Comparing Consumer Staples and Discretionary Stocks with Inflation and Other Macroeconomic Factors

Overview

Data Collection: This project analyzes the impact of inflation on consumer goods and services sectors, using daily prices of Consumer Staples (XLP) and Discretionary (XLY) ETFs from Yahoo Finance, alongside monthly CPI data from FRED (2010–2024). Unemployment and retail sales were included as supporting macroeconomic indicators.

Market Hypothesis: High inflation rates will cause consumer staples stocks to become less volatile and consumer discretionary stocks to become more volatile. This is because consumers will cut down on non-essential costs during periods of rising prices in order to prioritize necessities.

Methods

- **Exploratory Analysis:** Daily returns for XLP and XLY were standardized using z-scores and smoothed with a 21-day rolling mean to reduce noise. These smoothed returns were plotted alongside standardized monthly CPI percent changes to visually assess how inflation/deflation affects these sectors.

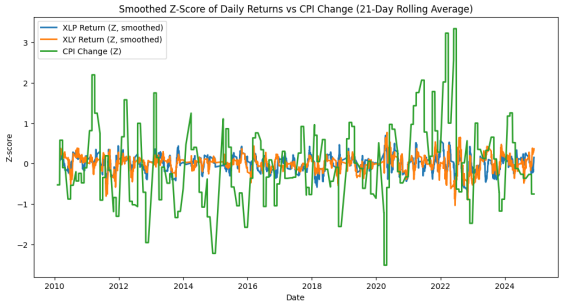

Figure 1: Smoothed Z-Scores of Sector Returns and CPI Change

- **Volatility Regimes:** A 21-day rolling standard deviation was used to capture short-term return volatility for each ETF. The CPI growth rate was used to classify time periods into "high inflation" and "low inflation" regimes based on whether the monthly CPI exceeded or fell below the median value over the entire dataset. Average volatility was then compared across regimes.

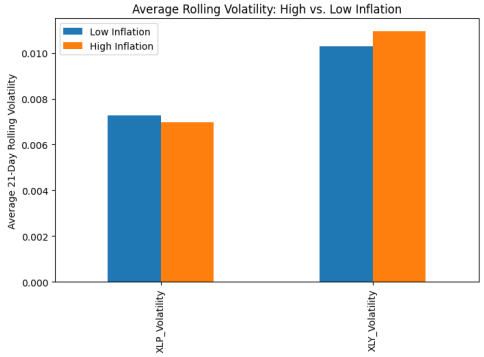

Figure 2: Average Rolling Volatility: High vs. Low Inflation

- **Correlation Analysis:** Two correlation studies were performed. (1) the relationship between CPI and the volatility difference between the sectors: $R = -0.3394$. (2) the relationship between CPI and the monthly return difference (XLP minus XLY): $R = 0.0726$. Since the correlation between CPI and the monthly return difference was so low, I decided to use a PCA dimensionality reduction to create a predictive model that utilized multiple macroeconomic factors reduced to 1 dimension.
- **Modeling:** First, three macroeconomic variables (CPI, unemployment rate, and retail sales) were transformed into a single feature using Principal Component Analysis (PCA). This first principal component (PC1) was used in an Ordinary Least Squares (OLS) regression to predict the monthly return spread. A Random Forest Regressor was also trained on the raw macro inputs to explore potential non-linear model types. The predictions of both models for a specific test set is shown below in the two graphs.

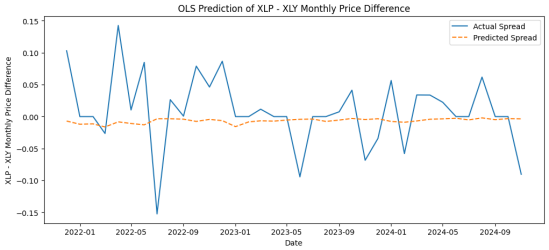

Figure 3: OLS Model: Predicted vs. Actual Monthly Return Difference (XLP – XLY) using PCA

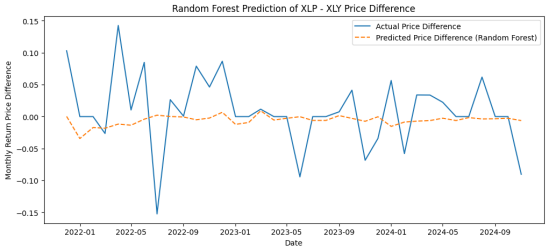

Figure 4: Random Forest: Predicted vs. Actual Monthly Return Difference using Raw Macro Inputs

Findings

- During high inflation, **XLY volatility increased**, while **XLP volatility decreased**, aligning with the initial hypothesis.
- **XLP consistently exhibited lower volatility** than XLY across all inflation regimes, confirming its role as a defensive sector.
- The **correlation between CPI and the return spread** (XLP – XLY) was weak ($R = 0.0726$), suggesting other factors drive relative price movement.
- The **correlation between CPI and the volatility difference** (XLP – XLY) was stronger and negative ($R = -0.3394$), showing CPI's clearer influence on sector risk than on returns.
- **OLS regression** using the first PCA component of CPI, unemployment, and retail sales found a statistically significant relationship ($p = 0.025$), but with modest predictive power ($R^2 = 0.112$).
- The **Random Forest Regressor** performed worse ($R^2 = -0.088$), likely due to limited data and weak macro-only signal, indicating underfitting and insufficient complexity.
- Both models struggled to capture the month-to-month volatility of the return spread, highlighting the limits of using only macroeconomic variables for forecasting.
- Despite low model performance, the empirical relationship between inflation and sector volatility supports the idea of an adaptive sector allocation strategy.

Conclusion

Volatility proved more responsive to **inflation** than **returns**. **XLP's resilience** and **XLY's sensitivity** confirmed the hypothesis. However, **forecasting accuracy** was limited, as both **linear and non-linear models** failed to capture complex market dynamics using **macroeconomic variables** alone. Still, a **CPI-driven market strategy** could be viable given these findings.

Specifically, there could be a **trading strategy** where a portfolio is **weighted more toward consumer discretionary stocks** during periods of **low or stable inflation**, prioritizing **capital growth**. On the other hand, during periods of **fast rising inflation**, the strategy shifts toward **consumer staples stocks**, prioritizing **stability**. Lastly, during periods of **deflation**, which signify **recessions or weak consumer demand**, the portfolio can continue to be **weighted toward consumer staples** to maintain stability.