Beating the Bond Market With No Skill

(with apologies to Roland Lochoff)

Dan diBartolomeo and Christopher Kantos

Northfield London Investment Seminar

November 2011

NORTHFIELD

Introduction

- At previous LQG events we have described an approach to combine equity factor risk models and structural models of credit risk to provide consistent measures of equity risk, default risk and default correlation.
  - The most important metric arising from this process is a “market implied” expected life of a firm. We employ this as a quantitative measure of the “sustainability” of firms
- In this presentation we will show how the a simple model using the expected life metric captured bankruptcy risk during the Global Financial Crisis and was predictive of subsequent credit rating changes and defaults
  - We will also show that a related simple portfolio strategy would resulted in significant alpha for US fixed income portfolios during the most stressful portion of the GFC

NORTHFIELD

Basic Contingent Claims Literature

- Merton (1974) poses the equity of a firm as a European call option on the firm's assets, with a strike price equal to the face value of the firm's debt
  - Alternatively, lenders are short a put on the firm assets
  - Default can occur only at debt maturity
- Black and Cox (1976) provide a "first passage" model
  - Default can occur before debt maturity
  - Firm extinction is assumed if asset values hit a boundary value (i.e. specified by bond covenants)
- Leland (1994) and Leland and Toft (1996)
  - Account for the tax deductibility of interest payments and costs of bankruptcy
  - Estimate boundary value as where equity value is maximized subject to bankruptcy

Reverse the Concept: Sustainability

- Instead of trying to estimate how likely it is that firm goes bankrupt, let's reverse the logic
- We will estimate the "market implied expected life" of firms using contingent claims analysis
  - Formally, our measure is the median of the expectation of the distribution of the life of the firm
  - Makes different default probabilities for different bond issues very natural as each maturity will lie at a different point in the survival time distribution
- Firms with no debt can now be included since it is possible that they get some debt in the future and default on that
- A quantitative measure of the fundamental and "social" concept of *sustainability*

NORTHFIELD

Our Basic Option Pricing Exercise

- Underlying is the firm's assets with asset volatility determined from the equity factor model
  - How volatile would a firm's stock be if the firm had no debt?
  - This is the volatility of the assets
- Solve numerically for the "implied expiration date" of the option that equates the option values to the stock price
  - *Market implied expected life of the firm*
  - See Yaksick (1998) for numerical methods for evaluating a perpetual American option
- Include a term structure of interest rates so that as the implied expiration date moves around, the interest rate changes appropriately

NORTHFIELD

Our Previously Published Research

- diBartolomeo, *Journal of Investing*, December 2010
- Used equity volatilities from Northfield US Fundamental Model
  - One year horizon for risk forecast
  - Near horizon" model are more suitable but less history available
- Estimate monthly for all firms in Northfield US equity universe from December 31, 1991 to March 31, 2010
- Study three samples:
  - All
  - Financial firms
  - Non-financial firms
- Sources of Time series variation
  - Stock prices, debt levels, Northfield risk forecasts
  - Mix of large and small firms, 4660 <= N <= 8309

NORTHFIELD

A Digression on “Too Big to Fail”

- For the full sample period of 1992 through March 31, 2010
- Non Financials:
  - Median 14.74, Cap Weighted 18.42
  - Revenue Weight 17.60
- Financials:
  - Median 22.28, Cap Weighted 17.06
  - Revenue Weighted, 7.86
- “Too Big to Fail” is really real
  - Risk taking is heavily concentrated in the largest financial firms
  - Risk taking has been concentrated in the largest financial firms for at least 20 years

NORTHFIELD

Analyzing Sovereign Debt

- Obviously, if the market thinks public companies are not going to be around very long, the economy is in a bad way
- Low equity valuations and high leverage equate to short life expectancy
  - Higher leverage can be sustained with higher growth rates that cause higher equity valuations
- We propose “revenue weighted” expected average life as a measure of systemic stress on an economy
  - By revenue weighting we capture the stress in the real economy
  - Avoids bias of cap weighting since failing firm’s have small market capitalization and don’t count as much
- Initial tests on sovereign debt are promising

NORTHFIELD

Quantifying “Sustainability”

- MSCI KLD DSI 400 index of US large cap firms considered socially responsible, 20 year history
  - Typically about 200 firms in common with the S&P 500
- July 31, 1995
  - DSI 400, Median 17, Average 17.91, Standard Deviation 9.93
  - S&P 500, Median 14, Average 15.40, Standard Deviation 9.28
  - Difference in Means is statistically significant at 95% level
- March 31, 2010
  - DSI 400, Median 30, Average 26.39, Standard Deviation 11.45
  - S&P 500, Median 30, Average 24.93, Standard Deviation, 10.92
  - Difference in Means is statistically significant at 90% but not 95%
- Testing on Disjoint Sets (DSI NOT S&P, S&P NOT DSI)
  - Statistically significant difference in means for every time period tested

NORTHFIELD

Results to "Sustainability" Equity Investing (1992 through March 2010)

Table 1[1]

	Mean Monthly Return	Cumulative Return	Monthly Standard Deviation	Annual Compound Return	Leveraged S&P Risk Equivalent Return
Q5 Equal	1.33	713.77	9.15	10.90	7.45
Q1 Equal	1.03	790.86	3.64	11.50	12.83
Q5 Cap	0.77	251.60	6.62	4.98	4.76
Q1 Cap	0.79	414.32	3.78	7.77	8.26
S&P 500[2]	0.75	347.74	4.32	6.78	6.78

NORTHFIELD

Combining Sustainability and MV (1992 through March 2010, 200 Max Positions)

	Mean Monthly	Cumulative	Monthly Standard Deviation	Annual Compound Return	Annual Sharpe Ratio
Q1 MV	1.07	840.43	2.96	12.34	.81
Q5 MV	1.77	2901.15	6.80	19.33	.71

NORTHFIELD

A Simple Start on Credit Ratings

- We combined rating levels from S&P, Moody's and Fitch into a unified letter scheme
- Each rating level was assigned a numerical value
  - A rating of "AAA" was 10 on the numeric scale
  - A rating of "D" (default) was 1 on the scale
  - Intermediate levels of AA,A,BBB,BB,B,CCC,CC,C
  - A "+" added .333
  - A "-" subtracted .333
- The scale is convenient but does not reflect any actual differences in probability of default (PD) or economic "loss given default" (LGD)

NORTHFIELD

Numeric Rating Values Based on Spreads

- As part of our normal fixed income analysis we estimate "option-adjusted spreads" for about 6 Million fixed income instruments on a monthly basis
- Measures the portion of bond yield not associated with time value of money. This is premium for credit risk and illiquidity
  - The median of the OAS values for set of the category members is used
  - Monthly history available to 2001
  - Bonds are broken into about 800 categories based on rating, geographic region of issue and sector
  - Computational model assumes lognormal interest rates and combines features from Fabozzi and Dattatreya (1989) and Black, Derman and Toy (1990).
- We can keep "AAA" ratings at 10, and "D" at 1 but rescale intermediate levels inversely proportional to OAS

NORTHFIELD

A Revised Numeric Scale From Spreads

60 Months Ending June 2011

Rating	Simple Numeric	OAS Spread BP	Spread Numeric
AAA	10	86	10
AA	9	89	9.96
A	8	107	9.73
BBB	7	149	9.20
BB	6	287	7.47
B	5	364	6.50
CCC	4	428	5.69
CC	3	455	5.35
C	2	494	4.86
D	1	801	1

NORTHFIELD

Criminal Abuse of a Temp

- We wanted a really clean history of US bond rating changes across all rating agencies
- We sent a temp (a classmate of co-presenter Chris Kantos) to the Boston Public Library to hand collect every rating change published in *Barrons* from 1992 to 2008
  - Information was hand entered into spreadsheets and then matched to issuers, in a partly automated , partly manual way
  - It took roughly **four months of tough full time effort**
  - There are roughly 8500 events in the data set and we have been able match about 6500 of those to entities with publicly traded equity
- The good news is that “Steve” was so good that he is now a very valued member of our Boston tech support staff

NORTHFIELD

Criminal Abuse Of An Intern

- Our summer intern was then left to do an “event study” type model of the rating changes for the subset of US corporate bonds
  - The big job is merging the “expected life” data derived from equities to issue level bond data
  - It sounds easy but it is really a mess to track the related equity across mergers, acquisitions and spin-offs
  - All data was standardized to make pooling across time easier
- Dependent variable was the percentage change in the “simple” numerical value of the credit rating
- Independent variables:
  - 12 month percentage change in expected life as of prior month end
  - 12 month change in the cross-sectional Z-score of expected life within the US equity universe
- *“Ethan” survived too*

NORTHFIELD

A Modest But Encouraging Result

- We converted all data to rank values within the pooled sample
- In-sample our model had a correlation of about 40% (R-squared = .16)
  - A very high degree of statistical significance on coefficients (T > 4)
  - R-squared was higher for subsets of lower grade bonds (i.e. NOT "A")
- Even with our simple model we could meaningfully predict subsequent changes in bond ratings
  - These results are all conditional that a change in rating would eventually take place since only such events existed in our data
  - Non-events (no rating change) were excluded from the sample by design
- **Perhaps our model would predict 14 of every 5 downgrades**

NORTHFIELD

Expanding Study to Full Data

- Universe is all US corporate bonds in the Northfield “Everything Everywhere” model
  - Typical size around 18,000 bond issues
- Study period from December 31, 2005 to June 30, 2011
- Minimum maturity one year
- Each bond is matched to contemporaneous expected life of issuer
  - Assignments are updated annually for mergers, acquisitions
- Return performance calculations exclude bonds with price outliers *at the start of the period*

NORTHFIELD

Things Go "Pear Shaped" In The GFC

- It should be intuitive that bonds with higher ratings should be associated with issuers with longer expected lives
  - Break all bonds into 20 rating categories (including "+" and "-")
  - Calculate average expected life for all bonds in each rating category
  - Correlate the average expected life and our simple numeric rating
- At 12/31/2005, the correlation across categories was +.68
  - Sample size of 17445 issues
- At 12/31/2007 (pre bailouts), the correlation was -.35
  - Sample size of 22069 issues
- By 12/31/2008, (post bailouts) the correlation was +.27
  - Sample size of 20043 issues

NORTHFIELD

A Simple Metric : Z Score of Expected Life Within Rating Category

- At each year end starting at 2005 we convert the expected life of issuer for each bond issue to a Z score within rating category
- *A negative Z score indicates that our metric suggests that the firm is less creditworthy than the published rating*
- Sort universe of 22000 bond issues into quintiles by Z score
- At 12/31/2006: Of the bottom quintile of 4400 bond issues, 2940 were from Wall Street firms that either went bankrupt, were acquired or needed major government assistance
- The rogues gallery included:
  - Bear Stearns (534 issues), Merrill Lynch (868), Lehman Brothers (657), Morgan Stanley (257), CIT Financial (338), Countrywide (136) and Washington Mutual (24)
- Nearly identical result for 12/31/2007

NORTHFIELD

Z-score Within Rating

January 2006 Through June 2011

NORTHFIELD

A Bit of Analysis

- US government intentions to mount the TARP bailout were announced on October 3, 2008 with most of the details filled in a couple weeks later.
- At October 31, 2008, the cumulative Q1/Q5 return spread was more than 1200 basis points in less than three years on widely diverse portfolios (1 bond from each issue).
- The cumulative return spread peaked in December 2008 and declined back to almost exactly zero by June 2011.
- *The implicit and explicit guarantees by the US Treasury and Federal Reserve had essentially driven the perceived creditworthiness of corporate bonds back to pre-GFC levels*

NORTHFIELD

Ongoing Research: Next Steps

- Revise all tests to use a OAS scaled numeric measure for changes in credit ratings
- Create a combined model with two additional factors
  - Year prior % change in numeric value of rating. There is a long literature on "sticky" values for appraisals of all kinds creating positive serial correlation
  - Expected life in excess of the bond maturity. We may not care that a company has an expected life of only 5 years if our bond is maturing in six months
  - Universe relative Z score for expected life minus the comparable Z score for the numeric value of the rating

NORTHFIELD

Conclusions

- Our model for the expected life of firms effectively combines equity factor risk models and contingent claims credit models in a unified framework
- Using expected life data as a metric for corporate credit risk allows for effective prediction of credit rating changes
- The expected life credit model correctly identified many firms at severe risk during the GFC
- We believe there is substantial alpha to be obtained from corporate bond portfolios by using expected life related metrics for credit risk

NORTHFIELD