RIT

Rochester Institute of Technology

FINC 780 – FINANCIAL ANALYTICS

Assignment 2: Trading Rule Back-testing

Project Report

Group 5

Banumaiah Umesh, Usha, ub4451
Dang, Ba Long, bd8923
Hsu, Miguel, mh9666
Iwashko, Ashlee, ari9718
Rajesh Panicker, Shreya, sr6727
Sarun, Julia, jns2613

Table of Contents

1. Introduction

- In this report, we explore and analyze a trading strategy based on the Dynamic Volatility Index (DVI), a volatility-based signal used for making market entry and exit decisions. The strategy is back tested using historical stock data to assess its effectiveness across different time periods and DVI thresholds. The key objectives of this assignment are to implement the back-testing framework, analyze the performance, and link the trading signal to behavioral finance principles.
- The implementation of the strategy involves the following:
  - Back testing the strategy using historical market data.
  - Testing the strategy over multiple time periods and varying DVI thresholds.
  - Analyzing the effectiveness of the strategy in terms of cumulative returns, Sharpe ratio, and maximum drawdown.
  - Linking the trading strategy to behavioral finance concepts to understand its real-world implications.

2. Function Implementation Understanding

- The back-testing framework was implemented using three key functions, each designed to evaluate the effectiveness of the trading strategy in different ways. These functions are:
  - Function 1: Base Level Back-test
    - The primary function that calculates the DVI signal (using RSI as a proxy for volatility) and generates buy/sell signals based on a threshold.
    - It computes daily returns and evaluates strategy returns by multiplying them with the generated signals.
    - The function provides key performance metrics such as cumulative returns, Sharpe ratio, and maximum drawdown, which are essential for evaluating the performance of the strategy.
    - Additionally, the function includes a plot of cumulative returns, helping to visually analyze the strategy's performance over time.
  - Function 2: Simulate Multiple Back-test Periods
    - This function evaluates the strategy over multiple time periods. It divides the given range of years into smaller periods and runs the back-test for each period.
    - The function allows for comparative analysis of the strategy's performance over different market conditions by storing the performance summary and cumulative returns for each period.
    - The performance of each period is plotted using a bar chart, which helps in visually comparing how the strategy performs across different timeframes.
  - Function 3: Simulate Multiple DVI Thresholds
    - This function tests the strategy's sensitivity to changes in the DVI threshold.

- By iterating over a range of DVI thresholds, the function assesses the strategy's performance at various levels of market volatility.
- It tracks long and short trades, cumulative returns, Sharpe ratio, and maximum drawdown for each threshold, which allows for a detailed comparison of performance.
- The results are visualized using a line plot, which illustrates how the strategy's cumulative returns change with different thresholds.
- Together, these functions provide a robust framework for evaluating the performance of a volatility-based trading strategy over various periods and thresholds.

3. Results of Functional Implementation

❖ The results of the functional implementation provide valuable insights into the performance of the DVI-based trading strategy. Here's a detailed analysis of the outcomes from running the back-tests using the functions described:

➢ Function 1 - Base Level Back-test:

- The base back-test function generates signals based on the DVI threshold and evaluates the returns by simulating a trading strategy that goes long or short depending on the volatility signal.
- Performance Summary:
  - The function provides key performance metrics, including cumulative returns, Sharpe ratio, and maximum drawdown. These metrics offer a comprehensive view of the strategy's risk and return profile.
  - In periods of high volatility, the strategy exhibited lower returns, which is consistent with the risk-averse behavior expected during periods of instability.
  - The Sharpe ratio helps assess whether the strategy provides sufficient returns for the level of risk taken. If the Sharpe ratio is above 1, it indicates that the risk-adjusted return is positive, which is desirable.

➢ Function 2 - Simulate Multiple Back-test Periods:

- This function evaluates the strategy over multiple time periods. By applying the back-test across different years, we can see how the strategy performs in both bullish and bearish market conditions.
- Performance Comparison:
  - The function provides a comparison of cumulative returns over different periods. In general, the strategy performed better during stable market conditions (low volatility periods) and struggled during periods of high volatility.
  - The bar chart visualization helped in easily identifying which periods saw the highest cumulative returns, highlighting the periods when the strategy was most effective.

➢ Function 3 - Simulate Multiple DVI Thresholds:

- This function tests how the strategy behaves when the DVI threshold is adjusted. By varying the threshold, we can assess whether the strategy's performance improves or worsens based on different volatility levels.
- Sensitivity Analysis:
  - The strategy demonstrated a more favorable performance with lower DVI thresholds, where the market was less volatile. As the DVI threshold increased, indicating higher market volatility, the performance diminished.
  - The line plot visualization allowed for an easy comparison of how cumulative returns changed as the threshold was varied, helping to identify the optimal threshold for minimizing risk while maximizing returns.
  - Overall, the functional implementation of the back-testing strategy has demonstrated its ability to adapt to changing market conditions, using the DVI signal to guide trading decisions. The strategy effectively mitigates risk during periods of high volatility, consistent with the principles of behavioral finance, especially loss aversion.

4. Link to Behavioral Finance

- The Dynamic Volatility Index (DVI), used in this trading strategy, has a direct connection to several key concepts in behavioral finance, which studies how psychological factors affect market behavior and decision-making.
- Loss Aversion
  - Loss aversion is a psychological bias where investors are more sensitive to potential losses than to equivalent gains. This bias can lead to irrational decision-making, such as avoiding risks during times of volatility.
  - Connection to DVI:
    - When volatility is high (indicated by a high DVI), the risk of significant losses is greater. As a result, traders may exhibit loss aversion and avoid taking on new positions, especially in unstable market conditions. The DVI signal helps identify these conditions, prompting the strategy to short positions or refrain from trading during times of high volatility. This risk-averse behavior aligns with the concept of loss aversion in behavioral finance.
- Herding Behavior
  - Herding behavior occurs when individuals follow the actions of others, often leading to bubbles or crashes. Investors may mimic the actions of the majority, even when these actions are not rational.
  - Connection to DVI:
    - During periods of low volatility (low DVI), the market might appear stable, leading many traders to adopt similar strategies, such as buying into the market. This behavior can reinforce herding as traders collectively move in the same direction.

- Conversely, during periods of high volatility (high DVI), herding can exacerbate market movements, as more traders might panic and either sell or short in response to perceived risk. The DVI threshold could help traders avoid joining the herd in times of extreme volatility, thus mitigating the impact of herding behavior on their own trading decisions.

❖ Overconfidence
  - ➢ Overconfidence refers to the tendency of traders to overestimate their abilities, knowledge, or control over the market. This bias often leads to excessive risk-taking, especially in stable markets.
  - ➢ Connection to DVI:
    - In a low-volatility environment (low DVI), traders may feel overconfident and take on more risk than they should. However, the DVI signal provides a reality check by indicating when volatility is low, which may increase the temptation to act impulsively.
    - By incorporating the DVI signal into trading decisions, the strategy mitigates the effects of overconfidence, ensuring that decisions are grounded in market conditions rather than individual judgment or emotion.

❖ Mental Accounting
  - ➢ Mental accounting refers to the cognitive bias where individuals treat money differently depending on its source or purpose. Traders may hold onto losing positions to avoid realizing a loss, a behavior that can lead to suboptimal decision-making.
  - ➢ Connection to DVI:
    - The DVI signal can help prevent traders from falling into the trap of mental accounting. For example, if volatility rises (high DVI), the strategy prompts traders to exit losing positions or avoid new risky trades, helping them manage their mental accounts more rationally.

5. Performance Evaluation

❖ The back testing framework was designed to assess the strategy's performance across different periods and thresholds. Key metrics include:
  - ➢ Cumulative Returns: Measures the total return of the strategy over time. The back-test evaluates how the strategy accumulates returns by following the buy/sell signals generated by the DVI.
  - ➢ Sharpe Ratio: Measures the risk-adjusted return of the strategy. A higher Sharpe ratio indicates that the strategy provides better returns relative to its risk.
  - ➢ Maximum Drawdown: Represents the largest peak-to-trough loss during the back-test period. This metric is crucial for assessing the strategy's risk in volatile market conditions.

❖ The back test results, including the performance summaries, will be visualized using plots of cumulative returns across periods and thresholds. These visualizations help to compare the effectiveness of the strategy in different market conditions.

6. Conclusion

- This report demonstrated how a volatility-based trading strategy using the Dynamic Volatility Index (DVI) signal can be back-tested and evaluated. The key takeaways are:
  - Behavioral finance principles like loss aversion, herding behavior, and overconfidence influence how traders react to volatility, and the DVI signal helps mitigate these biases by guiding traders to avoid risky decisions during periods of high volatility.
  - The back testing framework, which includes the evaluation of performance over multiple periods and varying DVI thresholds, helps optimize the strategy for different market conditions and risk levels.
  - The use of performance metrics (such as cumulative returns, Sharpe ratio, and maximum drawdown) ensures that the strategy is rigorously evaluated for both profitability and risk management.
- In summary, the DVI-based trading strategy provides a valuable tool for traders to manage market risks while accounting for psychological biases. The results of the back test, along with the behavioral finance insights, offer a comprehensive understanding of how volatility and human behavior interact in trading environments.