



Interfaces with Other Disciplines

Bankruptcy theory development and classification via genetic programming [☆]

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Abstract

Bankruptcy is a highly significant worldwide problem with high social costs. Traditional bankruptcy risk models have been criticized for falling short with respect to bankruptcy theory building due to either modeling assumptions or model complexity.

Genetic programming minimizes the amount of a priori structure that is associated with traditional functional forms and statistical selection procedures, but still produces easily understandable and implementable models. Genetic programming was used to analyze 28 potential bankruptcy variables found to be significant in multiple prior research studies, including 10 fraud risk factors. Data was taken from a sample of 422 bankrupt and non-bankrupt Norwegian companies for the period 1993–1998. Six variables were determined to be significant.

A genetic programming model was developed for the six variables from an expanded sample of 1136 bankrupt and non-bankrupt Norwegian companies. The model was 81% accurate on a validation sample, slightly better than prior genetic programming research on US public companies, and statistically significantly better than the 77% accuracy of a traditional logit model developed using the same variables and data. The most significant variable in the final model was the prior auditor opinion, thus validating the information value of the auditor's report. The model provides insight into the complex interaction of bankruptcy related factors, especially the effect of company size. The results suggest that accounting information, including the auditor's evaluation of it, is more important for larger than smaller firms. It also suggests that for small firms the most important information is liquidity and non-accounting information.

[☆] Data Availability: The data may be obtained from Compact Disclosure, Inc., a commercial data vendor.

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The genetic programming model relationships developed in this study also support prior bankruptcy research, including the finding that company size decreases bankruptcy risk when profits are positive. It also confirms that very high profit levels are associated with increased bankruptcy risk even for large companies an association that may be reflecting the potential for management to be “Cooking the Books”.

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1. Introduction

Corporate bankruptcy affects the economy of every country and is monitored by policy makers seeking to promote economic growth. For example, US business bankruptcy filings declined from 53,931 in 1997, to 44,196 in 1998, and to 37,564 in 1999 (American Bankruptcy Institute, 2001), a period during which growth in the US economy, as measured by gross national product, increased from 3.4% to 4.1% (Bureau of Economic Analysis, 2001).

At the level of the individual firm, the capital markets react to data about going concern prospects for firms. For example, both Beaver (1968) and Altman (1969) showed a negative stock market price reaction as a firm approached failure. Accordingly, the International Accounting Standards (IAS) require, “When preparing financial statements, management should make an assessment of an enterprise’s ability to continue as a going concern.” (International Accounting Standards Board, 2002, IAS No. 1, paragraph 23). If there are significant doubts about a company’s bankruptcy/non-bankruptcy status then the IAS requires information about those uncertainties to be disclosed. Disclosure responsibilities also extend to a company’s auditors. International Standard on Auditing (ISA) section 570 (International Auditing and Assurance Standards Board of International Federation of Accountants, 2003) requires the auditor to modify the auditor’s report by adding an emphasis of matter paragraph if there is significant doubt about the entity’s going concern status and adequate disclosure is made in the financial statements. If adequate disclosure is not made in the financial statements, the auditor should express a qualified or adverse opinion. Thus, auditors are required to signal stakeholders

about going concern problems. Although going concern problems can result in outcomes other than bankruptcy, this outcome is probably the one of most concern to stakeholders.

Bankruptcy prediction has been a major topic in accounting and finance for at least a century. Early research focused primarily on univariate models such as individual ratios while later research turned to multivariate models. Recent research has turned to modeling techniques like recursive partitioning, fuzzy logic, and rough sets. Despite a long research history, there is no bankruptcy prediction model based primarily on bankruptcy theory which is generally accepted. Additionally, as noted by Dimitras et al. “A unifying theory of business failure has not been developed ...” (1996, p. 487). To improve this situation either greater bankruptcy prediction research convergence or more theory building is needed.

Most prior bankruptcy research utilized techniques producing descriptions for classifying objects into classes based on the objects’ properties. One of the acknowledged difficulties with this type of inductive inference is its’ open-endedness which stems from the fact that there is no natural limit to the level of detail which may be used to describe reality. For example, while bankruptcy models produced by techniques such as neural networks, recursive partitioning, and rough sets theory can produce reasonable classification accuracy, they provide extremely detailed models which are difficult to generalize or develop theory from. Further, multivariate techniques are inadequate according to Michalski because, “The widely used traditional mathematical and statistical data analysis techniques, such as regression analysis, numerical taxonomy, or factor analysis are not sufficiently powerful ... for the task of ... detecting interesting

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