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Financial Ratios: Use, Predictive Power and the Z-Score

A fundamental step in the valuation process is the collection and analysis of a company's historical financial statements. Historical data analysis helps a valuator develop an understanding and profile of a subject business—positive and negative trends, strengths and weaknesses, investment attributes, quality of management, risks, and other factors that might impact a company's future performance. An integral part of this fundamental step is financial ratio analysis, an analytical technique employed to help measure the viability of a subject business. The purpose of this article is to discuss the use and predictive power of financial ratios. This article also serves to revive Altman's Discriminate Function Z, informally known as the Z-score, as a viable current day valuation

tool. Finally, this article serves to encourage caution in the use and reliance of financial ratios.

What Is A Financial Ratio?

In a formal setting (deposition or trial), we might describe financial ratios as "quantitative indicators of a firm's financial strengths and weaknesses." In a less formal setting, we might describe a financial ratio as a "fraction" expressing the relationship between two items. As a fraction, ratios have numerators and denominators. Ratios can be expressed as fractions, decimals, percentages or relationships. For example, a ratio of 2/1 can be expressed as 2.00, 200%, 2 to 1, or 2:1. Importantly, two conditions must exist for ratios to be useful in financial analysis: (1) the ratio must be

meaningful—a significant comparison, and (2) there must be a standard of comparison—is the ratio good or bad?

Financial ratio analysis allows for a large number of items in financial statements to be reduced to a limited number of ratios. No single ratio provides enough information to adequately develop a complete understanding of the financial condition or performance of a business. However, each ratio can be useful in identifying specific strengths and weaknesses that contribute to a firm's overall financial viability. Financial ratios are generally grouped into five types: liquidity, leverage, activity, profitability, and growth. Each type has a purpose or use that determines the relationships emphasized. Financial ratios commonly employed by valuation analysts, by type and purpose, are summarized in Table 1.

Table 1. Summary of Financial Ratios

Type of Ratio	Purpose of Ratio	Individual Ratio	
Liquidity	To measure a firm's ability to meet its maturing short-term obligations.	Current Ratio Quick Ratio Working Capital	
Leverage	To measure the extent to which a firm has been financed by debt.	Debt Ratio Interest Coverage	
Activity	To measure how effectively a firm is using its resources.	Inventory T/O Acc. Rec. T/O Asset TO	
Profitability	To measure management's overall effectiveness as shown by returns generated by sales.	Gross Margin Operating Profit Margin Return on Total Assets Return on Net Worth	
Growth	To measure a firm's ability to maintain its economic position relative to the growth of the economy and the industry.	Sales Net Income EPS	Dividends PS Market Price Book Value

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Ratio Comparisons

A meaningful ratio analysis requires both internal and external comparisons. An internal comparison involves comparing current day (valuation period) ratios with past or expected future ratios for the same company. Internal comparisons allow us to study the change (or expected change) in the financial condition and performance of a subject business over a period of years. External comparisons involve comparing the ratios of a subject business with those of similar businesses within an industry (or industry averages). Such comparisons provide insight into *relative* performance and financial standing. Sources commonly used by valuation analysts are summarized in Table 2.

Predictive Power and the Z-Score

As professionals, our reliance on financial ratios is determined by both our subjective beliefs and empirical studies. Subjective beliefs are determined by our respective experiences and will always be different. Empirical studies demonstrate research based on observed and measured phenomena rather than from theory or belief. A number of empirical studies have tested the predictive power of financial ratios using statistical techniques. The most renowned of these is Edward Altman's Discriminate Function Z, informally known as the Z-score.

What is Altman's Z-Score?

Developed in 1968,³ Altman's predictive model (Z-score) served to enhance the viability of financial ratio analysis as an analytical technique in assessing the performance of a business. Altman hypothesized that a meaningful (bankruptcy) prediction model could be developed by objectively selecting and weighting significant financial ratios. Employing a multiple discriminate analysis (MDA) statistical technique, Altman evaluated 22 different financial ratios using a database of 66 *publicly traded manufacturing* firms. Altman's research concluded that by combining five balance sheet and performance ratios, weighted by established coefficients that account for their relative importance, one could

Table 2. Financial Ratio References

Title	Scope	Types of Ratios
Dunn and Bradstreet <i>Industry Norms and Key Business Ratios</i>	Industry-wide: Over 800 different business activities as defined by SIC ¹ codes. Compilations are derived from credit reports from more than 400,000 public and private entities in all size ranges.	14 ratios including liquidity, leverage, profitability, and activity ratios.
The Risk Management Association ² (RMA) <i>Annual Statement Studies</i>	Industry-wide: Over 600 different business activities compiled from more than 150,000 statements provided by member institutions.	17 ratios including liquidity, leverage, profitability, and activity ratios.
Troy's <i>Almanac of Business and Industrial Financial Ratios</i>	Industry-wide: Over 164 business activities in 16 industries. Data is derived from IRS annual statistics.	10 ratios including liquidity, activity, and profitability.
Financial Research Associates (FRA) <i>Financial Studies of the Small Business</i>	Industry-wide: Companies with capitalization of \$1 million and under. Over 50 business activities in 6 industries. Data provided by CPAs nationwide.	16 ratios including liquidity, leverage, profitability, and activity ratios.
Schonfeld & Associates, Inc. <i>IRS Corporate Financial Ratios</i>	Industry-wide: Compiled from IRS corporate income tax returns. Over 250 NAICS industries reported.	76 ratios including liquidity, leverage, profitability, and activity ratios.

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discriminate or identify financially distressed companies. Altman’s final discriminate function is presented in Table 3.

Table 3. Altman’s Z-Score – Publicly Traded Manufacturing Firms

$$Z = 1.2(X1) + 1.4(X2) + 3.3(X3) + .6(X4) + .999(X5)$$

X1 = Working Capital / Total Assets
 X2 = Retained Earnings / Total Assets
 X3 = Earnings before Interest and Taxes / Total Assets
 X4 = Market Value Equity / Book Value of Total Debt
 X5 = Sales / Total Assets
 Z = Overall Index

Altman’s conventional model (above) was modified⁴ for use by privately held firms (Table 4) and non-manufacturing firms (Table 5) to correct for potential shortcomings.

Table 4. Altman’s Z-Score – Privately Held Firms

$$Z = .717(X1) + .847(X2) + 3.107(X3) + .420(X4) + .998 (X5)$$

Table 5. Altman’s Z-Score – Non-Manufacturing Firms

$$Z = 6.65(X1) + 3.26(X2) + 6.72(X3) + 1.05(X4)$$

In privately held firms, stock is not publicly traded and, therefore, X4 (market value of equity / book value of debt) cannot be calculated. Altman modified his model accordingly, employing book value of equity (X4) with less importance. In non-manufacturing firms, X5 (sales / total assets) can vary significantly from industry to industry and therein has little or no value. Altman modified his model accordingly, eliminating X5 for non-manufacturing firms.

Given that the Z-score is the overall index of the multiple discriminate function, Altman established cut-off points or boundaries to enable predictions without advanced computer analysis. Altman’s cutoffs are summarized in Table 6.

Table 6. Altman’s Predetermined Cutoffs

Prediction	Publicly Traded Manufacturing	Privately Held Manufacturing	Non-Manufacturing Firm
Bankrupt	< 1.81	< 1.23	< 1.1
Zone of Ignorance	1.81 to 2.99	1.23 to 2.90	1.1 to 2.6
Non bankrupt	> 2.99	> 2.90	> 2.6

Altman concluded for example, that publicly traded manufacturing firms with Z-scores below 1.81 always went bankrupt, whereas Z-scores above 2.99 represented healthy firms. Firms with Z-scores in between were sometimes misclassified, so they represent a “zone of ignorance” or “gray area.”

Altman’s Z-score in the Real World

More than 30 years after its development, the Z-score continues to be commonly used by auditors, financial analysts, consultants, bankers, investors, and courts of law. Altman’s Z-score “explicitly measure(s) a firm’s relative liquidity, longevity, operating profitability, leverage, solvency, and productivity—virtually all aspects of corporate performance.”⁶ A 2002 study conducted by PricewaterCoopers⁷ on 1,200 publicly owned manufacturing companies (1998 through 2001 data) concluded that the Z-score remains a viable measure of financial distress. Their study concluded that the Z-score’s performance was consistent with its historical test results—typically 80-90 percent accuracy one year prior to bankruptcy.

The Z-score offers an excellent measure for evaluating the financial health of a subject business—the lower the Z-score the greater chance of failure. The Z-score, which combines mutually exclusive ratios into a group, helps overcome the shortcomings of individual financial ratio analysis. Statistical models like the Z-score are more precise, lead to clearer conclusions, are more uniform, avoid judgment bias and, of course, their reli-

ability can be evaluated statistically. Simply stated, the Z-score provides calculated measures based on past experience rather than someone’s unverified opinion.

Cautions and Limitations of Ratio Analysis

Ratio analysis and related predictive models (e.g., Z-score) can be extremely useful tools in measuring the overall health of a subject firm; however, caution must be exercised. First, ratios are constructed from accounting data, which (as recent events have demonstrated) is subject to interpretations and even manipulation. Second, external comparisons (e.g., RMA Statement Studies) can be regarded only as general guidelines and not as absolute industry norms. Third, conformity to industry composite ratios does not establish *within a reasonable degree of certainty* that the subject firm is performing normally or is well managed.

Financial ratio analysis is certainly a critical part of the valuation process. Predictive models, like the Z-score, provide added value and credibility to the process and our work product. Such models, however, should not be used as the sole basis of evaluation. An analyst should gather first-hand knowledge about the operations and management of a subject business, outside the financial statements, to complement the ratios and conclusions related thereto. 🍷

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¹ *Standard Industrial Classification (SIC) codes as provided by the U.S. Office of Management and Budget until 1997. Replaced by North American Industry Classification System (NAICS). Conversion tables can be found at <http://www.census.gov/epcd/www/naics.html>.*

² *Formerly Robert Morris Associates—name changed in June of 2000.*

³ *Edward I. Altman, “Financial Ratios, Discriminate Analysis, and the Prediction of Corporate Bankruptcy,” Journal of Finance, 23 (September 1968), 589-609.*

⁴ *Gregory Idleman, “Z scores—A Guide to Failure Prediction,” The CPA Journal, Feb 1995, Vol 65, Issue 2.*

⁵ *Adopted by RMA—Annual Statement Studies, Industry Default Probabilities and Cash Flow Measures 2001–2002.*

⁶ *John Yozzo, “The Slow Burn of Corporate Distress,” American Bankruptcy Institute Journal, May 2002.*

⁷ *John Yozzo, “Bubble Valuations and Their Impact on the Z-Score Model,” American Bankruptcy Institute Journal, December 2002.*