Two Discriminant Analysis Models of Predicting Business Failure: A Contrast of the Most Recent with the First Model

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Managers can use models for predicting business failures to assess an organization's success or distress. Hundreds of such models have been constructed over last forty-five years. Altman's (1968) paper is the oldest and Bhandari and Iyer's (2013) paper, here after Bhandari (2013) is the most recent. Although both used discriminant analysis technique on matched sample of failed and non-failed firms they differ in all other respects. Altman's model by far is the most popular; it focused on publicly held manufacturing corporations, using balance sheet and income statement based ratios (none from cash flow statement) as explanatory variables. Bhandari's sample firms belonged to more than 25 industries and used financial ratios based on all three financial statements. Altman explored 22 ratio variables to select five best and justified them post-facto. Bhandari on the other hand used seven a-prior logically justified explanatory variables. This paper compares, contrast and critiques these two models.

INTRODUCTION

Managers in any organization, profit or nonprofit, are naturally concerned with the success or distress of his or her firm. One method of assessing a firm's performance is to use a composite measure which is based upon its financial statement data. Over the last 45 years, hundreds of studies have been published which constructed models to predict business failure. These models give numerical value, which depending upon its proximity to two extreme values (centroids), can be interpreted as degree of future distress (or success). These studies used U.S. and non-U.S. firms to build models based upon simple (univariate) or complex (multivariate) statistical techniques. Most of these studies focused on one particular industry. The data set consisted of for-profit business firm declaring bankrupt over a certain period. Bellovary et al (2007) summarized and analyzed 165 bankruptcy prediction models published from 1965 to 2004. Many more studies have followed since then and the others will follow in the future. According to Bellovary et al (2007) there are great varieties in bankruptcy prediction models from how many factors are considered to what methods are employed to develop model. The number of factors or explanatory variables ranged from 1 to 57. In addition to discriminant analysis, other techniques used were logit analysis, probit analysis, regression analysis, and neural network. Altman's (1868) model is the oldest and the most widely cited model using multivariate discriminant analysis (MDA) to predict corporate bankruptcy.

The purpose of this paper is to compare, contrast and critique two models of predicting business failure published 45 years apart: Altman in 1968 and Bhandari and Iyer's in 2013. Although both used discriminant analysis statistical technique (DA) on matched samples of failed and non-failed firms, they

differ in all other respect. Professor Altman is a prolific researcher, writer and author on the subject of business failure. His 1968 paper, published in the *Journal of Finance,* is the first to use DA to predict corporate bankruptcy, and Bhandari and Iyer's (2013) paper, published in *Managerial Finance,* is the most recent article on the same topic. In between hundreds of efforts were made in many countries on this topic.

Altman's (1968) twenty-one page paper is a highly acclaimed work in the area of bankruptcy prediction. It discussed traditional ratio analysis and its limitation; explained various aspects of multiple discriminant analysis (MDA); used MDA to build failure prediction model; and extensively discussed empirical results and its usefulness in: credit evaluation, predicting corporate problems, selecting appropriate investment policy, short-sale opportunities and merger decision. His model is widely cited in management books, in spite of its limitations, as acknowledged by him: "A limitation of this study is that the firms examined were all publicly held manufacturing corporations for which comprehensive financial data were obtainable, including market price quotations" (Altman, 1968, p.609). Bhandari and Iyer's (2013) ten-page paper is the most recent paper on the same topic. It used sample of firms which failed in 22 different industries during the 2008-2010 economic recession period.

This paper critiques the two papers in the following topical sequence: selection of sample firms, choice of explanatory variables, specification of models, results of analysis and validation of discriminant function, and ends with a summary and conclusion.

SELECTION OF SAMPLE FIRMS

Although, both the studies used DA technique on a matched sample, Altman (1968) used 66 publicly held manufacturing firms; whereas Bhandari-Iyer (hereafter Bhandari (2013)), used 100 firms from 22 different industries. Bhandari's model therefore, is a general purpose model which can be applied across industries, as long as all three financial statements are available. Altman picked 33 bankrupt firms "that filed a bankruptcy petition under Chapter X of the national bankruptcy act during the period 1946-1965."(Altman, 1968, p.593) Bhandari's 2013 sample consisted of 50 inactive (or failed) firms over a 3-year period (2008-2010) from COMPUSTAT data base. However, due to missing data, only 78 firms entered the test sample. Both studies paired or matched each failed firm with a non-bankrupt or non-failed firm on the basis of asset size and industry or standard industrial classification (SIC) code respectively. Temporal instability, inconsistencies, lack of uniformity of accounting procedures and fluctuations in external economic environment over 20-year period arguably impaired Altman's data set a lot more than Bhandari's 2013 data set.

CHOICE OF EXPLANATORY VARIABLES

Both authors used financial statement data one year prior to bankruptcy. However Altman (1968) used information from only accrual accounting based statements: balance sheet and income statement, none from the cash flow statement (CFS). Bhandari (2013) used all three financial statements as source for calculating key financial ratios. The rationale behind use of CFS based information is that cash inadequacy, resulting in default on debt obligations, is the main reason for business failure or bankruptcy proceeding . Bhandari (2013) justified importance of cash flow as follows:

> *Ever since accrual accounting system was adopted for recording and reporting business transactions, balance sheets and income statements were the main source of information for academics, analysts and investors for their research and decision making purposes. The importance of cash flow, though intuitive was not realized until the accounting regulators and textbook authors started emphasizing CFS. "Cash is King" phrase is now widely understood and respected. Obviously because cash is what buys things, pays wages and salaries; services and pays debt; and compensates stockholders (owners) - not accounting income! Inadequate cash can lead to default on accrued payables and ultimate bankruptcy. The most important and useful information in CFS is operating cash*

flow (OCF). A business is supposed to operate profitably and generate cash. OCF is that number! (Bhandari and Iyer, 2013, p.668)

There is a vast difference in Altman (1968) and Bhandari (2013) studies in selection of predictor variables. Altman (1968) started with "twenty-two potentially helpful variables (ratios)" (p.594) from which five variables were selected. He used different ratio profiles to perform discriminant analysis. When best prediction accuracy was achieved, he provided theoretical justification for inclusion of these five variables in his model. - A *data milking* approach as can be seen from the quote below from Altman's paper:

Because of the large number of variables found to be significant indicators of corporate problem in past studies, a list of twenty-two potentially helpful variables (ratios) is compiled for evaluation. The variables are classified into five standard ratio categories including liquidity, profitability, leverage, solvency and activity ratios. The ratios are chosen on the basis of their (1) popularity in the literature (2) potential relevance to the study and a few "new" ratios initiated in this paper. From the original list of variables, five variables are selected as doing the best overall job together in the prediction of corporate bankruptcy. (Altman, 1968, p.594)

Bhandari (2013) used exactly opposite approach. They selected seven predictor variables. The choice of these variables was logically justified before inclusion in the discriminant analysis model, as can be seen from the quote below:

As stated before most of failure prediction models used accrual accountingbased measures. Researchers in the past have used cash flow data but with mixed results. Cash inadequacy and worsening financial performance are often-cited reasons for financial distress or default. We therefore pro-actively selected the following seven predictor or explanatory variables to construct failure prediction model. These cash flow based variables have been cited in the literature as useful measures for evaluating a firm's performance. Instead of milking for predictor variables by churning data set we theoretically justify the choice of these variables. (Bhandari and Iyer, 2013, p.669).

In other words, Altman used *post-facto* approach and Bhandari used *a-priori* approach to justify the selection of explanatory variables. Financial statement data needed to calculate explanatory variables in Altman's model are: total assets (TA), current assets (CA), current liabilities (CL) working capital (WC = CA-CL), retained earnings (RE), earnings before interest and taxes (EBIT), market price of equity shares, total debt, sales and number of shares of preferred and common stock outstanding. Data needed to calculate predictor variables in Bhandari's model are: current assets (CA), current liabilities (CL), inventories (INV), sales, total assets (TA), interest, tax, and earnings before interest and taxes (EBIT).

Most of the ratios computed by both the authors are not popular ratios found in financial management text books and among publishers of industry wide averages. Therefore, we need to understand definition, explanation and justification of predictor variables selected by both the authors. Altman's (1968) post-facto justification for final five explanatory variables, selected from a list of 22 variables is excerpted in Appendix A: The Post-facto Definition, Explanation and Justification of Variables in Altman's (1968) Model.

As stated before Bhandari (2013) used a prior approach to select seven explanatory variables. All these ratios are logically justified for inclusion in the DA model. Although only one, the Quick or Acid-test ratio, is popular in finance textbooks, the remaining six ratios have been cited and supported by researchers in accounting and finance literature. Bhandari's a prior definition, explanation and justifications for selecting these seven measures as explanatory variables is excerpted in Appendix B. The A-prior Definition, Explanation and Justification of Variables in Bhandari's (2013) Model.

From the two appendices, reader can see that only one of the five ratios in Bhandari's model, that is quick ratio, is the traditional ratio, the rest are not. However, the other four ratios parallel the traditional ratios in the sense that they use operating cash flows in the numerator rather than net income.

SPECIFICATION OF MODEL

Both authors chose multivariate linear model and used discriminant analysis to estmate coefficients of explanatory variables of the failure prediction model. Briefly, multiple discriminant analysis is a multivariate technique by means of which multiple measurements are reduced to a single weighted composite score, which can distinguish between members of two or more groups. In case of two groups, the multivariate problem is reduced to a simple univariate problem in the form of an interval scaled measure called a discriminant score. The proximity of this score to the either centroids predicts the degree of financial success or distress of the firm. Most of the business failure, bond rating change, and corporate merger used this technique. Mathematically, the discriminant problem is to obtain coefficients (a_i's) of financial ratio variables (X_i's) in a linear equation,

$$Z = a_0 + a_1X_1 + a_2X_2 + \ldots\ldots + a_nX_n \quad (1)$$

which maximize the discriminant criterion known as Wilk's lambda, where
Wilk's λ = **(**between group variance on 'Z' scores) / (within group variance on 'Z' scores)

Altman (1968, p591, 597) discussed this technique in more details than here. There is copious literature on theoretical and applied aspects of this technique and multitude of papers in biological and social sciences which used discriminant analysis.

RESULTS

Both Altman (1968) and Bhandari (2013) performed univariate and multivariate analysis and presented results of statistical test of significance. Both authors presented group means and univariate tests of significance of each explanatory variable. The separation of group means on all the variables was as expected. Altman's (1968) discriminant function is as follows:

Altman's $Z_A = .012X_1 + .014X_2 + .033X_3 + .006X_4 + .999X_5$, where (2)
Z_A = Discriminant score
X_1 = Working capital/Total assets (WC/TA)
X_2 = Retained Earnings/Total assets (RE/TA)
X_3 = Earnings before interest and taxes/Total assets (EBIT/TA)
X_4 = Market value equity/Book value of total debt (MVofEQ/Debt)
X_5 = Sales/Total assets (Sales/TA)

Alternatively,
Z_A = .012(WC/TA) + .014(RE/TA) + .033(EBIT/TA) + .006(MVofEQ/Debt) + .999(Sale/TA) (3)
Group centroids and midpoint of Altman (1968) model are as follows:

-0.29	2.365	+5.02
Bankrupt	Midpoint	Non-bankrupt

The Altman (1968) model achieved an impressive classification accuracy of 95% on the test sample firms. Four out of five variables were significant at .001 level, variable X_5 was not.

Bhandari's (2013) seven variable discriminant function with intercept term is as follows:
Bhandari $Z_B = -.531 + .675\ X_1 + .001\ X_2 - .028\ X_3 + .637\ X_4 + .096\ X_5 + .165\ X_6 + .006\ X_7$, where (4)
Z_B = Discriminant score
X_1 = Operating cash flow divided by current liabilities (OCF/CL)
X_2 = Cash flow coverage of interest (OCF + INT + Tax / INT)
X_3 = Operating cash flow margin (OCF/Sales)
X_4 = Operating cash flow return on total assets (OCF/Asset)

X_5 = Earning Quality (EBIT/OCF)
X_6 = Quick Ratio or Acid-test ratio, QR or (CA-INV) /CL
X_7 = 3-year sales growth (Sales 3 Yr CAGR)

Alternatively,

$$Z_B = -.531 + .675(OCF/CL) + .001(OCF+INT+TAX/INT) - .028(OCF/Sales) + .637\ (OCF/Asset) + .096(EBIT/OCF) + .165(QR) + .006(Sales\ Growth\ 3\text{-}yr) \quad (5)$$

Group centroids and midpoint of Bhandari (2013) model are as follows:

___ - 0.718	_____ 0.019	_____ +0.756 ____
Failed	Midpoint	Nonfailed

Bhandari (2013) achieved 83.3% classification accuracy, less than Altman's (1968), probably due to a-priori selection of explanatory variables. Variable X_1 (OCF/CL) is significant at .000 level, variables X_4(OCF/Assets), X_6(QR), and X_5(EBIT/OCF) were significant at .007, .041, and .078 levels respectively. The remaining two were significant at 0.13 level.

Both the derived discriminant functions were significant at .000 level. However, both the papers incorrectly reported midpoints between the two centroids, around which an analyst can define the "zone of ignorance" (or indifference). The correct midpoint in Altman's study should be 2.365 (and not 2.675). Similarly midpoint in case of Bhandari (2013) model is 0.019 (and not 0.19). An analyst can arbitrarily define a zone of indecision on either side of these mid-points, instead of treating them as a cutoff value for failure or non-failure decision.

VALIDATION

Since testing a model on the original sample firms, from which the model is derived, is subject to upward bias, both authors used different techniques to test this bias. Altman used a variety of techniques to validate his model: split sample and secondary sample approaches. Bhandari used the Lachenbruch method (leave-one-out) or so-called jackknife method. This method is considered to be an unbiased estimation of classification accuracy. Altman's five replications of split-sample resulted in 91.2 to 97.0 % accuracy. His secondary sample approach resulted in 96 % and 79 % accurate prediction of 25 bankrupt and 66 non-bankrupt firms respectively. Bhandari's jackknife model achieved 79.5 % prediction accuracy.

Altman's Z-scores of Bhandari's 100 sample firms were available for 86 firms in the COMUSTAT data file. The average Z-value of 44 failed, and 42 non-failed firms were -7.07 and 2.0818 respectively. On the basis of a 2.365 cutoffs or midpoint, Altman's Z predicted all but one failed firm correctly, but 19 of non-failed firm incorrectly, an overall 76.7 % prediction accuracy. In other words, Altman's model performed very well in correctly predicting failures (or distress) but did poorly in predicting non-failures (success). Table I summarizes salient features of the two studies.

CONCLUSION

This paper tried to compares, contrasts and critiques the oldest (Altman, 1968) and the most recent (Bhandari, 2013) discriminant analysis based failure prediction models. Although both used the matched sample approach, their models differ in all other respects. Both these and hundreds of other models on this topic can be used to evaluate a firm's degree of impending success or failure on a continuous scale. However, most of these models focused on a particular industry but Bhandari's (2013) model can be used on any profit or nonprofit firm when all three audited financial statements are available.

TABLE I
COMPARISON OF ALTMAN (1968) AND BHANDARI AND IYER (2013) FAILURE PREDICTION MODELS

1		Altman's 1968 Paper	Bhandari and Ayer's 2013 Paper
2	Title	Financial Ratios, Discriminant Analysis and Prediction of Corporate Bankruptcy	Predicting Business Failure Using Cash Flow Statement Based Measures
3	Authors/Affiliation	Edward I. Altman New York University	Shyam B. Bhandari and Rajesh Iyer, Bradley University
4	Journal	Journal of Finance	Managerial Finance
5	Year	1968, September	2013, June
6	Pages	21 (589-609)	10 (667-676)
7	Dependant variable	Bankrupt/Non-bankrupt firm	Inactive/Active firms
8	Independent variables	Five out of 22, post-facto pick	Seven, a-prior selection
9	Sample size	66 paired (33 each)	100 paired (50 each), 78 in test sample.
10	Sample drawn from	1946-1965 period	2008-2010 period
11	Industry	One, manufacturing	Twenty different industries
12	Data source	Income statement and Balance sheet	Cash flow statement, Income statement and Balance sheet
13	Financial Ratios used as independent variables	WC/TA, RE/TA, EBIT/TA, MV OF Eq/DEBT, SALES/TA	OCF/CL,OCF/SALES, QR EBTI/OCF, OCF/ASSETS, 3-YR SALES GROWTH, (OCF+INT+TAX)/INT
14	Classification accuracy	95 %	83.3%
15	Group centroids and Midpoint	-0.29 and +5.02 2.365	-0.718 and +0.756 0.019
16	Order of relative contribution	EBIT/TA, SALES/TA, MV 0f EQUITY/DEBT	OCF/CL, OCF/TA EBIT/OCF
17	Financial statement Items needed	CA, CL, DEBT, TA, RE, MV of Eq, Sales, No. of shares	CA, CL, INV, TA, SALES, INT, EBIT, TAX, OCF
18	Validation Techniques	Split and secondary sample	Lachenbruch's leave-one-out method
19	Application	Publicly held manufacturing firms	Any firm with audited financial statements

Altman's paper nevertheless is the landmark study and is a must-read for any future research in this area. A comparison of the Altman's (the first) and Bhandari's (the most recent) models reveals interesting differences:

1. Altman's 1968 model is industry specific but Bhandari's 2013 model is generic and can be applied to firms across industries.
2. Altman (1968) selected predictor variables by a data milking approach whereas Bhandari used logically justified approach.
3. Altman (1968) used only accrual accounting statement based financial ratios; Bhandari (2013) used cash flow statement based data as well to select explanatory variables.

4. Altman (1968) had a smaller sample drawn over a very long period whereas Bhandari (2013) used a larger sample over a shorter period.
5. The most prominent item in Altman's model is total assets (TA); operating cash flows (OCF) is the most prominent item in Bhandari's (2013) model.
6. Although most of the financial ratios used by Altman (1968) and Bhandari (2013) are not readily available in published sources, Altman's (1968) ratios are not easily calculated unlike Bhandari's (2013).
7. Altman's (1968) model can be replicated only in case of large publicly traded, for profit manufacturing firms, but Bhandari (2013) model can be replicated on both large and small, profit and non-profit, public and private, manufacturing and non-manufacturing firms.
8. Altman's (1968) model is more parsimonious and achieved higher classification accuracy than Bhandari's (2013) model.
9. Altman's (1968) paper covered a variety of issues in much detail, whereas Bhandari's (2013) paper is narrowly focused.

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The author is grateful for helpful comments and suggestions by Dr. Kevin M. Teeven, Professor Emeritus at Bradley University.

APPENDIX A

The Post-facto Definition, Explanation and Justification of Variables in Altman's (1968) Model

X_1-Working Capital/Total Assets. The Working capital/Total assets ratio, frequently found in studies of corporate problems, is a measure of the net liquid assets of the firm relative to the total capitalization. Working capital is defined as the difference between current assets and current liabilities. Liquidity and size characteristics are explicitly considered. Ordinarily, a firm experiencing consistent operating losses

will have shrinking current assets in relation to total assets. Of the three liquidity ratios evaluated, this one proved to be the most valuable. Inclusion of this variable is consistent with the Merwin study which rated the net working capital to total asset ratio as the best indicator of ultimate discontinuance.

X_2,-Retained Earnings/Total Assets. This measure of cumulative profitability over time was cited earlier as one of the "new" ratios. The age of a firm is implicitly considered in this ratio. For example, a relatively young firm will probably show a low RE/TA ratio because it has not had time to build up its cumulative profits. Therefore, it may be argued that the young firm is somewhat discriminated against in this analysis, and its chance of being classified as bankrupt is relatively higher than another, older firm, ceteris paribus… But, this is precisely the situation in the real world. The incidence of failure is much higher in a firm's earlier years[25].

X_3-Earnings Before Interest and Taxes/Total Assets. This ratio is calculated by dividing the total assets of a firm into its earnings before interest and tax reductions. In essence, it is a measure of the true productivity of the firm's assets, abstracting from any tax or leverage factors. Since a firm's ultimate existence is based on the earning power of its assets, this ratio appears to be particularly appropriate for studies dealing with corporate failure…. Furthermore, insolvency in a bankruptcy sense occurs when the total liabilities exceed a fair valuation of the firm's assets with value determined by the earning power of the assets.

X_4-Market Value of Equity/Book Value of Total Debt. Equity is measured by the combined market value of all shares of stock, preferred and common, while debt includes both current and long-term. The measure shows how much the firm's assets can decline in value (measured by market value of equity plus debt) before the liabilities exceed the assets and the firm becomes insolvent…. For example, a company with a market value of its equity of $1,000 and debt of $500 could experience a two-thirds drop in asset value before insolvency. However, the same firm with $250 in equity will be insolvent if its drop is only one-third in value. This ratio adds a market value dimension which other failure studies did not consider[26]. It also appears to be a more effective predictor of bankruptcy than a similar, more commonly used ratio: Net worth/Total debt (book values).

X_5-Sales/Total Assets. The capital-turnover ratio is a standard financial ratio illustrating the sales generating ability of the firm's assets. It is one measure of management's capability in dealing with competitive conditions…. This final ratio is quite important because, as indicated below, it is the least significant ratio on an individual basis. In fact, based on the statistical significance measure, it would not have appeared at all. However, because of its unique relationship to other variables in the model, the Sales/Total assets ratio ranks second in its contribution to the overall discriminating ability of the model. (Altman, 1968, p. 594-595)

APPENDIX B

The A-prior Definition, Explanation and Justification of Variables in Bhandari's (2013) Model

X_1 Operating cash flow divided by current liabilities (OCF/CL): This ratio measures a firm's liquidity by comparing actual cash flow with the short-term obligations. The lower the value of this ratio higher the likelihood of business failure. Wild et al (2001), White et al (1998), Mills and Yamamura (1998), Dennis (1994) and Figlewicz (1991) recommend this ratio as a measure of firm's ability to pay short-term liabilities.

X_2 Cash flow coverage of interest (OCF + INT + Tax / INT): The numerator of this ratio is OCF plus interest and taxes paid. The denominator consists of both short-term and long-term interest. This ratio measures a firm's ability to service (cover) interest obligation on debt. It is similar to the Times Interest Earned (TIE) ratio which is based on data derived from the Income Statement. Higher the value of this ratio means lesser the chance of default on interest payment by a firm. Carslaw and Mills (1991),

Figlewicz et al (1991), White et al (1998), Stickney and Brown (1999), Mills and Yamamura (1998), and Fraser and Ormiston (2001) have recommended this ratio for evaluating a firm's financial strength.

X_3 Operating Cash Flow Margin (OCF/Sales): This ratio is similar to traditional profit margin ratio. It is calculated by dividing net sales into OCF, thereby measuring the ability of a firm to translate sales into cash. Journal articles by Carslaw (1991), Dennis (1994), and Figlewicz (1991) and textbooks authored by Fraser (2010) and White et al (1998) have used this ratio. This ratio is a more appropriate measure of a firm's operating profitability and liquidity as opposed to accrual accounting based profit margin ratios. There are at least four different profit margin ratios depending upon which profit (gross profit, operating profit, pre-tax profit or net profit) is in the numerator. But there is only one OCF margin ratio. This is another reason why the proposed ratio is more useful measure than net profit margin ratio.

X_4 Operating cash flow return on total assets(OCF/Asset): This ratio is similar to return on assets (ROA) but instead of net income, cash flow from operation is used in the numerator. This ratio measures cash generating ability of all the assets, i.e. assets provided by both creditors and stockholders of the firm. Figlewicz and Zeller (1991), Fraser and Orminston (2010) and White et al (1998)] have recommended this ratio…. Other cash flow return ratios similar to return on long-term capital and return on equity (ROE) can also be constructed by replacing OCF for net income in the numerator. For the sake of parsimony we chose not to include these ratio measures.

X_5 Quality of Earning (EBIT/OCF): According to White et al (1998, 956) the quality of earnings usually refers to the degree of conservatism in a firm's reported earnings. … They listed fifteen indicators of high earning quality. Fraser and Ormiston (2010; 149) listed twenty three key areas in the financial statement data that affect earning quality. Wild et al (2001, 143) consider three broad factors as determinants of earning quality. The prevailing practice is to adjust reported the earnings figure so as to obtain a figure which is reflective of the future performance. None of the approaches recommend a comparison with cash flow measures. It may be a highly simplistic approach but a ratio which divides an accrual accounting based earnings figure by a suitable cash flow figure can be a useful measure of earning quality. Thus the operating income (or earnings before interest and taxes) divided by OCF is one such measure. A value less than one signals that (accrual) income is of lesser quality and of impending financial trouble.

X_6 Quick Ratio (Acid-test ratio).This is a traditional but highly popular measure of corporate liquidity. Current assets minus inventories are divided by current liabilities. The "quick" assets are cash, marketable securities, receivables and pre-paid items. A lower value of this ratio is associated with firm under distress.

X_7 3-year sales growth (Sales 3 Yr CAGR). Declining sales often is a harbinger of corporate distress and its ultimate demise. Three years of sales growth is a good measure of a firm's future prospects. We hypothesize that a very low or negative sales growth will be associated with failing firms. This is the only measure not derived from CFS. (Bhandari & Iyer, 2013, p. 670-671)