The Changing Bole of Debt In Bankruptcy

by

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The fact of an increasingly highly leveraged economy has been proclaimed by many in the recent literature [Bernanke and Campbell, 1988; Kaufman, 1986; Friedman, 1986; Minsky, 1986; Taggart, 1985; and Kindleberger, 1989]. Table 1 provides an overview of the changing balance sheet of the U.S. nonagricultural corporate business sector from 1960 to 1985. As these figures indicate market debt has risen in the mid-1980s to a post-1950s high while net worth is trending down after a 1980 high.

The implications of this rise in debt have varied depending upon the theoretical view of the proclaimant. Table 2 records some of the undesirable effects that have already been witnessed from the increase in debt. These changes, the rise in the number of net downgradings of corporate bonds, the increase in the number of business failures and the increase in liabilities at the time of failure, are characteristically associated with recessions, yet they are transpiring in the midst of the longest expansion since the 1960s.

The fears that are most often expressed about this increased debt usage, are associated with their impact in a recession. While a recession in this highly leveraged economy is bound to exacerbate the number of business failures, it is also possible that even without a recession the sensitivity of business to failure has been affected by the expanded position that debt holds on the balance sheets of American corporations. In the succeeding sections it is this latter possibility that is explored. The first section details the literature on bankruptcy prediction for firms, focusing on the variables that have been most useful in prediction. The second section presents the variables of two of these models using a logit model and current data. In the final section a logit model that includes debt is developed which shows short term debt to be a major determinant of bankruptcy.

BANKRUPTCY PREDICTION

The literature on bankruptcy prediction is dominated by discriminant analysis models that proliferated in the 1970s. The major contributions to the applied work in this field have come from Beaver [1967], Altman [1968, 1983], Altman, Haldeman and Narayanann [1977],

TABLE 1

Balance Sheet of U.S. Nonfarm corporate Business Sector 1960-85

	1960 %	1965 %	1970 %	1975 %	1980 %	1985 %
Total Assets	131.6	119.7	126.6	131.6	139.8	132.6
Tangible	96.1	84.3	90.7	98.4	104.9	99.1
Financial	35.4	35.4	35.9	33.2	34.9	33.4
Liquid	10.0	8.6	6.7	7.5	6.9	8.0
Other	25.4	26.7	29.1	25.8	28.0	25.4
Total Liabilities	46.6	47.6	52.5	45.9	48.5	53.3
Market debt	30.1	30.3	34.4	32.7	32.1	36.8
Trade debt	12.5	13.4	15.7	10.8	12.6	12.0
Other	4.0	4.0	2.4	2.5	3.8	4.5
Net Worth	85.0	72.1	74.0	85.7	91.4	79.2

Notes: Data are yearend values, scaled by corresponding fourth-quarter gross national product (seasonally adjusted at annual rates). Detail may not add to totals due to rounding. Data for trade debt reflect a series break in 1974.
Source: Board of Governors of the Federal Reserve System; this is Table 5 in Friedman [1986].

TABLE 2

SOME EFFECTS OF INCREASED DEBT USAGE

Debt Defaults in Post World War II Recessions

	Number of Business Failures[a] (per 10,000 concerns)	Liabilities in Business Failures (percent of GNP)
Recessions during 1958-80		
1954	42	0.12
1958	56	0.16
1961	64	0.20
1970	44	0.19
1975	43	0.27
1980	42	0.17
Experience since 1980		
1981	61	0.23
1982	88	0.49
1983	110	0.47
1984	116	0.46
1985	123	0.54

Net Changes in Credit Ratings of Nonfinancial Corporate Bonds[b1]

First Half 1986	-97
First Half 1985	-135
1984	+1
1983	-98
1982	-154
1981	-31
1980	+13
1979	+28

a. Business failures comprise concerns involved in court proceedings or voluntary actions involving loss to creditors. Liabilities in business failures exclude long-term, publicly-held securities. Data for number of business failures and liabilities in business failures are adjusted for series breaks after 1983. Sources: American Bankers Association, Dun 6 Bradstreet, U.S. Department of Commerce (Taken from Table 6 Friedman [1986])

b. Taken from Table 2, Friedman[1986]

1. Source: Standard and Poor's

Deakin [1972, 19771, Libby [1975], and Edmister [1972]. Beaver [1967] initiated the use of univariate analysis in failure prediction. The results of his testing showed six balance sheet ratios to be useful in predicating failure up to five years prior to its actuality. His "best" predictors were cash flow to total debt, net income to total assets, total debt to total assets, working capital to total assets, the current ratio and a 'no-credit interval'.

Altman [1968] introduced the use of multivariate discriminant analysis in failure prediction. His Z-score model included five financial ratios that were found to be the "best" predictors: working capital to total assets; retained earnings to total assets; earnings before interest and taxes to total assets; market value of equity to book value of debt; and sales to total assets. The overlap between Beaver's and Altman's findings is obvious in the working capital to total assets ratio, but it is also clear that Beaver's net income to total assets is similar to Altman's retained earnings to total assets. Both fall into the category of profitability, so it becomes a debate as to which measure of profitability is the proper one. The other categorical overlap in their predictors is the debt-equity ratio. Since Beaver used strictly balance sheet data, his ratio was total debt to total assets, and both were measured in book values. Altman, however, used the market valuation of equity to total debt which added another dimension, the "market's" ex post view of the firm's value, to the comparative debt-equity ratio. In addition to these total debt-equity measures, Altman found a measure of debt service in his multivariate analysis to be statistically significant and to have predicative capacity; Beaver found cash flow to debt and his "no credit interval" to be instrumental in predicting failure. Both Altman and Beaver drew their samples from the 1946-1965 time period. Given that this was a period in economic history in which debt usage was abnormally low, a high debt-equity ratio could be expected to accompany a failed firm.' Debt was used conservatively by most firms, for the finance of choice was internal funds. Another characteristic of this period was the type of debt used by firms. For the average healthy firm working capital was funded by internal sources of funds or when necessary short term borrowing that could be rolled over in a production period was used. Capital expenditures, too, were primarily financed by internal funds, but when they were insufficient, long term debt was used.' The total debt to assets ratio in 1945 in the manufacturing sector was 0.20, and it had only risen to 0.26 by 1958 [Meiselman and Shapiro, 1964]. In general, there was a very conservative use of debt in this period.

The next set of studies drew on firms that had failed between 1964 and 1975. The time periods in which bankrupt firms were selected for each of these studies was far shorter than the previous ones. Altman, Haldeman and Narayanan [1977] used a 6 year period; Deakin [1972] and Libby [1975] used a 7 year period; and Deakin [1977] used a 9 year period. Even though these are shorter time periods, the cyclical activity during this 12 year period was great. This business cycle activity may cause the assumption of stationarity to be violated. This violation is a recurrent problem in studies like these that transpire over time, and it has not been addressed adequately.

The first Deakin [1972] study drew on Beaver's [1967] work. He combined Beaver's ratios into a linear discriminant function which allowed him to make a multivariate analysis. Deakin's results are similar to Beaver's in that cash flow to debt is one of the dominant predictors. Equally important in predicting failure was the net income to total assets ratio, finally, in the third year before bankruptcy total debt to total assets acted as a strong predictor. Libby [1975] used the same data" set as Deakin, but used principal components analysis to aid in the selection of important predictive variables. His results found net income to total assets, current assets to sales, the current ratio, current assets to total assets and cash to total assets to be the best combination of predictors. Deakin's second study [1977] utilized the predictors that Libby found significant and compared their predictions to those of the auditors'. Finally, the Altman, Haldeman and Narayanan (AHN)

[1977] study found seven variables to be important predictors: earnings before interest and taxes to total assets; normalized standard error of estimate around a 10 year profitability trend; debt service coverage; retained earnings to total assets; the current ratio; market value of equity to total capitalization; and a logarithmic transformation of total assets,

The major overlap among the predictors identified in these studies is in the various profitability measures. In ranking their predictors AHN found retained earnings to total assets, the normalized standard error of estimate and market value to total capitalization to be the three most important variables. Deakin [1972] found net income to total assets to be as important as cash flow to debt for predictive purposes. Libby did not rank his variables, but of the five variables to emerge as important, net income to total assets was one of them. Libby's results differed from the other two in that current assets in relation to other balance sheet variables was the dominant variable. While a priori it would be expected that some measure of earnings/profits would play a significant role as a failure predictor, it would also be expected that debt would emerge as an important predictor. Unlike the earlier studies, the present ones found little evidence that debt was significant. In the AHN study the debt service coverage ratio ranked six out of the seven variables, and in Deakin [1972] total debt to total assets was important for discriminating failure only in the third year prior to bankruptcy. The question that arises from these results is whether debt does play such a minimal role or whether it was the cyclical volatility of the time period and the overall growth in debt usage which represented structural change, thus violating the stationarity assumption.

In the following section a logit model that utilizes the important variables of both of the Altman models will be developed and analyzed.[3] These models were chosen as those to be replicated because of their dominant role in the corporate failure literature. The coefficients of the variables will be generated from a current data base and then they will be tested for their statistical significance. Given the structural changes in the economy that have transpired since 1968 and 1977, it is not expected that these models will be statistically significant or have strong predictive capabilities.

THE 1968 AND 1977 MODELS

The data set on which the Altman models will be tested was derived from Standard and Poor's COMPUSTAT. The construction of the data set was through an almost random process. For the years 1985, 1986 and 1987 all firms that declared bankruptcy or were liquidated for economic reasons and had complete information for a core of predictive variables were put into the bankrupt sub-sample.[4] Since the information on bankrupt firms is scarce, it was necessary to include all of the bankrupt firms in the sub-sample. The solvent sub-sample was randomly chosen from each year on the basis of complete information for the same core variables as for the bankrupt firms. When in this selection process a bankrupt firm was chosen,, it was discarded as redundant, and when a firm chosen in the 1985 sub-sample was also chosen in 1986 or 1987, it, too, was discarded. The final sample included 413 firms, 44 of which were bankrupt and 369 that were solvent. The 3 years, 1985-1987, were chosen for their currency as well as their economic similarity.

The major problem with this data set is that it excludes data on most of the firms that go bankrupt. Inclusion in COMPUSTAT is defined as having securities that are traded on an exchange. This requirement indicates that a firm has been in operation for a while and that it has obtained a certain level investor confidence as well as a high profile. Since most of the firms that go bankrupt are small, very young, low profile and single proprietorship, they are excluded from the data set. Therefore, the findings can only be said to hold for corporate firms.

Since size has been found to be a very important determinant in failure prediction, a brief overview of the sample is important.[5] The bankrupt firms are on average smaller than the solvent firms. The average bankrupt firm had total assets worth $166.79 millions versus the average solvent firm with its total assets of $320.02 millions. The smallest add largest bankrupt firm had total assets worth $0.96 and $2,648.3 millions, respectively. The smallest solvent firm was worth $0.14 million and the largest had total assets worth $25,198.0 millions. Using a quartile distribution the average bankrupt firm in each quartile starting with the first was worth $2.39, $10.35, $37.65 and $616.77 millions, respectively. The same distribution for the solvent firms is $2.44, $12.16, $55.16 and $1,226.44 millions. The non-bankrupt firms increasingly out-size the bankrupt firms which could affect the results if size is not accounted for in the model.

The first Altman [1968] model utilized 5 variables, working capital to total assets (WCAT), retained earnings to total assets (REAT), earnings before interest and taxes to total assets (ADPAT), debt to shareholder's equity (DTSEQ), and sales to total assets (SALEAT). Altman's results found a negative relationship between WCAT, REAT, ADPAT and SALEAT and bankruptcy, and a positive relationship between bankruptcy and DTSEQ. These same signs would be expected to hold in the logit model. Table 3A gives the results on Altman's variables using the current data and logit model. Not only are many of the variables insignificant, but their signs are also wrong. Both WCAT and REAT take the right signs, but ADPAT, DTSEQ and SALEAT have the wrong signs. Only REAT has the right sign and is significant at $\alpha \leq 0.05$. While SALEAT is significant at the 0.01 level, it has the incorrect sign. None of the other variables, except the intercept, are significant at even the 0.10 level. The overall indicator of significance, the X^2, is 16.65 which demonstrates that the model is significant at $\alpha = 0.01$.[6] Unfortunately, since the model appears to be misspecified, the X^2 is useless.

The Altman models were constructed in an attempt to find the best predictors and to make economic sense. Translated into logit and using current data the 1968 model exhibits an inadequacy in terms of economic insight and as Table 3a shows its predictive capability was not maintained over the years. The conceptual structure of failure analysis is construction of a model that will discriminate between the two categories of failed and still

TABLE 3
ALTMAN: THE 1968 MODEL

A.

VARIABLE	COEFFICIENT	STD. ERROR	T-STAT.	2-TAIL SIG.
C	-2.5599865	0.2995281	-8.5467316	0.000
WCAT	-0.3425700	0.2748379	-1.2464440	0.213
REAT	-0.1707311	0.0827548	-2.0630967	0.039
ADPAT	0.5134788	0.4943521	1.0386906	0.299
DTSEQ	-0.1026468	0.0646855	-1.5868603	0.113
SALEAT	0.3938967	0.1527229	2.5791605	0.010

Log likelihood	-131.76880	X^2 = 16.652
Cases with BANK = 1	44	Correct Prediction: 3/44 = 7%
Cases with BANK = 0	369	Correct Prediction: 366/369 = 99%

B.	Covariance	Correlation
WCAT,WCAT	0.4205423	1.0000000
WCAT,REAT	0.5912325	0.4334355
WCAT,ADPAT	0.2062992	0.5995321
WCAT,DTSEQ	0.0323418	0.0186680
WCAT,SALEAT	-0.0059632	-0.0105219
REAT,REAT	4.4244365	1.0000000
REAT,ADPAT	0.8432450	0.7555176
REAT,DTSEQ	0.3186734	0.0567094
REAT,SALEAT	0.3910054	0.2127017
ADPAT,ADPAT	0.2815531	1.0000000
ADPAT,DTSEQ	0.1033027	0.0728736
ADPAT,SALEAT	0.1197977	0.2583363
DTSEQ,DTSEQ	7.1371183	1.0000000
DTSEQ,SALEAT	-0.0566082	-0.0242457
SALEAT,SALEAT	0.7637754	1.0000000

successful. This model does not have that capacity; it tends to identify all of the firms as solvent. Thus, the total sample's correct prediction result of 89% masks the underlying correct bankruptcy prediction of 7%. Since the bankrupt firms are only 10% of the total sample, their correct prediction rate plays a very small role in the total sample results.

Another problem with this model if it is to be used for more than prediction is its multicorrelation. As the data in Table 3B indicate, there is a high degree of correlation among the various profitability measures and WCAT. While correlation is not considered to be a problem in prediction models, it is problematic for models that attempt to explain behavior.

In the 1968 model Altman accounted for size in his matched-pair sample and since our sample was random, it may be making an impact on the model's performance. In the 1977 model Altman altered his sampling method so that a more random sample was used and he then used size as a predictive variable in his model.

Altman, Haldeman and Narayanan [1977], taking into consideration the technical advances that had been made in discriminant analysis, generated a new corporate failure model, ZETA CREDIT RISK. While the coefficients of this model are not in the public domain, AHN tested the model the model against the 1968 model using both current and 1968 data and it showed itself to have good predictive capabilities. As was stated in the previous section, this model relies heavily on earnings/profitability criterion, and not debt, to differentiate between failed and solvent firms.

In analyzing the AHN variables within the logit model and with current data two variations became necessary. The AHN model uses a normalized standard error of estimate variable that is based on a 10 year trend. Maintaining a meaningful number of bankrupt firms in the sample required a reduction to a six year trend. Also, the market value of common equity to total capitalization variable in AHN was a 5 year average, for the same reason as previously mentioned this variable is the current year value, not an average.

The results of the logit model are provided in Table 4A. The t-statistics show only two variables are significant at $\alpha \leq 0.01$, the current ratio (CR) and the expectational future earnings variable (MKVLICPT). Retained earnings to total assets (REAT) is significant at $\alpha = 0.10$ level. All three of these variables also have the correct sign. The remaining are insignificant variables, of which only earnings before interest and taxes to total assets (ADPAT) has the wrong sign. The others, log of total assets (LNAT), earnings before interest and taxes to interest payments (ADPINT) and normalized standard error of estimate (STANDSEE), have the correct sign.

Overall, the X^2 indicates that the model is significant at less than 0.005, but the predictive capability of the logit model falls far below that of its discriminant analysis origin. Table 4A shows the correct predictions for the AHN model. In bankruptcy prediction it scored 15% correct, while in solvency it had a 98% correct prediction rate. The total correct prediction rate was 89%. While this model is more accurate in bankruptcy prediction than the 1968 model, it still is not very good. A random draw from this sample would predict an 11% correct bankruptcy prediction rate.

Another indicator of effectiveness is the probability effects. The coefficients of these variables are insufficient information to determine the effects of a change in a variable's value on the probability of bankruptcy since the function is non-linear. The change in the probability due to a change in a variable's value is determined in the following manner:

$$\frac{Pr(Y = 1)}{X_k} = (logit(\Sigma B_k X_k)*(1-logit(\Sigma B_k X_k))*B_k \qquad (1)$$

where Pr(Y=1) refers to the probability of bankruptcy. The probability effects for each of these variables are also shown in Table 4A. Each variable has been evaluated at the mean value of the sample. The only variable that stands out as individually producing a strong change in the probability of bankruptcy when there is a change in its value is STANDSEE and

TABLE 4

ALTMAN, HALDEMAN, NARAYANAN: THE 1977 MODEL

A.

VARIABLE	COEFFICIENT	PROB. EFFECTS	T-STAT.	2-TAIL SIG.
C	0.1289881		0.2040490	0.838
ADPAT	0.0394426	0.001100	0.0433909	0.965
LNAT	-0.1053832	-0.003000	-1.0040816	0.315
ADPINT	-0.0003453	-8.58E-06	-0.3669110	0.714
CR	-0.3871663	-0.011000	-3.1200493	0.002
REAT	-0.4536267	-0.013000	-1.7082658	0.088
MKVLICPT	-0.4029344	-0.012000	-3.3568218	0.001
STANDSEE	0.4475885	-0.130000	1.1791449	0.238

Log likelihood -99.357787 X^2 = 53.38

Cases with BANK = 1 40 Correct Prediction: 6/40 = 15%

Cases with BANK = 0 324 Correct Prediction: 319/324 = 98%

B.

	Covariance	Correlation
ADPAT,ADPAT	0.1268868	1.0000000
ADPAT,LNAT	0.3156105	0.4281439
ADPAT,ADPINT	85.192943	0.1617919
ADPAT,CR	-0.1323850	-0.0507242
ADPAT,REAT	0.3597301	0.7998908
ADPAT,MKVLICPT	-2.1572371	-0.5780330
ADPAT,STANDSEE	-0.2052097	-0.5699339
LNAT,LNAT	4.2825924	1.0000000
LNAT,ADPINT	391.56638	0.1280011
LNAT,CR	-3.1471470	-0.2075621
LNAT,REAT	1.2346456	0.4725537
LNAT,MKVLICPT	-5.7725071	-0.2662405
LNAT,STANDSEE	-0.7001223	-0.3346998
ADPINT,ADPINT	2185128.4	1.0000000
ADPINT,CR	-340.02170	-0.0313944
ADPINT,REAT	225.06250	0.1205943
ADPINT,MKVLICPT	-619.55947	-0.0400044
ADPINT,STANDSEE	-81.330164	-0.0544312
CR,CR	53.682305	1.0000000
CR,REAT	0.1841801	0.0199108
CR,MKVLICPT	0.3036285	0.0039554
CR,STANDSEE	0.1804377	0.0243639
REAT,REAT	1.5939532	1.0000000
REAT,MKVLICPT	-8.5401853	-0.6456431
REAT,STANDSEE	-0.7978927	-0.6252326
MKVLICPT,MKVLICPT	109.76756	1.0000000
MKVLICPT,STANDSEE	6.2460523	0.5897983
STANDSEE,STANDSEE	1.0217160	1.0000000

it was insignificant. The significant variables with correct signs would produce 1% changes in probability. These variables do not have a very strong effect on bankruptcy prediction.

As in the previous model, the conceptualmodelwas constructed primarily for prediction purposes, but economic meaning for the variables was also instrumental in the process of variable choice. If the model was being constructed solely for the purpose of prediction, then the multicollinearity of the variables would not be of concern. Table 4B provides data on the correlation among the 7 variables in the model. As might be expected there is a relatively high correlation among the profitability variables and with the profitability dispersion variable. The size variable, LNAT, is also correlated with the profit variables. This multicollinearity may be the reason for some of the insignificant t-statistics, since overall the X^2 is highly significant.

The results were as expected for these "old" models. While the 1968 model performed abysmally, the 1977 model made some improvements, but neither provided a satisfactory prediction rate nor set of explanatory variables. A partial explanation for these models inadequate performance lies in the changed structure of the U.S. economy. Fundamentally, corporations still operate in order to obtain profits and grow, but the strategies they use and the economic environment in which they implement them have changed since the mid-1970s and certainly since the 1960s. In the succeeding section another model that emerged out of the current economic environment provides some information on prevailing forces that are inducing bankruptcy.

The 1989 Model--DEBT

In the late 1980s a renewed fear of the negative power of debt has emerged with the growth in junk bond issues and banks' involvement with security underwriting and bridge capital. The rise in the number of bankruptcies that are large firms and the rise in the average liabilities of all firms declaring bankruptcy are also important changes that have emerged on the 1980s economic landscape. Such alterations and innovations in 'corporate finance and the concomitant effects on balance sheets would be expected to have an effect on the models that seek to isolate the determinants of and/or to predict bankruptcy. The model described in Table 5A reflects the impact of this changing role of debt, as well as the continued importance of some of the long standing variables that have been associated with bankruptcy.

The most significant feature of this model is the importance of the debt variable. Whereas when other models have found a debt ratio to be statistically significant, it was usually weak in terms of it explanatory or predictive capabilities. As the results in Table 5A show, the short term debt to total assets (DLCAT) variable is not only statistically significant, it also the strongest explanatory variable as the probability effects indicate.[7] The next best explanatory variable is shareholder's equity to total capitalization at book value (SEQICPT). This variable measures the ownership share of capitalization, and it would be expected to have the negative relationship to bankruptcy that its sign indicates. The remaining variables, earnings before interest and taxes to total assets (ROA), the log of market value of the firm (LNMKVL) and market value to total capitalization (MKVLICPT), have the correct signs and are statistically significant at a < 0.01, expect for ROA which is significant at a < 0.05, but as their probability effects show have relatively minor effects on the probability of bankruptcy. Overall, the model is statistically significant at a < 0.005 with its X^2 of 80.74.

Even though this model was not constructed in order to maximize its predictive capabilities, its within sample predictions out-perform the two previous models as well as the expected outcome from a random draw. As the results in Table 5A indicate the correct prediction rate for the entire sample is 93%. As with the previous models this statistic masks the true predictive capabilities of the model. The correct prediction rate of bankruptcy is 39% and the rate for solvency is 99%. This bankruptcy prediction rate compares very favorable with the 1968 model's 7%, the 1977 model's 15% and the population proportion,

TABLE 5
THE DEBT MODEL

A.

VARIABLE	COEFFICIENT	PROB. EFFECTS	T-STAT.	2-TAIL SIG.
C	0.2998173		0.4149414	0.678
ROA	-0.0136170	-0.0006000	-2.0686999	0.039
LNMKVL	-0.3336386	-0.0135000	-2.8115693	0.005
DLCAT	5.9125162	0.2401000	3.7472965	0.000
SEQICPT	-1.8640436	-0.0757000	-2.7874662	0.005
MKVLICPT	-0.3130367	-0.0127000	-2.6808081	0.007

Log likelihood -89.394777 X^2 = 80.742
Cases with BANK = 1 41 Correct Prediction: 16/41 = 39%
Cases with BANK = 0 337 Correct Prediction: 334/337 = 99%

B.	Covariance	Correlation
ROA,ROA	1416.2294	1.0000000
ROA,LNMKVL	17.570889	0.2376399
ROA,DLCAT	-0.7799334	-0.1638033
ROA,SEQICPT	-0.0354938	-0.0031390
ROA,MKVLICPT	-204.86469	-0.5256556
LNMKVL,LNMKVL	3.8602482	1.0000000
LNMKVL,DLCAT	-0.0499561	-0.2009615
LNMKVL,SEQICPT	-0.0420978	-0.0713117
LNMKVL,MKVLICPT	0.8360647	0.0410897
DLCAT,DLCAT	0.0160080	1.0000000
DLCAT,SEQICPT	-0.0091181	-0.2398527
DLCAT,MKVLICPT	-0.0094086	-0.0071805
SEQICPT,SEQICPT	0.0902780	1.0000000
SEQICPT,MKVLICPT	0.1879204	0.0603926
MKVLICPT,MKVLICPT	107.25018	1.0000000

11%.

As a corollary to the total sample prediction, the data set was deconstructed into its three years of data, 1985, 1986 and 1987, and then the model was tested on each year. Since debt usage has been rising during this time period and concomitantly the share of ownership capital to total capitalization has been declining (Table 1), it might be expected that the model would become a better predictor over time. Table 6 shows the results of this test. In 1985 which had the largest number of bankrupt firms the correct prediction rate of bankruptcy was 35% and for solvency is was 99%; this compares to the bankruptcy population proportion of 17%. The 1986 bankruptcy prediction rate was 50% and for solvency it was 98%. This compares to the bankruptcy population proportion of 7%. Finally, for 1987 the bankruptcy prediction rate was 43% and for solvency it was 99%. The bankruptcy population proportion in this year was 6%. While the model did perform better in 1986 and 1987 than it did in 1985, the expected annual increases in performance did not materialize. This may be due to the inadequate number of bankrupt firms for the 1986 and 1987 sub-samples or to the changing size of the bankrupt firms over time. In 1985 firms with total assets worth more than $200 million comprised 15% of the sample; in 1987 they exceeded 40% of the sample.

TABLE 6
PREDICTIONS BASED ON ANNUAL SUB-SAMPLES

YEAR	CORRECT PREDICTION Pr(Y=1)	CORRECT PREDICTION Pr(Y=0)	POPULATION PROPORTION
1985	35%	99%	17%
1986	50%	98%	7%
1987	43%	99%	6%

Since this model was explanatory rather than predictive in nature, the correlation among the variables is meaningful. In Table 5B the correlation coefficients are displayed. While it may have been expected that the capitalization ratios would be collinear, they were not. The only clear case of collinearity is between ROA and MKVLICPT. The usual sign of this multicollinearity, a reduced t-statistic, was not produced.

CONCLUSION

The changing economic environment of the late 1980s has been dominated by the financial innovations brought about by the growing demand for credit by U.S. corpsrations. When looking at this phenomena from a very long perspective of 50 to 60 years as some researchers have done [Taggart, 1985; Ciccolo and Baum, 1985], the rise in leverage on corporations' balance sheets may not create high anxiety. However, incorporating into that picture the episode known as the Great Depression should give one pause and a moment for reflection. It was the Great Depression that followed the prosperous episodes of the 1920s when households' and the financial sector's use of debt pushed up the private sector's debt-equity ratio.

When looking at the rise in debt usage from a more localized view as this study has done, the damage that is possible even without a recession is brought into focus. Debt, short term debt, has emerged as a very decisive factor in the study of bankruptcy. In contrast to the previous studies on failure where earnings and profitability dominated as predictors/determinants, this study has provided support for the view that in this time period the rise in short term debt usage may lead to increases in bankruptcy. As the data also very vividly point out, this increase is not isolated to small firms, but increasingly, large firms are joining the ranks of the failed.

ENDNOTES

1. One aspect of the debate on the economy's financial position concerns the historical levels of the corporate, household and government's debt-equity ratios. Taggart [1985] and Ciccolo and Baum [1985] find the U.S. post-World War II economy to have had an abnormally low corporate debt ratio when compared to the 1920s and 1930s.

2. The Graduate School of Business at Harvard University produced a study of corporate finance that was overseen by W. H. Locke Anderson [1964]. The principle data source for this study was the Quarterly Financial&port for Manufacturing Corporations, 1948-1960 that was compiled by the Federal Trade Commission-Securities Exchange Commission. In this study Locke reports that the fasting growing component of the manufacturing sector's balance sheet was in noncurrent liabilities which was primarily comprised of long term debt.' He gauges the growth of long term debt to be twice that of equity. While indicating that the use of debt grew during this period, he also pointed out that the acquisition of physical assets was primarily financed by retained earnings.

Miselman and Shapiro [1964] in an NBER study produce a corporate balance sheet for the manufacturing sector that is in basic agreement with the Locke study. Like Locke their results indicate that the growth in long term debt outpaced equity by a wide margin. Between 1945 and 1958 Miselman and Shapiro show total long term liabilities to have multiplied by five times, common stock to have less than doubled and net worth to have grown by 140%. Total short term liabilities grew by over 150%, so that they grew faster than common stock, but not as fast as long term liabilities. At the start of the study, 1945, outstanding long term liabilities had a value that was $5 million less than short term liabilities, while by the end of the study, 1958, they had surpassed the value of outstanding short liabilities by more than $2 million.

3. The many early critics of discriminant analysis emphasized not only violations of the assumptions of classical statistics, but technical problems in the method that were derivative from the assumption violations [Joy and Tollefson, 1975 and 1978; Eisenbeis, 1977; and Johnson, 1970]. Research into these problems provided some technical answers [Lachenbruch, 1967; Lachenbruch, Sneeringer and Revo, 1973; and Marks and Dunn, 1974], however, the dominance of the school of thought that views econometric techniques as the proper tools for applied economic research has caused discriminant analysis to be pushed to the side.

4. Firms that sought bankruptcy protection for non-economic reasons, protection from contracts enforcement or legal proceeding, were not included in the sample. Such firms were using the bankruptcy laws as legal protection against employees and plaintiffs, not owners or creditors.

5. In many of the early discriminant analysis studies the effects of size were mitigated by using a matched-pair choice-based sample. This can produce statistical problems, so in this study a random sampling method was employed.

6. While in regression analysis an F statistic can be used to test the overall hypothesis that all of the coefficients are equal to zero, in logit this same test is provided by the X^2 distribution which is based on the likelihood ratio test. The likelihood ratio statistic, c, is determined as follows:

$$c = -2(\log L0 - \log L1)$$

where L1 is the value of the likelihood function for the full model and LO is the maximum value of the likelihood function if all coefficients except the intercept are 0 [Aldrich and Nelson, 1984].

7. To assure the disbelievers that the debt financial ratio is not masking the activity of an expenditure variable, various ratios comprised of expenditure values were tried and found to have the incorrect signs and/or to be insignificant.

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