

## Stage 1 Analysis

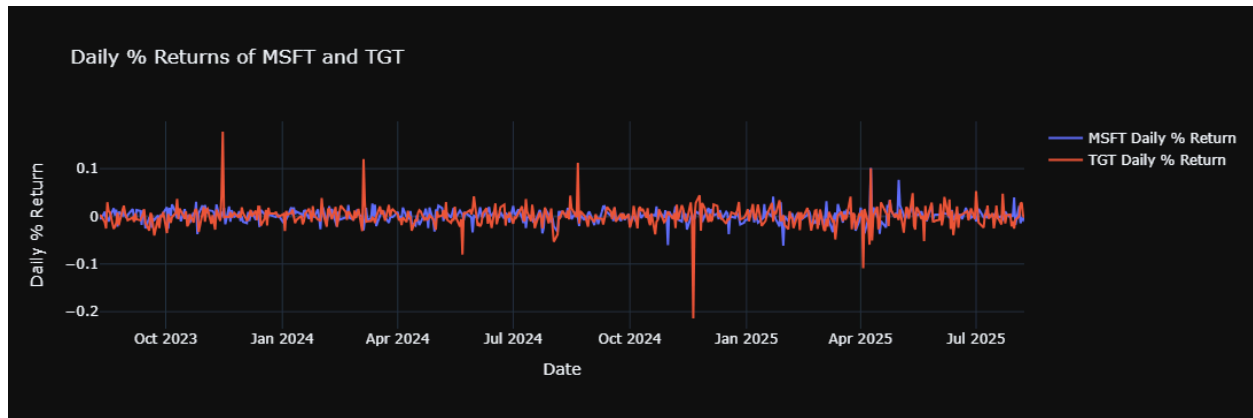
*This document aims to depict the results of the trading strategy's initial results backtest. The purpose of this analysis is to better understand the results, and use that interpretation to design a roadmap for further research.*

08/12/2025

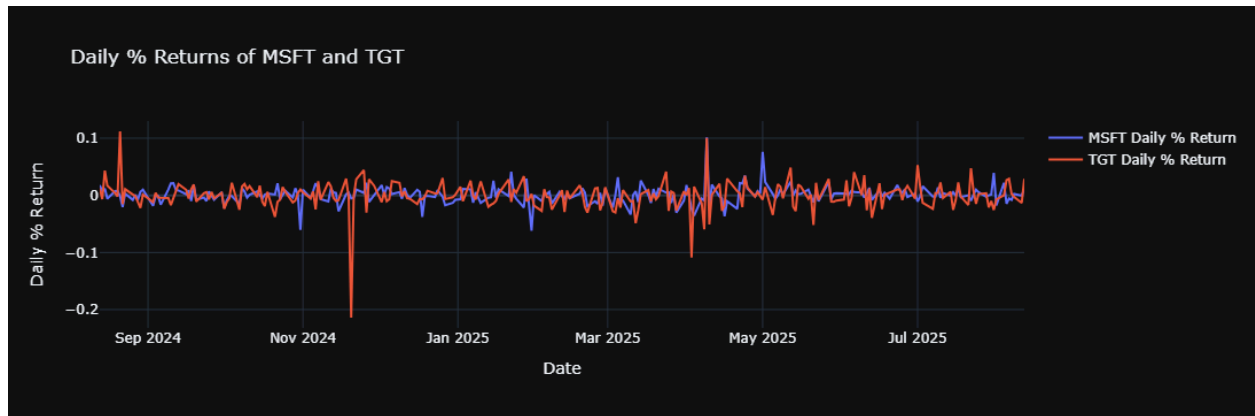
### General Analysis Framework:

The Stage 1 Analysis involves initially visualizing the daily % returns of MSFT and TGT in 1 graph, and based on our initial hypothesis that these 2 stocks move inversely on a daily basis, there should be diamond like shapes forming over time that showcase or establish initial proof of an inverse relationship between the 2 stocks. Next, as the algorithm is implemented we will backtest it across 4 different periods: 2-years, 1-year, 6 months and 3 months. We look at the cumulative returns across these periods (value of \$1 invested into the strategy across 2-years/1-year/6-months/3-months). Finally we look at a bootstrapped Monte-Carlo simulation (data is resampled 1000 times).

**Figure 1. Daily % Returns of MSFT and TGT between August 2023 to August 2025 (2y)**



**Figure 2. Daily % Returns of MSFT and TGT between August 2024 to August 2025 (1y)**



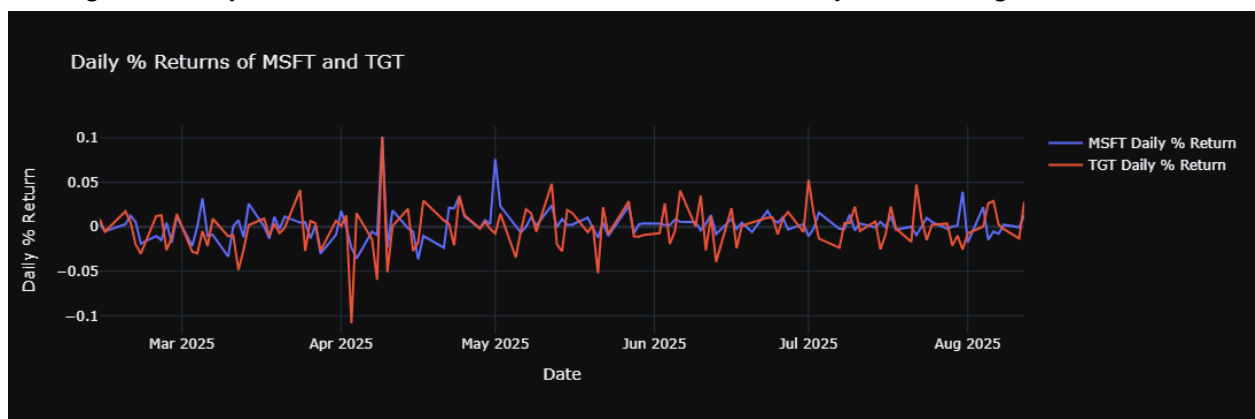
### Interpretation and Analysis (Figures 3 and 4):

Across both the 2-year (Figure 1) and 1-year (Figure 2) views, MSFT (blue) and TGT (red) daily returns are primarily centered close to zero, with frequent small fluctuations throughout for MSFT and occasional large spikes for TGT. These spikes are potentially linked to earnings or market news, particularly sharp downward moves in late 2024 and early 2025, while MSFT shows more moderate swings. While there are instances of inverse movement, such as TGT dropping when MSFT remains stable or slightly positive, this pattern is not consistent across the entire period. In many cases, both move in the same direction on a given day, suggesting the negative correlation is not persistent but episodic. This indicates that the inverse relationship may emerge only under certain market or sector rotation conditions.

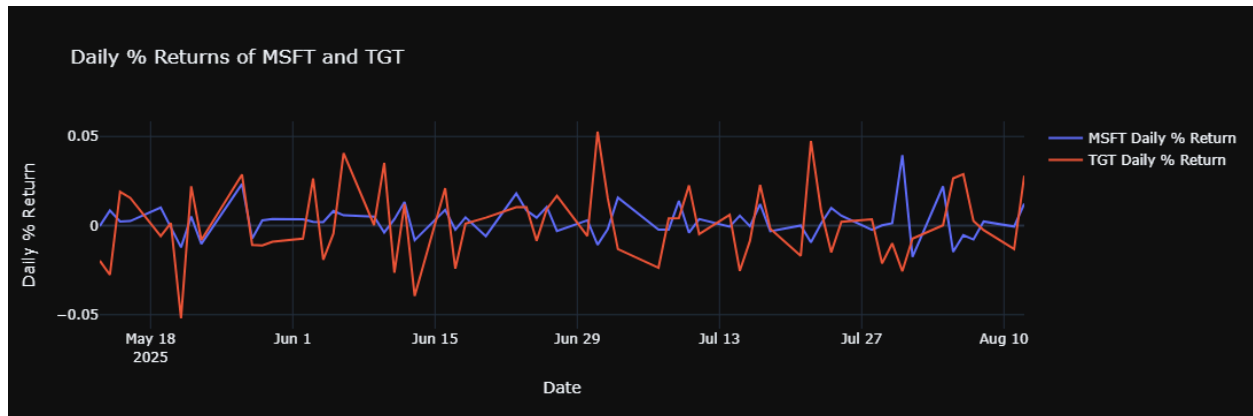
### Key implications for the research roadmap:

- Identify time periods with strong negative correlation and focus trading during these regimes.
- Consider volatility-adjusted or winsorized returns to reduce the impact of extreme outliers.
- Explore dynamic hedge ratios instead of a fixed 50-50 MSFT-TGT allocation.
- Integrate macro or sector rotation indicators to filter for optimal trade conditions.

**Figure 3. Daily % Returns of MSFT and TGT between February 2025 to August 2025 (6mo)**



**Figure 4. Daily % Returns of MSFT and TGT between February 2025 to August 2025 (3mo)**



### Interpretation and Analysis (Figures 3 and 4):

In both the 6-month (Figure 3) and 3-month (Figure 4) views, there are more clear noticeable instances where MSFT and TGT move in opposite directions on the same day, often with similar magnitude. This is more visually distinct in the 3-month chart, where alternating peaks and troughs suggest clearer short-term inverse behavior.

Shorter windows highlight that TGT's large moves tend to occur in bursts rather than being evenly distributed. These bursts are often followed by relatively muted MSFT reactions, potentially creating tradable z-score extremes. Furthermore, over these shorter horizons, MSFT's return series appears steadier relative to TGT, which may make it the more stable anchor for mean reversion calculations, with TGT acting as the more volatile leg of the pairs.

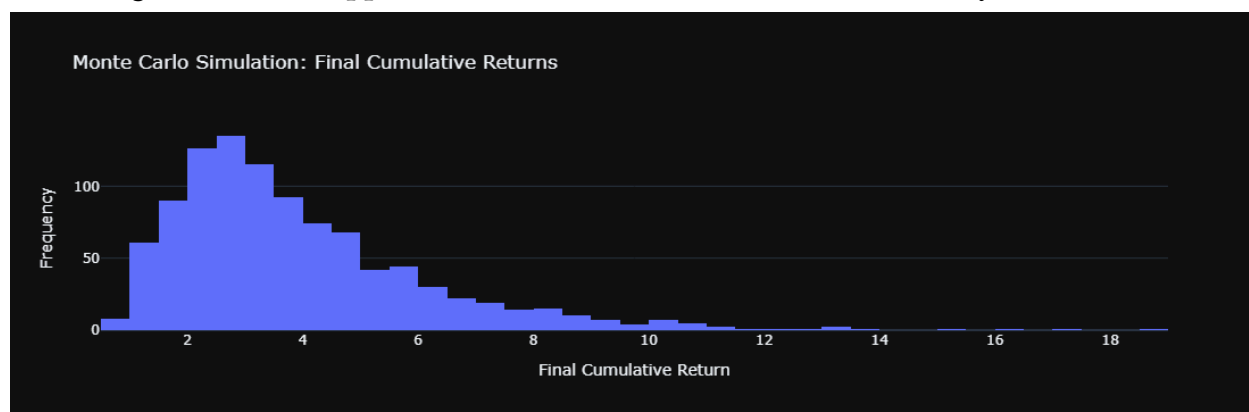
## 2-year Backtest

**Figure 5. Cumulative Returns from the 2-year backtest**

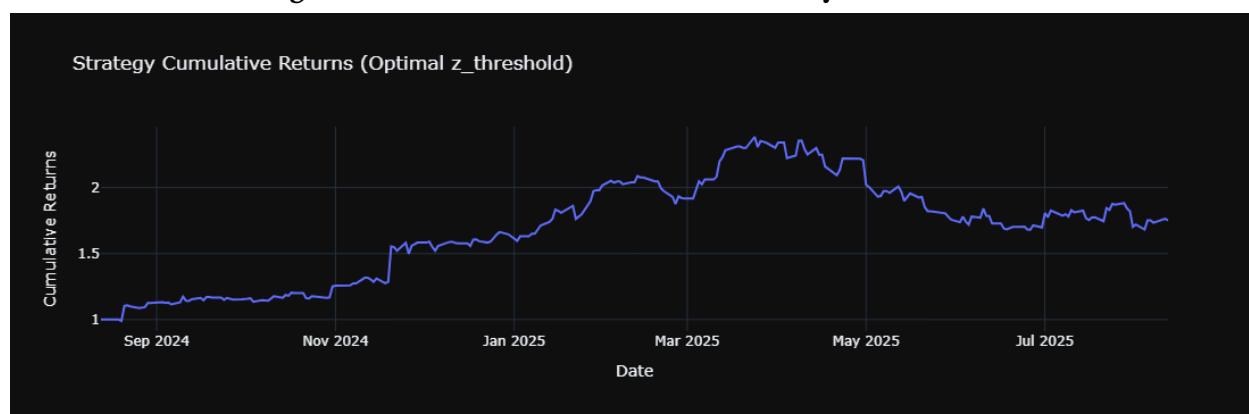


Optimal z-score as per parameter sweep implemented: **0.22** (Cumulative Return: ~ 329%)

**Figure 6. Bootstrapped Monte Carlo Simulation Results on the 2-year Backtest**

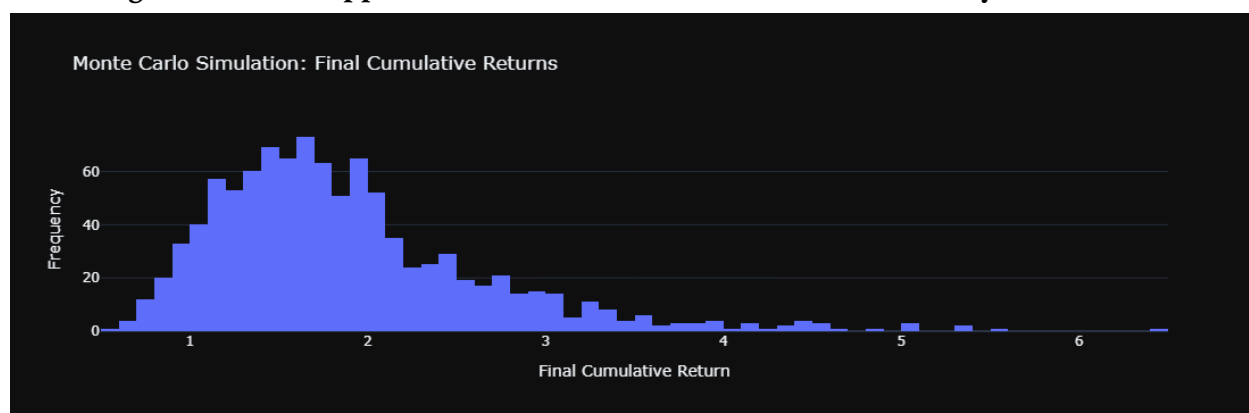


**Figure 7. Cumulative Returns from the 1-year backtest**



Optimal  $z$ -score as per parameter sweep implemented: **0.34** (Cumulative Return: ~ 75%)

**Figure 8. Bootstrapped Monte Carlo Simulation Results for the 1-year Backtest**

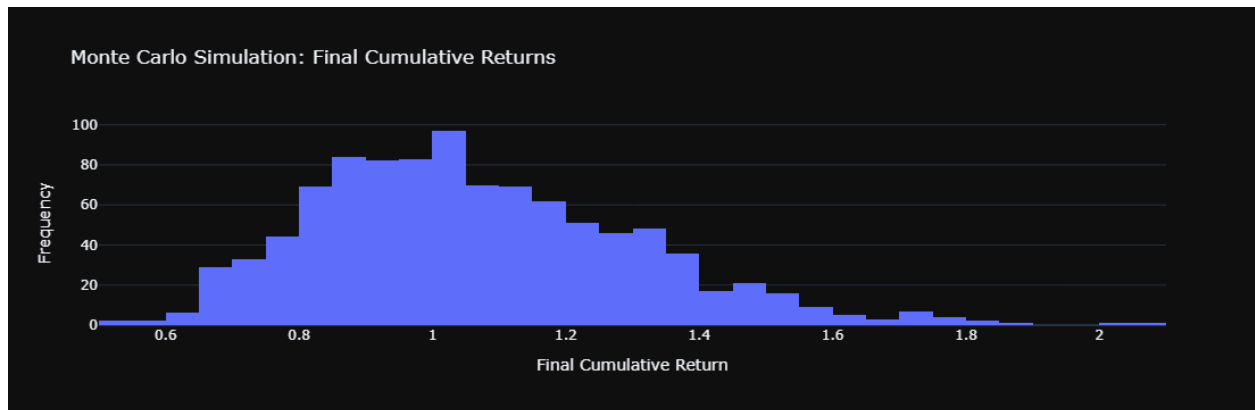


**Figure 9. Cumulative Returns from the 6-month backtest**

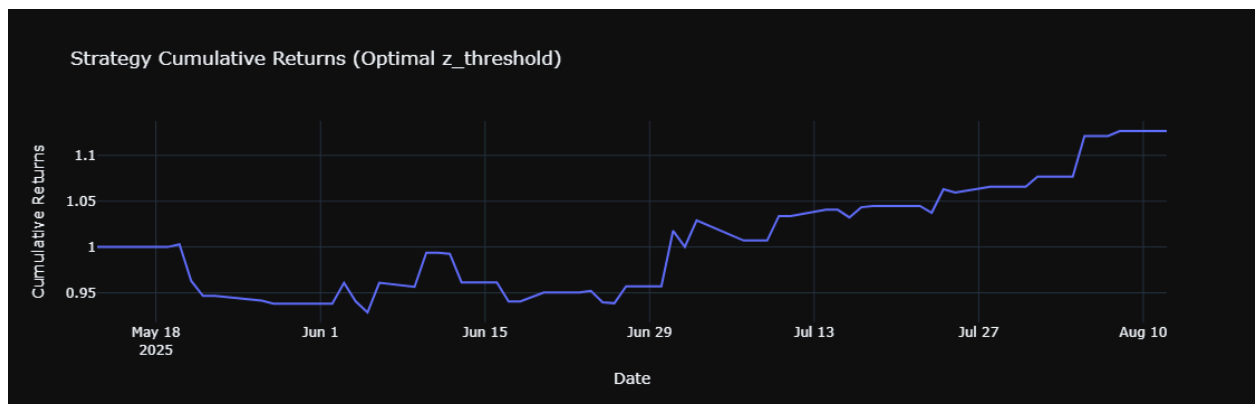


Optimal z-score as per parameter sweep implemented: **0.80** (Cumulative Return: ~ 4%)

**Figure 10. Bootstrapped Monte Carlo Simulation Results for the 6-month Backtest**

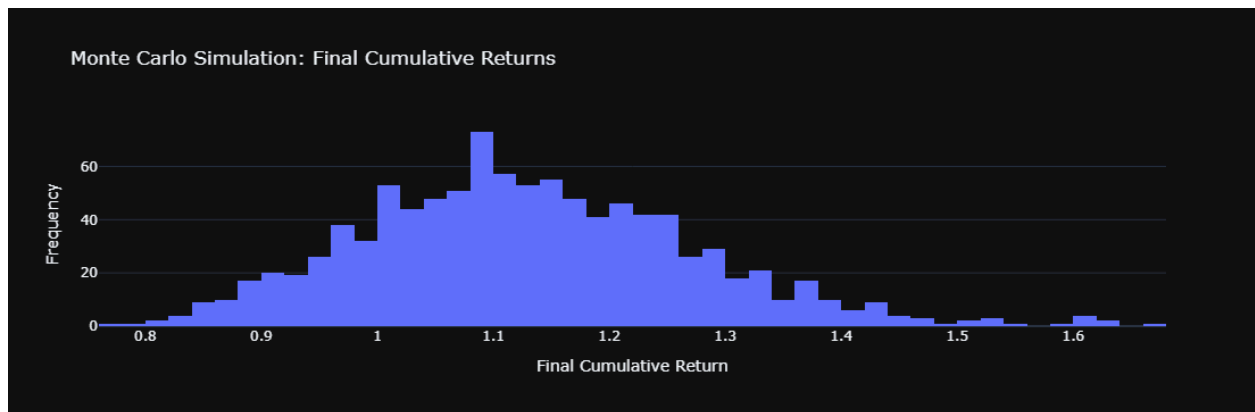


**Figure 11. Cumulative Returns from the 3-month Backtest**



Optimal z-score as per parameter sweep implemented: **0.84** (Cumulative Return: ~ 12.6%)

**Figure 12. Bootstrapped Monte Carlo Simulation Results for the 3-month Backtest**



### **Interpretation and Analysis (Figure 5 through 12):**

The cumulative returns across the periods backtested reveal profitable results, however, their trends include pullbacks at certain times. It would be useful to understand market regimes, and look into times where the strategy led to significant returns or significant losses. If the strategy led to significant returns, what were the driving forces of that and vice versa with losses. An additional question that could be asked is, does this strategy act as a great hedge to potential systematic risks that can affect the entire market (recessionary pressures etc..)?

Another area of focus in the next stage would be understanding this strategy's performance during different levels of market volatility. Across all the periods, we see that the strategy's returns peaked in April 2025, the month where the VIX peaked as well. Is it possible that this strategy thrives during greater volatility driven by uncertainty? Can potentially set a threshold for the VIX to activate this strategy and minimize the losses as the VIX cools down.

## Stage 2 Roadmap

In further research these areas will be explored:

1. **Regime & Correlation Analysis** – Identify time periods when MSFT–TGT correlation is strongly negative, and restrict trades to those high-confidence regimes.
2. **Volatility & VIX Filters** – Test performance across different volatility environments and evaluate using a VIX-based trigger to activate/deactivate the strategy.
3. **Dynamic Hedge Ratios** – Replace the fixed 50-50 allocation with hedge ratios based on historical beta or rolling volatility to improve risk-adjusted returns.
4. **Scenario Testing & Stress Analysis** – Assess strategy resilience under recessionary conditions, market crashes, and sector-specific shocks to evaluate hedging potential.