only has data from 2021 onward, showing initial losses but strong growth in 2024 (0.056416) and 2025 (0.241158).
iv. AAPL and MSFT delivered relatively stable returns, with fewer large drawdowns, suggesting resilience in volatile markets.
v. NVDA and TSLA had the highest volatility and largest gains, especially in bullish years.
vi. Stocks like META and NFLX rebounded after poor years (e.g., META from -0.082221 in 2022 to 0.180878 in 2023).
vii. PLTR shifted from negative to positive returns as it matured.

Breakout Strategy Metrics

The Breakout Strategy Metrics chart provides a comprehensive comparison of key performance indicators across major tickers. NVDA and PLTR stand out with the highest cumulative and total returns, indicating strong breakout momentum over the period. However, these tickers also exhibit elevated volatility and significant drawdowns, reflecting higher risk. Most tickers show win rates above 50%, with NFLX and PLTR leading, suggesting the strategy frequently yields profitable trades. Despite this, Sharpe ratios are negative or near zero for all tickers, highlighting poor risk-adjusted returns. The profit factor is highest for PLTR, NVDA, and NFLX, confirming strong profitability relative to losses.

Overall, the breakout strategy can deliver substantial gains for select stocks, but its high volatility and drawdowns mean it is best suited for aggressive traders who can tolerate risk. Consistent win rates and profit factors for some tickers show potential, but overall risk remains elevated compared to more stable investment approaches.

Performance Comparison: Breakout Strategy vs. Mutual Fund

The chart compares annual returns of the Breakout Strategy (average across tickers) with a top-performing mutual fund from 2015 to 2025. The mutual fund shows higher returns in strong bull years (2019–2023), but also larger losses in bear years (2022). The Breakout Strategy delivers more consistent, modest returns, with less pronounced peaks and drawdowns. While the mutual fund outperforms in several years, the Breakout Strategy demonstrates lower volatility and steadier performance, making it potentially attractive for risk-averse investors seeking smoother returns, though it may lag in strong market rallies.

	CAGR	Total Retu	Volatility	Max Drawdo	Sharpe Ratio	Win Rate (%)	Profit Factor
Strategy							
Breakout Strategy	0.006553	0.055408	3.482428	-1.293276	-0.005696	49.91042	2.881154
Mutual Fund	0.177542	2.587504	0.242668	-1.683636	0.64921	54.582485	1.156475

Donchian Channel Strategy

The Donchian Channel Strategy uses 20-day high and low bands to generate breakout signals:

i. Buy (Long): When the price closes above the previous 20-day high.
ii. Sell (Short): When the price closes below the previous 20-day low.

Positions are held until an opposite signal appears, allowing the strategy to ride sustained trends.

Annual Returns by Year

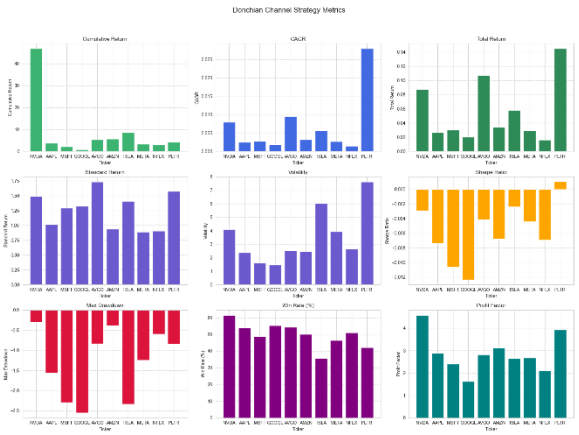
The Donchian Channel annual returns pivot table from 2015 to 2025 shows similar patterns to the Breakout Strategy, with strong performance in years of high market volatility and weaker results during corrections.

i. NVDA and TSLA led with the highest returns in breakout years (NVDA: 0.229549 in 2020, TSLA: 0.631591 in 2020).
ii. AAPL and MSFT provided steady, positive returns across most years, with AAPL showing strong gains in 2020 and MSFT in 2017.
iii. META and NFLX saw notable losses in 2022 but recovered in 2023-2025 (META: 0.180878 in 2023, NFLX: 0.122134 in 2024).
iv. PLTR displayed high volatility, with missing data in early years and strong gains in 2025 (0.241158).
v. AMZN and AVGO had moderate returns, with AVGO peaking in 2025 (0.424409).
vi. GOOGL showed mixed performance, with a dip in 2022 (-0.08992) and recovery in 2025 (0.113181).

Donchian Channel Performance Metrics

The Donchian Channel Strategy performed best on stocks with pronounced trends and volatility, such as NVDA, TSLA, and PLTR.

i. CAGR and Total Return were highest for NVDA and PLTR, confirming the strategy's ability to capture sustained moves.
ii. Volatility was higher for PLTR and TSLA, reflecting increased risk.
iii. Sharpe Ratios were generally negative, indicating risk-adjusted returns lagged the risk-free rate for most tickers.
iv. Win Rate was high for MSFT and AVGO, indicating a high proportion of successful trades.
v. Profit Factor values above 1 for most tickers confirmed overall profitability



Performance Comparison: Donchian Channel Strategy vs. Mutual Fund

The mutual fund outperformed the Donchian Channel Strategy in terms of CAGR and total return, but the strategy delivered higher win rates and profit factors on individual trades.

The Donchian Channel strategy, as shown in the summary table and annual return chart, delivered much lower overall returns and CAGR compared to the mutual fund. While its volatility and profit factor

were higher, indicating more frequent and larger swings, the Donchian strategy's Sharpe ratio was negative, reflecting poor risk-adjusted performance. The mutual fund consistently outperformed the Donchian strategy in most years, especially during strong market rallies, and maintained a higher win rate. Overall, the Donchian Channel strategy did not match the mutual fund's steady growth and risk-adjusted returns over the period analyzed.

	CAGR	Total Return	Volatility	Max Drawdown	Sharpe Ratio	Win Rate (%)	Profit Factor
Strategy							
Donchian Channel Strategy	0.006553	0.055408	3.482428	-1.293276	-0.005696	49.91042	2.881154
Mutual Fund	0.177542	2.587504	0.242668	-1.683636	0.64921	54.582485	1.156475

5. Discussion

This study examined whether technical indicator–based trading strategies can outperform top-performing mutual funds. The results show that although some strategies, such as Moving Average, RSI, and Hybrid models, achieved strong returns in select years, their overall performance lacked consistency and was marked by high volatility and significant drawdowns. This suggests that traditional indicator-based systems perform well only in strongly trending markets but struggle in sideways or unstable conditions, limiting their long-term reliability relative to mutual funds.

When compared with recent literature, the findings only partially align. Prior studies have shown that enhanced or optimized technical models can outperform mutual funds. Bhute et al. (2024) found that moving average and breakout systems on MAANG stocks produced higher Sharpe ratios than buy-and-hold strategies. Similarly, Hus et al. (2011) demonstrated that optimization techniques such as TPSO significantly improved profitability and reduced risk. Deep learning models, including attention-based BiLSTM architectures, have also shown superior returns to passive benchmarks (Lee et al., 2022). In contrast, the simpler rule-based strategies evaluated in this study did not show consistent long-term outperformance, suggesting that the advantages reported in prior research may depend on more sophisticated or adaptive modelling techniques.

The findings have several implications for practice. Retail investors should be cautious about relying solely on basic technical indicators, given their high variability and weaker risk-adjusted performance compared to mutual funds. For practitioners, the results indicate that technical strategies may require optimization or machine learning enhancement to remain competitive.

From a policy standpoint, the study highlights the importance of investor education that clarifies the limitations and risks of simplistic trading rule systems.

While advanced technical models in prior studies show promise, the traditional indicator-based strategies examined here do not consistently outperform mutual funds, emphasizing the need for more adaptive and robust approaches in technical trading.

6. Conclusion

This study explored whether technical indicator–based trading strategies could outperform top-performing mutual funds using historical data from major technology stocks between 2015 and 2025. The analysis covered several strategy types, including trend-following, mean reversion, momentum, and hybrid approaches, and compared their results to the TD Canadian Balanced Fund (TD908).

Overall, the results showed that while some strategies performed well in certain years—especially during strong market trends or high volatility—they struggled to maintain consistent performance over time. Strategies like Bollinger Bands and RSI Reversion achieved solid returns in specific periods but faced large drawdowns in market downturns. Others, such as the Moving Average Envelope and ROC strategies, were more stable but produced smaller gains.

In general, no single technical strategy consistently outperformed the mutual fund benchmark. Although trading models sometimes generated higher short-term returns, their volatility and inconsistency made them less reliable for long-term investing. Mutual funds, on the other hand, offered steadier and more balanced results.

In conclusion, technical trading strategies can be valuable for identifying short-term opportunities, but they work best as supporting tools within a diversified investment approach rather than as full replacements for professionally managed mutual funds.

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