

FINC 423
Advanced Corporate Finance
Fall 2020

Handout #26

Estimating Hypothetical Bond Ratings
(Revised)

Empirical Analysis of S&P Credit Ratings

In order to understand the effect of recapitalization on the Weighted-Average-Cost-of-Capital of a firm, we need some insight into the effect of a change in capital structure on the cost-of-debt financing. Here we will begin to develop a framework to understand this relationship.

I gathered all the data available on Compustat for firms with published bond ratings in the fiscal years 2012 through 2014. I also collected the accounting data for these companies. I will develop a model to see how well the accounting data explains the ratings of these bonds.

As the basis for the model I refer to a well-known paper by Blume, Lim and McKinlay published in the *Journal of Finance* in 1998. They argue that four variables do a reasonably good job of explaining bond ratings: [1] firm size, [2] the coverage ratio (times interest earned), [3] the total debt ratio, and [4] return on assets (ROA).

In order to execute a regression, I have to convert the ratings to numeric values. Because there are very few observations with ratings below B- I lump all of these together. The numeric conversions are shown in the table below. Notice the inverse relationship between the numeric scores and the letter bond ratings.

Numeric Conversion of Bond Ratings			
Rating	Numeric Scale	Rating	Numeric Scale
AAA	1	BBB-	10
AA+	2	BB+	11
AA	3	BB	12
AA-	4	BB-	13
A+	5	B+	14
A	6	B	15
A-	7	B-	16
BBB+	8	Below B-	17
BBB	9		

The Blume, Lim and McKinlay (BLM) model is specified as follows:

$$\text{RATING} = \alpha + \beta_1(\text{SIZELA}) + \beta_2(\text{COVER_BLM}) + \beta_3(\text{LEV B}) + \beta_4(\text{ROA}) + e$$

where RATING is the numeric value of the rating. SIZELA is the proxy for firm size, this is the natural logarithm of the book value of total assets (in \$M). COVER_BLM is based on the coverage ratio, which is defined as Operating Income After Depreciation divided by Interest Expenses. If this value is greater than ten, the value is set to ten, and if the value is less than zero (is negative) it is set to zero. LEVB is Total Debt divided by Total Assets, and ROA is Net Income divided by Total Assets.

The regression results are given below.

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*****
                                The SAS System                                38
                                10:46 Saturday, February 21, 2015

                                The REG Procedure
                                Model: MODEL1
                                Dependent Variable: RATING

                                Number of Observations Read      3243
                                Number of Observations Used      3243

                                Analysis of Variance

Source              DF          Sum of          Mean
                   Squares          Square    F Value    Pr > F

Model                4           24490        6122.57940    1535.34    <.0001
Error              3238           12912         3.98776
Corrected Total    3242           37403

                                Root MSE          1.99694    R-Square      0.6548
                                Dependent Mean    10.74838    Adj R-Sq     0.6543
                                Coeff Var        18.57896

                                Parameter Estimates

Variable            DF      Parameter      Standard
                   Estimate      Error    t Value    Pr > |t|

Intercept           1      22.73436      0.23210     97.95    <.0001
SIZELA              1      -1.15023      0.02410    -47.73    <.0001
COVERAD_BLM         1      -0.37576      0.01288    -29.17    <.0001
LEV B               1       0.30004      0.09652     3.11     0.0019
ROA                 1      -4.66973      0.58346     -8.00    <.0001
*****
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Note that the model is estimated using 3,243 observations. The r^2 is above 65%, so this specification explains almost two-thirds of the variability in bond ratings. All of the coefficient estimates have very high t-values. Thus, they are certainly significantly related with the ratings.

From these results the estimate of the rating can be written as

$$\text{RATING} = 22.73436 + -1.15023(\text{SIZELA}) + -0.37576(\text{COVER_BLM}) + 0.30004(\text{LEVB}) + -4.66973(\text{ROA})$$

Hypothetical Rating for Pfizer

As a test, I will see what the formula suggests Pfizer's bonds should be rated given its corporate structure on July 17, 2020. On this date, Pfizer's debt is rated AA- by S&P and A1 by Moody's. In this example I will use material that we gathered earlier in Handouts #4 and #18. I also include a table of yields on bond portfolios of different yields for that date. I append the relevant matter below.

From the Balance Sheet, Total Assets (Book Value) for Pfizer at the end of the 2019 fiscal year are \$167,489M. The units are very important here. Compustat presents Total Assets in millions of dollars, and that is what we must use in the BLM model, because my regression parameters are based on that assumption.

Total Debt is the sum of Long-Term Debt including the current portion and Notes Payable. For Pfizer in 2019, Notes Payable is \$14,734M, Current Portion is \$1,738M, Long-Term Debt is \$37,003M, so the total is \$53,475M.

Therefore, $\text{SIZELA} = \text{LN}(167,489) = 12.02867$

Also, the total debt ratio, $\text{LEVB} = 53,475 / 167,489 = 0.31927$

On the 2019 Income Statement for Pfizer net income is \$16,273M.

Therefore, $\text{ROA} = 16,273 / 167,489 = 0.09716$

Again, from the 2019 Income Statement, Operating Income After Depreciation is \$14,247M and Interest Expenses are \$1,662M.

Therefore, the Coverage Ratio $= 14,247 / 1,662 = 8.5722$.

Since this number is between ten and zero, I do not have to adjust it according to Blume, Lim and McKinlays' method. Be very careful to check if your firm's Coverage Ratio is greater than ten.

So, the theoretical bond rating for Pfizer is

$$\begin{aligned}\text{RATING} &= 22.73436 + -1.15023(12.02867) + -0.37576(8.57220) + \\ &0.30004(0.31927) + -4.66973(0.09716) = 5.31926\end{aligned}$$

In the table on the first page a numerical score of five corresponds to an A+ rated bond. Pfizer's debt is rated A1 by Moody's and AA- by S&P So, in this case the model does a pretty good job of explaining Pfizer's current credit ratings. You may not be so lucky!

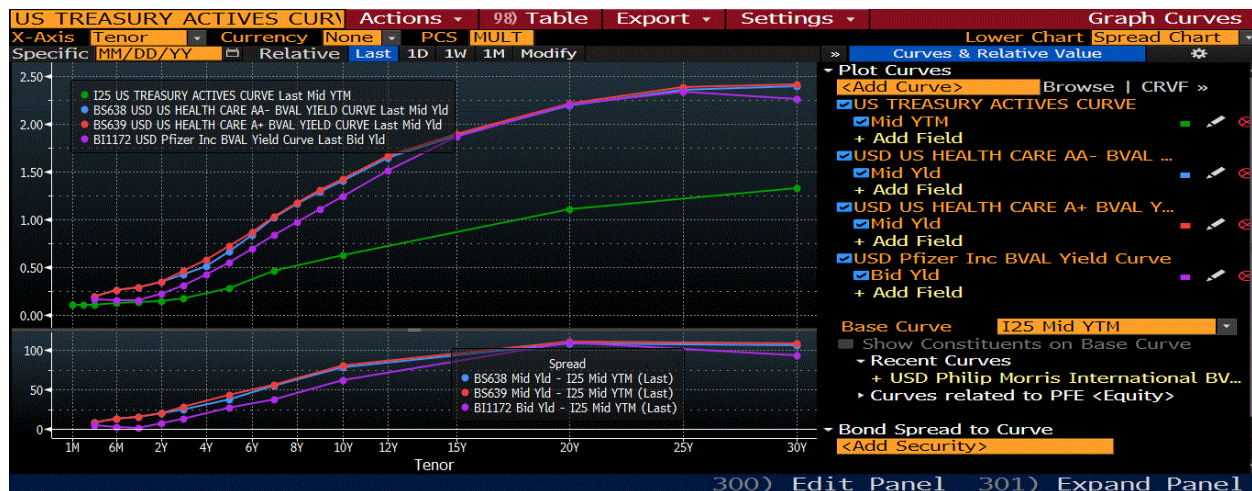
Also, recall that in 2019, Pfizer reported a large negative-valued special. Therefore, in Handout #18, I also create a hypothetical income statement removing the Special Item.

	<i>Actual</i>	<i>Base</i>
Sales	51,750	51,750
COGS & SGA	31,493	31,495
EBITDA	20,257	20,255
Depreciation	6,010	6,008
EBIT	14,247	14,247
Interest Expenses	1,662	1,662
Non Operating		
Income	(878)	(878)
Special Items	5,975	
EBT	17,682	11,707
Taxes	1,384	1,171
Net Income	16,273	10,536

Would it make a difference if I estimated the credit rating based on these parameters? Of course, the rating will be slightly lower. Notice the Firm Size, Financial Leverage Ratio, and Coverage Ratio are all unchanged. But, the ROA would be quite a bit lower, 6.291% (10,536/167,489) instead of 9.716%.

If I plug this into the BLM model I get a result of 5.47597, as expected, a little lower rating than the earlier estimate of 5.31926, but not really substantially different. This would suggest a rating between A+ and A.

Let's see how Pfizer does in the market. I compare Pfizer to portfolios of A+ and AA- rated bonds issued by firms in the Health Care sector using the CRVF function in Bloomberg on July 17, 2020).



There are four curves in this graph. The Green line is the Treasury Yield Curve. The Purple line is for Pfizer. The Red line is for A+ rated Health Care bonds. The Blue line is for AA+ rated Health Care bonds.

Clearly, Pfizer is borrowing at rates very similar to health care firms with similar ratings. In some portions of the curve (notably around ten years to maturity), Pfizer is borrowing at lower rates than other Health Care firms with similar ratings.

Health Care firms seem a good match for Pfizer. But, recall that the Bloomberg Terminal also provides information on portfolios of bonds in many other sectors (Industrials, Corporate, Composite, Communications, Consumer Discretionary, Consumer Staples, Energy, Financials, Health Care, Technology and Utilities). Think about which sector (or sectors) might be a good match for your firm.

Estimating the Hypothetical Rating for Pfizer at a New Capital Structure

Ultimately, we want to have some notion of how a change in a firm's capital structure will affect Pfizer's bond rating, and hence its required return on debt.

We can use the work that we did on Pfizer in Handout #18 as a basis for such an analysis.

Consider page 3 in Handout #18, where we estimate a new balance sheet for the firm. On page 7 we approximate a new income statement, assuming that the firm will issue ten-year bonds, and our initial presumption is that will have to pay 1.29% on these instruments.

The book-value of assets remains at \$167,489M, and the logarithm of this amount (SIZE_{LA}) is still 12.02867. The book-value of debt is now \$92,216M. So, the debt-to-asset ratio is 0.55058 (92,216 / 167,489.). On the income statement, we now assume that net income will be about \$10,086 (based on no special items and a 10% tax rate), therefore, ROA = 0.06022 (10,086 / 167,489). Operating income is still \$14,247M, but our new estimate of interest obligations is \$2,162M. Therefore, the coverage ratio is 6.58973.

We can now plug these new values into our BLM regression model.

$$\begin{aligned} \text{RATING} = & 22.73436 + -1.15023(\text{SIZE}_{LA}) + -0.37576(\text{COVER_BLM}) + \\ & 0.30004(\text{LEV}_B) + -4.66973(\text{ROA}) \end{aligned}$$

Then, substituting:

$$\begin{aligned} \text{RATING} = & 22.73436 + -1.15023(12.02867) + -0.37576(6.58973) + \\ & 0.30004(0.55058) + -4.66973(0.06022) = 6.30645 \end{aligned}$$

As expected, the rating score has increased, from the previous (comparable) value of 5.47957. This suggests a lower rating by about one notch. So, we might expect the rating of AA-/A+ to fall to A+/A. It seems very, very unlikely that the rating could fall into the BBB+ range.

What Will Happen to the Credit Rating and Cost-of-Debt for Pfizer if They Recapitalize?

So, what will happen if Pfizer recapitalizes?

On the next page, I provide selected data on the bond portfolios for the Health Care firms from July 17, 2020 using the CMX function on the Bloomberg Terminal. I only collect data for the bond portfolios rated A- and higher, because I doubt Pfizer's rating could fall lower than that.

On that day, Pfizer's 10-year bonds carried a yield of 1.29%. That is a about 9 to 14 basis points lower than the yields for the AA- and A+ 10-year portfolios, which bear yields of 1.408% and 1.428% respectively. Note, that the A+ bonds yield about 2 basis points higher than the AA-.

Therefore, we might surmise that if Pfizer's rating drops one notch, the rate on their 10-year bonds might rise by less than 5 basis points; somewhere between 1.30% to 1.35%..

What, if things got a little worse? The yield on the 10-year portfolios for A and A- Health Care bonds are 1.478% and 1.498% respectively. These are about 8 to 10 basis points below on the A+ bonds.

Therefore, my best guess is that the rate on the 10-year bonds for Pfizer might increase be 10 basis points, from about 1.30% to, say, 1.40%.

I would think that in the worst-case scenario, where the rating falls to A/A-, the rate might increase by up to 15 basis points, in the neighborhood of 1.45%.

Of course, any fall in rating will also affect the yield (and prevailing price) of Pfizer's already outstanding bonds.

When estimating WACC in Handout #4, I also calculated the Pfizer's long-term debt had a weighted-average time-to-maturity of about 14 years, and the weighted-average yield on the bonds was about 1.48%.

The portfolios of Health care bonds with maturities of 15 years and rated AA-, A+, A and A- bear yields of 1.887%, 1.898%, 1.968% and 1.988%. Notice that Pfizer's overall rate is quite a bit lower than these. Given, the data above, if the rating falls one notch, you might surmise that the yield might rise from 1 (1.887% to 1.898%) to 9 basis points (1.887% to about 1.98%).

So, I might guess somewhere between 1.50% and 1.60%.

Again, there is little reason to think that Pfizer's rating could fall below A- (the worst possible case). Rates are very low now, and Yield Curve is reasonably flat. So, the effects of the changing ratings are not dramatic.

Bloomberg Data
BVAL Yield Curves (CMX)
Average Yields on U.S. Health Care Bonds of Various Ratings and Maturities

7/17/2020

Health Care Bond Portfolio Returns by Rating

	<i>T-Bonds</i>	<i>AAA</i>	<i>AA+</i>	<i>AA</i>	<i>AA-</i>	<i>A+</i>	<i>A</i>	<i>A-</i>
<i>3 Month</i>	0.112	0.196	0.196	0.196	0.196	0.196	0.256	0.283
<i>6 Month</i>	0.130	0.258	0.259	0.260	0.260	0.260	0.313	0.320
<i>1 Year</i>	0.140	0.265	0.294	0.295	0.295	0.295	0.355	0.355
<i>2 Year</i>	0.146	0.286	0.343	0.352	0.352	0.352	0.416	0.416
<i>3 Year</i>	0.180	0.340	0.412	0.428	0.428	0.463	0.525	0.525
<i>5 Year</i>	0.284	0.568	0.661	0.661	0.661	0.718	0.789	0.789
<i>7 Year</i>	0.470	0.897	0.996	1.009	1.017	1.025	1.092	1.100
<i>10 Year</i>	0.627	1.279	1.368	1.388	1.408	1.428	1.478	1.498
<i>15 Year</i>		1.731	1.833	1.853	1.887	1.898	1.968	1.988
<i>30 Year</i>	1.329	2.216	2.348	2.372	2.392	2.412	2.432	2.453