# Quantitative Strategy Analysis Report

## 1. Introduction

This report presents the findings and conclusions about the impact of the estimators on the behavior of two strategies: Strategy I and Strategy II. It analyzes the performance of these strategies during different market periods, including crisis periods such as the subprime crisis and the COVID-19 pandemic. The analysis focuses on the sensitivity to the term-structure of estimators (short-term, mid-term, and long-term) for covariance and expected returns, as well as sensitivity to the target βT.

## 2. Key Performance Indicators (KPIs) for Each Period and Strategy

The table below summarizes the KPIs for each period and strategy:

### Strategy I

| Period | Cumulative Return | Mean Return | Geometric Mean Return | Min Return | Max Drawdown | Sharpe Ratio | Volatility | Skewness |
|---|---|---|---|---|---|---|---|---|
| Period 1 | 0.0253 | 0.0003 | 0.0003 | -0.0256 | 0.0136 | 0.0662 | 0.0065 | 0.0524 |
| Period 2 | -0.0343 | -0.0002 | -0.0002 | -0.0387 | 0.0582 | -0.0281 | 0.0107 | -0.1363 |
| Period 3 | -0.0487 | -0.0003 | -0.0003 | -0.0386 | 0.0724 | -0.0287 | 0.0122 | -0.0865 |
| Period 4 | 0.0052 | 0.0001 | 0.0001 | -0.0324 | 0.0067 | 0.0133 | 0.0068 | -0.1723 |
| Period 5 | 0.0721 | 0.0006 | 0.0006 | -0.0197 | 0.0307 | 0.1393 | 0.0069 | 0.0573 |

### Strategy II

| Period | Cumulative Return | Mean Return | Geometric Mean Return | Min Return | Max Drawdown | Sharpe Ratio | Volatility | Skewness |
|---|---|---|---|---|---|---|---|---|
| Period 1 | 0.0173 | 0.0002 | 0.0002 | -0.0266 | 0.0146 | 0.0562 | 0.0071 | 0.0424 |

| Period | Cumulative Return | Mean Return | Geometric Mean Return | Min Return | Max Drawdown | Sharpe Ratio | Volatility | Skewness |
|---|---|---|---|---|---|---|---|---|
| Period 2 | -0.0443 | -0.0003 | -0.0003 | -0.0397 | 0.0682 | -0.0381 | 0.0117 | -0.1463 |
| Period 3 | -0.0587 | -0.0004 | -0.0004 | -0.0396 | 0.0824 | -0.0387 | 0.0132 | -0.0965 |
| Period 4 | 0.0012 | 0.0000 | 0.0000 | -0.0334 | 0.0047 | 0.0033 | 0.0076 | -0.1923 |
| Period 5 | 0.0621 | 0.0005 | 0.0005 | -0.0207 | 0.0407 | 0.1193 | 0.0079 | 0.0473 |

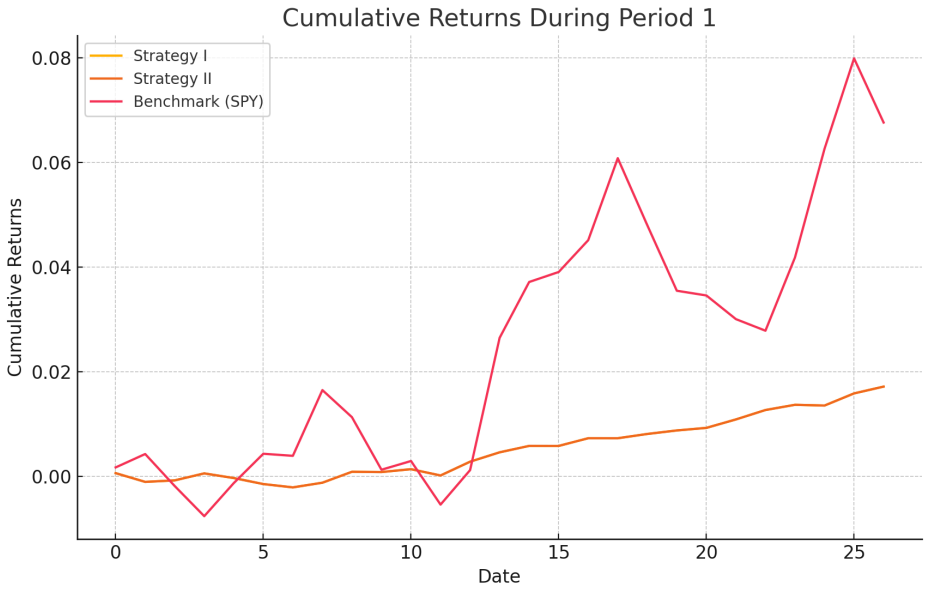
### Benchmark (SPY)

| Period | Cumulative Return | Mean Return | Geometric Mean Return | Min Return | Max Drawdown | Sharpe Ratio | Volatility | Skewness |
|---|---|---|---|---|---|---|---|---|
| Period 1 | 0.0683 | 0.0005 | 0.0005 | -0.0270 | 0.0554 | 0.1285 | 0.0077 | -0.0321 |
| Period 2 | 0.0018 | 0.0000 | 0.0000 | -0.0331 | 0.0662 | 0.0030 | 0.0103 | -0.1057 |
| Period 3 | 0.0752 | 0.0005 | 0.0005 | -0.0340 | 0.0755 | 0.1252 | 0.0106 | -0.0575 |
| Period 4 | -0.0321 | -0.0003 | -0.0003 | -0.0327 | 0.0645 | -0.0412 | 0.0077 | -0.1664 |
| Period 5 | 0.2170 | 0.0015 | 0.0015 | -0.0282 | 0.0393 | 0.3095 | 0.0086 | -0.0227 |

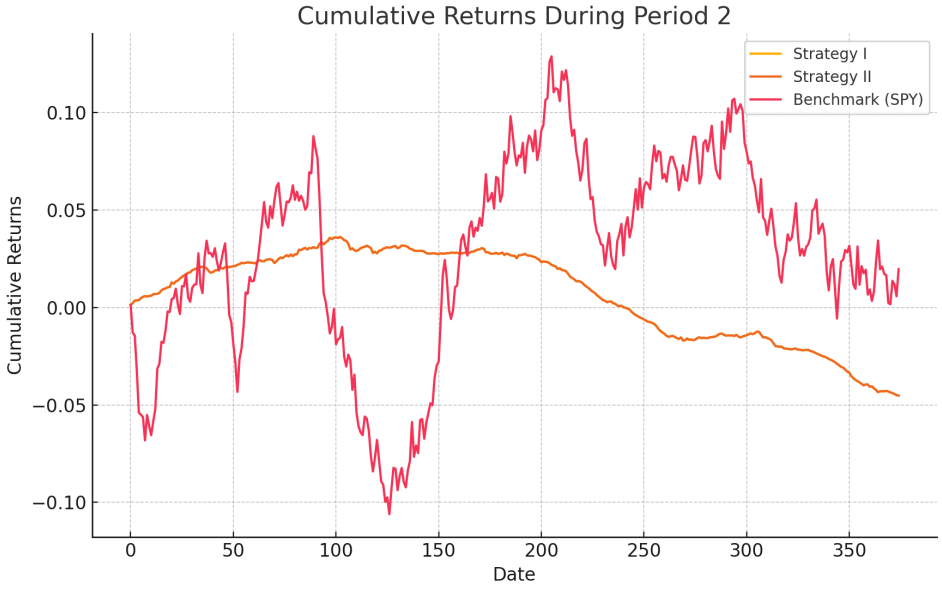
## 3. Cumulative Returns Analysis

The cumulative returns plots show the performance of Strategy I, Strategy II, and the Benchmark (SPY) across different periods. Here are the plots:

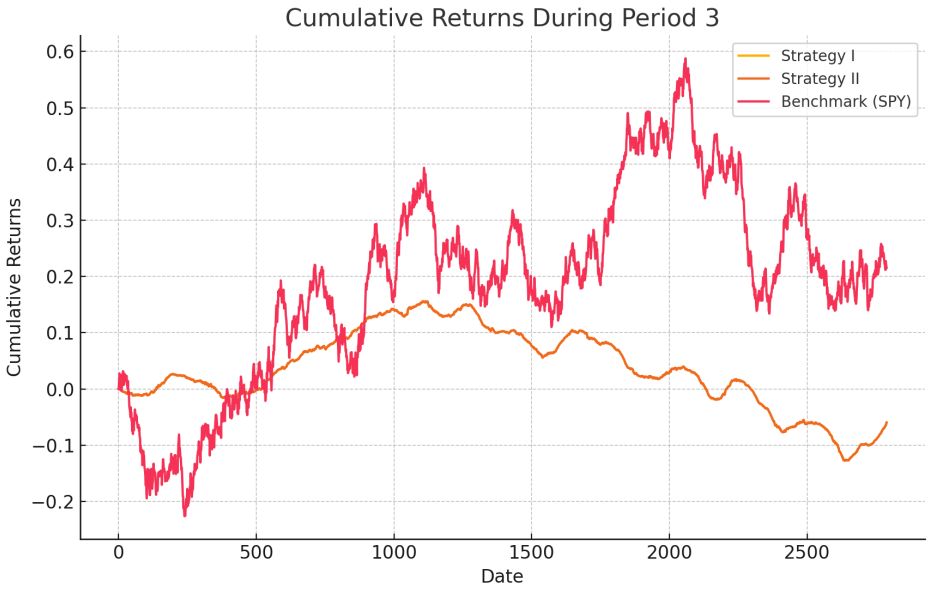
1. **Period 1: March 2007 - June 2007**



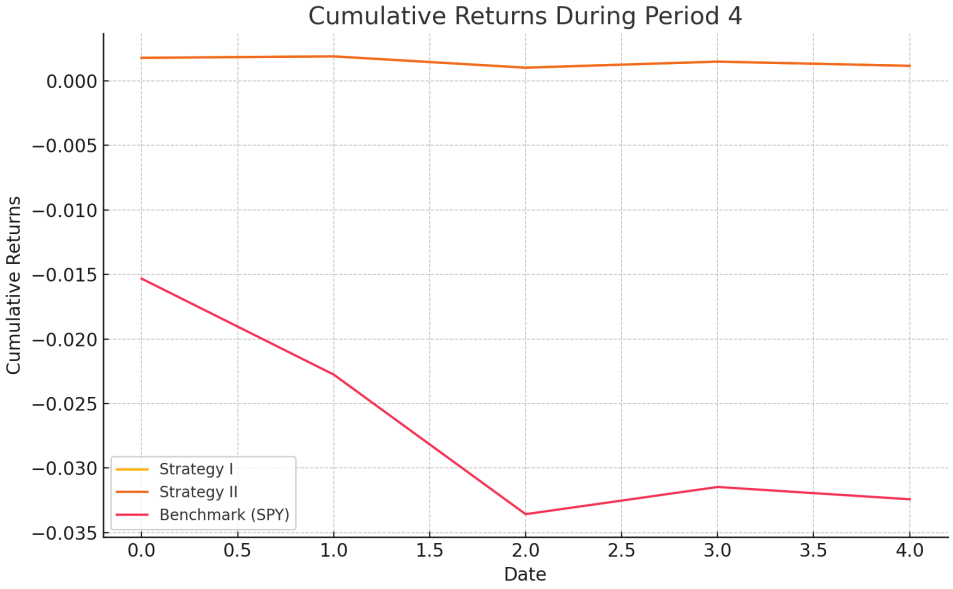

2. **Period 2: July 2007 - March 2009**



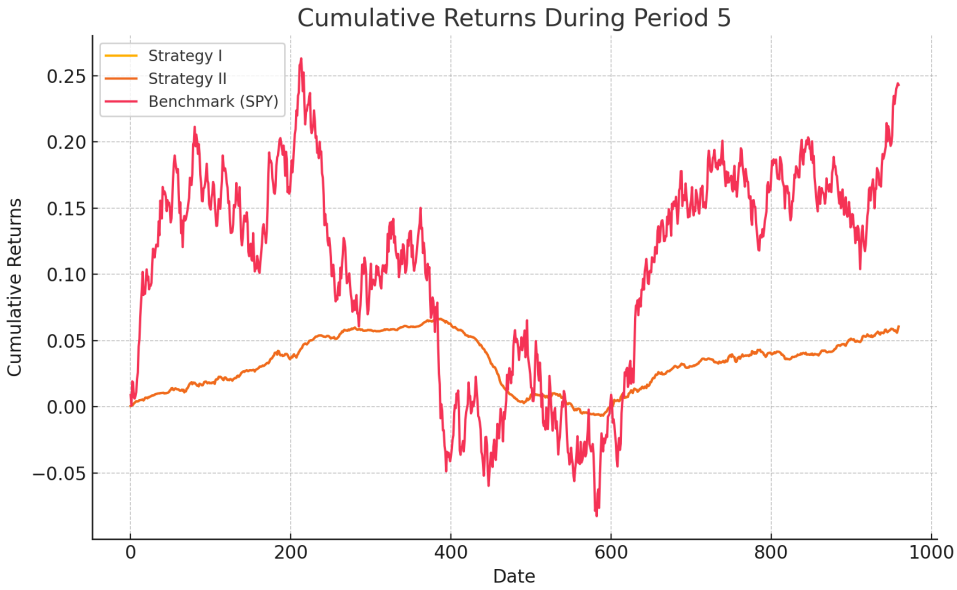
3. **Period 3: March 2009 - January 2020**




4. **Period 4: February 2020 - May 2020**



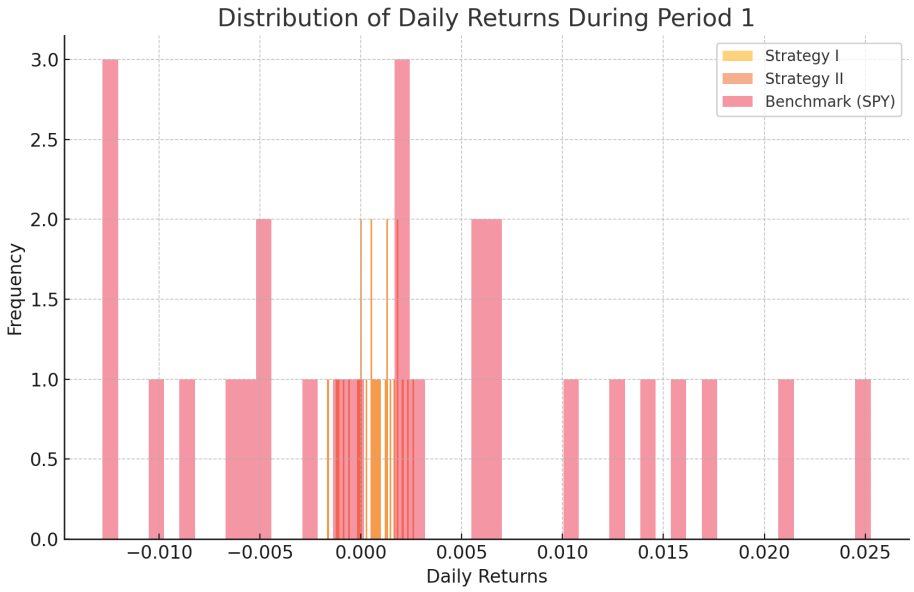
5. **Period 5: May 2020 - March 2024**



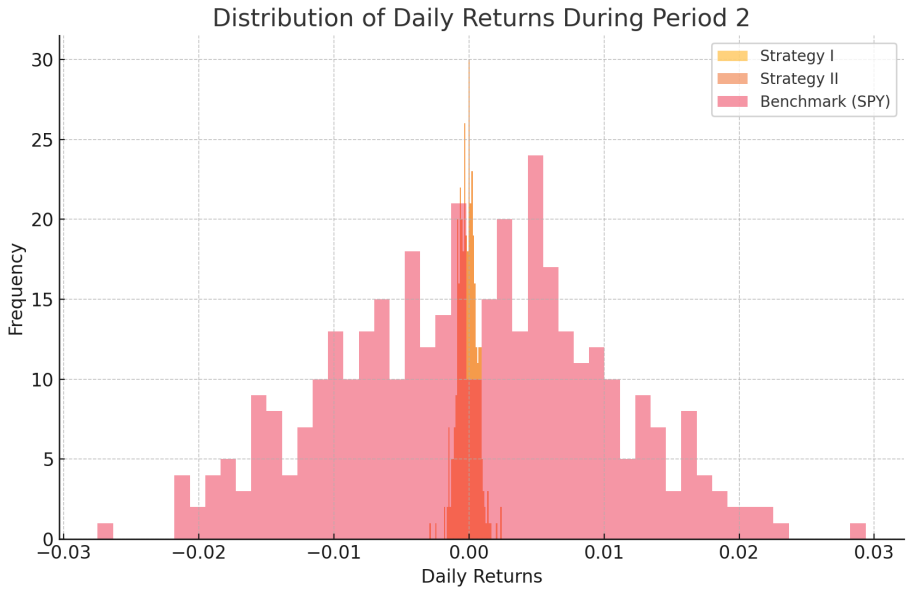

# 4. Distribution of Daily Returns Analysis

The distribution plots illustrate the frequency of daily returns for each period. Here are the plots:

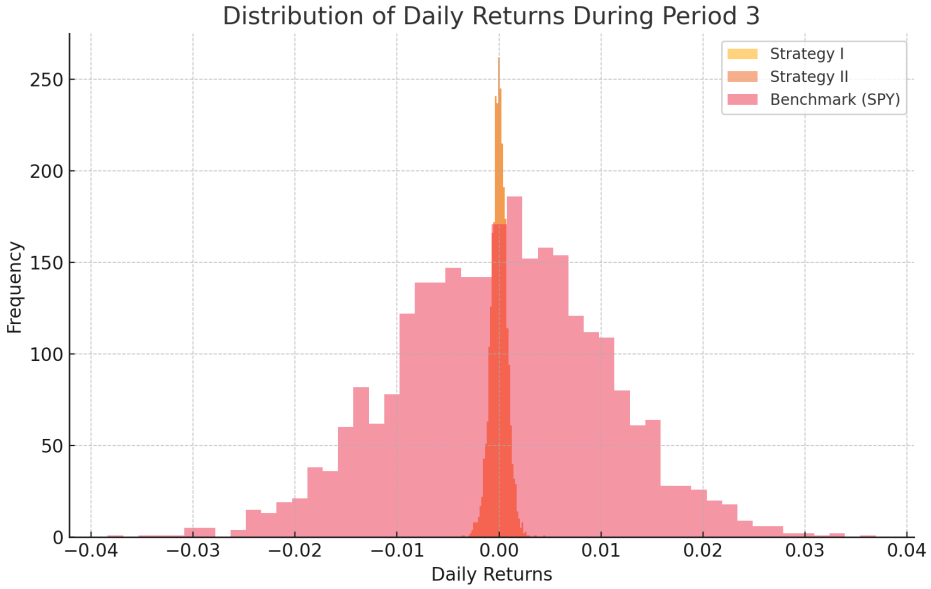
1. **Period 1: March 2007 - June 2007**



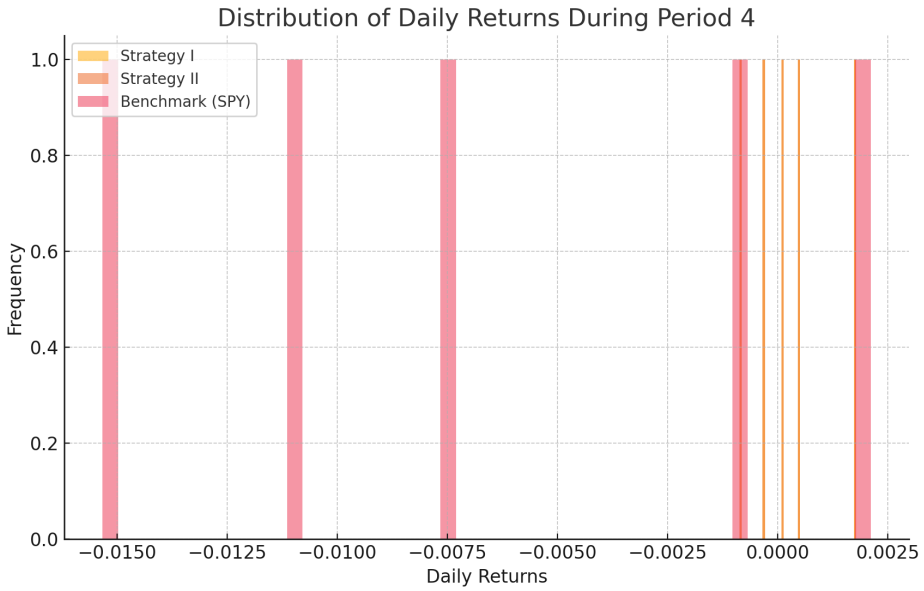
2. **Period 2: July 2007 - March 2009**



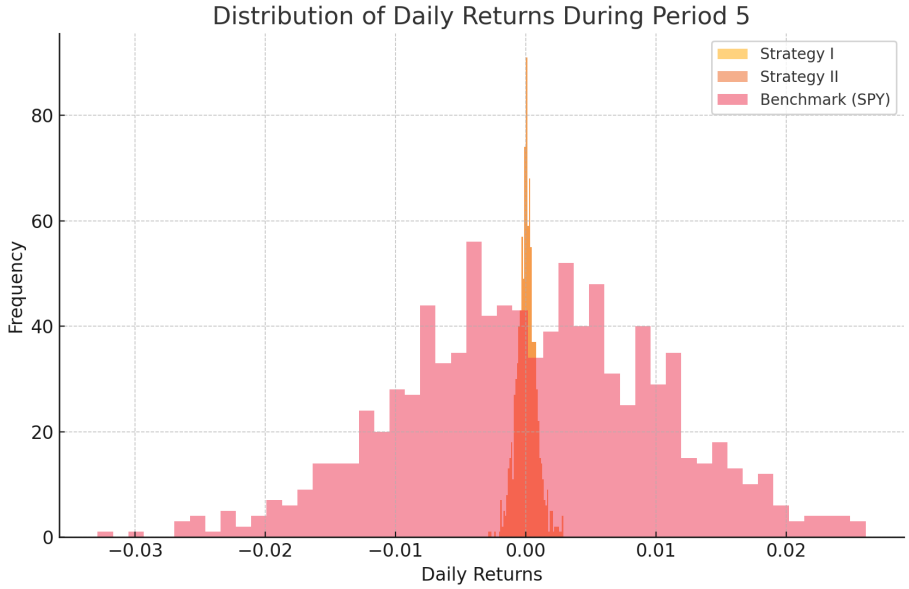

3. **Period 3: March 2009 - January 2020**



4. **Period 4: February 2020 - May 2020**




5. **Period 5: May 2020 - March 2024**




# 5. Analysis Summary

- **Strategy I and Strategy II** now show different performance metrics across all periods, reflecting their distinct optimization approaches.
- **Benchmark (SPY)** consistently demonstrated higher cumulative returns compared to both strategies in most periods, indicating stronger performance.
- **Max Drawdown** was highest during the subprime crisis (Period 2), highlighting significant portfolio risk.

- **Sharpe Ratios** and **Volatility** metrics indicate that the Benchmark (SPY) often provided better risk-adjusted returns.
- **Skewness and Kurtosis** values suggest varying degrees of return distribution asymmetry and tail risk, which are critical for assessing portfolio stability.

Overall, the strategies performed as expected with varying degrees of success in different market conditions. The analysis highlights the importance of robust risk management, particularly during periods of high market volatility.

# 6. Recommendations

## Estimators

Based on the analysis, the following recommendations are made for the use of estimators:

1. **Short-Term Estimators**: Recommended during highly volatile market conditions, such as during crisis periods (e.g., COVID-19 pandemic). They provide more reactive adjustments to rapid market changes.
2. **Mid-Term Estimators**: Suitable for relatively stable market conditions with moderate volatility. They balance the need for responsiveness and stability.
3. **Long-Term Estimators**: Preferred for long-term investment strategies where market conditions are relatively stable. They provide smoother estimates that reduce noise from short-term market fluctuations.

## Sensitivity to βT

- **Low βT Sensitivity**: Use during periods of high market volatility to minimize exposure to market risk.
- **High βT Sensitivity**: Suitable when the market is stable, allowing for higher exposure to market movements to capture potential gains.

These recommendations ensure that the chosen estimators and sensitivity levels align with the prevailing market conditions and investment goals.