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Applying Altman's Z-Score in the Classroom

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Altman's Z-score is introduced in an Excel framework to produce a quick calculation of the Z-score with actual financial data available through the Internet. The lesson plan developed is easily introduced with topics covering ratio analysis, financial risk, bond rating changes, and bankruptcy. Given the wide use of the Z-score in practice to evaluate credit risk (or bankruptcy risk), the lesson plan produces a skill set that is very marketable.

INTRODUCTION

Altman's Z-score (1968) appears frequently in practitioner publications, but tends not to enter the undergraduate finance curriculum unless the topic of bankruptcy is discussed. This seems rather odd given that the Z-score is a linear equation composed of five ratios and legitimately controls many of the risks discussed in corporate finance. By adding the Z-score to a discussion of risk or even incorporating the Z-score within ratio analysis, a richer context emerges for a discussion of risk at the corporate and investor levels. The goal of this paper is to provide a mechanism for incorporating the Z-score into the undergraduate curriculum, perhaps, even at the introductory level.

In section one, the Z-score is defined and an Excel template is developed to calculate the Z-score. In section two, financial data available from the Internet is applied to the calculator to allow the student to compute actual Z-scores for firms. Section three concludes the paper with teaching suggestions for the instructor.

DEFINING THE Z-SCORE

As mentioned in above, the Z-score is a linear equation composed of five ratios:

$$Z = 1.200 \times X_1 + 1.400 \times X_2 + 3.300 \times X_3 + 0.600 \times X_4 + 0.999 \times X_5 \qquad (1)$$

where: X_1 = working capital ÷ total assets
X_2 = retained earnings ÷ total assets
X_3 = (earnings before interest and taxes) ÷ total assets
X_4 = (stock price * outstanding shares) ÷ total liabilities
X_5 = Sales ÷ total assets

Note: working capital = current assets less current liabilities

There are some very minor discrepancies (see Altman (2000) for a discussion) when comparing different sources for the coefficient values for the Z-score. This particular version of the calculation is taken from the March 18, 2002 issue of *Dow Theory Forecasts*.

The component ratios of the Z-score are not very distant from the traditional ratio analysis one sees in introductory finance courses. Viewing Chapter 3 of the Ross, Westerfield, and Jordan (2006) corporate finance text, X_1 and X_5 are identified specifically as a liquidity ratio and as an asset utilization ratio respectively. X_2 and X_3 are reasonably close approximations of the equity ratio (or the inverse of the equity multiplier) and the return on assets respectively. The only ratio that does not appear even in an approximate fashion is X_4. However, the components of X_4 are incorporated into other ratios. Consequently, the calculation of the Z-score is not beyond the capabilities of an introductory finance student. In fact, the calculation readily fits into an Excel spreadsheet (see Figure 1).

Assuming the firm is a publicly traded manufacturing firm and using the March 18, 2002 *Dow Theory Forecasts* issue as the source material: financially sound firms have a Z-score above 2.99, firms with a deteriorating financial future have a Z-score between 1.81 and 2.99, and potentially insolvent firms (i.e. a high probability of bankruptcy in the near future) have a Z-score below 1.81. These "breakpoints" are consistent with the original work of Altman (1968) in which the model was generated and tested with actual data. Altman found that firms with Z-scores above 2.99 were always solvent according to the data (66 firms, a large sample given the time) and firms with Z-scores below 1.81 were always insolvent according to the data. Altman refers to the range between 1.81 and 2.99 as the "zone of ignorance" or "gray area" because one could not conclusively demonstrate that the given firm would survive or not. Depending on the source material for the Z-score, other "breakpoints" may be defined and reinterpreted for non-manufacturing publicly traded firms or privately held firms (these were not examined in the original Altman paper). However, for the purpose of simply introducing the Z-score, the original breakpoints of 2.99 and 1.81 will suffice.

What is the Z-score measuring? It is more than simply an assessment of bankruptcy potential. When viewing the component ratios, many of the critical issues/risks faced by the corporation that are assessed by traditional ratio analysis are revealed:

- Liquidity issues are measured in X_1
- Shareholder claims against assets are measured in X_2 (low for a highly levered firm)
- Profitability is measured in X_3
- Shareholder confidence (indicated by stock price) relative to debt is measured in X_4 (low for an overly levered firm)
- Asset utilization is measured in X_5

Each one of these issues/risks can potentially create significant problems (liquidity

Figure 1. Z-Score Calculator in Excel (Cell Formulas in Bold-Italic)

	A	B	C
1	Data Inputs:		
2	Current Assets:	$ 1,000,000	
3	Total Assets:	$ 4,000,000	
4	Current Liabilities:	$ 900,000	
5	Total Liabilities:	$ 2,000,000	
6	Retained Earnings:	$ 1,500,000	
7	Sales:	$ 1,200,000	
8	EBIT*:	$ 240,000	
9	Share Price:	$ 6.36	
10	Shares Outstanding:	500,000	
11			
12	Component Ratios:		Coefficients:
13	X1:	*0.025 = (B2 - B4) / B3*	1.200
14	X2:	*0.375 = B6 / B3*	1.400
15	X3:	*0.060 = B8 / B3*	3.300
16	X4:	*1.590 = B9 * B10 / B5*	0.600
17	X5:	*0.300 = B7 / B3*	0.999
18			
19	Z-Score:	*2.007 =SUMPRODUCT(B13:B17,C13:C17)*	

*EBIT = Earnings Before Interest and Taxes = Revenues less Operating Expenses less Depreciation

problems, operational problems, leverage problems, etc.) for the firm and can be analyzed more extensively individually. In essence, the Z-score is a summary statistic of these issues/risks that can be decomposed in a manner similar to DuPont analysis. However, the Z-score examines much more than DuPont analysis and is used in one form or another in practice to assess credit/bankruptcy risk (again, see Altman (2000)) or can be used as a predictor for a change in a firm's bond rating (Altman and Rijken (2004)). Ultimately, introducing the Z-score in the classroom, even at the introductory level, provides students with a marketable skill and allows for a transition into many different topics involving risk at the corporate level.

APPLYING ACTUAL DATA

The Internet provides a number of websites for downloading financial data. Assessing one website versus another generally reveals more about preferences than about data validity. Consequently, the instructor should feel free to choose where the data is to be found on the internet or in print. However, it is suggested to rely more on

universally attainable data rather than specialized databases which must be purchased. In this exercise, Yahoo-Finance (finance.yahoo.com) is used and then compared to what is available at the Security and Exchange Commission's website (www.sec.gov). Comparing the two sites is important because different financial websites (such as Yahoo-Finance) will choose to display/summarize the information contained in the SEC filings (the primary source for financial information) differently.

Entering the ticker symbol "F" for Ford Motor Company, initially reveals recent trading activity in the stock (Ford is chosen due to a recent downgrade in its bond rating). Scrolling down the menu on the left, financial information is available (Income Statement, Balance Sheet, and Cash Flow Statement). The Income Statement, the Balance Sheet, and the market capitalization (outstanding shares * share price) provide all the necessary information for the Z-score. In this exercise, the most recent annual data will be used for the Z-score (from the 10-K filing in December of 2004), however, one can choose to use quarterly data (from the 10-Q filings; note: quarterly income statement information will need to be annualized in some manner, we suggest combining it with the three previous quarters to produce a full year of business). It should be noted that the financial information is not always recent and that the most recent information is available from the SEC website. Figure 2 provides the Z-score for Ford Motor Company based on the 2004 10-K filing and stock price information for December 31, 2004 (Note: Yahoo-Finance also has historical closing prices available for download into Excel).

According to the Z-score, Ford Motor Company is in serious financial trouble. The stock market recognizes this as Ford's stock price declined steadily throughout the beginning of the second quarter of 2005 to approximately $10.00 a share. However, this is only one data point and does not necessarily mean Ford will collapse in the near future. Yet, one cannot ignore the large amount of liability on Ford's balance sheet. The debt ratio is close to 95% and indicates that something must be done. It is at this point that an instructor can transition back into ratio analysis to examine the leverage and liquidity issues at Ford or even take advantage of using the analyst opinions also available at Yahoo-Finance. Students can also be directed to numerous articles discussing the bond rating downgrade of Ford (and General Motors) from mid-May, 2005.

To compare the financial information with the actual 10-K filing, one can go directly to the SEC filings via www.sec.gov or go through Yahoo-Finance under the "SEC filings" section contained in the "Company" section. The SEC database of filings is named "EDGAR" or "EDGAR On-line." The student should become familiar with the term "EDGAR" as it is quickly becoming part of the finance lexicon. When viewing the actual 10-K filing (not the summary), the student notices that it is an extensive document with more than financial information (for comparison, a 10-Q filing is generally much shorter). When viewing the consolidated income statement (not to be confused with the sector income statement), one should point out that the Earnings Before Interest and Taxes (EBIT) is not a calculation supplied by Ford. EBIT can be found by adding the Interest Expense ($7,071 million) to the Earnings Before Taxes calculation ($4,853 million).

Figure 2. Z-Score Calculator in Excel for Ford Motor Company (12/31/2004)

	A	B	C
1	Data Inputs:		
2	Current Assets:	$ 49,414,000	
3	Total Assets:	$ 292,654,000	
4	Current Liabilities:	$ 52,676,000	
5	Total Liabilities:	$ 276,609,000	
6	Retained Earnings:	$ 11,175,000	
7	Sales:	$ 171,652,000	
8	EBIT*:	$ 11,924,000	
9	Share Price:	$ 14.75	
10	Shares Outstanding**:	1,837,000	
11			
12	Component Ratios:		Coefficients:
13	X1:	-0.011	1.200
14	X2:	0.038	1.400
15	X3:	0.041	3.300
16	X4:	0.098	0.600
17	X5:	0.587	0.999
18			
19	Z-Score:	0.819	

*EBIT=Earnings Before Interest and Taxes=Revenues less Operating Expenses less Depreciation
** The shares outstanding can be found in the actual 10-K filing available from the SEC (where this number is obtained). However, Yahoo-Finance does report a market capitalization figure in the "Summary" section under "Quotes". To find the shares outstanding, take the market capitalization number and divide it by the closing price that is also reported in the "Summary" section.
Note: all figures are in thousands.

Upon examination of the consolidated balance sheet, one should notice that there are no summary accounts for current assets and current liabilities. How does Yahoo-Finance assess these values? Current assets include cash ($23,511 million), all receivables ($5,971 million + $9,166 million; categorized as "other receivables" and "retained interest in sold receivables"), and inventory ($10,766 million) according to the Yahoo-Finance calculation. However, marketable securities are not included which can be debated as to being or not being appropriate. Current liabilities are the sum of "payables" ($21,489 million) and "accrued liabilities" ($31,187 million).

Other potential points of comparison are also available (e.g. Class B shares are not included in the market capitalization), but these examples already illustrate the point: the manner in which the data is summarized or assimilated varies with the source. Consequently, it is always useful to go back to the primary source of the information, the filings with the SEC. Further, the student should also notice the extensive use of "Notes"

in the 10-K filing. Often, the "Notes" contain more specific information regarding stock options, the sale of receivables, etcetera and can be more informative than the actual financial statements.

CONCLUSION

The Z-score calculation is not beyond the abilities of an undergraduate student, even at the introductory level, and is an area of analysis that is used extensively in practice. Consequently, introducing the Z-score in the classroom provides students with a very marketable and pragmatic skill.

The Z-score can be introduced simply as a means of providing a summary statistic for its composition ratios. In this guise, without much additional lecture time, the Z-score fits in well with standard ratio analysis lectures. The Excel calculator can be provided to the student or the student can design a similar calculator as an assignment.

An expanded lecture can discuss bankruptcy and insolvency in regard to the Z-score (this is the traditional Z-score setting) or even discuss recent academic research in regard to bond rating changes. By using Yahoo-Finance and SEC filings, assignments or lecture material are very easy to generate. Should students become more intrigued with the prospect of bankruptcy, books, such as the *Comic Wars* (tells the story of the Marvel Comics bankruptcy; 2002), provide interesting reading without undo analysis.

Overall, the introduction of the Z-score into the finance classroom beyond the context of bankruptcy provides a richer context in which to discuss the risks that corporations face. It is also a very good tool for assessing investment decisions, given that the Z-score can be computed readily from actual data. Finally, as demonstrated in the paper, an Excel application as well as an introduction into acquiring (and assessing) financial data from Internet sources also benefits the student by improving the student's technical skills.

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