z-score

characteristics

author:	Altman, Edward I.
country:	United States
period:	1968
type:	tool
role:	consultant and manager
activity:	analyse
topic:	finance & accounting
abstr. level:	organisation
perspective:	rational
status:	for review
module:	classics I
comments:	1

description:

The z-score model was developed to predict firm bankruptcy and provide a basis for safer investment decisions and better assessment of supplier and customer credit worthiness.

Edward I. Altman first published the model in 1968. Altman holds a PhD in finance from the University of California and authored many articles and books on bankruptcy.

The z-score model claimed to predict bankruptcy correctly in ~95% of the cases one year prior to defaulting, and in 83% of the cases two years in advance. The model was created with an initial dataset of 66 US manufacturing companies (33 non-bankrupt firms and 33 bankrupt firms) using multiple discriminant analysis (MDA). This statistical method distinguishes two or more classes of objects (in this case bankrupt and non-bankrupt organisations) by making a linear combination of attributes of each class. The input for the model requires only publicly available data from annual reports.
The main equation to predict bankruptcy is:

Z = 1.2X1 + 1.4X2 + 3.3X3 + 0.6X4 + 1.0X5

in which the variables are calculated as factors as follows:

X1 = working capital/total assets = (current assets-current liabilities)/total assets,
This factor measures firm liquidity. Low liquidity (low X1) is a predicting factor for bankruptcy since it measures a company's ability to pay its bills. Other liquidity ratios, such as current ratio (=current assets/current liabilities) and quick ratio (=cash and debtors/current liabilities) have shown a smaller significance in predicting bankruptcy.

X2 = retained earnings/total assets ,
This factor measures age and leverage. Retained earnings are part of the balance sheet as a subset under equity. Retained earnings represent the equity that the company has earned and not paid out to shareholders over its lifetime. Younger companies that have had less time to retain earnings (lower X2), are more prone to bankruptcy. Similarly, more leveraged firms (lower X2) have a higher risk of bankruptcy when their profitability drops.

X3 = earnings before interest and taxes/total assets ,
This factor measures productivity - the earning power of the firm's assets. The earning power is the basis of each firm's existence. A firm can only survive if it can make money. More earning power signifies a smaller risk of bankruptcy.

X4 = market value equity/book value of total liabilities ,
This factor measures solvency. An insolvent company is not able to pay back its liabilities and may go bankrupt when its creditors move in to reclaim their outstanding loans. An insolvent company can be saved only if the firm's creditors believe that better times are ahead or that the company can increase its equity relative to its liabilities by issuing new shares,. The market value of equity is used because it more accurately predicts bankruptcy than book value.

X5 = sales/total assets ,
This factor measures the firm's sales generating ability and is somewhat similar to earning power (X3). However, when used in combination with earnings before interest (EBIT) in the z-score mode, this factor contributes a high discriminating power because of its statistical relation with the other factors, l.

Z = overall index .
The overall z-score discriminates between firms that are likely to go bankrupt one year's time from healthy firms by using a cutoff score for the overall index:

Z < 1.81	High probability of bankruptcy for the firm
1.81 < Z < 2.99	Gray area - uncertain
2.99 < Z	Low probability of bankruptcy for the firm

In a stricter version of the model, 2.69 rather than 2.99 is used as cutoff score. However, this increases the chance of falsely assigning a lower bankruptcy probability to a particular firm. This is a choice between having relatively more false negatives (2.69 - type II errors) or relatively more false positives (2.99 - type I errors).

Statistically, the z-score model has shown to correctly predict bankruptcy in 95% of the cases one year prior to bankruptcy. This information can be used to guide managers in their investment decisions to make them potentially safer. Moreover, the model can be used to assess the credibility of (potential) customers and the financial health of the company's crucial suppliers.

assets:

Infineon annual report 2007
ProvenModels • editor PM • version 1.3 • 1 MB

TI annual report 2008
ProvenModels • editor PM • version 1.3 • 957 KB

z-score
ProvenModels • editor PM • version 1.2 • 73 KB

| z-score sample
ProvenModels • editor PM • version 1.3 • 65 KB

pros:

- The model has proven to have a high predictive accuracy. Years after the initial development of the model (1999), Altman selected 25 new companies with a similar asset size range and revisited the model. The z-score model was still found accurate in 80% to 90% of the time.
- The z-score model is relatively easy to use. The calculations are simple and the necessary data can be found in available annual reports. In 1977, Altman developed the ZETA model with a slightly higher predictive accuracy and a broader applicability. However, this model is more difficult to calculate.

cons:

- The model is industry specific. It was built on an initial dataset of manufacturing firms. These firms have a relatively high share of assets on the balance sheet compared to other company types. Additionally, the formula uses a firm□s total assets as a variable in 4 out of 5 factors and has a significant influence on the z-score□s calculation. The model can be less suitable for other industries such as the financial sector, where companies hold lower shares of assets on their balance sheet.Therefore the model will be less suitable for other company types with a lower share of assets on the balance sheet. Examples of such companies are found in the financial sector.
- The initial dataset of only 66 firms was small. This is uncommon in statistics since it can result in lower predictive accuracy.
- Predictions about the future are never 100% accurate. This model is no exception. Therefore investment decisions should be based on more than this model. Examples of auxiliary information sources are the CEO□s track record, market outlook, write-off speed, etc.

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