

# AMERICAN BANKRUPTCY INSTITUTE JOURNAL

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## Value & Cents

BY NITIN BAJAJ, ADRIENNA HUFFMAN AND DAVID PLASTINO<sup>1</sup>

### Solvency Shortcuts: The Use and Misuse of Simple Tools for Predicting Financial Distress



**Nitin Bajaj**  
The Brattle Group  
Washington, D.C.



**Adrienna Huffman**  
The Brattle Group  
San Francisco



**Coordinating Editor  
David Plastino**  
The Brattle Group  
Boston

Corporate insolvency can be difficult to predict. For every company that slowly makes its way toward a bankruptcy filing, there is one that collapses in months, weeks or even days. Causes of failure can be numerous, including economic shocks, industry decline, cyclical forces and operational issues. In this dynamic environment, market professionals and advisers need tools to monitor financial health, but not everyone has the time, skills or information to conduct a “bottoms-up” assessment of a company’s health. Furthermore, the cost of a detailed analysis might not justify the benefit. Consequently, rules of thumb and shortcut measures have become popular ways to assess the creditworthiness and risk of companies.

This article focuses on various shortcut measures. We first review and discuss one of the most popular solvency shortcut measures — the Altman Z-Score — then other solvency indicators will be examined, such as the leverage and interest-coverage ratios that commonly appear as debt covenants in loan documents. Finally, an empirical analysis will be conducted assessing, on an *ex ante* basis, the ability of these measures to predict future insolvency.

#### Background on the Altman Z-Score

The original Altman Z-Score study, first published in 1968,<sup>2</sup> created a simple formula to measure the probability that publicly traded companies

would go bankrupt. In creating the Z-Score, Prof. Edward Altman of the New York University Stern School of Business built upon the work of William Beaver, who had designed various univariate analyses (*i.e.*, various accounting ratios) for assessing bankruptcy risk. Prof. Altman’s insight was to use a multivariate technique (*i.e.*, combining various ratios) to predict bankruptcy.

The Altman Z-Score is a multi-discriminant model. In simple terms, this means that it takes multiple inputs and produces a single outcome (known as the Z-Score) that rates a company on the spectrum.<sup>3</sup> The original Altman Z-Score formula was based on a sample regression of 66 publicly traded manufacturing firms, and Prof. Altman found it to be 95 percent accurate in predicting financial failure one year prior to bankruptcy.<sup>4</sup> In subsequent articles, Prof. Altman has defended the Z-Score’s multivariate approach and the specific variables that it uses (Altman 2000, Chuvakin & Germania 2003).

The Altman Z-Score equation consists of five ratios that measure a company’s liquidity, profitability, financial leverage, solvency and sales activity. Prof. Altman’s original 1968 analysis, which is still commonly used today, is  $Z=0.12*X_1+0.014*X_2+0.033*X_3+0.006*X_4+0.999*X_5$ ,<sup>5</sup> where  $X_1$  is working capital divided by book value of total assets,  $X_2$  is retained earnings divided by book value of total assets,  $X_3$  is earnings before interest and taxes divided by book value of total

<sup>1</sup> Mr. Plastino is also a lecturer in finance at Boston University’s Questrom School of Business. The opinions expressed are those of the authors and do not necessarily reflect the views of the firm or its clients. This article is for general information purposes and is not intended to be and should not be taken as legal advice.

<sup>2</sup> Edward Altman, “Financial Ratios, Discriminant Analysis and the Prediction of Corporate Bankruptcy,” *The Journal of Finance* (1968), 23(4), pp. 589-609.

<sup>3</sup> Intuitively, the Z-Score is simply the commonly used statistical metric that provides the distance (below or above) in terms of standard deviations, of the individual sample observations from the population mean in a normally distributed sample.

<sup>4</sup> Altman, *supra* n.2, p. 599.

<sup>5</sup> *Id.* at p. 594.

assets,  $X_4$  is market value of equity divided by book value of debt, and  $X_5$  is sales divided by book value of total assets. The final Z-Score values from this analysis can be interpreted as follows:<sup>6</sup> (1)  $Z > 2.99$  *Safe Zone*: considered financially healthy; (2)  $1.81 < Z < 2.99$  *Grey Zone*: could go either way; or (3)  $Z < 1.81$  *Distress Zone*: risk that the company will go bankrupt within two years.

While still popular in its original form, Prof. Altman has updated the Z-Score formula twice. In 1983, he developed a revised Z-Score that would apply to private companies. The only ratio that changed in the model is  $X_4$ , where the book value of equity was substituted for the market value of equity. In 1993, Prof. Altman again updated his formula to eliminate the fifth ratio ( $X_5$ ) to minimize “the potential industry effect [that] is more likely to take place when such an industry-sensitive variable as asset turnover is included.”<sup>7</sup> He found that his 1993 model proved to be 90.9 percent accurate in predicting bankruptcy one year before a firm’s insolvency and had a 97 percent accuracy rate in identifying firms that would not go bankrupt.<sup>8</sup>

## Assessment of the Altman Z-Score as a Solvency Shortcut

Given its simplicity and academic support, the Altman Z-Score has been a popular model for assessing bankruptcy risk over the last five to six decades, and it is included in the offerings of data-providers such as Capital IQ. Firms have used the Z-Score to assess firm performance, including when making lending decisions. A McKinsey study concluded that “the Altman Z-Score is a better leading indicator of company strength through a crisis than is stock-market performance.”<sup>9</sup> The same study articulates the advantages of Z-Score in highlighting a company’s resilience through margin improvement, revenue growth and optionality (retained additional optional investment opportunities). The Altman Z-Score is also popular because it is a single composite measure, summarizing several financial ratios that individually can be used to track solvency.

The Altman Z-Score also has its shortcomings. Prof. Altman has discussed issues relating to the subjectivity of the weightings in the model. Various authors have argued that the predictive abilities of the Altman Z-Score model decline, and vary by country. Practitioners, Altman included,<sup>10</sup> often recommend re-tooling the model in accordance with data reflecting the

local market of interest, yet this is an iterative and time-consuming process that is too complicated for average investors.

The predictive ability of the Altman Z-Score also varies by industry. The original model was based on a sample of manufacturing firms, and various authors have pointed to the failure of the Altman Z-Score to accurately predict solvency issues for non-manufacturing firms (Schaeffer 2000). While the revised 1993 model attempted to correct this weakness, it is unclear how applicable the Altman Z-Score is for “asset-light” businesses, including technology companies.<sup>11</sup>

Users of the Z-Score should also be aware that it is most accurate as a short-term forecasting tool. The original Altman Z-Score study successfully predicted “financial failure for 95 percent of the firms, one year prior to their demise.” The accuracy of the model decreased to 72 percent and 52 percent, respectively, for firms two and three years prior to bankruptcy. The Altman Z-Score also does not incorporate relatively recent changes in financial-reporting requirements, such as those impacting accounting for leases.

## Other Bankruptcy Shortcuts

While the Altman Z-Score is a popular metric, ratios may also be used to predict future insolvency. Let’s consider several financial statement ratios that academic literature has found to be commonly used in loan covenants.<sup>12</sup> The selection of these covenant ratios by lenders is indicative that they are relevant for assessing solvency and capital adequacy.

Three common balance-sheet covenants (leverage, net worth and the current ratio) and one income-statement covenant (interest-coverage ratio) have been selected.<sup>13</sup> The financial-statement-covenant ratios are defined as follows:

- **Leverage:** The ratio of total book value of debt to total book value of assets. A lower ratio is generally indicative of better financial health.
- **Net worth:** Defined as book value of equity, or total assets less total liabilities. Positive net worth indicates that the company’s assets exceed its total liabilities on a book value basis.
- **Current ratio:** Defined as current assets divided by current liabilities. A ratio of one indicates that the company has short-term assets equal to its short-term liabilities.
- **Interest coverage:** The ratio of earnings (commonly measured as earnings before interest and taxes, or EBITDA) to interest expense. An interest coverage ratio of less than one indicates that interest expense exceeds the

Nitin Bajaj is an associate in The Brattle Group’s Bankruptcy and Restructuring Practice in Washington, D.C. Adrienna Huffman is an associate in the firm’s San Francisco office. David Plastino is a principal in the firm’s Boston office and co-leader of its Bankruptcy and Restructuring Practice.

6 *Id.*

7 Edward Altman, *Corporate Financial Distress and Bankruptcy* (John Wiley & Sons 1993), p. 204.

8 *Id.*

9 Cindy Levy, Mihir Mysore, Kevin Sneader & Bob Sternfels, “The Emerging Resilients: Achieving ‘Escape Velocity,’” McKinsey (Oct. 6, 2020).

10 Larry Gao, “The Altman Z-Score After 50 Years: Use and Misuse,” CFA Inst. (Altman stated, “I’ve always argued [that] it’s better to use a local model rather than the original U.S. model. And I’ve done it myself. I’ve personally built models in Brazil, Australia, France, Italy, and Canada.”).

11 See, e.g., “Edward I. Altman’s Z-Score Gets Rejuvenated for New Businesses, Even for India,” *The Free Press Journal* (May 29, 2019) (“We found Z double prime to be accurate for retailers. But I cannot really say it will be accurate for technology firms.”).

12 Peter Demerjian, “Accounting Standards and Debt Covenants: Has the Balance Sheet Approach Led to a Decline in the Use of Balance Sheet Covenants?,” *Journal of Accounting and Economics* (2011), 52(2-3).

13 *Id.* at p. 183.

income or cash flow a company is generating from its operating activities.

These covenant ratios are easy to calculate because they use financial statement information that is produced by most companies. However, it is commonly understood that (unlike the Z-Score) there are no set levels that indicate financial distress. Instead, examining trends in one or more ratios over time typically provides better indications of future insolvency than a single ratio calculated at a point in time. For example, if in one year a company's net worth is greater than zero, but in the following year it becomes negative, then the trend indicates a worsening of the company's financial position. If net worth increased, one might reach the opposite conclusion. Analyzing trends in multiple ratios over time will best allow for an inference of a company's financial position.

Finally, "normal" ratio levels can vary by industry. Therefore, when considering ratios as indicators of insolvency, it is important to not only conduct a trend analysis, but also consider the solvency ratios of companies in the same industry.

In summary, applying ratios to assess solvency risk can be complex. To be probative, such an analysis requires selection of the correct ratios, computation of those ratios at various points in time, and benchmarking against industry norms. Even then (unlike the Z-Score), the analysis might not specifically answer the question of whether a company is headed toward insolvency. However, unlike the Z-Score, direct-ratio analysis considers the "facts and circumstances" in a way that the Altman Z-Score does not.

## Empirical Analysis to Evaluate Shortcut Measures of Performance

To evaluate the strengths and weaknesses of the aforementioned methods, let's conduct an empirical analysis to assess, on an *ex ante* basis, the Altman Z-Score and the four covenant ratios' ability to predict future insolvency. To execute this analysis, Capital IQ was used to identify a sample of publicly listed U.S. companies that voluntarily filed a petition for bankruptcy from 2010-21. This search

produced a sample of 68 firms, of which 42 were traded on the major U.S. exchanges and 26 (38 percent) were traded over the counter (OTC). OTC stocks tend to be low-volume and less-profitable smaller companies that do not meet the criteria to be listed on a formal exchange. As a result, summary statistics for the two samples are presented separately to assess whether the measures perform differently between the two populations.

Using this sample of companies, let's calculate the Altman Z-Score and the four financial statement covenant ratios in each of the three years prior to the company's petition filing date. Exhibit 1 reports the results for public companies excluding OTC firms. Overall, Exhibit 1 indicates that the Altman Z-Score performs well in that it becomes increasingly negative, on average, from three years out to the year prior. As previously discussed, a Z-Score of less than 1.10 indicates a distress zone; beginning three years prior to the bankruptcy filing, on average, firms' Z-Score is 0.10, indicating they are in distress.

The other shortcut measures that follow a consistent pattern in the three years leading up to companies' bankruptcy filings, as reflected in Exhibit 1, include net worth, which declines over time on average until it becomes negative in the year prior to the bankruptcy filing; leverage increases over the three years prior to bankruptcy filing; and declines in the current ratio over the three years prior to the bankruptcy filing until it is less than one, on average, in the year prior to bankruptcy. Both interest-coverage ratios decline from year T-3 until the year prior to bankruptcy filing, on average, albeit in an inconsistent manner.

Let's next summarize the results for the OTC firms in Exhibit 2. The results appear to be the opposite of those reported for the U.S. publicly listed companies — that is, the results in Exhibit 2 suggest that the income-statement covenant, interest coverage and current ratio are the best predictors of bankruptcy for OTC firms. While the Altman Z-Score also indicates distress in OTC firms, the Z-Score increases over time, which is inconsistent with the pattern observed in the publicly listed company sample. Net worth and leverage also increase in the three years prior to bankruptcy for OTC firms, the opposite trend for insolvency, while lever-

**Exhibit 1: U.S. Public Companies, Excluding OTC Firms (2010-21)**

Variables	Fiscal Year from Voluntary Filing (T)		
	T-3	T-2	T-1
Altman Z-Score	0.1	-0.2	-1.2
Net Worth (Equity/Assets)	0.1	0.1	-0.1
Leverage (Debt/Assets)	0.6	0.6	0.8
Interest Coverage 1 (EBITDA/Interest Expense)	3.2	1.9	2.2
Interest Coverage 2 (CFO/Interest Expense)	2.4	2.6	1.1
Current Ratio (Current Assets/Current Liabilities)	1.5	1.4	0.9

*Source: Capital IQ. Notes: Sample reflects 42 companies listed on the NYSE or Nasdaq exchange that voluntarily filed for bankruptcy during the period 2010-21. Values reported are averages for observations corresponding to the fiscal year relative to voluntary filing (T). Altman Z-score is measured using the Capital IQ variable "iq\_z\_score."*

age declines in the three years prior to bankruptcy — again, an opposite insolvency trend.

## Conclusion

Overall, the results from the empirical analysis suggest that bankruptcy shortcut measures are predictive of insolvency. However, the results also suggest that no single measure is perfect, and that the predictive power of different methods depends on the characteristics of the company being assessed. As previously noted, the advantage of a single ratio or metric like the Altman Z-Score is that it is simple and relatively easy to apply. However, results reinforce the notion that there is likely a trade-off between simplicity and accuracy. Even when applying solvency “shortcuts,” analyzing multiple metrics is a best practice that will likely lead to more robust predictions. **abi**

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### Exhibit 2: U.S. OTC Companies (2010-21)

Variables	Fiscal Year from Voluntary Filing (T)		
	T-3	T-2	T-1
Altman Z-Score	-63.7	-9.9	-6.9
Net Worth (Equity/Assets)	-14.3	-2.0	-1.1
Leverage (Debt/Assets)	5.9	1.4	1.2
Interest Coverage 1 (EBITDA/Interest Expense)	1.5	-1.1	-4.2
Interest Coverage 2 (CFO/Interest Expense)	3.4	-1.3	-4.5
Current Ratio (Current Assets/Current Liabilities)	2.2	2.0	1.2

*Source: Capital IQ. Notes: Sample reflects 26 companies traded on the OTC markets that voluntarily filed for bankruptcy during the period 2010-21. Values reported are averages for observations corresponding to the fiscal year relative to voluntary filing (T). Altman Z-score is measured using the Capital IQ variable “iq\_z\_score.”*