

A Spread Trade for IEF

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Abstract

This paper aims to expand on Paul Teetor's work and further study a pair trading strategy using the iShares Barclays 7-10 Year Treasury Bond Fund (NYSE: IEF) and 10-year Treasury Note futures (ZN). The approach combines an Ordinary Least Squares (OLS) regression model and an ARIMA model for the residuals, leveraging both models to generate trading signals. The strategy's effectiveness is evaluated based on various performance metrics, including the Sharpe ratio and Maximum Drawdown.

Introduction

Pair trading is a market-neutral strategy that exploits the historical correlation between two securities. This paper outlines a method using IEF and ZN, both of which have a strong inherent relationship as they are both connected to the US Treasury market. Furthermore, the model residuals are demonstrably mean-reverting, which naturally leads to relative value trades. This is very encouraging because it suggests a simple spread -- IEF versus 10-year Treasury Note futures -- could be profitably traded.

Model Development

The initial, full model was a time-series regression on the futures prices using daily closing prices.

$$IEF_i = \beta_0 + \beta_{TY} \times TY_i + \epsilon_i$$

$$\epsilon_i \sim \text{ARIMA}(p, 1, q)$$

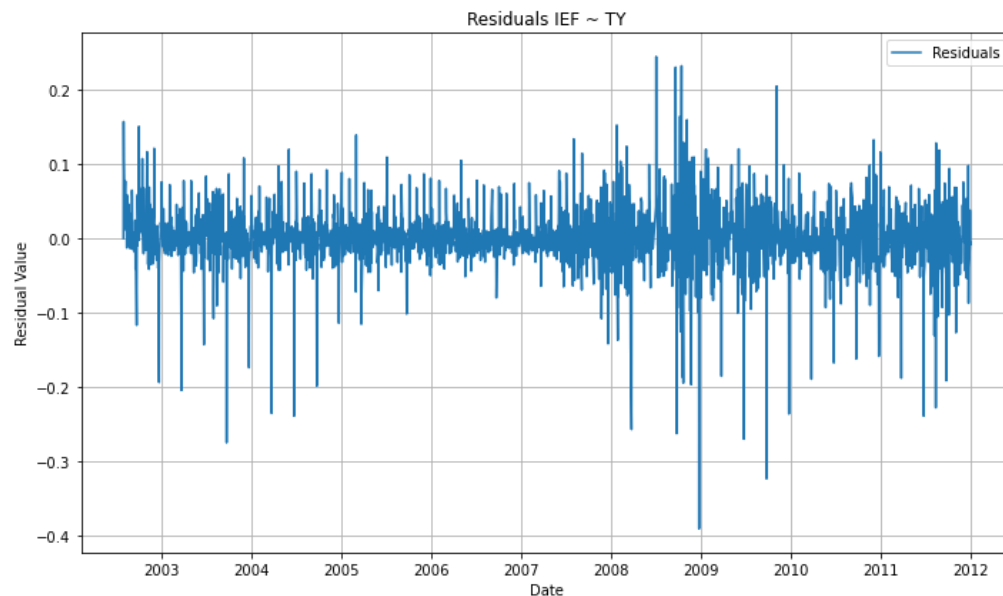
where

- TY is the 10-year Treasury note futures.

The initial fit selected $p = 1$ and $q = 2$, giving an ARIMA(1,1,2) model for the residuals. The indicated hedge ratio was approximately 950 shares of IEF for each TY contract.

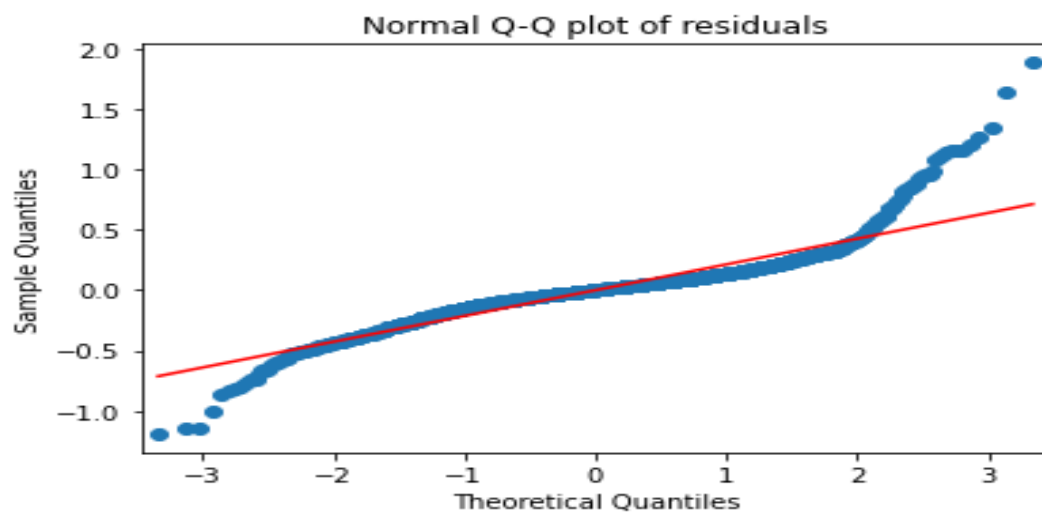
I assumed that the TY futures would be necessary for modeling IEF since the futures would, essentially, create a portfolio which matched the average maturity of the bond fund.

Model Assessment



The model residuals are mostly clean and show no bias. There are however explosions in variance during periods of fed intervention. Most of this variance can be observed during the unprecedented market conditions following the 2008 financial crisis.

This variance is also reflected in the Normal quantile-quantile plot of residuals.

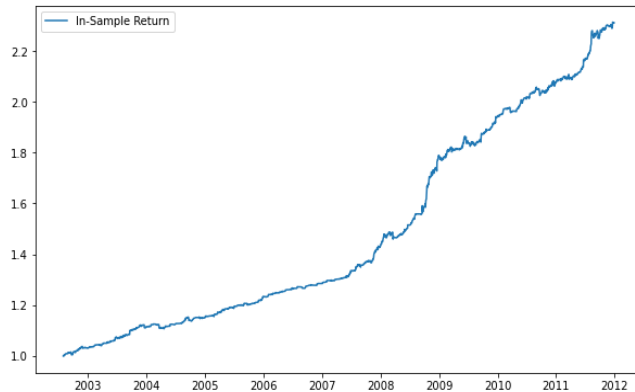


Clearly, there are out-sized residuals, as indicated by the fat tails. This casts some suspicion on the model, but it's mostly explained by market volatility during cycles of fed intervention.

Testing the residuals for mean reversion gives a p-value of essentially zero, using the Augmented Dickey-Fuller test, so we can be confident they are mean-reverting. This is no surprise after seeing the plot of residuals, above.

Trading Model

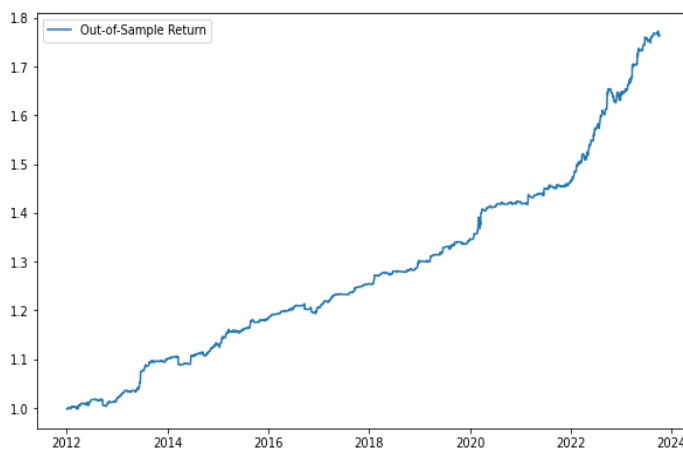
The trading strategy is engineered to generate either a buy or sell directive when the variance of residuals surpasses 0.1 or declines beyond -0.1, respectively. Upon signal detection, trades are initiated at the outset of the subsequent trading day and concluded by the end of that very day. Preliminary evaluations based on the training data indicate favorable performance metrics. The strategy achieved a Sharpe ratio of 2.6638 and realized a cumulative portfolio return of 131.04%.



Sharpe Ratio	2.6637954
Maximum Drawdown	-0.021024877
Win/Loss Ratio	1.732656514
Average Win	0.001573379
Average Loss	-0.001301812
Total Portfolio Return	131.04%

Out-of-sample test

In out-of-sample testing, the model demonstrated its efficacy by securing a positive return. Specifically, it realized a cumulative portfolio return of 76.47% and a Sharpe ratio of 1.9213. However, it's imperative to acknowledge that these figures were derived in the absence of transaction cost computations. This omission could potentially alter the model's profitability when applied in real-world trading scenarios.



Sharpe Ratio	1.921301972
Maximum Drawdown	-0.0172915
Win/Loss Ratio	1.580851064
Average Win	0.001435252
Average Loss	-0.001055299
Total Portfolio Return	76.47%

Conclusion

A primary observation from the analysis is that the 10-year Treasury Note futures (TY) appear to be an effective hedge for the IEF stock. This outcome is advantageous, particularly since the spread trade remains straightforward and eliminates the need for a diverse array of futures contracts.

A secondary insight from the model indicates that its residuals have historically exhibited mean-reverting tendencies. This pattern paves the way for capitalizing on mean-reversion trades. Essentially, these residuals serve as benchmarks for overvaluation and undervaluation, facilitating entry into the spread at strategic intervals. An illustrative chart of recent residuals underscores these potential opportunities.

