HW: Intermarket Prediction

February 13, 2025

In this HW we construct a 2-stage regression for predicting hedged CDS spread "returns" using boxcar and discounted least squares for the predictive phase, and compare the two.

1 Data

The class website contains 5 year CDS rates for debt from several companies over a multi-year range in `Liq5YCDS.delim`. Read this data, and load the corresponding adjusted close prices for the corresponding equity[1].

CDS spreads are not directly investable in the way equities are, but we can still learn a lot from treating them in ways similar to how we treat asset prices. In particular, just like equity prices, spreads are bounded below by zero and have no functional upper bound. Compute weekly Wednesday to Wednesday returns r^{Equity} on the adjusted equity close prices, and similar "returns" r^{CDS} on the CDS spreads. In addition, obtain "market equity returns" m as the weekly returns on adjusted prices of the SPY ETF.

2 Models

A *predictive* regression is aimed at predicting future behavior in some convenient way. For quantitative investment strategies, such a regression would typically be aimed at predicting asset returns. For predictive segments of the following analysis you will compare boxcar OLS window size G against exponentially decaying regression weights with half life H. Contemporaneous regressions should be boxcar OLS with window size $G \approx 10 - 30$.

Begin by forming a CDS "index return" r^{Index} as the arithmetic average of the r^{CDS}.

For each ticker $E = E_1, \ldots, E_N$, you will be working with both contemporaneous and predictive models for its "spread returns". The contemporaneous model is of the form

$$r_E^{\text{CDS}} \sim r_E^{\text{Equity}} + r^{\text{Index}} + \epsilon. \tag{1}$$

[1] Not all debt issuers *have* publicly traded equity. I have selected CDS rates from issuers that do.

Starting from the $K+1$st week of available returns, define weekly calibration data for contemporaneous returns as the returns from the K previous weeks, where in our case we tend to use use $K \approx G$.

Create one contemporaneous model of the (CAPM) form

$$r_E^{\text{Equity}} \sim m + \epsilon \tag{2}$$

using G week boxcar OLS and denote its weekly regression coefficients for the n-th data row as $\gamma_{E,n}$.

Also create a contemporaneous model[2] of the form

$$r_E^{\text{CDS}} \sim r_E^{\text{Equity}} + r^{\text{Index}} + \epsilon. \tag{3}$$

using G week boxcar OLS.

For the upcoming n-th data row, we attempt to predict its change in CDS spread *hedged by the contemporaneous predictors*. Define the *hedge portfolio return* as the returns on predictors in the contemporaneous model[3]

$$f_{E,n} = \beta_{E,\text{Equity}}^{(n)} r_{E,n}^{\text{Equity}} + \beta_{E,\text{Index}}^{(n)} r_n^{\text{Index}}. \tag{4}$$

As you see $f_{E,n}$ is just a prediction from our contemporaneous model for a single data row, so it is easy to obtain.

Now we will define the *residual return*[4] as the residual error in this prediction

$$\rho_{E,n} = r_{E,n}^{\text{CDS}} - f_{E,n}. \tag{5}$$

We also define residual equity return as

$$c_{E,n} = r_{E,n}^{\text{Equity}} - \gamma_{E,n} m_n \tag{6}$$

Once we have our data series of residual returns ρ for all equities and weeks, we will form predictive regression models in exponentially decaying and boxcar forms. Create new models of the form

$$\rho_{E,n} = c_{E,n-1} + \epsilon \tag{7}$$

that use the past week's equity return residual to predict novel changes (i.e. residuals) to CDS spread and call the regression coefficients $\mu_{E,n}$. The residuals of the predictive model itself are

$$q_{E,n} = \rho_{E,n} - \mu_{E,n} c_{E,n-1}. \tag{8}$$

[2] This is essentially the same as in your previous HW

[3] Remember that the β values depend on both the ticker and which data row n we are working with.

[4] Confusing fact: residual return is often also called "hedged return" which is dangerously similar-sounding to "hedge return".

3 Opportunity

Choosing a threshold j for predicted return size, or (your choice) a quantile trading percentage p, analyze the performance of a strategy that hedges CDS spread with equity, with the notional hedge ratio[5] set to δ.

For purposes of this exercise, you may assume CDS PL is linear in spreads, i.e. that the spreads represent some kind of total return series.

4 Analysis

Compare opportunities for a small variety of parameters decay H, boxcar G, j, p, and δ

[5] In real-live scenarios we take δ from some kind of analysis rather than crudely setting a constant.