Systematically Harvesting Fallen Angel Risk Premia

Working Paper
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1 Introduction

This model seeks to identify the *fallen angel* risk premia and systematically trade it. For practicality and ease of implementation, it uses credit ETFs as proxies for extracting and trading the risk premium. The model performs surprisingly well, maintains reasonable signal turnover, and remains relatively market-neutral. The signal generation methodology is fairly simplistic. The model has potential for more advanced optimization, signal processing, and machine learning enhancements, though these aspects are beyond the scope of this article. The model achieves a sharpe ratio around ∼2.0 in-sample and ∼1.3 out-of-sample. All results within this article exclude transaction costs, but signal holding days are considered to prevent excessive turnover. Further research is needed to fully quantify the impact of transaction cost and slippage, though the returns are likely resilient to these factors. All of the results and the model can be found in this GitHub repo.[1]

2 Data

The data is gathered from multiple sources. Credit ETF fundamentals were sourced from Bloomberg Terminal, while price data was obtained from Yahoo Finance. Ideally, price data would come from Bloomberg Terminal, but due to data limits, Yahoo Finance EoD quotes are sufficient. The adjusted close price is used, as it accounts for dividends and splits. The following ETFs were collected.

Ticker	ETF
AGG	iShares Core US Aggregate Bond ETF
ANGL	VanEck Fallen Angel High Yield Bond ETF
LQD	iShares iBoxx $ Inv Grade Corporate Bond ETF
SJNK	SPDR Bloomberg Short Term High Yield Bond ETF
FALN	iShares Fallen Angels USD Bond ETF
HYG	iShares iBoxx $ High Yield Corporate Bond ETF
JNK	SPDR Bloomberg High Yield Bond ETF

For each ETF, a few key *fundamentals* were collected. Specifically they include YAS_YLD_SPREAD, YAS_BOND_YLD, and YAS_ISPREAD_TO_GOVT. The ETF-specific fundamentals were cleaned using a series of z-score windows.

[1] https://github.com/diegodalvarez/FallenAngelRiskPremia

3 Fallen Angels: The Best of High Yield or the Worst of Investment Grade

Since fallen angels exist at a transitional stage within credit risk, it is crucial to understand their relationship to both high yield and investment grade. It is important to clearly distinguish between these two credit risk categories due to the heterogeneity of the high yield and investment grade sectors. While a full analysis should be conducted at the CUSIP level, this discussion will focus solely on the ETFs, which adhere to the rules of their respective underlying indices.

Admittedly, fallen angel risk premia is inherently difficult to analyze. Investment grade credit risk is generically defined as the sum of interest rate/term premia along with an additional credit risk premia. Investment grade credit risk premia has been extensively studied. Ilmanen [Ilm12] provides a comprehensive overview of credit risk. Hallerbach [Hal18] reviews fundamental mathematical models of generic investment grade credit risk and explores alternative credit risk premia calculations.

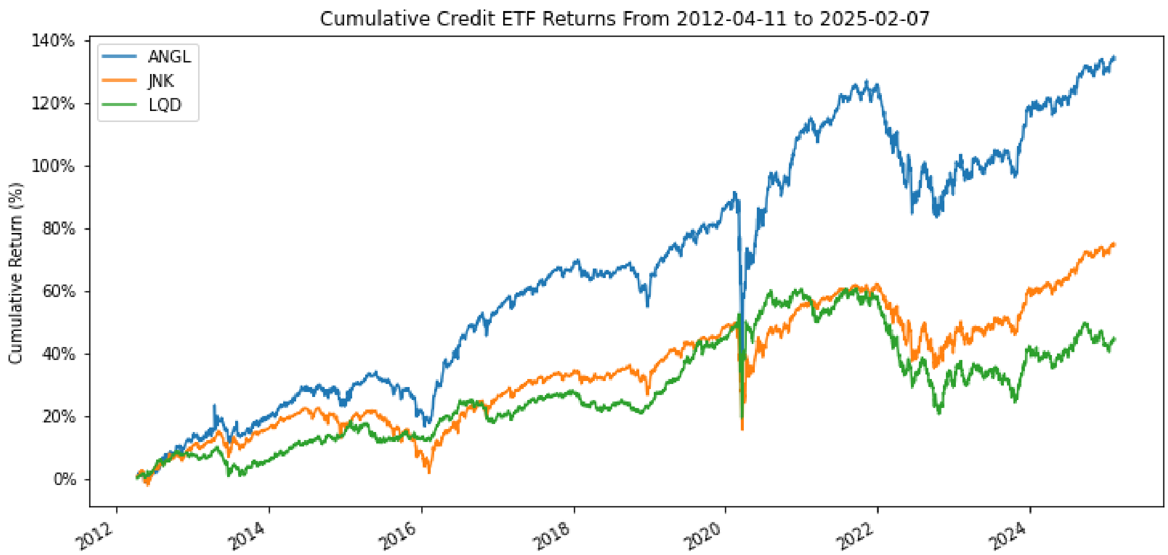
Generally, investment grade credit risk premium is expressed as the excess duration neutral returns over US Treasuries. This risk premium is regularly extracted by asset managers, who buy investment grade bonds while being short US Treasuries. Extending the same risk premium calculation, high yield would be defined as the additional credit risk component added to investment grade risk, with some liquidity component. That premium is a bit more difficult to extract. High yield is a less-studied premium, and to the author's knowledge, there is not a clearly defined framework for extracting the sole high yield risk premium after accounting for investment grade. That being stated the author does not claim that a methodology does not exists, but is simply unaware of one. There are two logical extensions to determine the *pure* high yield risk premium. The first is take the difference of excess duration neutral returns of high yield and investment grade returns, controlling for US Treasuries. The second would be to take the excess duration neutral returns of high yield, controlling for investment grade. In practice, high yield long-short portfolio managers are not always duration neutral and routinely short equities to achieve market neutrality. Since actual practitioners incur some duration exposure, and for simplicity, dollar neutral excess returns are used. An alternative method for identifying fallen angel risk premia can be implemented through CDS, but that will not be covered here.

The *difficulty* within fallen angels is that high yield bonds tend to be shorter maturities than their respective investment grade counterparts, and tend to be callable. This makes fallen angels a *tricky* problem, having both the attributes of investment grade bonds (initially) but living in the high yield universe. It is presumed that this *trickiness* leads to market dislocations and mispricings, as the high yield market has trouble accurately pricing newly added investment grade bonds.

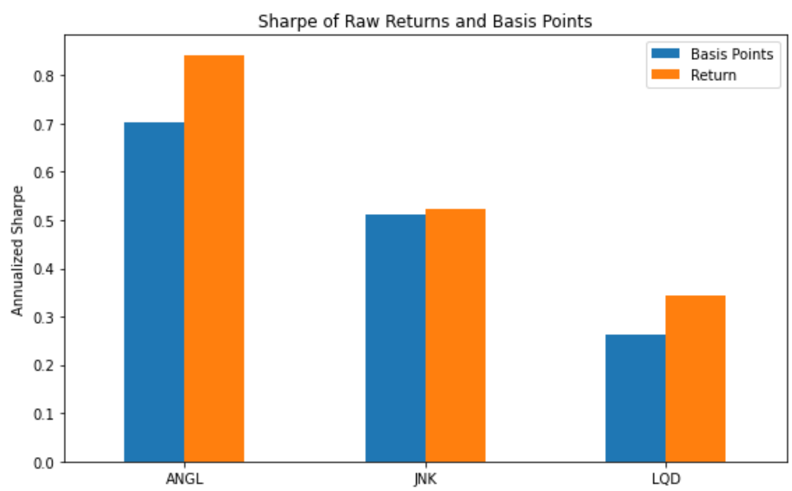
A more robust model based on individual bonds rather than ETFs would allow for selecting underlying securities, predict ratings downgrades, hedge on a CUSIP basis, and control for other factors that may be present such as size or sector. One benefit of using the ETFs is that it provides a clearer picture of the credit risk premium. The following ETFs will be used: for fallen angels (ANGL), high yield (JNK), and investment grade (LQD). It should be noted that other relevant ETFs will be included in the backtest. These ETFs were chosen because they closely *match* their underlying index. For example, JNK tracks the index, while HYG provides exposure to it.

3.1 Returns Comparison

From a pure returns standpoint, it is evident that fallen angels moderately outperform both high yield and investment grade. The cumulative returns also show the narrow returns differential between high yield and investment grade.

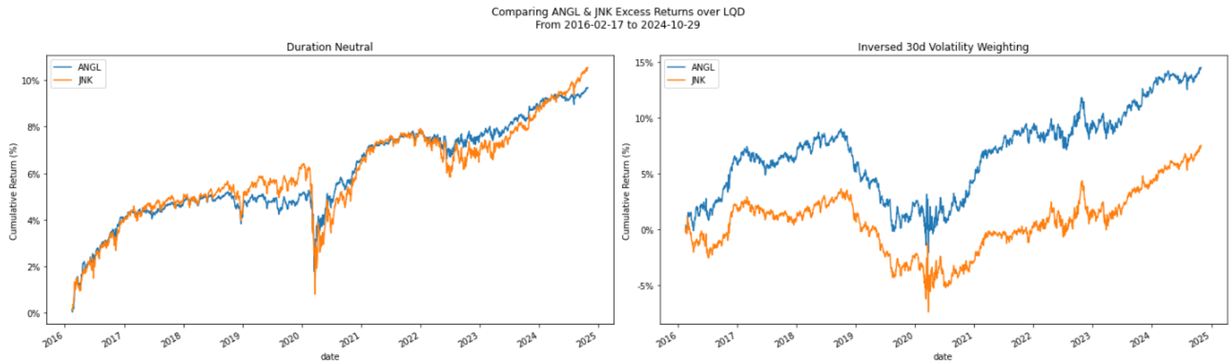


From a risk-adjusted perspective, fallen angels still outperform the rest of their bond categories. The high yield universe still maintains its additional risk premium (in risk-adjusted terms) to investment grade as well. From these two graphs (sharpe and returns), one can surmise (quite naively) that there is a return premium (both raw and risk-adjusted) that can be extracted. Below is a graph of each ETF's sharpe. Basis points are calculated as the price difference divided by modified duration.



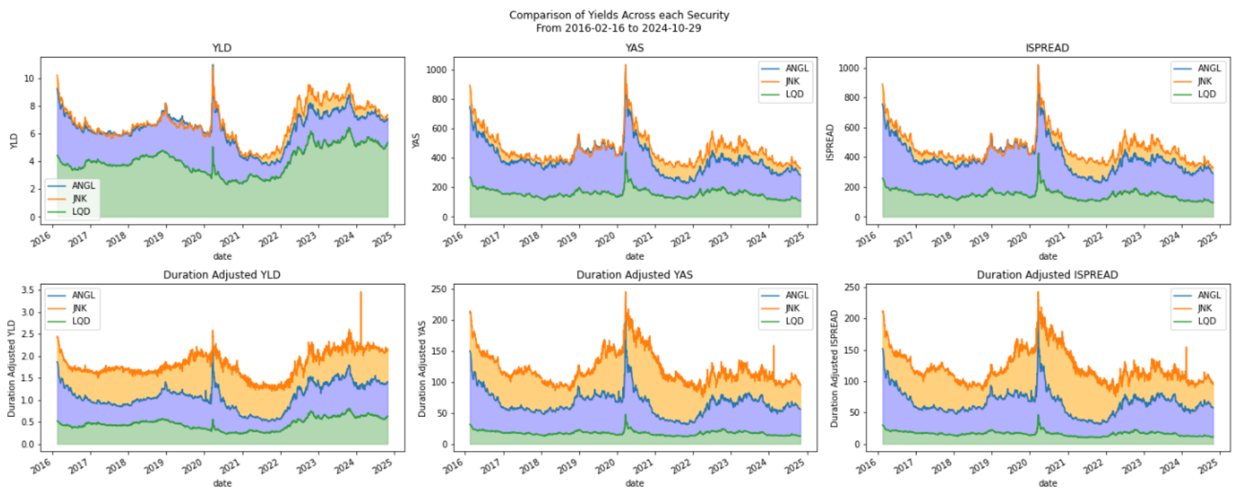
Unexpectedly, this should not be the case with fallen angels. By definition they should embed less credit risk, as they are the highest grade within the high yield category, yet they deliver better returns. In the next section, which covers yields, fallen angels present themselves in a more identifiable way.

Below is a plot of high yield and fallen angel excess returns after accounting for investment grade returns. The returns of fallen angels are nearly identical to high yield within the duration neutral context, and they outperform in the volatility neutral returns. This starts to shed some light on the sharpe differences, since fallen angels deliver almost the same excess *high yield* returns while by definition having less credit risk.

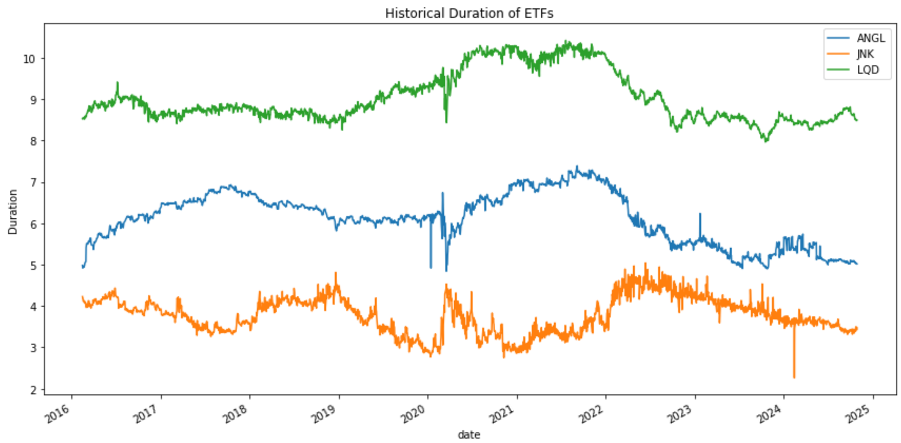


3.2 Yield Comparison

From a yield perspective, the fallen angel risk premium becomes more apparent. This result is not surprising, since the credit risk of fallen angels should be intermediate between investment grade and high yield. The top row shows the fallen angel yields are very close to high yield, but the duration-adjusted yields reveal clear segmentation within the market, suggesting duration and maturity play a role.



The duration-adjusted yields help better distinguish between the bonds. The key to this puzzle lies in recognizing that fallen angel bonds, despite sharing the high yield credit rating, are inherently different from typical high yield bonds. High yield bonds have shorter maturities due to perceived credit risk (and occasionally call risk), while investment grade tends to have longer maturities. Unfortunately, average maturity data was not collected for direct comparison. Some reverse engineering can be done, knowing that the yields between high yield and fallen angels are close; their durations can be examined.



The duration of fallen angels is higher than of high yield, yet their yields remain closely linked. This implies that the discrepancy stems from the difference in remaining coupons, which is related to maturity.

4 Analyzing Raw Fallen Angel Risk Premia

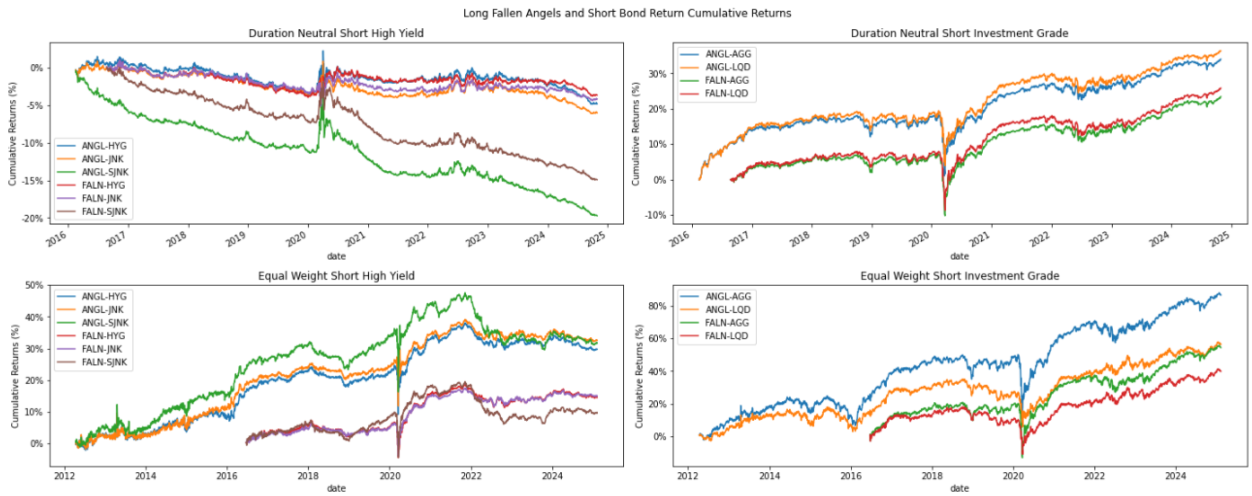
There are 2 *hypothesized* components of the fallen angel risk premia.

1. **Credit Rating Risk Premium** $\rightarrow$ If market pricing anticipates credit rating changes, bonds likely experience price deterioration before a downgrade. This implies that from a pure fundamentals standpoint the bond is *fairly* priced prior to the downgrade and the following price action after is driven by technical factors rather than fundamentals.

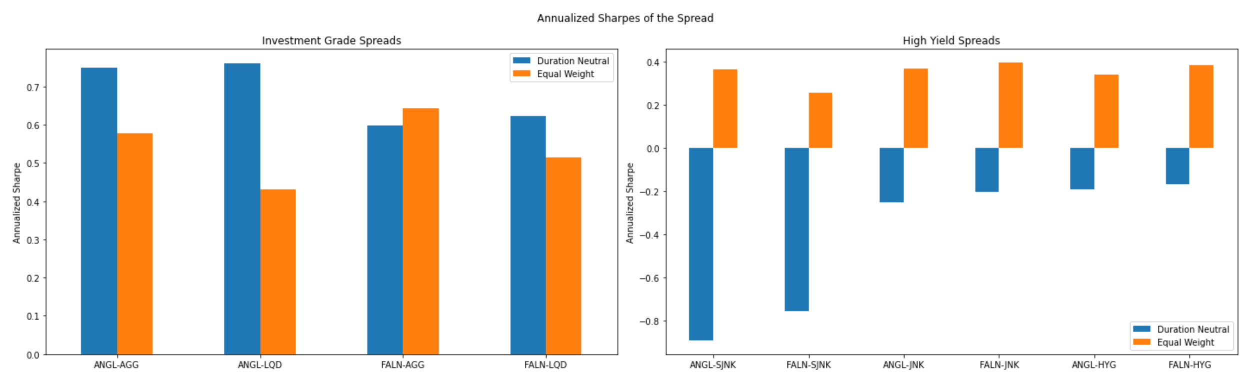
2. **Forced Selling & Providing Liquidity to Mandated Sellers** $\rightarrow$ Institutional investors with mandated investment grade holdings, such as insurance firms, pensions, and mutal funds are required to sell downgraded bonds upon their transition to high yield. Forced selling puts downward pressure on bonds that is not fundamentally driven. This downward pressure causes the bonds the trade at a discount relative to their *new* high yield classification.

Some research focusing on the impact of the forced selling component has led to some debate. Ambrose et al [ACH12] focus on the impact of insurance companies selling fallen angels. They find that the impact of insurance companies is almost negligable. They surmise that if insurance companies had price impact then they'd devise a scheme to hide trades to reduce impact and the data suggests that they don't. Other research such as Mounier [All20] from AllianceBernstein state that forced selling is a component of fallen angels and that insurance companies are incentived to sell the position to avoid write-down or other regulatory and accounting changes. Benson & Hayes in [BH19] state passive managers that track indexes have to shed fallen angels once they are cut and removed from the index. They also go on to state the inefficiencies within the high yield market when it comes to abosrbing fallen angels.

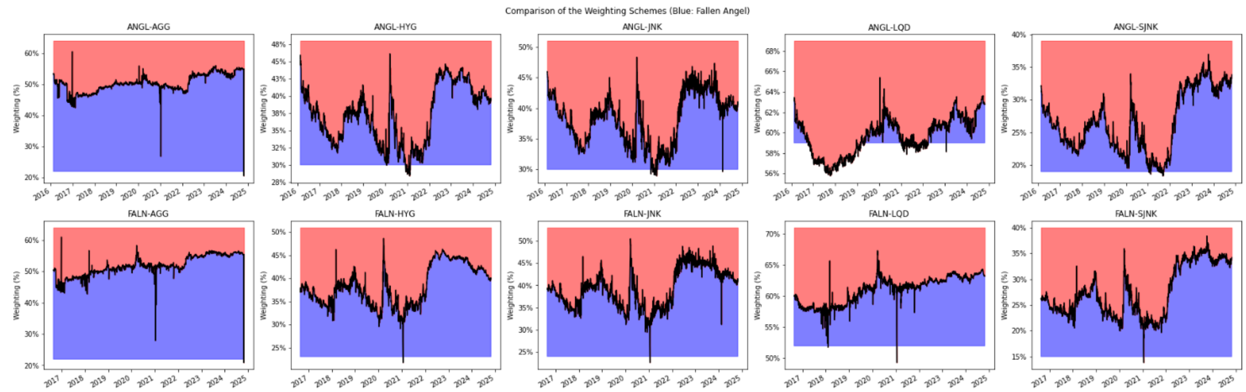
The fallen angel risk premia will be measured using excess return. The two return measurements approaches are: dollar neutral (50/50 long-short) and duration neutral. All return spreads are generated by being long FALN and ANGL and being short another ETF. The results of these excess return calculations are presented below.



The main *premium* of interest will be long fallen angels and short high yield. This will be referred to as the *fallen angel risk premium.* Surprisingly, the fallen angel risk premia produces a positive sharpe in equal weight terms ($\sim$ 0.34) and a negative sharpe in duration neutral terms ($\sim$ -0.4). Below is a plot of the sharpes per each spread.



Unfortunately there is not a clear explanation why there is such a discrepancy between sharpe ratios. The first attempt examined the weighting scheme, since products like SJNK (Shorter Dated JNK) will have obvious duration mismatches. Plotting the weighting scheme does not indicate a clear mismatch between the two securities; however, some variation exists, particularly when short high yield.



The working theory is that high yield long-short trading is typically not duration neutral, which contrasts with investment grade long-short trading. Therefore, the calculation is of limited relevance. High yield traders who wish to be market neutral have multiple strategies for hedging their exposure to market risk. It is not uncommon to be short equities when taking a long position in high yield bonds.

In this case, fallen angels appear to be a highly unusual asset from a risk standpoint. By definition, they are not equivalent to high yield as they exhibit a distinct risk premium, nor are they investment grade. Fallen angels exist in a unique *transitional space* making them challenge to hedge effectively.

5 Developing a Signal to Trade Fallen Angel Risk Premia

Now that the risk premia has been examined, a trading signal can be generated to systematically exploit the dislocation between yield and returns. Several considerations must be taken into account. The working theory is that being long fallen angels and short high yield is the preferred spread to trade. Instead of being duration neutral, the portfolio is dollar neutral, and the interest rate metrics are not duration adjusted. Here is the reasoning.

1. It is expected that the returns of fallen angels move in line with high yield as seen in the duration neutral excess return of high yield and fallen angels after accounting for investment grade
2. Although it is ideal, perfectly-hedged duration is not always achieved, and many trading teams will take positive or negative duration exposures. The dollar neutrality condition will hold back on being fully exposed (long or short) to duration.
3. Duration-adjusted yields are not used since the return spreads are not duration neutral.

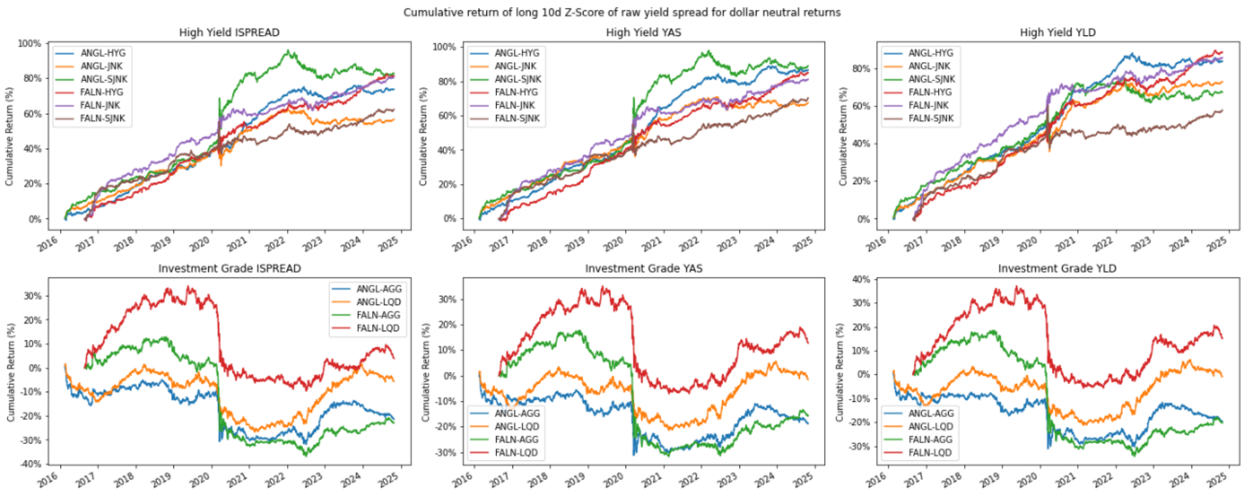
For full disclosure, investment grade spreads and duration neutral returns differentials will also be presented even though the main portfolio is dollar neutral, short high yield, and uses duration-unadjusted yields. For terminology, *spread* will refer to returns-spread and *yield-spread* will refer to the spread between yields.

First, begin by creating the spread of being long fallen angels and short their respective bond counterparts (high yield). Then, generate the signal by taking the yield-spread (YAS_YLD_SPREAD, YAS_BOND_YLD and YAS_ISPREAD_TO_GOVT) followed by calculating a z-score using exponential weighting. In this case, the parameters are set to 10 days, which is equivalent to 2 weeks. The signal returns are generating by taking a long position in the z-score. The interpretation follows.

1. Rich z-score → fallen angel yields richen to high yield implying that fallen angels are cheap to high yield
2. Cheap z-score → fallen angels yields cheapen to high yield implying that the fallen angels are expensive to high yield

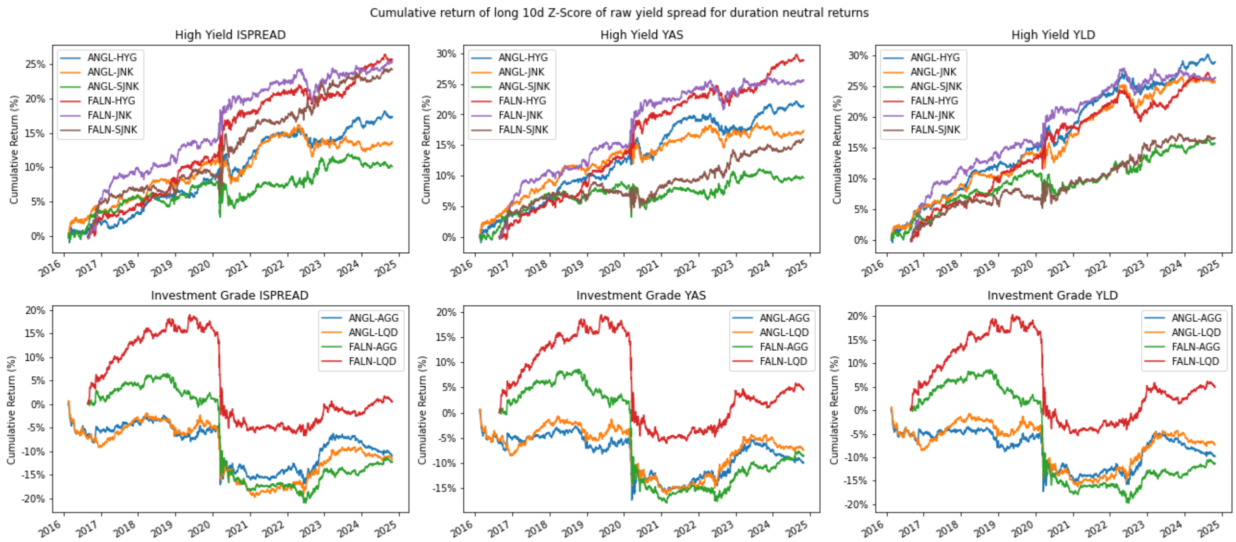
5.1 Signal Results

Below are the results of the equal weight returns. Investment grade returns are presented although the *working* method uses a high yield. Surprisingly, the results for high yield are strong across all yield-spread measurements

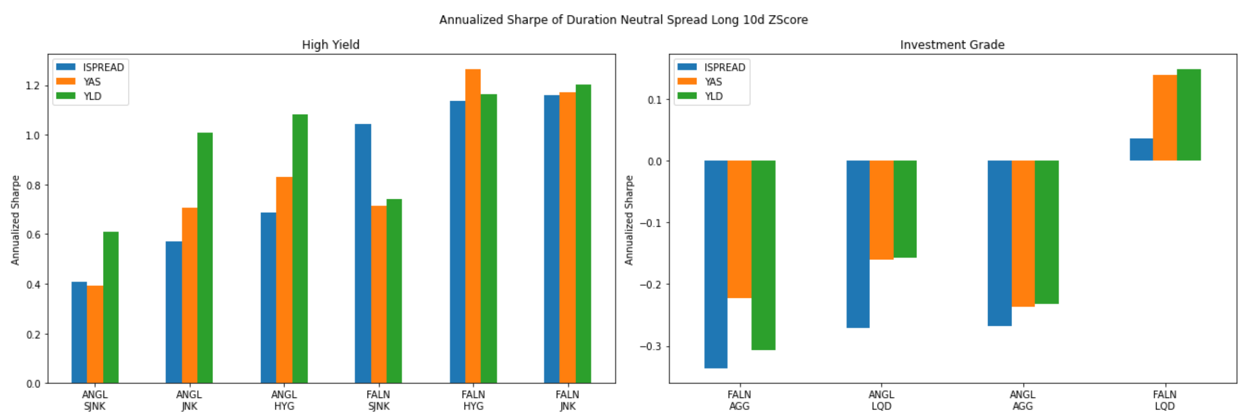


The sharpes on a security basis are quite strong with respect to the high yield ETFs. For investment grade, they are weaker which is to be expected.

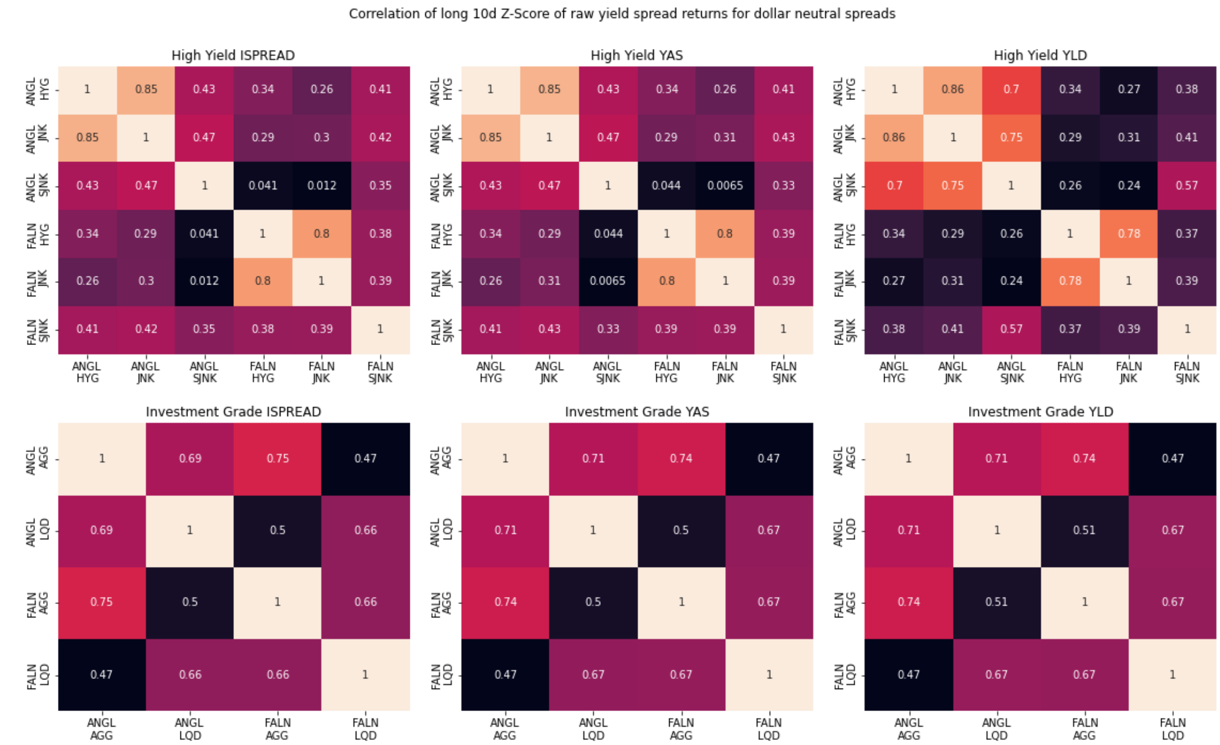
The signal returns are still consistent for duration neutral returns, with respect to high yield.

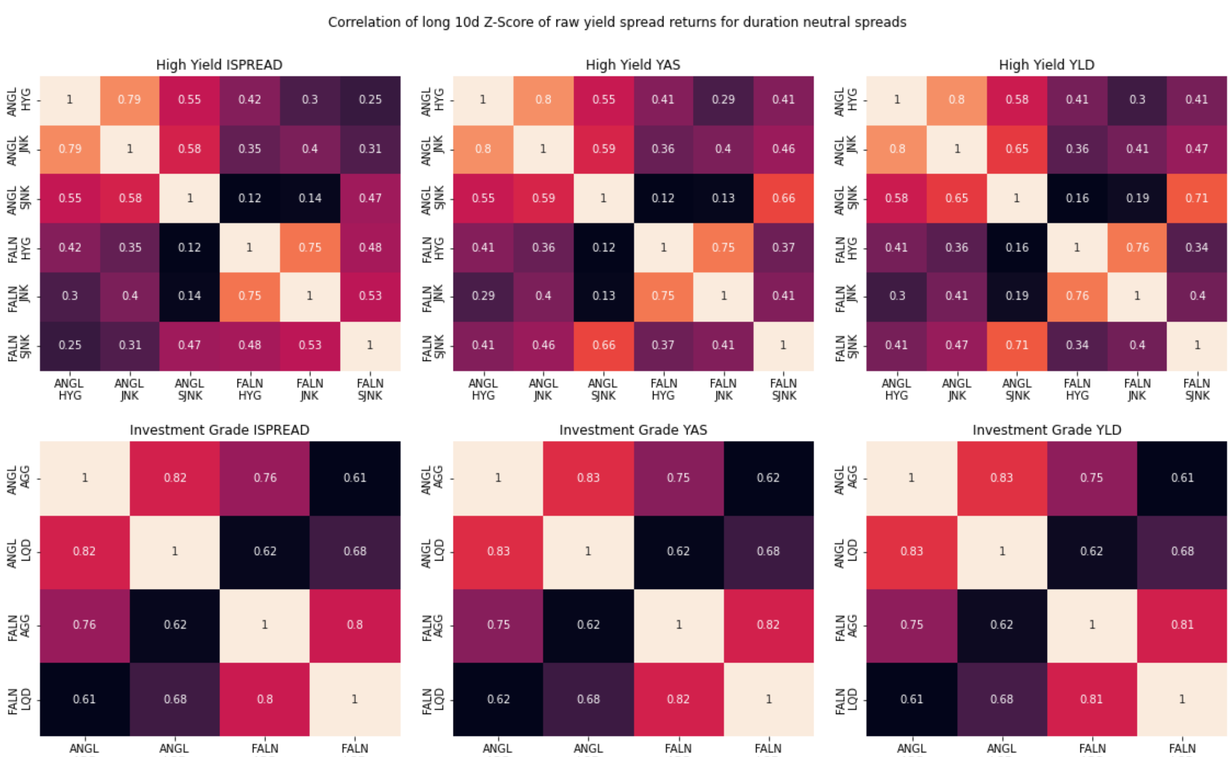


And its corresponding sharpes as well.

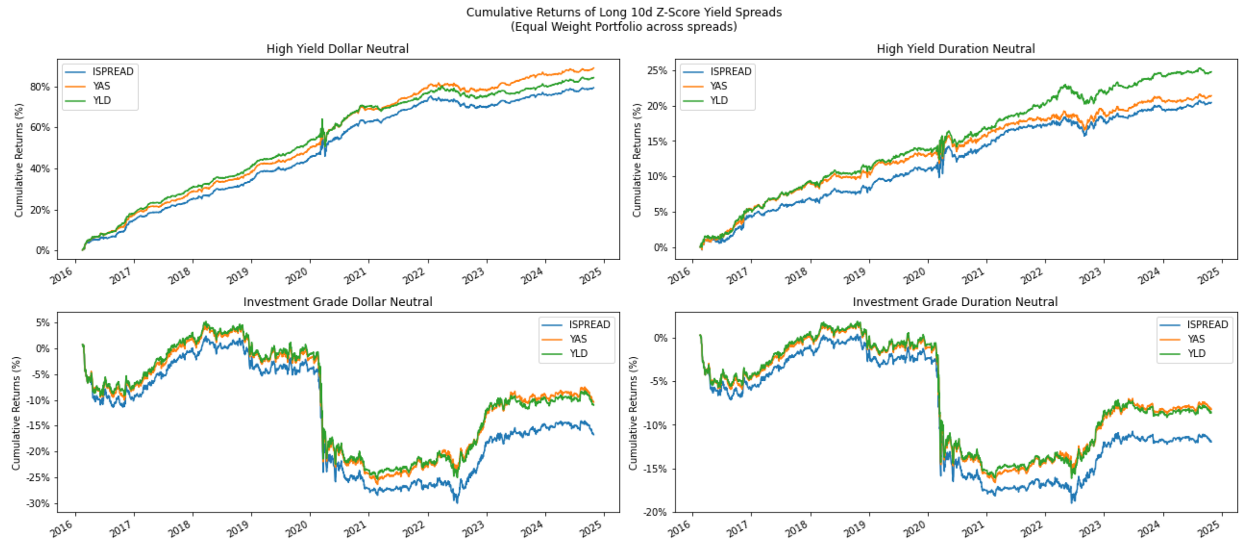


The signals can be easily combined for trading within a portfolio. They exhibit low correlation with each other.

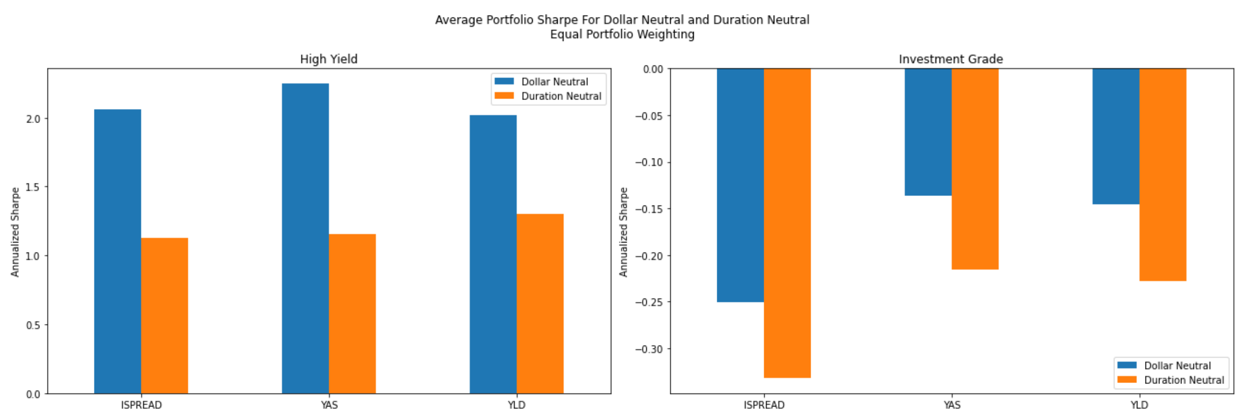




Setting aside portfolio optimization for now, the default portfolio weighting scheme will use an equal weight allocation across all spreads. The following shows the returns of dollar neutral and duration neutral spreads for high yield and investment grade.



From a performance perspective, the duration neutral and dollar neutral returns exhibit significant differences in total return. The dollar neutral spreads return about ∼80% since inception, while the duration neutral returns deliver about ∼25%, respectively. From a sharpe perspective, the dollar neutral delivers about ∼2 and the duration-adjusted delivers about ∼1.1



The results are surprisingly good. Although some assumptions were made, they are quite reasonable. The following list outlines methods to test the validity of these assumptions.

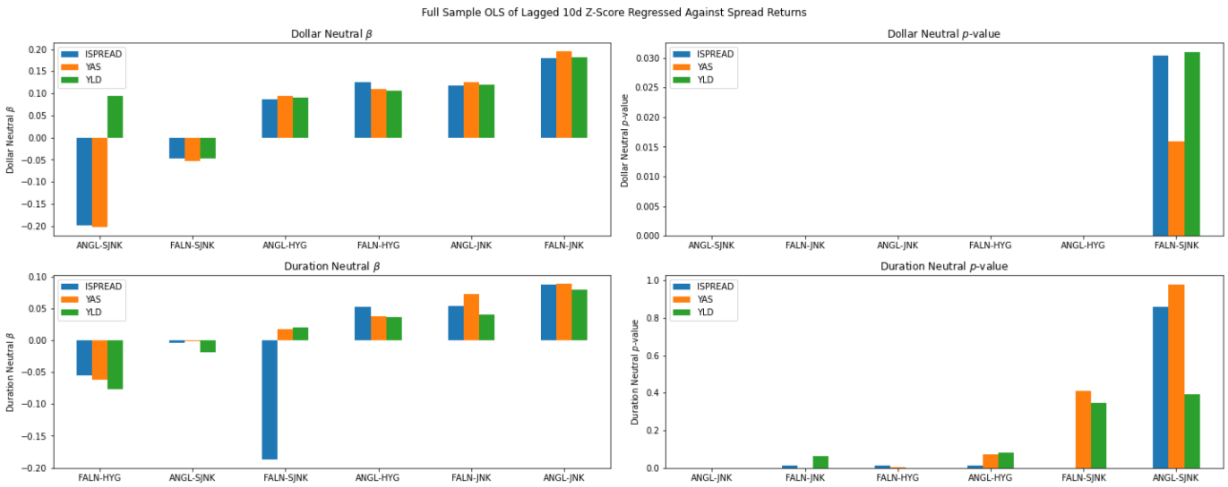
1. The Z-Score window → This was set to 10 days, which is comparable to a 2 week look back period. Additional tests need to be taken to prove that 10 days is not just a statistical fluke.

2. Being long z-scores → Although the interpretation is quite straightforward, its just a matter of *happenstance* and that bias needs to be tested.

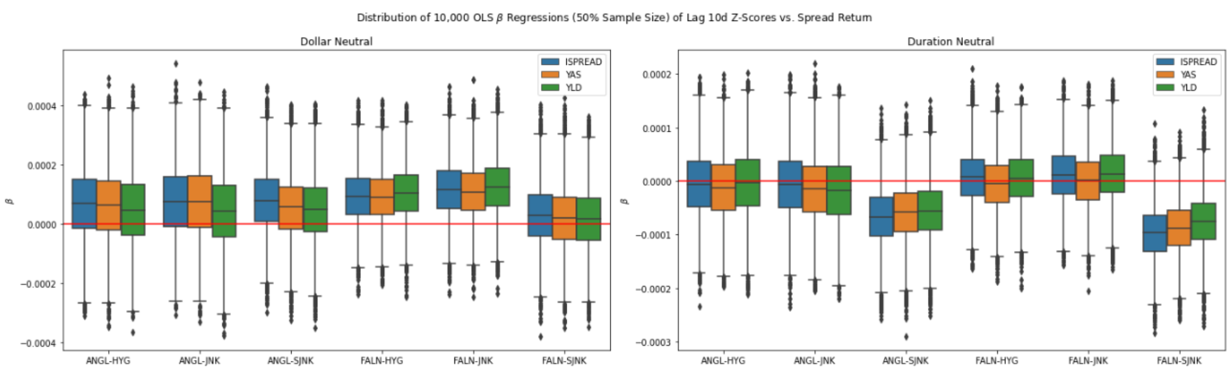
Potential biases, such as shorting investment grade bonds, will not be included, as it is reasonable to assume that investment grade bonds are not suitable short candidates.

6 Signal Analysis

The first bias to test is the *long-z-score-bias*. To test this start with a full-sample in-sample OLS regression of the signal (*lagged z-score*) against spread returns. Initial results show that βs > 0 which should be expected, implying that long z-scores generates positive returns. The following are the parameters of OLS regression.

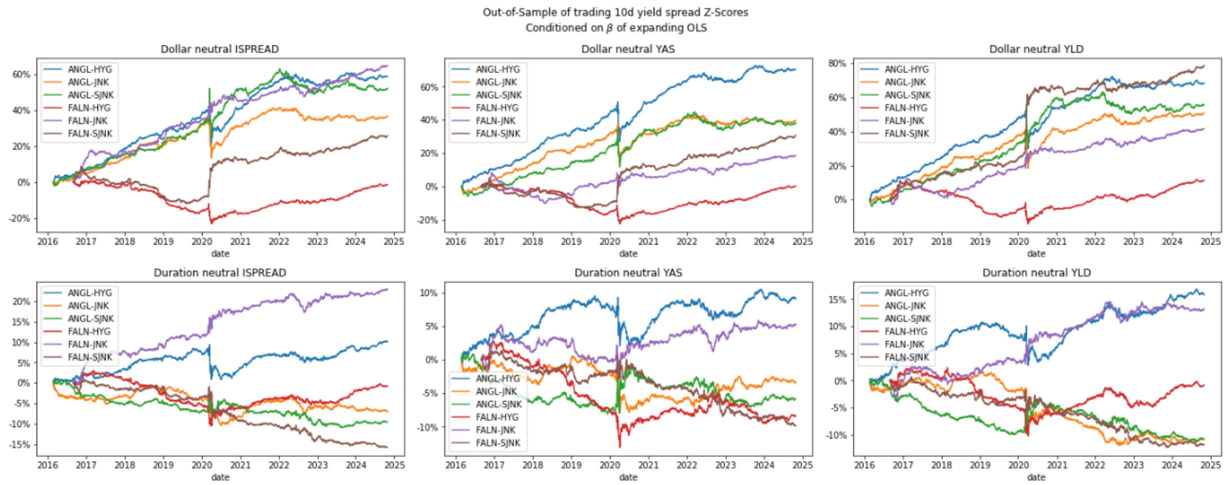


The results are align with expectations. SJNK, a shorter-dated high yield ETF does not perform well within the model. This issue occurs throughout the analysis. The most likely explanation is the presence of duration mismatches throughout the model, with SJNK showing the greatest mismatch between fallen angels and high yield. The βs are full-sample; to relax that condition, run a sampled regression and compare the results. In this case select 10,000 random samples, each containing 50% of the data, run the regression, and calculate β. Once those βs are collected, a distribution can be constructed and analyzed. The same methodology applies from above, it is preferable that $\beta > 0$. Below is a box-plot of those β values.



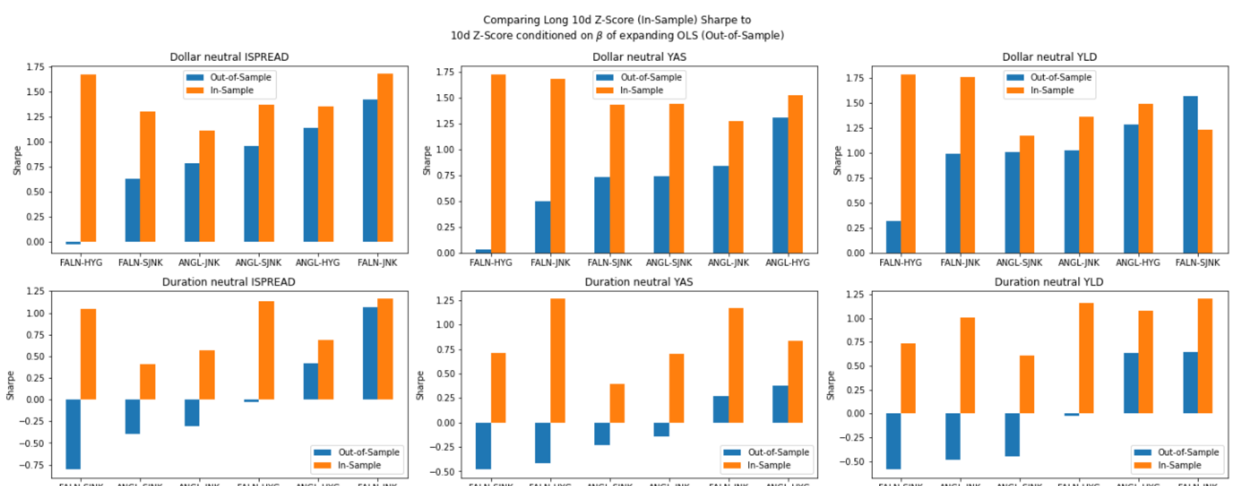
When examining the dollar neutral returns, SJNK exhibits the most problems. The initial full-sample analysis showed that assuming *long z-score* for SJNK was incorrect, and this graph confirms that. Certain spreads such as ANGL-HYG and ANGL-JNK begin to show inconsistencies. Their lower quartiles fall slightly below zero. This implies that although the full sample regression shows positive βs and acceptable p-values, it was prone to sampling bias. As per the duration neutral tests, the distributions are more scattered than the dollar neutral. The OLS results of the full sample suggested that the distribution of βs should be consistent.

To test a full raw out-of-sample result, an expanding window lagged regression will be used. For consistency, drawdown management - such as a stop loss-will not be implemented. In a real trading scenario, positions are typically stopped-out after posting poor results. However, in this case, all of them are retained to give a realistic measurement of sharpe lost in the out-of-sample analysis. Below are the returns of the expanding out-of-sample regression.

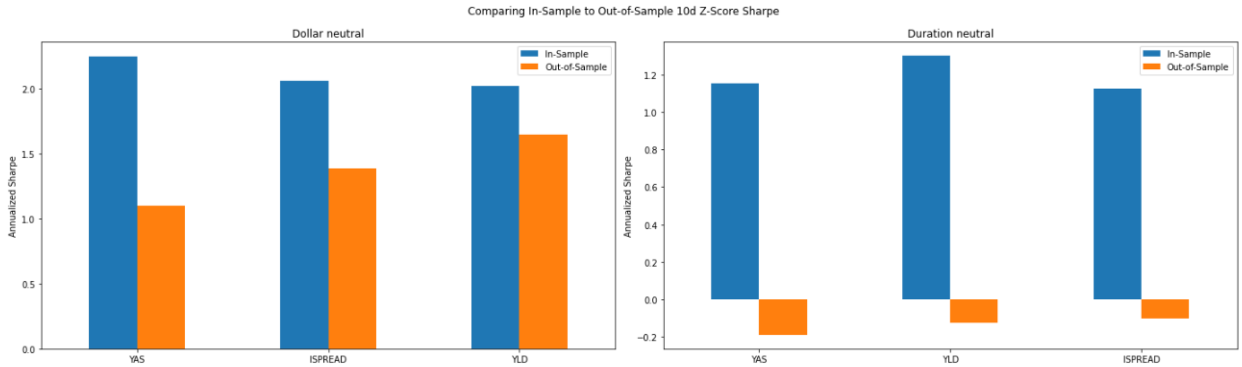


The out-of-sample returns reveal some weaknesses in the model, which were initially suggested by the bootstrapped test using the β-distribution. Duration neutral spreads perform poorly out-of-sample, whereas dollar neutral returns perform significantly better. Some out-of-sample (under)performance within dollar neutral returns were not *inferred* by the bootstrapped β-distribution. For example, dollar neutral FALN-HYG had a reasonably strong distribution with the lower quartile of βs being above 0, yet its returns were quite poor. The efficacy of the test is debatable, though the sample size is relatively large given the data. Another explanation is that the β was weak to begin with, suggesting that the relationship may not be as strong as originally presented.

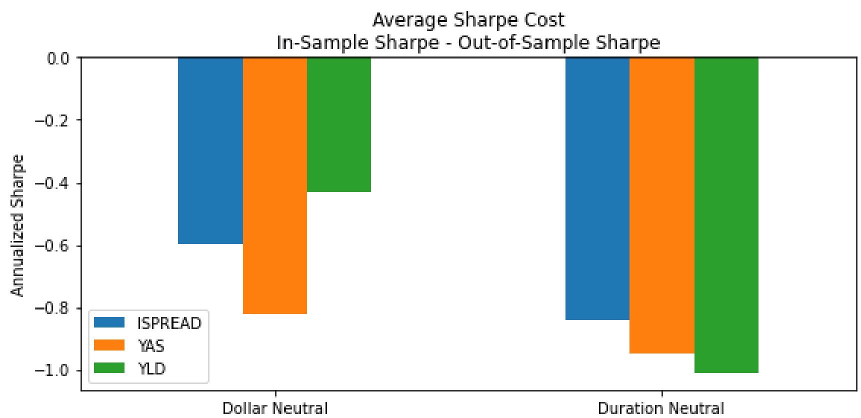
The plot below compares the in-sample sharpes to the out-of-sample sharpes. This plot indicates a significant decline in sharpe out-of-sample. A decline in sharpe out-of-sample is expected across all strategies, which occurs with the exception of dollar neutral FALN-SJNK spread. Among the dollar neutral strategies, many still maintain positive >1 sharpe. Duration neutral sharpes tend to turn negative out-of-sample, while the positive ones weaken further.



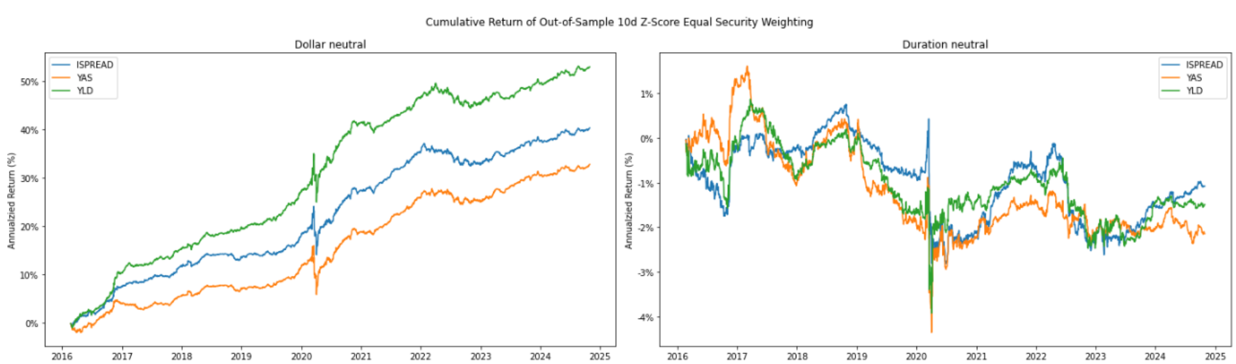
The plot below displays the sharpe for the equal weight portfolios. Nearly all of the sharpe within the duration neutral portfolio is lost, resulting in negative or near-zero values. The sharpe for the dollar neutral portfolios remain relatively strong, with values above 1.



Now, compare the average sharpe decline between in-sample vs out-of-sample. Ideally, a sharpe reduction should almost always occur when moving out-of-sample which is indeed observed. The concerning factor is the magnitude of sharpe decline and out-of-sample results. From a trading perspective, a strategy with a ∼0.8 sharpe decline when moving to out-of-sample appears unattractive. Despite that sharpe decline, dollar neutral portfolios still achieve a >1 sharpe. For context, the out-of-sample sharpe reduction is comparable to the raw sharpe of fallen angels and nearly twice the raw sharpe of LQD. Regarding the negative performance of duration neutral returns, their out-of-sample sharpe reduction is ∼0.9. The likely reason for the negative out-of-sample performance is that their initial in-sample sharpes were not strong enough (compared to dollar neutral) to withstand the out-of-sample decline.



Below are the cumulative returns for each out-of-sample portfolio. The dollar neutral returns exhibit strong performance, whereas duration neutral returns underperform.



To verify the outperformance of the portfolios over their respective benchmarks, a simple statistical test is conducted. The test involves computing the difference between portfolio's 30 day rolling sharpe and its benchmark, followed by a one-sample t-test to determine whether the mean is statistically different from 0.

Table 1: Performance Metrics for Portfolios vs. Benchmark ETFs

Portfolio	Benchmark ETF	μ (ann)	p-value	t-stat
ISPREAD	ANGL	0.597715	1.28e-11	6.808113
ISPREAD	JNK	0.830484	3.25e-22	9.799908
ISPREAD	LQD	1.440075	6.10e-51	15.414814
YAS	ANGL	0.429060	8.11e-06	4.473098
YAS	JNK	0.661830	4.30e-13	7.290921
YAS	LQD	1.271420	2.27e-37	13.021785
YLD	ANGL	0.965832	1.08e-27	11.059033
YLD	JNK	1.198602	1.32e-43	14.162518
YLD	LQD	1.808192	2.06e-76	19.260804

A similar test can be conducted using a 30 day rolling α from an OLS regression.

Benchmark	Portfolio	daily $\bar{\alpha}$	p-value	t-test
ANGL	ISPREAD	0.013772	1.52e-116	24.425882
ANGL	YAS	0.012362	8.03e-84	20.277601
ANGL	YLD	0.017208	7.13e-162	29.597021
JNK	ISPREAD	0.015252	2.52e-144	27.651416
JNK	YAS	0.013562	4.06e-109	23.523957
JNK	YLD	0.018714	7.65e-187	32.277787
LQD	ISPREAD	0.015226	4.61e-144	27.621934
LQD	YAS	0.012971	2.12e-94	21.672591
LQD	YLD	0.018963	2.64e-184	32.009269

7 Signal Consistency

The second bias to address is the *z-score window bias.* The goal is to assess the consistency of the z-score and that a 10 day z-score is not a statistical fluke. There is always the risk that 10 day window is *cherry-picked*, although it is a reasonably chosen. This model will evaluate that. Below is a plot of the sharpe for each window. Only high yield ETFs are used, and out-of-sample results are conditioned on the expanding OLS β.

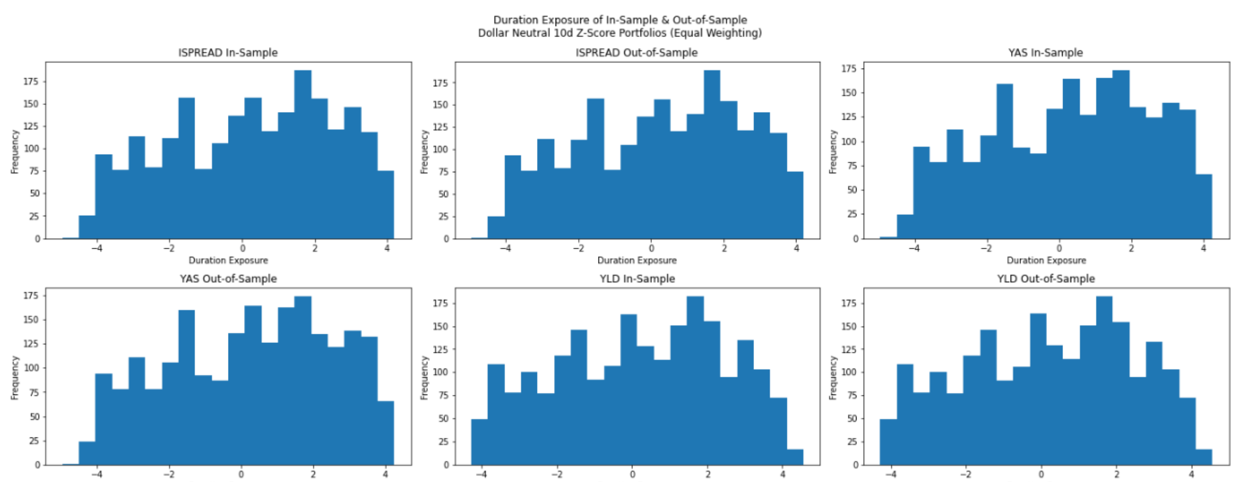
It is evident that the sharpe declines as the window increases. But the steady change in sharpe shows that the 10 day z-score isn't an outlier. Surprisingly the sharpe still maintains strong performance in both dollar and duration neutral with longer windows.

8 Portfolio Attributes

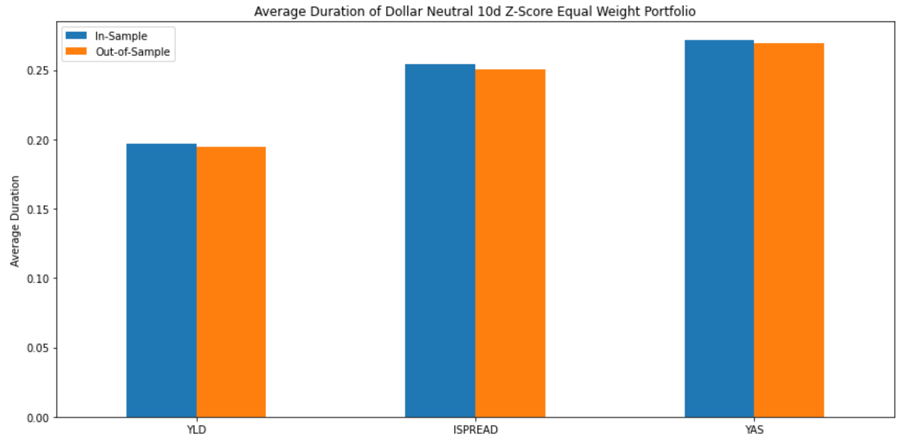
This sections will cover the performance and exposures of the portfolio. The statistics presented are the dollar neutral spreads using a 10 day z-score window both in-sample and out-of-sample. Several statistics are relevant for understanding the performance.

8.1 Duration Exposure

The first statistic to cover to is duration exposure, as the portfolio does not attempt to hedge duration but relies on the dollar neutrality to *cap* duration. Below is a plot of portfolio's duration.

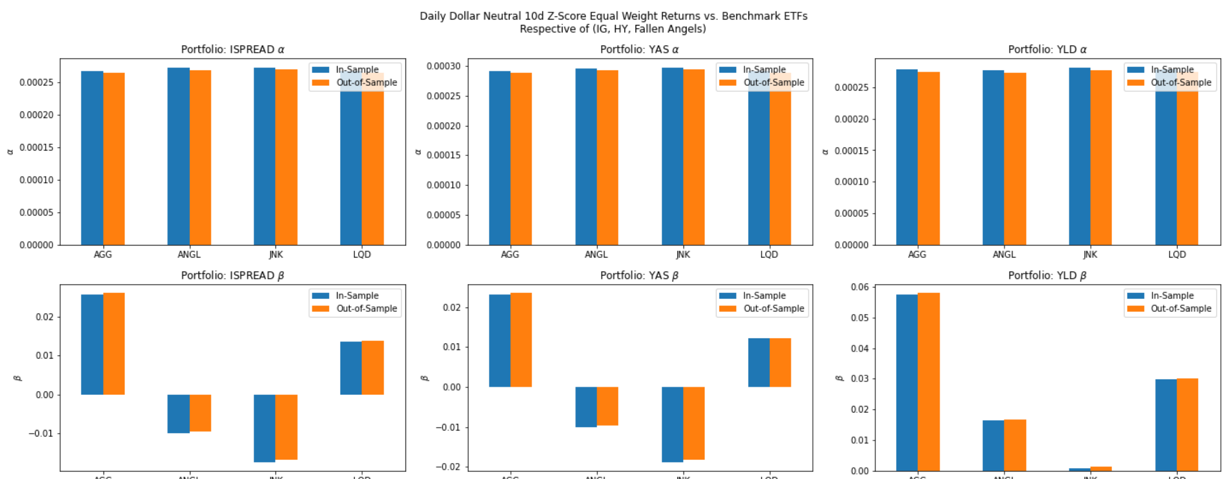


Duration exposure can vary over time, but it appears to be driven by outsized events. Looking at the average duration for each portfolio, it is clear that the duration exposure is minimal.



8.2 Market Exposure

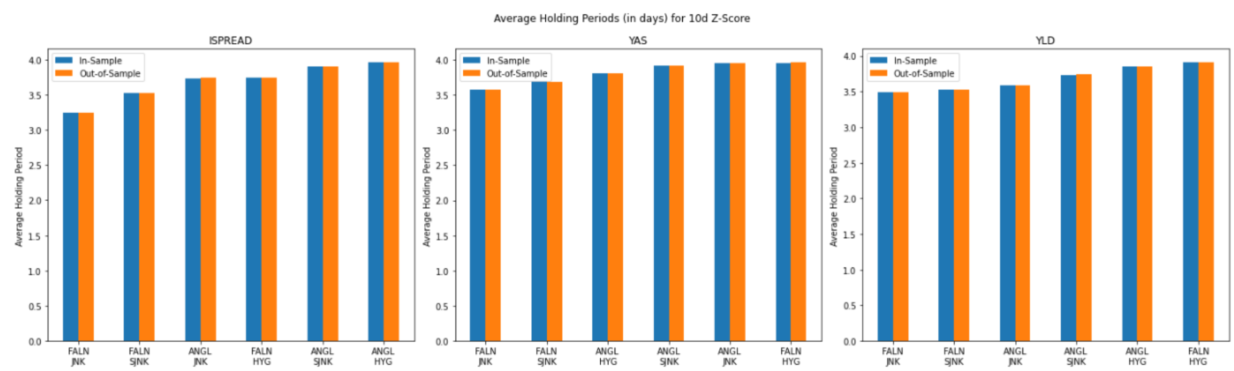
Next, measure the exposure of the portfolios to the underlying fixed income markets. To make the analysis relevant, regress the portfolio returns against LQD, AGG, ANGL, and JNK representing investment grade, the broader bond market, fallen angels, and high yield respectively. The daily regression shows little to no exposures with respect to βs and across-the-board positive α.



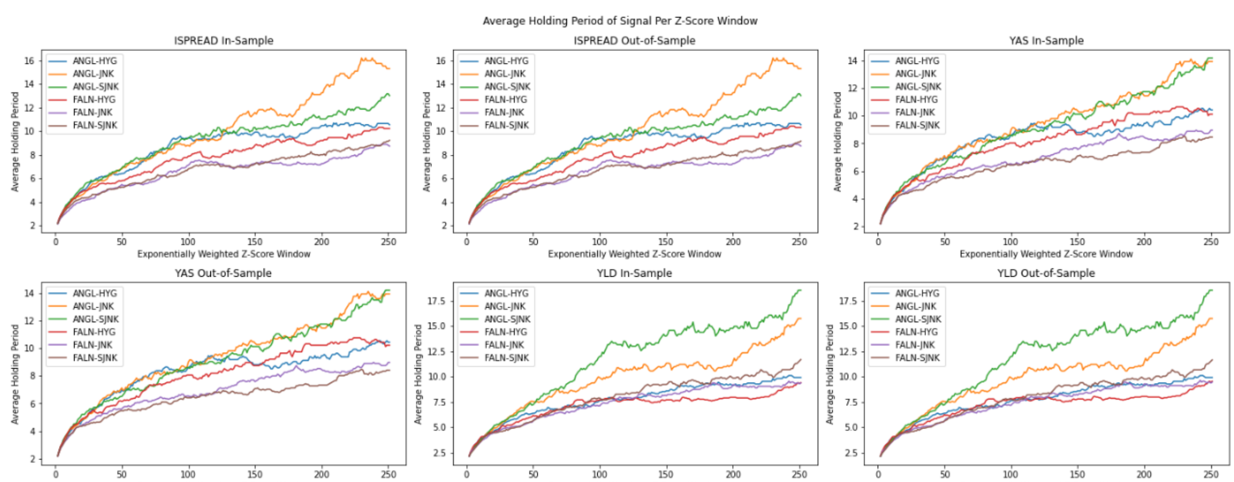
Running a regression on monthly returns reveals a different story. Regarding the βs it is clear that the portfolios show a strong positive loading to LQD, which is surprising given that the portfolio does contain any investment grade ETFs within it.

8.3 Holding Period & Signal Turnover

A key consideration for this model is signal turnover, which is directly proportional to transaction cost. Below is the average holding period for each pair (counting only trading days).



The signal turnover is about every 3 trading which is reasonable but more on the faster side. Below is a plot of the average holding period for each z-score window.



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