



## ARTICLE

## Industry specific financial distress modeling



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**Abstract** This study investigates uncertainty levels of various industries and tries to determine financial ratios having the greatest information content in determining the set of industry characteristics. It then uses these ratios to develop industry specific financial distress models. First, we employ factor analysis to determine the set of ratios that are most informative in specified industries. Second, we use a method based on the concept of entropy to measure the level of uncertainty in industries and also to single out the ratios that best reflect the uncertainty levels in specific industries. Finally, we conduct a logistic regression analysis and derive industry specific financial distress models which can be used to judge the predictive ability of selected financial ratios for each industry. The results show that financial ratios do indeed echo industry characteristics and that information content of specific ratios varies among different industries. Our findings show diverging impact of industry characteristics on companies; and thus the necessity of constructing industry specific financial distress models.

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## Introduction

In recent years financial ratio analyses have become popular managerial tools as well as tools for determining economic activity of firms. The ratios have gained acceptance even by small businesses for examining and describing the operations, and also by banks for making loan criticisms (Horrigan, 1968). They provide clarifications and insights into financial statements in making a variety of business decisions.

In this regard, financial ratio analysis reduces uncertainty in decision making by providing a reliable assessment of the planning, operating, investing effectiveness and the health of financial activities of a businesses.

In the literature, a functional relationship between the financial ratios and some dependent variable of interest is estimated for prediction purposes. This type of models are mostly used by the investment analysts in estimating future profitability of a firm as well as by researchers in developing statistical models to predict failure of a company, to assess potential risks, to help with credit rating, etc. (Altman, 1968; Aziz et al., 1988; Beaver, 1966; Koh, 1992; Mossman et al., 1998; Ohlson, 1980; Taffler, 1983; Zmijewski, 1984). However, these or similar studies in the literature seldom

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took industry related factors into account, either by including control variables for industry effects or by constructing separate corporate failure prediction models for each industry to avoid inaccurate coefficient estimates. The sensitivity of bankruptcy prediction models to industry classifications (characteristics) raises the question of whether a single bankruptcy prediction model is sufficient to evaluate the financial conditions of firms in different industries. In other words, in the bankruptcy prediction models, whether using the same financial ratios for firms in different industries deteriorate the predicting ability of these models. Thus, this study aims to fill this gap in the literature by building industry specific financial distress models for certain industry groups sharing similar industry characteristics. Doing that, we aim to reduce the burden of information mass for the users of financial statements by limiting the number of financial ratios to those that have been found to have the greatest information content for each particular industry group.

To build industry specific financial distress models, we analyze information content of financial ratios in measuring the level of uncertainty of S&P 1500 firms in different industries to determine a set of industry specific financial ratios which possess the greatest amount of information for a specific industry. First, we chose 51 commonly used financial ratios and by use of factor analysis reduced them to several factors that account for the maximum variation in the data for the period 1990–2011. This technique further enables us to focus on the most stable and robust ratios between the sub-periods 1990–2000 and 2001–2011 by limiting the level of multicollinearity among the ratios. Second, following information theory perspective, we use the entropy method to find those financial ratios that provide more information on the level of uncertainty of firms within a particular industry group. The entropy method allows us to compute the probability distributions of perfect and imperfect information to determine the predictive ability of the information contained in the ratios for selected industries. The sensitivity of bankruptcy prediction models to industry classifications further raises the question of whether a single bankruptcy prediction model is sufficient to evaluate the financial condition of firms from different industries. Thus, after obtaining the set of financial ratios that possess the highest information content regarding the uncertainty level of firms within an industry group, we employ a logistic regression model to derive industry specific financial distress models. Finally, we examine the classification accuracy of these models in determining financially distressed companies.

Although there are studies that use entropy method in measuring information loss in the aggregation of accounting numbers (Theil, 1969; Lev, 1969) and that employ factor analysis of financial ratio patterns to examine stability of financial ratios over time and across countries (Yli-Olli and Virtanen, 1985, 1986), to our knowledge, no study has specifically analyzed the information content of financial ratios across industries. Moreover, few studies employ data reduction techniques in selecting financial ratios that are used in bankruptcy prediction models (Taffler, 1983). Thus, this study not only uses factor analysis as a data reduction technique but also employs the entropy method, as a second step, to examine the predictive ability and information content of the financial ratios derived from factor

analysis. Finally, although there are considerable number of financial distress models in the accounting literature that predict company failure, most of these fail to capture industry characteristics and do not differentiate among distress probabilities in different industry groups. Therefore, our study serves as a first attempt distinguishing between distressed and non-distressed companies across industries; and in providing financial statement users with sharper tools to assess the probability of financial distress of firms in different industry groups.

This study consists of five sections. In Literature review section, we summarize the pertinent accounting literature: those that examine the information content of financial ratios in decision making; and those that build financial distress models which are commonly used in financial distress prediction. Next, we explain data and methodology and conduct factor analysis followed by entropy method to select the most informative financial ratios and derive financial ratio sets that are specific to each industry. In the following section, we report descriptive statistics and empirical outcomes along with necessary robustness checks. The final section is devoted to discussion and future research.

## Literature review

### Reducing set of financial ratios and determining their information content

A common goal of financial ratio analysis research is to derive the most useful financial ratios which provide substantial information about future events to be used in financial distress/bankruptcy models for prediction. Research on the determination of most useful financial ratios has largely focused on three main aspects: (i) stability of financial ratios over time, (ii) variations in financial ratios due to industry characteristics and (iii) obtaining a financial ratio set free from redundant information. To empirically determine the stability of financial ratios over time and the best information set, researchers employ factor analysis that start with an initial set of variables to obtain a smaller set of factors (combination of variables). They suggest that, financial ratios can be used in the financial distress/bankruptcy models if they show stable patterns of the factor values over time (Ezzamel et al., 1987; Pinches et al., 1973; Yli-Olli and Virtanen, 1985). Considering the second aspect, some researchers use factor and/or cluster analyses to identify industry specific differences and to determine variations among the financial ratios due to industry characteristics (Gupta, 1969; Gupta and Huefner, 1972; Johnson, 1979).

Because of the commonality of financial components within the financial ratios, the degree of overlap between those ratios with the same numerator or denominator becomes even greater, so much so that the additional information one ratio provides might be very small or even nil over another. Hence, taking into account the third aspect, selecting the most useful ratios, researchers use principal component analysis and/or canonical correlation analysis to separate redundant ratios from those that contain substantial information. This tends to limit the level of multicollinearity among the financial ratios (Chen and

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