# IDENTIFIABLE ATTRIBUTES OF SUCCESSFUL RESTRUCTURING POTENTIAL

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## ABSTRACT

*Business managers contemplate multiple options when making informed operating and restructuring decisions. Firms in the US, even when not financially distressed, can seek court protection while reorganizing by filing for Chapter 11 bankruptcy for breathing room to restructure. Opportunity costs, risk shifting, corporate governance, and managerial motivations are important, however, financial reports rarely indicate whether or how such qualitative factors influence managers' potential operational choices motivation to restructure. By adding proxies for such qualitative factors, including measures of perceivable incentives, pressures or threats leading to changes in a firm's operational structure, creditor categories, and proxies of management's reaction to such incentives, pressures or threats, we analyze the predictive value of examining management choices for forecasting the likelihood of successful corporate restructuring. Our results suggest that the examination of operational activities is essential to good decision-making by managers and external stakeholders alike. To the extent that policymakers, investors, creditors and other stakeholders would benefit from early detection of signs of the corporation's intention to restructure, this study provides insights into factors associated with recovery after major corporate changes.*

**Keywords**: Corporate Change, Corporate Governance, Restructuring, Reorganization, Merger, Acquisition, Leveraged Buyout, Market Share, Nonfinancial, Qualitative, Operational, Auditor

## INTRODUCTION

Accountants, academics, economists, investors, regulators and other stakeholders often take distinct approaches for studying potential success or failure of firms in terms of financial performance. While some groups advance knowledge through studying influences external to the firm, others look to internal processes of the firm, and then others look at both internal and external forces, with emphasis on the comparative impact of external versus internal forces. Few researchers attempt to integrate these two categories of independent variables into a causality model. Theories from the internal compared to the external perspective of the challenges to successful performance tend to view the firm as either financially and managerially autonomous entities, or remotely controlled automatons. Our study focuses on internal factors that may indicate the firm's capability to successfully restructure. Based on theory, we propose models for forecasting the likelihood of a firm to indeed, accomplish its official restructuring goals. These theories originate from the view that a firm's processes are significant in a firm's resilience, or autonomy. Regulatory bodies might emphasize the need for additional regulation, while accountants and academics might advocate additional ethics training, technology training or other forms of education when a firm must reorganize (Rosner, 2003).



**Citation Information:** Lloyd, C.B., Ibrahim, S., & Keys, P.Y. (2022). Identifiable attributes of successful restructuring potential. *Academy of Accounting and Financial Studies Journal, 26*(6), 1-19.

We derive our evidence from a natural experiment of publicly known efforts toward reorganization. Thus, through observing firms that utilized Chapter 11 formalities during 2008 through 2020, we test the efficacy of our models. Our exploration employs key qualitive indicators involved by our sample of firms for the likelihood of successful restructuring. While some firms strategically file bankruptcy (CH11) for restructuring purposes (Chapter 11 reorganization), other firms simply file to completely dissolve the entity (Chapter 7 liquidation).

Shareholders may perceive the effects of management decisions on their wealth differently, and therefore react differentially to various corporate events, particularly types of restructuring decisions, changes in corporate governance practices, specific regulatory changes, risk shifting, claims ownership characteristics, and different categories or chapters of bankruptcy filing (Rose-Green & Dawkins, 2002; Bris et al., 2006; Barker et al., 2001; Moulton & Thomas, 1993; Brown & Mooradian, 1993).

Rose-Green & Dawkins (2002) find that stakeholders differentiate between firm strategy and financial distress based upon investor reactions between the use of a restructuring or reorganization bankruptcy (categorized as a Chapter 11 bankruptcy), contrasted with investor reactions around financial distress or liquidation bankruptcies (categorized as a Chapter 7 bankruptcy). Can certain actions by managers and corporate leaders of restructuring firms give stakeholders insights into strategic choices for the firm? How likely are those actions to coincide with outcomes consistent with the objectives of the firm's stakeholders (i.e., the shareholders, the employees, the creditors, and others)?

Our findings show significant relationships between qualitative factors and successful restructuring post-Chapter 11 ("*reorganization-bankruptcy*") filing. We find that the Altman model is not significantly related to reorganization-bankruptcy filing. Moreover, we find that a number of qualitative factors acting alone or in concert with other qualitative factors have a significantly more important association with reorganization-bankruptcy filings than financial ratios. Further, we find that qualitative characteristics are significantly different when comparing reorganization-bankruptcy firms with Chapter 7 (distressed) firms and non-bankrupt firms. Evidence is provided that there are other incentives for filing reorganization-bankruptcy. For example, our findings suggest that a reorganization-bankruptcy is utilized as an efficient proxy or intermediate step for leveraged buy-outs, mergers, equity swapping, and going-private transactions, often to the detriment of bondholders and other debtholders.

By extension, we find that specific governance characteristics are significantly different in those firms that emerge from bankruptcy reorganized, in comparison to those that liquidate or fail to emerge. There is strong evidence that firms that initiate reorganization through changes in corporate governance and other risk shifting techniques are more likely to emerge from bankruptcy reorganization successfully reorganized. Finally, we find that there is significant CEO turnover surrounding reorganization-bankruptcy and that the new replacement CEO's compensation package is significantly different in form and substance than that of the pre-reorganization-bankruptcy CEO.

Overall, a better specified model, based on theory, which includes qualitative considerations and which considers bankruptcy categories, balances the performance of bankruptcy models that include only financial variables. In conclusion, our findings suggest that reorganization-bankruptcy provides both an incentive and a mechanism to improve the quality of corporate governance (Ittner & Larcker, 1998b).

An implication of this research is that managers in distressed firms take different actions; some are value-maximizing while others are value-destroying. The purpose of this study



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is to examine whether certain operational and non-financial measures, which may be related to strategic choices are associated with the likelihood of corporate restructuring.

## BACKGROUND AND DEVELOPMENT OF HYPOTHESES

### Bankruptcy Prediction

After the seminal works of Beaver (1966) and Altman (1968) demonstrating the predictive value of financial ratios for firm failure, a number of researchers spent their time evaluating the effectiveness of these financial statement based models in determining bankruptcy across industries e.g., Cochran et al. (2006) with internet firms; Knox et al. (2009) hospitals, across time e.g., Grice & Ingram (2001) using a sample from 1985-1991; Beaver et al. 2005 using a sample from 1962 to 2002), and with regards to the length of the prediction interval e.g., Philosophov & Philosophov (2002) using prediction windows from one year to five years before a bankruptcy event). Ohlson (1980) on factors that affect the robustness of prediction regressions and Zmijewski's (1984) subsequent research on the methodological issues in early bankruptcy studies led to cautionary discussions of the pitfalls and limitations of bankruptcy prediction modeling (e.g., Grice & Dugan, 2001), as well as a stream of research regarding the technical aspects of modeling the probability of bankruptcy - most notably, Shumway's (2001) introduction of hazard models. This research encouraged further evaluations of the traditional logistic regression techniques (i.e., logit models) leading researchers to consider other traditional methods of identifying bankruptcy potential (e.g., a comparison of hazard modeling to auditor's propensity to give going concern opinions by Sun, 2007) or to explore applications of alternative techniques to the problem (e.g., binary quantile regression modeling as in Li & Miu, 2010; spline modeling as in Giordani et al., 2014; data envelopment analysis modeling as in Mousavi et al., 2015; fuzzy set qualitative comparative analysis as in Boratyńska, 2016; neural network analysis as in Jones et al., 2017). Thus, while the predominant methods in accounting are logit and hazard models, we find innovation and exploration in research on prediction methods.

In contrast, the literature on expanding the variables beyond those which are available from the publicly filed financial statements is relatively limited. The earliest research on the nature of variables selected for inclusion in bankruptcy prediction models primarily focused on financial statement items or three areas of financial ability: profitability, cash flow generation, and leverage. The bankruptcy prediction literature since Shumway (2001) has included more focus on market-based variables (e.g., Hillegeist et al., 2004; Agarwal & Taffler, 2008; Charitou et al., 2007; Bauer & Agarwal, 2014; Tian et al., 2015) or other financial information not found in financial statements (such as bond downgrades as in Kim & Nabar, 2007; equity prices and residual prices in conjunction with macroeconomic indicators as in Tinoco & Wilson, 2013). One viewpoint is that accounting-based variables and market-based variables need not be considered mutually exclusive in prediction modeling if the combined sets add to predictive power by capturing a mix of information about the firm (Beaver et al., 2005).

We find that very little published evidence that researchers considered nonfinancial measures in bankruptcy prediction before the most recent decade. Keasey & Watson (1987) examined several non-financial factors in the prediction of small company failure in the U.K. context. They found that a model including non-financial factors related to 'normal business hazards' (e.g., strikes, the loss of a large customer, and '*managerial defects'*) performed better than a model including only financial variables. Smith & Taffler (2000) analyzed the association between the chairman's statement and subsequent firm. Using form-oriented and meaning-



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oriented variables, they found that discretionary narrative disclosures have information that is useful for decision making as well as for determining the likelihood of firms' survival. Senteney et al. (2006) examined whether auditor opinions or auditor changes were associated with bankruptcy and found that failing firms lean towards changing auditors more than healthy firms and that auditor qualified opinions can indicate impending bankruptcy.

Xu & Zhang (2009) found that the added variables capturing the main bank system and Keiretsu structures unique to firms operating in Japan added value to bankruptcy prediction models beyond accounting and market based variables for their sample of 3,510 Japanese listed firms from 1992 to 2005. Wu et al. (2010) evaluated several bankruptcy prediction models and included firm characteristics with the customary accounting and market based variables. They found that diversification, measured by the number of business segments, and firm size are both related to the probability of bankruptcy in their sample that covers the years from 1980 to 2006. Eisdorfer & Hsu (2011) found that measures of innovation were important for bankruptcy prediction among technology firms in a sample from 1976 to 2005. Beams et al. (2013) found that CEO and CFO resignations are associated with future bankruptcy. Jones (2017) used a gradient boosting model that overcomes the limitations on the number of variables included in bankruptcy prediction. In addition to a wide set of variables used in earlier studies (e.g., macroeconomic, bond downgrades, size, and industry), his set of 91 variables included ownership concentration/structure data, compensation data, and analysts' estimates to analyze corporate bankruptcies from 1987 to 2013. Although Jones (2017) indicates that his model overcomes the 'number of variables' problem, he readily acknowledges that the gradient boosting model presents challenges for interpretation to parameter estimates. His results, however, are consistent with that above indicating that predictive power is enhanced using a variable set that includes nonfinancial measures along with the typical accounting-based and market-based measures. Furthermore, he found that the ownership concentration/structure and compensation variables outperformed the market-based variables in their ability to predict bankruptcy in his sample (Ittner & Larcker, 1998a).

## Bankruptcy Prediction and Operational Measures

Bankruptcy may represent a strategic choice by management or it may be an unplanned event. No matter how bankruptcy results, it is not an event to be taken lightly given the potential for high costs to shareholders, employees, creditors, and other stakeholders[1]. Therefore, managers facing financial distress or who believe a bankruptcy is an optimal strategic choice will make certain choices that are likely to affect operational outcomes.

Given the findings of prior literature on nonfinancial measures, we propose the following hypotheses related to operational actions and the likelihood of bankruptcy:

***$H_a$:*** *A bankruptcy prediction model that includes operational measures in addition to financial measures will be better able to predict bankruptcy in the short-term and long-term than a model purely based on financial measures.*

***$H_b$:*** *After controlling for financial measures, operational measures are significantly related to future bankruptcy.*

[1] The finance literature includes several papers measuring the costs associated with bankruptcy (e.g., Warner, 1977; Ang, Chua, and McConnell 1982; Bris, Welch, and Zhu 2006).



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## SAMPLE SELECTION AND METHODOLOGY

### Sample Selection

The main source of bankruptcy data is LoPucki's Bankruptcy Research Database (BRD) of big-case bankruptcies that lists bankruptcies in the years 1978 to 2008. Bankruptcy is defined as an original filing of Chapter 7 or Chapter 11. The primary information extracted from BRD includes firm names, industry code, case number, and date of filing. For inclusion in the BRD database, the firm has to have assets worth $100 million or more (measured in 1980 dollars) at the time of filing and is required to file 10-Ks with the SEC. The search resulted in 501 firms. This source of bankruptcy firms was supplemented by identifying additional bankruptcies from the Compustat database. However, inclusion in the sample was restricted to the same conditions for inclusion into the BRD database. This search resulted in 235 additional bankruptcy firms. The two bankruptcy datasets were combined for a total of 736 bankruptcy firms to form the initial bankruptcy sample. Bankruptcy firm-year observations were then developed from the available pre-bankruptcy data for this sample of bankruptcy firms. For this study, firms that file at least one bankruptcy are retroactively and prospectively classified as bankrupt. Bankruptcy firm-year observations that are not one of the three pre-bankruptcy years are then deleted from the sample (Said et al., 2003).

Financial data from Compustat was collected for the identified bankrupt as well as all non-bankrupt firms. In accordance with the BRD database criteria, non-bankruptcy firms were eliminated from the sample if assets were not worth $100 million measured in 1980 dollars at the time of observation. Since this study is concerned with longer-term bankruptcy detection, we delete bankruptcy firms that did not have all three years of financial data prior to bankruptcy. This resulted in a final sample of 314 bankruptcy firms (942 firm-year observations) and 48,506 non-bankruptcy firm-year observations. Table 1 provides the industrial and yearly distributions of this final sample.

**Table 1**
**PANEL A: INDUSTRY DISTRIBUTION FOR BANKRUPTCY & NON-BANKRUPTCY FIRMS**

| | Bankruptcy firms | | Non-bankruptcy firms | |
|---|---|---|---|---|
| | N | % | N | % |
| Natural Resources | 25 | 7.96 | 2968 | 6.12 |
| Construction and Metal | 37 | 11.78 | 3845 | 7.93 |
| Food | 6 | 1.91 | 1958 | 4.04 |
| Consumer Goods | 25 | 7.96 | 1818 | 3.75 |
| Paper and printing | 14 | 4.46 | 2564 | 5.29 |
| Chemical and petroleum | 11 | 3.5 | 4427 | 9.13 |
| Machinery and Equipment | 27 | 8.6 | 8445 | 17.41 |
| Transportation-related | 28 | 8.92 | 3452 | 7.12 |
| Telecommunications | 38 | 12.1 | 6773 | 13.96 |
| Wholesale and retail | 57 | 18.15 | 6180 | 12.74 |
| Entertainment | 10 | 3.18 | 702 | 1.45 |
| Business Services | 15 | 4.78 | 3212 | 6.62 |
| Health and other services | 20 | 6.37 | 1972 | 4.07 |



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| | | | | |
|---|---|---|---|---|
| Non-classifiable | 1 | 0.32 | 190 | 0.39 |
| Total | 314 | 100 | 48506 | 100 |

**Table 1**
**PANEL B: YEARLY DISTRIBUTION OF BANKRUPTCY AND NON-BANKRUPTCY FIRMS**

| | Bankruptcy Firms | | Non-Bankruptcy Firms | |
|---|---|---|---|---|
| | **N** | **%** | **N** | **%** |
| 1978 | 0 | 0 | 1,249 | 2.57 |
| 1979 | 0 | 0 | 1,242 | 2.56 |
| 1980 | 0 | 0 | 1,215 | 2.5 |
| 1981 | 4 | 1.27 | 1,206 | 2.49 |
| 1982 | 16 | 5.1 | 1,166 | 2.4 |
| 1983 | 4 | 1.27 | 1,381 | 2.85 |
| 1984 | 8 | 2.55 | 1,375 | 2.83 |
| 1985 | 9 | 2.87 | 1,362 | 2.81 |
| 1986 | 11 | 3.5 | 1,368 | 2.82 |
| 1987 | 4 | 1.27 | 1,388 | 2.86 |
| 1988 | 5 | 1.59 | 1,356 | 2.8 |
| 1989 | 4 | 1.27 | 1,347 | 2.78 |
| 1990 | 11 | 3.5 | 1,330 | 2.74 |
| 1991 | 9 | 2.87 | 1,370 | 2.82 |
| 1992 | 8 | 2.55 | 1,430 | 2.95 |
| 1993 | 12 | 3.82 | 1,555 | 3.21 |
| 1994 | 3 | 0.96 | 1,669 | 3.44 |
| 1995 | 5 | 1.59 | 1,806 | 3.72 |
| 1996 | 5 | 1.59 | 1,927 | 3.97 |
| 1997 | 5 | 1.59 | 2,049 | 4.22 |
| 1998 | 13 | 4.14 | 2,109 | 4.35 |
| 1999 | 18 | 5.73 | 2,167 | 4.47 |
| 2000 | 39 | 12.42 | 2,268 | 4.68 |
| 2001 | 37 | 11.78 | 2,180 | 4.49 |
| 2002 | 31 | 9.87 | 2,199 | 4.53 |
| 2003 | 23 | 7.32 | 2,232 | 4.6 |
| 2004 | 11 | 3.5 | 2,308 | 4.76 |
| 2005 | 12 | 3.82 | 2,304 | 4.75 |
| 2006 | 5 | 1.59 | 1,948 | 4.02 |
| 2007 | 2 | 0.64 | 0 | 0 |
| Total | 314 | 100 | 48,506 | 100 |

Panel A presents the industrial distribution of both bankrupt and non-bankrupt firms. Most industries constitute less than 10% of the bankruptcy sample other than construction and metal (12%), telecommunications (12%), and wholesale and retail (18%). As for the non-bankruptcy sample, most industries constitute less than 10% to the sample, other than machinery and equipment (17%), telecommunications (14%), and wholesale and retail (13%). There does not appear to be any significant difference between the samples with respect to industry distribution. We present the yearly distribution of the bankruptcy and non-bankruptcy sample in panel B. There are no bankruptcy cases in years 1978 to 1980 since data for three years prior to bankruptcy was necessary. Bankruptcy in each of the remaining years are below 5% other than in years 1982, 1999, 2000, 2001, 2002, and 2003 (these constitute 5%, 6%, 12%, 11%, 10% and 7% of the full sample, respectively). Observations in the non-bankruptcy sample are approximately evenly distributed throughout the sample years.



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## METHODOLOGY

In this study, we replicate and extend the Altman (1984) model since this is the most commonly used model in practice (Altman, 2000). However, we update the methodology by employing a logit model rather than the discriminant analysis methodology used in (Altman, 1968). This method is preferable as it does not impose restrictions on prior bankruptcy percentages (Ohlson, 1980, 112). Furthermore, Gilbert et al. (1990) argued that the high predictive ability of models based on financial ratios could be due to the way the control group is selected. They showed that a financial ratio-based model was unable to distinguish bankruptcies from other distressed firms. Furthermore, they showed that the variables that are able to discriminate between bankrupt and distressed firms are different from those that discriminate between bankrupt and randomly selected non-bankrupt firms. Hence, we do not restrict our comparison to a randomly selected group of non-bankrupt firms but rather compare the bankruptcies to all non-bankrupt firms with available data. Alternatively, in robustness tests, we use a hazard model. The hazard model method uses all available information to determine each firm's bankruptcy risk at each point in time and generally provides consistent and unbiased coefficients. The Altman (1968) model specification, termed model 1, is as follows:[2]

$$Prob(Bankruptcy) = \beta_1 WC(alt) + \beta_2 RE(alt) + \beta_3 MVE(alt) + \beta_4 EBIT(alt) + \beta_5 S(alt) + \varepsilon \quad (1)$$

Where
*WC(alt)* = working capital scaled by total assets (Compustat data 179 / data 6);
*RE(alt)* = retained earnings scaled by total assets (data 36 / data 6);
*MVE(alt)* = market value of equity scaled by book value of debt ([data 25*data 199] / data 181);
*EBIT(alt)* = operating income scaled by total assets (data 178 / data 6); and
*S(alt)* = sales scaled by total assets (data 12 / data6).

To test the hypotheses of the study, we employ a combined model to determine whether a group of predictors will improve the model. The operational effects model tested is developed by combining non-financial and operational measures with the Altman (1968) model, in model 2, as follows:

$$Prob(Bankruptcy) = \beta_1 WC(alt) + \beta_2 RE(alt) + \beta_3 MVE(alt) + \beta_4 EBIT(alt) + \beta_5 Sales(alt) + \beta_6 \Delta MktSh + \beta_7 \Delta Emply + \beta_8 LitStlm + \beta_9 LitRisk + \beta_{10} MergAcq + \beta_{11} LevBuy + \beta_{12} \Delta Auditor + \beta_{13} \Delta AudOp + \varepsilon \quad (2)$$

Where the financial variables are as previously defined and the remaining variables are defined as follows:
*ΔMktSh* (Growth potential proxy) = change in firm sales from prior year to current year as a ratio of the total sales of the industry (data item 12 / industry total sales);
Δ*Emply* (Change in number of employees) = the difference in the log of number of employees from prior year to current year;
*LitRisk* (Litigation risk proxy) = an indicator variable set to 1 for litigious industry codes: bio-technology (2833-2836), computer hardware (3570-3577), electronics (3600-3674), retailing (5200-5961), computer software (7371-7379), and 0 otherwise;
*LitStlm* (participation in litigation settlement or insurance payout) = an indicator variable set to 1 if the firm participates in a litigation settlement or insurance payout (data 372), and 0 otherwise;
*MergAcq* = an indicator variable set to 1 if the firm participates in a merger/acquisition, and 0 otherwise;

[2] Firm and year subscripts have been deleted for simplicity.



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*LevBuy* = an indicator variable set to 1 if the firm participates in a leveraged buyout, and 0 otherwise;
Δ*Auditor* = an indicator variable set to 1 if the auditor was changed from prior year to current year, and 0 otherwise; and
Δ*AudOp* = an indicator variable set to 1 if the audit opinion in current year was changed to a more adverse one than in the prior year, and 0 otherwise.

The non-financial and operational measures included in the bankruptcy model are based on prior research. Firstly, Δ*MktShr* is used as a proxy for growth potential (e.g. Amir & Lev 1996; Riley et al., 2003). We expect a negative coefficient since reduction in growth potential is an indicator of financial distress.

The change in employees, *ΔEmply*, is included as it has been shown that workforce reduction or downsizing may be associated with bankruptcy (Perotti & Spier, 1993; Stiglitz et al., 2003; Powell & Yawson, 2007; Campbell, 2008). As before, we expect a negative coefficient in the regression.

We employ two measures to proxy for litigation risk since prior research shows that filing for bankruptcy is sometimes used to circumvent litigation (Rice & Davis, 1999; Plevin, 2003). The first is litigation settlement (*LitStlm*) indicating whether the firm had settled any litigation claims during the year. We also include a litigation risk proxy (*LitRisk*) adopted from Francis et al. (1994) and Frankel et al. (2002) based on industry membership. We expect a negative coefficient for both variables, although the litigation risk proxy may be too general to provide significant results.

Variables that proxy for corporate restructuring are also included in the model, namely merger/acquisition (*MergAcq*) and leveraged buyout (*LevBuy*). Both merger/acquisition and leveraged buyouts are expected to eliminate the decision to file for bankruptcy (Gilson et al., 1990) so we expect a negative coefficient sign.

We also include the change in auditor (*ΔAuditor*) and expect a positive coefficient, indicating that a move to a different auditor will be associated with a higher likelihood of bankruptcy. This is expected given that change in auditor is associated with the perception of lower quality audits (Robertson et al., 2014) or an indication of issues with current auditors around going-concern (Senteney et al., 2006).[3]

Finally, we include the change in auditor opinion (*ΔAudOp*), and expect a positive coefficient, indicating that a move to a less favorable opinion will be associated with a higher likelihood of bankruptcy.

The appendix to the paper presents definitions and the measurement of the financial and non-financial or operational measures used in the above model.

## DESCRIPTIVES AND EMPIRICAL RESULTS

### Descriptives

Table 2, panel A, presents the descriptive statistics and univariate differences for the variables in the sample of 942 bankruptcy firm-year observations and 48,506 non-bankruptcy firm-year observations.

[3] We treat a change from Arthur Anderson to any auditor during the year 2002 as a no-change observation since firms were forced to change auditors following the bankruptcy of Arthur Anderson.



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**Table 2**
**PANEL A: DESCRIPTIVE STATISTICS: COMPARATIVE MEAN & MEDIAN VALUES OF VARIABLES FOR BANKRUPTCY & NON-BANKRUPTCY FIRMS**

| | Bankruptcy Firms | | Non-Bankruptcy Firms | | | |
|---|---|---|---|---|---|---|
| Variable | Mean | Median | Mean | Median | Mean difference | Median difference |
| *WC(alt)* | -0.004 | 0.087 | 0.193 | 0.17 | -0.197[a] | -0.084[a] |
| *RE(alt)* | -0.506 | -0.046 | 0.18 | 0.219 | -0.686[a] | -0.264[a] |
| *EBIT(alt)* | -0.052 | 0.027 | 0.092 | 0.092 | -0.144[a] | -0.065[a] |
| *MVE(alt)* | 1.059 | 0.277 | 3.41 | 1.382 | -2.351[a] | -1.105[a] |
| *S(alt)* | 1.149 | 1.029 | 1.151 | 0.993 | -0.002 | 0.036 |
| Δ*MktSh* | 0.407 | 0.046 | 0.377 | 0.097 | 0.03 | -0.051[a] |
| Δ*Emply* | 0.147 | -0.015 | 0.182 | 0.027 | -0.034 | -0.041[a] |
| *LitStlm* | 3.50% | | 5.09% | | -1.59%[b] | |
| *LitRisk* | 21.34% | | 23.88% | | -2.54%[c] | |
| *MergAcq* | 21.34% | | 38.12% | | -16.78%[a] | |
| *LevBuy* | 0.00% | | 0.46% | | -0.46%[b] | |
| *ΔAυδιτορ* | 6.79% | | 4.98% | | 1.81%[b] | |
| *ΔAυδOπ* | 20.49% | | 10.53% | | 9.96%[a] | |
| Firm-Year Observations | 942 | | 48,506 | | | |

All variables are defined in the appendix.
a,b,c denote significance at the 1%, 5%, and 10% levels, respectively, based on two-sided t-statistics for mean differences, Wilcoxon z-scores for median differences in continuous variables, and Chi-square tests or Fisher tests for differences in categorical variables.

The Table 2, panel A, shows that mean (median) financial statement ratios of non-bankruptcy firms, other than sales (*S(alt)*), are significantly greater than that of the ratios of bankruptcy firms. For example, the mean (median) working capital ratio (*WC(alt)*) is -0.004(0.087) and 0.193(0.170) for bankruptcy and non-bankruptcy firms, respectively. The mean (median) market value of equity ratio (*MVE(alt)*) is 1.059(0.277) and 3.410(1.382) for bankruptcy and non-bankruptcy firms, respectively. Bankruptcy firms also have a lower increase in employees and less prevalence of litigation settlement than non-bankruptcy firms (mean and median differences in *ΔEmply* are -0.034 and -0.041, respectively, significant at the 1% level, and mean difference in *LitStlm* is -1.59%, significant at the 5% level). Furthermore, bankruptcy firms have a higher incidence of change in auditors as well as opinion (mean difference in *ΔAuditor* is 1.81%, significant at the 5% level, and mean difference in *ΔAudOp* is 9.96%, significant at the 1% level).

**Table 2**
**PANEL B: PEARSON CORRELATION COEFFICIENTS: N=49,448**

| | *RE(alt)* | *EBIT(alt)* | *MVE(alt)* | *S(alt)* | Δ*MktSh* | Δ*Emply* | *LitStlm* | *LitRisk* | *MergAcq* | *LevBuy* | *ΔAuditor* | Δ*AudOp* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | |
| ***WC(alt)*** | 0.246[a] | 0.208[a] | 0.241[a] | 0.154[a] | 0.000 | -0.004 | -0.013[a] | 0.234[a] | 0.026[a] | 0.009[b] | -0.043[a] | -0.056[a] |
| | | | | | | | | | | | | |



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| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ***RE(alt)*** | | 0.575[a] | 0.018[a] | 0.080[a] | -0.007 | -0.005 | -0.037[a] | -0.073[a] | 0.006 | 0.012[a] | -0.032[a] | -0.045[a] |
| ***EBIT(alt)*** | | | 0.072[a] | 0.163[a] | -0.009[b] | -0.003 | -0.011[b] | -0.035[a] | -0.002 | 0.010[b] | -0.036[a] | -0.059[a] |
| ***MVE(alt)*** | | | | -0.064[a] | 0.004 | 0.004 | 0.014[a] | 0.189[a] | -0.033[a] | -0.015[a] | 0.006 | -0.008[c] |
| ***S(alt)*** | | | | | -0.010[b] | -0.006 | -0.032[a] | 0.135[a] | 0.029[a] | 0.043[a] | -0.043[a] | -0.040[a] |
| ***∆MktSh*** | | | | | | 0.017[a] | -0.003 | -0.003 | -0.005 | -0.001 | -0.001 | 0.008[c] |
| ***∆Emply*** | | | | | | | -0.002 | 0.000 | 0.006 | -0.001 | 0.021[a] | -0.003 |
| ***LitStlm*** | | | | | | | | 0.028[a] | -0.137[a] | -0.016[a] | -0.008[c] | 0.071[a] |
| ***LitRisk*** | | | | | | | | | -0.027[a] | -0.005 | 0.005 | 0.019[a] |
| ***MergAcq*** | | | | | | | | | | -0.053[a] | -0.023[a] | -0.059[a] |
| ***LevBuy*** | | | | | | | | | | | -0.011[b] | -0.021[a] |
| ***∆Auditor*** | | | | | | | | | | | | 0.018[a] |

All variables are defined in the appendix.
a,b,c denote significance at the 1%, 5%, and 10% levels, respectively.

Table 2, panel B, provides Pearson correlation coefficients between the financial and non-financial measures. The correlation between *RE(alt)* and *EBIT(alt)* is relatively high (r = 0.575). However, concerns with collinearity problems are customarily overlooked in the Altman (1968) model in favor of retaining this combination of variables in the model. Moreover, since the group performs well in discriminant analysis, the literature historically utilizes the model as it is. As for the operational effects variables, while many of the variables are significantly related to each other, the coefficient values of the related variables are rather low, with the highest coefficient value at r = -0.137 for the negative correlation between *MergAcq* and *LitStlm*. Hence, none of these correlations appears large enough to present collinearity problems.

## Results of Logit Regressions

We begin by presenting the results of the logistic regressions. Table 3 provides the empirical results for the sample of bankrupt and non-bankrupt firms one-year, two-years, and three-years prior to bankruptcy (Liedtka, 2002).

**Table 3**
**LOGISTIC REGRESSION COEFFICIENTS (P-VALUES) FOR SAMPLE OF NON-BANKRUPT FIRMS AND BANKRUPT FIRMS ONE-YEAR, TWO-YEARS AND THREE-YEARS PRIOR TO BANKRUPTCY: N=48,820**

| | | **One-year prior to bankruptcy** | | **Two-years prior to bankruptcy** | | **Three-years prior to bankruptcy** | |
|---|---|---|---|---|---|---|---|
| **Independent Variable** | Sign Estimate | **Model 1** | **Model 2** | **Model 1** | **Model 2** | **Model 1** | **Model 2** |
| ***Intercept*** | ? | -2.198 | -2.173 | -2.257 | -2.159 | -2.268 | -2.133 |
| | | (0.000[a]) | (0.000[a]) | (0.000[a]) | (0.000[a]) | (0.000[a]) | (0.000[a]) |
| ***WC(alt)*** | _ | -1.687 | -1.617 | -0.520 | -0.487 | 0.002 | 0.012 |
| | | (0.000[a]) | (0.000[a]) | (0.000[a]) | (0.002[a]) | (0.988) | (0.940) |
| ***RE(alt)*** | _ | -0.071 | -0.066 | -0.040 | -0.039 | -0.038 | -0.039 |
| | | (0.000[a]) | (0.000[a]) | (0.004[a]) | (0.003[a]) | (0.001[a]) | (0.000[a]) |



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| | | | | | | | |
|---|---|---|---|---|---|---|---|
| ***EBIT(alt)*** | _ | -2.325 | -2.253 | -1.984 | -2.013 | -1.458 | -1.485 |
| | | (0.000[a]) | (0.000[a]) | (0.000[a]) | (0.000[a]) | (0.000[a]) | (0.000[a]) |
| ***MVE(alt)*** | _ | -0.136 | -0.132 | -0.042 | -0.043 | -0.073 | -0.076 |
| | | (0.098[c]) | (0.021[b]) | (0.396) | (0.422) | (0.011[b]) | (0.013[b]) |
| ***S(alt)*** | _ | 0.118 | 0.122 | 0.045 | 0.052 | 0.016 | 0.020 |
| | | (0.000[a]) | (0.000[a]) | (0.041[b]) | (0.019[b]) | (0.503) | (0.395) |
| ***ΔMktShr*** | _ | | -0.092 | | 0.000 | | 0.000 |
| | | | (0.362) | | (0.257) | | (0.392) |
| ***ΔEmply*** | _ | | -0.055 | | 0.000 | | 0.000 |
| | | | (0.816) | | (0.817) | | (0.186) |
| ***LitStlm*** | _ | | -0.201 | | -0.175 | | -0.372 |
| | | | (0.056[c]) | | (0.145) | | (0.005[a]) |
| ***LitRisk*** | _ | | 0.040 | | -0.046 | | -0.011 |
| | | | (0.616) | | (0.640) | | (0.888) |
| ***MergAcq*** | _ | | -0.347 | | -0.324 | | -0.326 |
| | | | (0.000[a]) | | (0.000[a]) | | (0.000[a]) |
| ***LevBuy*** | _ | | -4.502 | | -4.112 | | -3.000 |
| | | | (0.000[a]) | | (0.000[a]) | | (0.000[a]) |
| ***ΔAuditor*** | + | | 0.121 | | 0.060 | | -0.179 |
| | | | (0.190) | | (0.554) | | (0.098[c]) |
| ***ΔAudOp*** | + | | 0.381 | | 0.058 | | -0.062 |
| | | | (0.000[a]) | | (0.428) | | (0.399) |
| ***Industry*** | | Controlled | Controlled | Controlled | Controlled | Controlled | Controlled |
| ***Year*** | | Controlled | Controlled | Controlled | Controlled | Controlled | Controlled |
| ***Psuedo $R^2$*** | | 26.14% | 28.79% | 8.22% | 9.65% | 5.07% | 6.78% |

All variables are defined in the appendix.
a,b,c denote two-tailed significance at the 1%, 5%, and 10% levels, respectively.

The first columns of results provide the empirical results of the logistic regression analysis utilized to replicate the Altman (1968) model (model 1) as well as the combined model for bankruptcy firms (model 2) one-year prior to bankruptcy. Results of model 1 indicate that four of the five financial statement variables (working capital, retained earnings, earnings before interest and taxes, and market value of equity) are significantly related to the probability of bankruptcy in the predicted direction. Sales is significantly related to the probability of bankruptcy but in the opposite direction (coefficient on *S(alt)* is 0.118, significant at the 1% level). Results for model 2 which includes the operational variables show the same pattern as model 1 on the five financial ratio variables. Furthermore, four operational factors are significantly associated with the probability of bankruptcy: litigation settlement is significantly negative (coefficient = -0.201, significant at the 10% level), indicating that bankrupt firms are less likely to enter into settlement agreements; merger and acquisition activity is significantly negative (coefficient = -0.347, significant at the 1% level), indicating that bankruptcy firms are less likely to enter into merger and acquisition activities one year prior to bankruptcy; incidence of a leveraged buyout has a significant and negative coefficient (coefficient = -4.502, significant at the 1% level), indicating that bankrupt firms are less likely to engage in a leveraged buyout one year prior to bankruptcy; and the change in the auditor opinion is positive and significant (coefficient = 0.381, significant at the 1% level), indicating that bankrupt firms are more likely to move to a less favorable opinion in the year prior to bankruptcy. The explanatory power of the model is improved ($R^2$=28.79%) as compared to the Altman (1968) model ($R^2$=26.14%). As



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expected one year prior to bankruptcy, after controlling for financial measures, as hypothesized, several non-financial and operational measures are significantly related to future bankruptcy: litigation settlement, merger and acquisition activity, incidence of a leveraged buyout and the change in the auditor opinion with the likelihood of moving to a less favorable opinion in the year prior to bankruptcy.

The next two columns present the results of the logistic regression two years prior to bankruptcy. The Pseudo $R^2$ for model 2 is 9.65% as compared to that of the Altman model of 8.22%. The coefficients are similar to those one year prior to bankruptcy, except the market value of equity is not significant in either model two years prior to bankruptcy. The two variables, litigation settlement and change in auditor opinion, are no longer significantly related to the probability of bankruptcy, although the direction of relationship remains as before. As expected, two years prior to bankruptcy, leveraged buyout and merger and acquisition activity continue as significantly strong indications of corporate failure. Change in market share slightly increased in significance, although the strength in significance two years prior to bankruptcy of the bankruptcy indicators, change in employees, litigation settlement, litigation risk, change in auditor and change in audit opinion unexpectedly declined. In that there remains a relationship between the hypothesized variables and bankruptcy, albeit weak, we interpret this as a possible timing issue i.e., indicative of untimely or delayed reporting or recognition of the hypothesized nonfinancial activities. Delays or untimely reporting typically impair the decision usefulness of proxies for firms' performance. A primary underlying motivation for such delays is the impact of such proxies (for loss recognition) on equity incentives (see Dechow et al., 2011, 264).

The final two columns present the results three years prior to bankruptcy. As before, the explanatory power of model 2 exceeds that of model 1. The Pseudo $R^2$ for model 2 is 6.78% as compared to that of the Altman model of 5.07%. Two financial ratio variables, working capital and sales, are no longer significantly related to the probability of bankruptcy. Four non-financial and operational measures remain associated with bankruptcy: litigation settlement, undertaking a merger and acquisition, undertaking a leveraged buyout, and changing audit firms (coefficient of *LitStlm* is -0.372, significant at the 1% level; coefficient of *MergAcq* is -0.326, significant at the 1% level; coefficient of *LevBuy* is -3.000, significant at the 1% level; coefficient of *ΔAuditor* is -0.179, significant at the 10% level). As expected, years before their ultimate failure, firms tend to informally work toward resolving issues related to unbooked liabilities. For instance, our results indicate that three years prior to bankruptcy, firms attempt to control bad news by strategically settling litigation out-of-court, changing auditors, engaging in merger and acquisition negotiations, and partaking in leveraged buyouts.

Overall, the results show an improvement in models that include not only financial ratios, but non-financial and operational measures. The non-financial measures that are associated with the probability of bankruptcy are litigation settlement and restructuring in the form of a merger/acquisition or a leveraged buyout. Moreover, change in auditor opinion or change in auditor is also associated with a greater probability of bankruptcy, yet only when they occur in specific time intervals relative to the period of bankruptcy. Contrary to our expectations, one measure that was not found to be significantly associated with the probability of bankruptcy is the growth potential, captured by the change in market share and the change in number of employees. We also did not expect to find a differential effect across time periods for the change in auditor and change in auditor's opinion variables. Issues such as untimely reports of liabilities or unreported liabilities, unreported internal activities, and the use of data captured during business periods employing outdated accounting standards may be contributing factors that



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impair accurately measuring nonfinancial variables. Even though the above tests do not strongly indicate which model performs better in terms of detection rates equally across every pre-bankruptcy year, it is clear that there are non-financial or operational factors that are strongly associated with bankruptcy at different times in pre-bankruptcy decision process that are not captured in a purely financial detection model.

## Classification of Bankruptcy Firms

In this section, we present discriminant analysis results for the financial and combined models to enable us to compare the misclassification of bankrupt and non-bankrupt firms using both models. However, rather than using the full sample to measure the discriminant analysis function as well as estimate misclassification, we use the U-method, which is based on the "leave one-out" principle. This method is similar to selecting a hold-out sample on which to test the discriminant analysis function. Specifically, the discriminant function is fitted to repeatedly drawn samples of the original population. Therefore, a dataset with 100 observations would involve 100 different discriminant analyses being performed, each on 99 of the 100 observations. Each time the discriminant function is calculated, it is used to classify the remaining observation that was not involved in the calculation of the function Table 4.

**Table 4**
**PERCENTAGE OF CORRECTLY CLASSIFIED AND MISCLASSIFIED BANKRUPTCIES AND NON-BANKRUPTCIES USING DISCRIMINANT ANALYSIS FOR MODELS 1 AND 2 USING U-METHOD N=48,820**

| | **Model 1** | | **Model 2** | |
|---|---|---|---|---|
| | Percent Correct | Percent Error | Percent Correct | Percent Error |
| **One-year prior to bankruptcy** | | | | |
| Bankrupt | 57.32 | 42.68 | 60.83 | 39.17 |
| Non-Bankrupt | 95.86 | 4.14 | 95.35 | 4.65 |
| **Two-years prior to bankruptcy** | | | | |
| Bankrupt | 46.18 | 53.82 | 50.64 | 49.36 |
| Non-Bankrupt | 88.63 | 11.37 | 87.85 | 12.15 |
| **Three-years prior to bankruptcy** | | | | |
| Bankrupt | 40.76 | 59.24 | 50.96 | 49.04 |
| Non-Bankrupt | 83.89 | 16.11 | 80.84 | 19.16 |

All variables are defined in the appendix.
a,b,c denote significance at the 1%, 5%, and 10% levels, respectively.

We find that the combined model outperforms the financial model for each of the three years prior to bankruptcy. The results show that model 1 correctly identifies 57%, 46%, and 41% of bankrupt firms one-year, two-years and three-years prior to bankruptcy, respectively. By contrast, the combined model correctly identifies 61%, 51% and 51% of the bankruptcy firms for these same pre-bankruptcy periods. The range of difference for correct classification is from 4 to 10%. For all years prior to bankruptcy, correct classification of non-bankrupt firms is similar for both models with a range of difference from 1 to 3%. For example, for non-bankrupt firms, the financial model is successful in classifying 96%, 89% and 84% and the combined model classifies 95%, 88%, and 81% correctly one, two and three years prior to bankruptcy, respectively. The classification rates of bankrupt firms are much smaller than those found in previous literature (Altman, 1968; Ohlson, 1980) since their sampling methodology is over-represented with bankrupt firms and this can overestimate detection rates (Gilbert et al., 1990).



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## Hazard Model Results

Proportional hazard models relate the time that passes before some event occurs (in this case, bankruptcy) to variables that may be related to the event. The main benefit of using this methodology is that a hazard model is not static and controls for each firm's period at risk (Shumway, 2001). Table 5 reports hazard model coefficients for individual model effects (analysis of maximum likelihood estimates) on the same variables reported in Table 3. The hazard analysis indicates that operational factors could lessen the importance of financial factors (working capital, retained earnings, and sales) in determining the likelihood of filing for bankruptcy the further away the analysis is from the bankruptcy filing.

**Table 5**
**PROPORTIONAL HAZARD MODEL COEFFICIENTS (P-VALUES) FOR SAMPLE OF NON-BANKRUPT FIRMS AND BANKRUPT FIRMS ONE-YEAR, TWO-YEARS AND THREE-YEARS PRIOR TO BANKRUPTCY N=48,820**

| | | One-year prior to bankruptcy | | Two-years prior to bankruptcy | | Three-years prior to bankruptcy | |
|---|---|---|---|---|---|---|---|
| **Independent Variable** | Sign Estimate | **Model 1** | **Model 2** | **Model 1** | **Model 2** | **Model 1** | **Model 2** |
| ***WC(alt)*** | _ | -0.146 | -0.251 | -0.673 | -0.601 | -0.114 | -0.053 |
| | | (0.092[c]) | (0.005[a]) | (0.001[a]) | (0.003[a]) | -0.65 | -0.83 |
| ***RE(alt)*** | _ | -0.021 | -0.039 | 0.354 | 0.345 | -0.094 | -0.1 |
| | | -0.285 | (0.061[c]) | (0.000[a]) | (0.000[a]) | (0.047[b]) | (0.044[b]) |
| ***MVE(alt)*** | _ | -1.363 | -0.851 | -3.187 | -3.141 | -0.189 | -0.14 |
| | | (0.000[a]) | (0.001[a]) | (0.000[a]) | (0.000[a]) | -0.255 | -0.418 |
| ***EBIT(alt)*** | _ | -1.094 | -1.048 | -0.334 | -0.365 | -0.299 | -0.328 |
| | | (0.000[a]) | (0.000[a]) | (0.000[a]) | (0.000[a]) | (0.000[a]) | (0.000[a]) |
| ***S(alt)*** | _ | -0.19 | -0.158 | 0.002 | 0.008 | -0.038 | -0.046 |
| | | (0.008[a]) | (0.030[b]) | -0.97 | -0.908 | -0.583 | -0.519 |
| ∆***MktShr*** | _ | | -0.052 | | 0 | | 0 |
| | | | -0.692 | | -0.96 | | -0.752 |
| ∆***Emply*** | _ | | -0.521 | | 0 | | 0.001 |
| | | | (0.038[b]) | | -0.966 | | -0.809 |
| ***LitStlm*** | _ | | -0.337 | | -0.33 | | -1.021 |
| | | | -0.238 | | -0.247 | | (0.008[a]) |
| ***LitRisk*** | + | | 0.461 | | 0.206 | | 0.195 |
| | | | (0.002[a]) | | -0.164 | | -0.187 |
| ***MergAcq*** | _ | | -0.791 | | -0.881 | | -0.924 |
| | | | (0.000[a]) | | (0.000[a]) | | (0.000[a]) |
| ***LevBuy*** | _ | | -11.549 | | -11.839 | | -11.792 |
| | | | -0.961 | | -0.962 | | -0.959 |
| ∆***Auditor*** | + | | 0.344 | | 0.108 | | -0.479 |
| | | | (0.083[c]) | | -0.634 | | -0.12 |
| ∆***AudOp*** | + | | 1.367 | | 0.289 | | -0.05 |
| | | | (0.000[a]) | | (0.069[c]) | | -0.785 |
| $\chi^2$ | | 442.57 | 626.31 | 213.78 | 270.93 | 122.52 | 187.43 |

The results show that, in Model 1, one year before bankruptcy, all but one of the financial variables (retained earnings) are associated with bankruptcy. However, some financial variables lose significance in periods over one year prior to bankruptcy. For example, two years prior to



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bankruptcy, sales loses significance in both models and three years prior to bankruptcy, three variables, working capital, market value of equity and sales lose significance in both models. Similarly, the operational variables that are associated with bankruptcy vary over the years. For example, one year prior to bankruptcy, in the combined model, five of the operational variables (change in employees, litigation risk, merger/ acquisition, auditor change and audit opinion change) included in the combined model are associated with bankruptcy (coefficient of *ΔEmply* is -0.521, significant at the 5% level; coefficient of *LitRisk* is 0.461, significant at the 1% level; coefficient of *MergAcq* is -0.791, significant at the 1% level; coefficient of *ΔAuditor* is 0.344, significant at the 10% level; coefficient of *ΔAudOp* is 1.367, significant at the 1% level). The results show the failure of bankruptcy firms to effectively restructure through the self-help mechanisms of consummating relationships with new business alliances, layoffs of the workforce, and distancing the firms from past auditors and audit opinions one year before bankruptcy. Moreover, the effects of litigation risk indicate a strong association between bankruptcy and the firm's industry placement (Maines et al., 2002).

Two years prior to bankruptcy, decreased working capital, increased retained earnings, decreased earnings, decreased market value of equity, audit opinion change and merger/ acquisition are strongly associated with a firm's risk of filing bankruptcy (coefficient of *MergAcq* is -0.881, significant at the 1% level; coefficient of *ΔAudOp* is 0.289, significant at the 10% level). Three years prior to bankruptcy, only two financial variables (retained earnings and earnings) and two operational variables (litigation settlement and merger/acquisition) are associated with the likelihood of filing bankruptcy (coefficient of *LitStlm* is -1.021, significant at the 1% level; coefficient of *MergAcq* is -0.924, significant at the 1% level).

For all three years, model 2 specification is higher than that of model 1 (Chi-square likelihood ratio is 442.57 and 626.31 for model 1 and model 2, respectively one year prior to bankruptcy; Chi-square likelihood ratio is 213.78 and 270.93 for model 1 and model 2, respectively two years prior to bankruptcy; Chi-square likelihood ratio is 122.52 and 187.43 for model 1 and model, respectively three years prior to bankruptcy).

In comparing the results from the logistic regression to the hazard model, we find that the results are similar, except that the change in employees' variable is only significant using the hazard model one-year prior to bankruptcy. Furthermore, litigation settlement is only significant three years prior to bankruptcy using the hazard model in contrast to the logistic regression results in which it is also significant one-year prior to bankruptcy. While the results indicate a negative association between bankruptcy and leveraged buyouts, the coefficients lose their significance in the hazard model in contrast to the strong significance in the logistic regression model for all three years prior to bankruptcy. While the effects of auditor change and audit opinion change vary, the hazard model indicates a strong direct association between bankruptcy and auditor change in the short-term (one year prior to bankruptcy), as well as a strong link to audit opinion change two years and one year prior to bankruptcy.

Overall, the significant operational variables in the hazard model that are consistent with the logistic regression model are litigation settlement and mergers and acquisitions, as well as the change in the auditor's opinion (Beaver et al., 2005, Powell & Yawson, 2007).

## CONCLUSION

Bankruptcy research indicates that there are now secular changes in the explanatory power of financial ratios with respect to bankruptcy. In particular, forces over the last 40 years



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potentially affect the ability of financial ratios to predict bankruptcy. This study extends bankruptcy prediction research by investigating a subset of variables that provide explanatory power to bankruptcy models. The extended model that includes non-financial and operational measures in addition to the traditional financial ratios is tested for its overall performance over a series of three pre-bankruptcy years. We find that these variables prove to be significantly useful indicators of forthcoming bankruptcy. The empirical results provide evidence that the informativeness of financial ratios weakens as the length between the prediction period and the bankruptcy filing date increases. Furthermore, we find that the performance of a model that includes both financial ratios and non-traditional measures is stronger than a model that includes only financial variables. These findings show that these non-traditional measures are informative and provide relevant and timely signals to stakeholders in advance of bankruptcy. Our findings contribute to the literature by developing a relevant theoretically-based model which includes qualitative considerations. The results suggest that due to information asymmetry in financial reporting, other factors should be considered in determining the likelihood of bankruptcy.

Going forward, Maines advance the notion *"that research suggests that noncomparability among types and formats likely hampers investors' ability to use nonfinancial measures. There is a trade-off, however, between ease of comparability and having firms provide disclosures that reflect the economics of the firm and management's strategy for the firm."* Hence, we contend that to the extent that policymakers, stockholders, bondholders and other stakeholders would benefit from early detection of signs of bankruptcy, this study provides insight into important factors associated with bankruptcy.

## Appendix

**APPENDIX**
**VARIABLE DEFINITIONS**

| Variable Name | Measurement | Definition | COMPUSTAT Data Item Number |
|---|---|---|---|
| **Financial Variables:** | | | |
| *WC(alt)* | WC/TA | Working capital | 179/6 |
| *RE(alt)* | RE/TA | Retained earnings | 36/6 |
| *EBIT(alt)* | EBIT/TA | Earnings before interest and tax | 178/6 |
| *MVE(alt)* | MVE/TL | Market value of equity | 199*25/181 |
| *S(alt)* | S/TA | Sales | 6-Dec |
| **Non-financial and Operational Variables:** | | | |
| Δ*MktShr* | Change in firm revenue / Total revenue of industry from prior year to current year | Change in market share | 12 |
| Δ *Emply* | Change in log(Emply) from prior year to current year | Change in employees (logarithmic) | 29 |
| *LitStlm* | 1=Litigation settlement, 0=otherwise | Litigation settlement dummy | 372 |
| *LitRisk* | 1=Litigious Industries, 0=otherwise | Litigation risk | |
| *MergAcq* | 1=had a merger or acquisition, 0=otherwise | Mergers and acquisitions | |
| *LevBuy* | 1=underwent a leveraged buyout, 0=otherwise | Leveraged buyout | |



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| | | | |
|---|---|---|---|
| Δ*Auditor* | 1=auditor in current year is different than that in prior year, adjusted for Arthur Anderson change in year 2002, | | |
| | 0=otherwise | Auditor change | 149 |
| Δ*AudOp* | 1=auditor opinion in current year is more adverse than that in prior year, 0=otherwise | Auditor opinion change | 149 |

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**Citation Information:** Lloyd, C.B., Ibrahim, S., & Keys, P.Y. (2022). Identifiable attributes of successful restructuring potential. *Academy of Accounting and Financial Studies Journal, 26*(6), 1-19.

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**Received:** 22-Sep-2022, Manuscript No. AAFSJ-22-12599; **Editor assigned:** 23-Sep -2022, PreQC No. AAFSJ-22-12599(PQ); **Reviewed:** 07-Oct-2022, QC No. AAFSJ-22-12599; **Revised:** 11-Oct-2022, Manuscript No. AAFSJ-22-12599(R); **Published:** 18-Oct-2022



**Citation Information:** Lloyd, C.B., Ibrahim, S., & Keys, P.Y. (2022). Identifiable attributes of successful restructuring potential. *Academy of Accounting and Financial Studies Journal, 26*(6), 1-19.