Trading Financial Distress Using the Altman Z-Score

Gregory Colonescu, Adam Wilensky, Tiffany Yan

April 2023

Abstract

This study explores the relationship between bankruptcy risk and stock prices. The paper tests the hypothesis that financially distressed stocks should demand a higher risk discount due to the non-diversifiable credit risk that is not attributable to broader market risk. Results suggest that the Altman Z-score strategy yields a slightly positive alpha with a 95% confidence interval. Further testing is needed to determine the strategy's robustness across various market conditions.

Hypothesis

This paper discusses the hypothesis that the bankruptcy risk, measured by the Altman Z-score, should demand a higher risk discount than what is currently priced into the market (as in the current price should be lower given a fixed future value). Therefore, firms with high bankruptcy risk should have lower stock prices to reward investors bearing higher risk. On the flip side, firms with low bankruptcy risk should have higher stock prices.

Background Research

This section discusses three of the underlying reasonings for our hypothesis. First, it explains why equity returns are close to zero when a firm enters bankruptcy. Second, it explains the assumption that bankruptcy risk is an idiosyncratic risk. Third, it explains why the Altman Z-score is the adequate measure for predicting financial distress.

A firm would file for Chapter 11 if it is having trouble meeting its debt obligations. In these circumstances, it is possible that the value of the firm often drops to the point where the pre-petition equity claims are wiped out entirely (Moyer, Martin, Martin 2012). According to the absolute priority rule, firm shareholders will not recover anything until the creditors are paid in full. In a sample period from 1970 to 2016, the average shareholder recovery rate in bankruptcy scenarios was 7.1%, meaning their post-petition claims were worth only 7.1% of pre-petition claims (Kim 2019).

Existing academic literature suggests that the stocks of financially distressed companies tend to move in tandem with one another. The size of their debt service obligations are closely tied to interest rates, credit markets activity which influences refinancing, and prevailing restructuring and bankruptcy laws. As a result, this financial distress risk is not diversifiable, so investors should expect to be compensated with a premium for bearing that risk (Campbell, Hilscher, Szilagyi 2008).

This strategy uses the Altman Z-score, which measures the probability of financial distress, as the proxy for bankruptcy risk. The Altman Z-score was created using five ratio categories including liquidity, profitability, leverage, solvency, and activity. The model uses multiple discriminant analysis as the statistical technique. The formula for Altman Z-Score :

$$Z = 1.2X_1 + 1.4X_2 + 3.3X_3 + .6X_4 + 1.0X_5$$

$$X_1 = \frac{Working\ Capital}{Total\ Assets}, \quad X_2 = \frac{Retained\ Earnings}{Total\ Assets}, \quad X_3 = \frac{EBIT}{Total\ Assets}, \quad X_4 = \frac{MV\ Equity}{BV\ of\ Total\ Liabilities},$$

$$X_5 = \frac{Sales}{Total\ Assets}$$

The Altman Z-score has been widely used in predicting bankruptcy and assessing financial distress. Several studies have shown its effectiveness in various industries and across different time periods. However, it is essential to consider the model's limitations, such as its sensitivity to changes in the accounting practices and industry-specific factors. Moreover, the Z-score's predictive power may vary across countries with distinct legal and institutional frameworks. For this reason, the backtest in this paper is limited to domestic US equities. Originally, Altman focused on manufacturing firms; this paper seeks to quantify the results of the Z- score on all sectors.

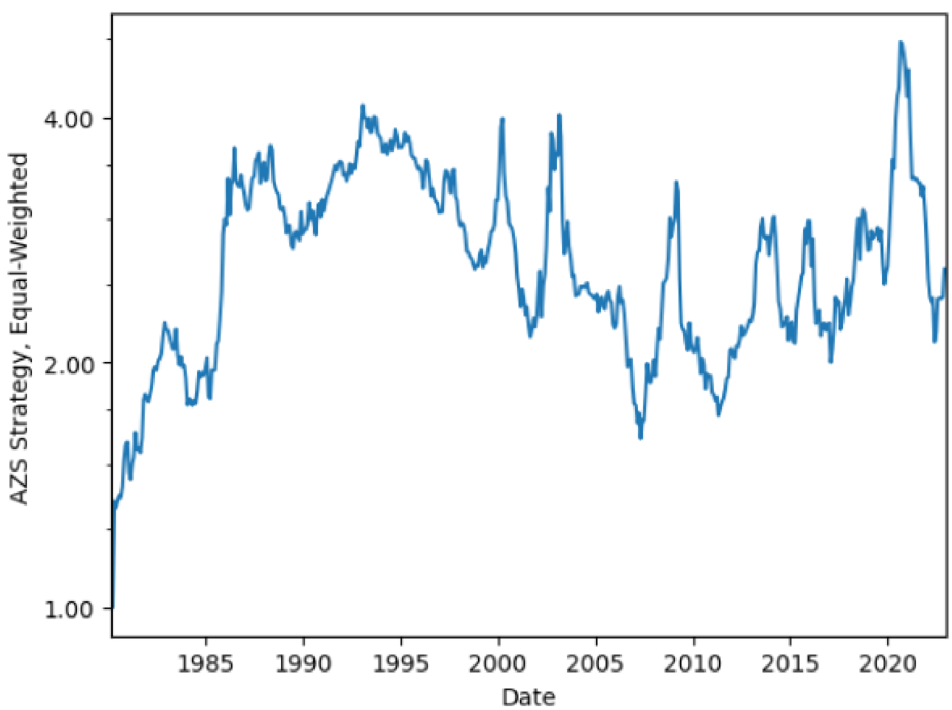
Strategy Details

The proposed strategy aims to back-test the Altman Z-score on monthly returns for all domestic equities to assess its performance. We then sort the Z-score, with Z-scores within the range of 0-1.8 being companies with higher probability of financial distress, and Z-scores above 2.99 being companies that are financially stable with a low risk of financial distress.

The trading rule involves selling the 10% of equities with the lowest Z-scores (highest financial distress risk) and purchasing the top 10% of equities with the highest Z-scores (lowest financial distress risk). This approach aims to capitalize on the premium earned by investing in low-risk, financially stable companies while avoiding potential losses associated with high-risk, financially distressed companies. The holding period for the strategy is 1 month, with the Z-score being updated at the end of each month. The strategy is equal-weighted.

Backtest Results

Graph of Strategy



** Cumulative performance of $1 -- equal weighted Z-Score strategy*

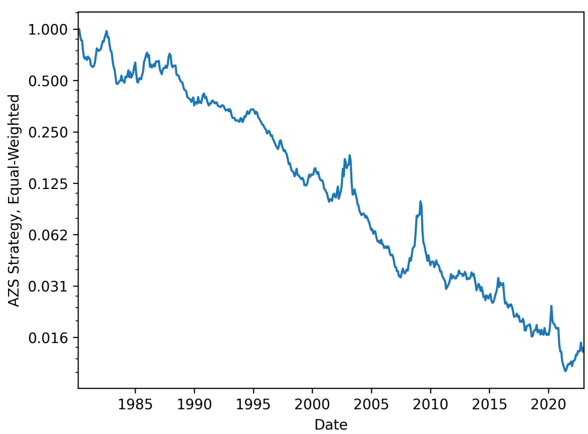
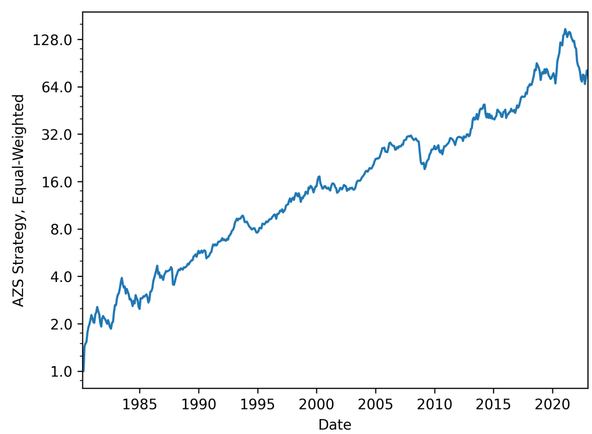
Summary stats of Z-score strategy

arith mean	0.330%
arith mean (ann)	3.955%
geomean mean	0.186%
geomean mean (ann)	2.255%
sigma	5.399%
sigma (ann)	18.702%
avg drawdown	26.986%
max drawdown	61.053%
alpha	0.400%
alpha SE	0.240%
alpha (ann)	4.799%
alpha SE (ann)	2.880%
alpha CI lower end	-0.847%
alpha CI upper end	10.445%
beta	-0.104
beta SE	0.052
beta CI lower end	-.206
beta CI upper end	-.002
Sharpe ratio	0.061
Sharpe ratio (ann)	0.211
information ratio	0.074
information ratio (ann)	0.257

Interpretation of Results

The results of this initial backtest show a slightly positive alpha with annualized mean return of ~ 4%. The 95% confidence interval of the annualized alpha is (-0.847%, 10.445%), which is not significant. In fact, the annualized alpha is only significant at the 90% confidence interval, where it is (0.061%, 9.537%). The 95% confidence interval of the beta is (-.206, -.002), which is significant.

Long and Short Breakdown

<table>
<tr><td>Short</td><td>Long</td></tr>
<tr><td>
</td><td>
</td></tr>
</table>

Summary Stats of Long vs Short

Short Side

arith mean	-0.656%
arith mean (ann)	-7.872%
geomean mean	-0.833%
geomean mean (ann)	-9.556%
sigma (ann)	20.584%
avg drawdown	76.714%
max drawdown	99.010%
alpha (ann)	-0.953%
alpha SE (ann)	2.407%
alpha CI lower end	-5.670%
alpha CI upper end	3.764%
beta	-0.853
betaSE	0.044
beta CI lower end	-0.938
beta CI upper end	-0.768
Sharpe ratio (ann)	-0.382
information ratio (ann)	-0.046

Long Side

arith mean	0.986%
arith mean (ann)	11.827%
geomean mean	0.848%
geomean mean (ann)	10.658%
sigma (ann)	5.336%
avg drawdown	18.486%
max drawdown	9.407%
alpha (ann)	55.232%
alpha SE (ann)	0.479%
alpha CI lower end	1.446%
alpha CI upper end	10.058%
beta	0.749
betaSE	0.040
beta CI lower end	0.671
beta CI upper end	0.827
Sharpe ratio (ann)	0.640
information ratio (ann)	0.311

The alpha from our strategy stems from the long side, which has an alpha of 5.75%, while the short side has a -.95% alpha, which doesn't mean much because the 95% confidence interval of (-5.670%, 3.764%) contains 0. This would show that bankruptcy risk is priced properly on a risk-adjusted basis, but **LACK** of bankruptcy risk is discounted.

Next Steps

Starting simple, we would look to implement a stop loss, incorporate transaction costs and bid-ask spreads, and look at other countries to see how the strategy performs. A rank weighted strategy might also be worth testing since it would line up with the original hypothesis that companies with higher bankruptcy risks are overpriced. Under the same idea, limiting or expanding the percentiles we're looking at could make sense as well, but this could fall in the territory of data mining. Finally, looking at other pieces of information to create a different portfolio could be helpful, either in terms of incorporating this in a multi-factor model to take out the value and size effects, or combining with SPY to create a beta neutral portfolio or maximize the Sharpe Ratio.

Bibliography

Campbell, John, et al. “In Search of Distress Risk.” *The Journal of Finance*, LXIII, no. 6, 2008, https://doi.org/10.3386/w12362.

Moyer, Stephen G., et al. “A Primer on Distressed Investing: Buying Companies by Acquiring Their Debt.” *Journal of Applied Corporate Finance*, vol. 24, no. 4, 2012, pp. 59–76., https://doi.org/10.1111/j.1745-6622.2012.00401.x.

Kim, Daniel. “Shareholder Recovery and Leverage.” *SSRN Electronic Journal*, 31 May 2019, https://doi.org/10.2139/ssrn.3288759.