Eastern Economic Journal, Volume XVII, No. 2, April–June 1991

Financial Instability: A Recession Simulation on the U.S. Corporate Structure

Dorene Isenberg*

The role of debt/credit in a market economy has recently received an unusual amount of theoretical and empirical attention, as well as coverage by the popular press.[1] The rising incidence of debt on balance sheets due to the increasingly important role of debt-finance has led to rising debt-equity ratios and other financial measures of illiquidity and insolvency. This empirical phenomenon is caught in the conundrum of prevailing economic theory: in general, theory contends that debt usage will ultimately produce a neutral effect on the value of the firm and an optimal debt-equity ratio will be obtained.[2] Such theoretical results act to assuage the fears implicit in the current empirical situation.

The argument put forward in this paper denies the neutrality of debt, emphasizing instead, the connection between the financial and production sectors. This connection transmits the disruptions in the financial sector to the nonfinancial sector where they can cause interruptions in the production process [Fisher, 1933; Minsky, 1986]. Along with arguing that debt-usage is not neutral, it also argues that the currency of its cost is bankruptcy. A financially fragile economy is undesirable because of its potential harm: fragility can lead to insolvency which means disruption and bankruptcy, the loss of capital value. Bankruptcy incurs costs that can affect the level of economic activity. It is not a costless process.[3]

This paper empirically examines the current extent of corporate vulnerability to financial disruption. Since vulnerability has no absolute definition, it is measured, in this instance, by the projected incidence of bankruptcy. These projections are generated by two separate methods: discriminant analysis and financial ratio analysis for insolvency on a recession-simulated corporate financial structure. The first section discusses the real costs of bankruptcy which lays a foundation for its economic importance. The second section provides some detail on the current history of corporate financial policy and on some of the problems with earlier analyses of its level of risk. The third section presents the methods of analysis, and the final section presents the results of the financial and discriminant analyses.

THE COSTS OF BANKRUPTCY

In general, economic theory relies heavily upon the concept of free entry and exit, therefore bankruptcy, one of the exits, is considered a costless activity. When a cost has been associated with bankruptcy, it has been through its repercussion: unemployment. However, there is a counter to this argument which is that unemployment produces benefits, market discipline. Recent research adds another dimension to this argument. It finds new costs that produce reductions in aggregate demand and in aggregate supply.

*Drew University, Madison, NJ 07940. Special thanks are due to Jeffrey Pliskin and William Gaynor for their insightful comments and conversations, and to the Jerome A. Levy Economics Institute for its financial support.

Bernanke [1983] contends that with asymmetrical information financial disruption increases the cost of financial intermediation which causes a reduction in the level of credit supplied to borrowers. This reduction in credit leads to a decline in economic activity. The asymmetrical flow of information keeps a financial intermediary from being able to differentiate between quality and risky borrowers. Since differentiation is impossible, the price of credit to all borrowers rises producing a decrease in the level of loans extended. Utilizing the same assumption, asymmetrical information, Stiglitz and Weiss [1981] produce the same results. However, in their argument the financial intermediary acts not through the price mechanism, but by rationing credit.

At the same time that they produce declines in the level of credit available to borrowers, bankruptcy costs affect components of aggregate demand causing declines in output. Caskey and Fazzari [1987] show that wage and price flexibility, rather than damping the effects of unexpected changes in demand or money supply, may produce an unstable economic position in both the short and long term. The mechanism they introduce is a cash balance effect which is the outcome of the interaction between the actual price level, the outstanding debt contracts, and the expected price level that is embodied in those contracts. Deviations of the actual price level from the expected price level produce increases (decreases) in the safety margins of debtors who respond by increasing (decreasing) their expenditures. DeLong and Summers [1986] also focus upon the aggregate demand effects of price flexibility. However, they see the impact working through changes in investment expenditures which are altered by changes in the real interest rate as well as Tobin's q.

Hudson [1989] acknowledges the demand side effects from bankruptcy, but his major focus is on the supply-side. Bankruptcy's supply-side effects impact not just the utilization rate of capital but its continued existence. Given the thin market for used capital equipment, once a firm goes bankrupt, the equipment may be physically destroyed (for scrap value) rather than resold. While there is a real estate market for used buildings, plant may be destroyed rather than resold. This plant and equipment destruction implies that the supply-side effects of bankruptcy lead to declines in productivity, and to the increased probability that when demand turns up, there will be a lag in the supply response.

Hudson also advances the idea of a bankruptcy multiplier. In doing so he follows in the tradition of the financial approach to recession, debt deflation. The death of a firm promotes the death of other firms via its credit linkages. A creditor is only as healthy as its borrowers; the default of a borrower reduces the net worth of a lender. In a recession, when even well-managed firms are failing, the accumulation of defaults may induce the bankruptcy of lenders. Such failures do not denote a move towards efficiency. They indicate the excessive costs that accompany bankruptcies arising from economic disruption.

THE DEBT ENVIRONMENT

Since the early 1980s researchers have noted that debt-usage is on the rise. While calling attention to the changing balance sheets of American manufacturers, these economists held that these higher debt levels and debt ratios were not unusually high when placed in an historical context.[4] More recently the business press, in concert with a new set of economists, has noted the alarming changes in the use of "junk bonds," the higher than heretofore expected default risk associated with them and their increasing proportion of the portfolios of individuals and financial institutions. The growth of the "junk bond" market has coincided with the industrial restructuring imposed by LBOs and takeovers and financial deregulation. This economic restructuring is associated by some economists with an increase in efficiency, while others view the changes as dangerous to long run growth and stability.[5]

In a recent article, Bernanke and Campbell (B&C) [1988] present, in meticulous detail, an overview of the changing financial structure of the production sector between 1969 and 1986. Using market valuations of the debt and assets of the firm, they found that debt-asset ratios were higher on average in the 1980s than during the late 1960s and early 1970s.[6] However, the average debt-asset ratio of the mid to late 1970s surpassed the 1980s. Even when these sample averages were disaggregated and distributed, the mid to late 1970s remained the era with the highest debt-asset values. In contrast to the debt-equity values, the ratio of interest expense to cash flow was more than 1.5 times greater in the 1980s than in any previous period in their study.

After putting the current debt picture into an historical framework, B&C attempt to gauge the severity of the corporate financial position. First, they use Altman's Z-score model [Altman, 1968] which is based on a discriminant function constructed from 1960s data. The results from using this model on each sample between 1969 and 1986 were inconclusive. As B&C noted, this type of analysis is time period dependent. Given that it reflects the economic structure of the 1960s, it may not provide accurate results when applied over a 17 year time span.[7]

Given the inconclusive outcome of the Z-score analysis, B&C proceeded to simulate the effects of recessions on the 1986 corporate financial structure and to gauge what the impact would be in terms of increased illiquidity and insolvency. Their simulation was run using only three variables, debt-asset ratio, ratio of interest expense to cash flow, and the ratio of interest expense to current assets. The size of each simulated recessionary change in these variables was derived from its change in the 1973–1974 and 1981–1982 recessions. These changes were applied to the 1986 values of these variables, and a mean and distribution were generated. In the 1973–74 simulation the debt-asset ratios exhibited a dramatic rise that pushed 10% of the sample into insolvency, i.e., their debt-asset ratios were greater than one. The changes in the other two ratios were not as spectacular, but they were substantial.

The effects of the 1981–1982 recession on the 1986 sample were noticeable, but minor. This result may be due to their having used 1980 as a base year when it, too, was a recession year.[8] In contrast to the first simulation, the 1981–1982 simulated debt-asset ratios only exceeded unity in the 99th percentile. The interest expense to cash flow ratios reflected a much heavier debt burden than the 1973–74 results did. These ratios were either negative or exceeded 100 in the 90th percentile starting in the second year of the recession and in both years of the recession in the 99th. The changes in the interest-expense-to-current-assets ratio were milder than in the 1973–74 simulation.

The following analysis of the U.S. corporate financial structure and its vulnerability builds on the groundwork laid down by B&C. Instead of relying on a possibly outdated discriminant function, I have estimated a new function that reflects the current economic structure. The important variables identified by the discriminant analysis are then used to simulate the economic impact of a recession on the current financial structure. These alterations in approach produce results that are far less reassuring about the current corporate financial position than the Bernanke and Campbell findings.

THE DATA AND DISCRIMINANT FUNCTION

The data set used in this study was drawn from Standard and Poor's COMPUSTAT. The construction of the discriminant function required a matched-pair sample, so the data were culled for bankrupt firms in the manufacturing sector that had complete information between 1985 and 1987.[9] There were 52 bankrupt firms that met these requirements. Each solvent firm was chosen to match a bankrupt firm. Matching proceeded according to asset size, last year of operation and SIC code. The resulting matched-pair sample consisted of 104 firms with asset values ranging from $0.8M to $29.865B and four-digit SIC codes between 2000 and 3999.

The variable selection processes utilized in this study included a conditional deletion method which tests each variable for its ability to reduce the F-statistic associated with Wilk's lambda [Altman, Avery, Eisenbeis and Sinkey, 1981], the univariate F-statistic, and a search process that ranked each variable's contribution to the discrimination process. Thus, both multivariate and univariate tests aided in variable selection. Table 1 presents the results for the eight best current variables and for Altman's Z-score model. Comparing the results in the table indicates that the new variables are better discriminators between bankrupt and solvent firms in the current period than Altman's. The only Altman variable that reduced the F-statistic was WCAT. Comparing the new discriminators to past ones highlights the emergence of short term debt as an important variable. Previous studies have found a total debt ratio to be a good discriminator, but the only short-term debt variable of any importance was the current ratio. The results in Table I show five of the eight discriminators to be short-term debt ratios. The immediate

TABLE 1
Discriminant Function Variables

Variables		Univariate F Statistic[a]		Change in Wilks' Lambda F-Statistic[a]	
Isenberg	Altman	Isenberg	Altman	Isenberg	Altman
ICBT	DMKVAL	1.88	6.00**	0.11	−0.80
		1.13		*0.35*	
QUIK	ROE	4.64**	1.08	2.61	−0.90
		*5.95***		*1.37*	
WCAT	WCAT	17.55*	17.55*	0.60	0.74
		*19.95**		*2.38*	
CUR	CFLAT	4.19**	4.55**	3.16	−0.77
		*6.48**		*1.03*	
DLCAT	SALEAT	13.04*	0.18	0.43	−0.98
		*12.83**		*0.17*	
DLCDT		20.92*		3.13	
		*18.52**		*5.64*	
LCTAT		12.25*		0.35	
		*20.19**		*1.54*	
NPM		2.36		4.85	
		0.01		*0.00*	

Definitions: ICBT, interest times earnings; QUIK, quick ratio; WCAT, working capital to total assets; CUR, current ratio; DLCAT, short-term debt to total assets; DLCDT, short-term debt to total debt; LCTAT, current liabilities to total assets; NPM, net profit margin; DMKVAL, total debt to market value of equity; ROE, rate of return on equity; CFLAT, cash flow to total assets; and SALEAT, sales to total assets.

a. The first result for each variable is derived from the hold-out method, and the italicized entry is derived from the Lachenbruch method.

*Significant at 0.01 level.

**Significant at 0.05 level.

implication of these ratios is obvious, there has been a dramatic change in the financial structure of the U.S. corporation. The previous section suggested this change; the results of these tests underscore it.

To test the robustness of the new variables, two different discriminant methods were used. First, the hold-out method which requires that the sample be subdivided into two subsamples each with equal numbers of solvent and failed firms. One subsample is used to estimate a discriminant function which is then used on the other subsample to classify it and determine the sample proportions of misclassified observations. The second method, the Lachenbruch method, is an iterative process based upon holding out one observation at a time, estimating a discriminant function with the remaining observations and then classifying the held-out observation [Lachenbruch, 1967]. While this method has a strong advantage in its insensitivity to normality assumptions, its execution for very large samples is problematic, since it produces N discriminant functions [Altman, Avery, Eisenbeis and Sinkey, 1981].[10]

Table 2 reproduces the classification results from each of these estimating techniques.[11] The prior probabilities adopted in each case were 1% probability of bankruptcy and 99% probability of solvency. These prior probabilities were derived from the average bankruptcy rate in the U.S.[12] Using prior probabilities compensates for the assumed probabilities of 50% that would be estimated from the population proportions in the matched-pair sample. Since there is not a 50-50 chance that a firm will go bankrupt, especially if it is either large or has been in existence longer than one year, the effect of the priors on the classification of observations is of consequence.

The results of the hold-out method indicate that when the discriminant function is used to classify an independent sample, it will correctly classify 65% (17/26) of the bankrupt firms and 73% (19/26) of the solvent firms. Overall, the classification scheme is correct in 69% (36/52) of the cases. Given that the

TABLE 2

A. HOLD-OUT METHOD
1. SELF TEST

	Bankrupt	Solvent	N
Bankrupt	16	10	26
Solvent	0	26	26
	16	36	52

2. HOLD-OUT TEST

	Bankrupt	Solvent	N
Bankrupt	17	9	26
Solvent	7	19	26
	24	28	52

B. LACHENBRUCH METHOD

	Bankrupt	Solvent	N
Bankrupt	30	22	52
Solvent	13	39	52
	43	61	104

proportional chance criterion is 50% [Morrison, 1969], the discriminant function is out-performing chance by almost 40%.[13]

The Lachenbruch method produces classification results similar to the hold-out method's. It correctly classified bankrupt firms 58% (30/52) of the time and solvent firms 75% (39/52) of the time. Overall, the classifications were correct in 66% (69/104) of the cases. Again, with a proportional chance criterion of 50% this result indicates that the discriminant function is out-performing chance by 32%.[14]

THE SIMULATIONS

The most recent year for which complete financial information on the eight discriminators was available was 1988, so it is the base year for this study. The structure of the 1988 manufacturing sector of the economy is represented by a sample of 1611 firms drawn from COMPUSTAT. Of these firms, 1589 were solvent and 22 had filed for bankruptcy but were still in operation.[15] This produces an inherent structural proportionality of 0.01 and 0.99 in the sample.

Before the recession simulations were run, the discriminant function was used on the 1988 sample to determine its ability to separate bankrupt from solvent firms in this base-year sample. The technique used was a variation on the hold-out method. The discriminant function was estimated using the matched-pair sample consisting of 52 solvent and 52 failed firms. This discriminant function was then used to classify the 1988 sample of 1611 firms.

Table 3 presents the results. Of the 22 bankrupt firms, 10 were correctly identified; and of the 1589 solvent firms, 1226 were correctly classified. This produced a 45% and 77% correct classification rate for the bankrupt and solvent firms, respectively, and a 77% overall correct classification rate.[16]

In the individual categories it is apparent that the correct classification rate was lower for the bankrupt firms, but this finding must be put in the proper context. The chance classification of a bankrupt firm is 1% in this sample, so the discriminant function's ability to classify these firms correctly in 45% of the cases attests to its discriminating prowess. Its ability to correctly classify the solvent firms, however, is less dramatic. A chance solvent classification based on population proportionality would be

TABLE 3
Results From Discriminant Analysis on 1988 Sample

	Bankrupt	Solvent	N
Bankrupt	10	12	22
Solvent	363	1226	1589
Total	373	1238	1611

99% in this sample. However, the correct classification rate was only 77%. Obviously, the power of the model lies in its ability to detect bankruptcy.

The recession simulations were run on recession-modified variables constructed from the 1988 base-year sample. The average annual change for each variable in each firm in the 1974–75 and 1980–82 recessions was determined; the base years being 1973 and 1979, respectively.[17] The firms' variables in the 1988 sample were modified by these annual average recession changes producing the recession-modified variables. Then, the discriminant function was run on this modified sample for each year of the "recession." The result was the expected number of bankruptcies in each year of the simulated recession.

In addition to indicating the level of financial fragility through bankruptcy prediction, a decile distribution of the debt-asset ratio was produced for each year of the "recession."[18] Since this ratio is the usual indicator of insolvency, a time-lapse analysis of its changes during a "recession" provides additional information on the potential for bankruptcy.

"1974–1975 Recession"

In the first year of a recession as strong as that experienced in 1974, 968 firms would be classified as bankrupt and 643 as solvent. However, not all of the firms classified as bankrupt or solvent were. Given the results from the initial 1988 discriminant analysis, adjustments were made to the recession prediction which produced a more accurate illustration of a recessions's impact. The discriminant analysis simulation results are shown in Table 4 and the new distributions in Table 5. The adjustment factors were based on the categorical misclassifications as well as the in-category correct classification rates. In the 1988 classification, the discriminant function separated 373 firms into the bankrupt category; only 10 of these firms were actually bankrupt. This is a 2.7% correct classification. In actuality, 22 firms were bankrupt, so the in-category correct classification rate was 45%. Using these classification

TABLE 4
Simulations of 1980–82 and 1974–75 Recessions

A. 1974–75 RECESSION SIMULATION RESULTS			
Year 1: Classified as	Bankrupt	Solvent	N
	968	643	1611
Year 2: Classified as	Bankrupt	Solvent	N
	1081	530	1611
B. 1980–82 RECESSION SIMULATION RESULTS			
Year 1: Classified as	Bankrupt	Solvent	N
	713	898	1611
Year 2: Classified as	Bankrupt	Solvent	N
	1002	609	1611
Year 3: Classified as	Bankrupt	Solvent	N
	1165	446	1611

TABLE 5
Debt-Asset Ratio Decile Distribution

Decile	0	1	2	3	4	5	6	7	8	9
Base Year										
1988	0.01	0.07	0.14	0.22	0.30	0.41	0.56	0.81	1.34	7.01
"1974–1975 Recession"										
Year 1	0.04	0.18	0.36	0.56	0.78	1.04	1.42	2.06	3.41	17.80
Year 2	0.03	0.15	0.29	0.45	0.62	0.83	1.14	1.65	2.73	14.30
"1980–1982 Recession"										
Year 1	0.02	0.08	0.15	0.23	0.32	0.42	0.58	0.84	1.40	7.33
Year 2	0.02	0.10	0.20	0.30	0.42	0.56	0.78	1.12	1.86	9.74
Year 3	0.03	0.15	0.29	0.44	0.61	0.82	1.12	1.62	2.69	14.11

rates as adjustment factors produced the following picture of a recessionary impact. With 968 firms categorized as bankrupt, given the previous correct classification probabilities, 58 of the 1611 firms in the sample would actually be bankrupt by the end of the first year of the recession leaving 1553 as solvent. The impact after the first year of a recession as strong as that in 1973 would be more than an 150% increase in bankruptcy.

The second year of the 1974–75 recession simulation indicated 1081 firms classified as bankrupt and 530 as solvent. Using the same adjustment factors, there were 64 bankruptcies and 1547 firms remained solvent. The bankruptcy rate in the sample population increased from 1.4% in 1988, to 3.6% in recession year 1, and to 4.0% in recession year 2. These are dramatic increases, yet they are conservative. These failures are simply individual firm classifications; they fail to reflect the backward and forward linkages in an economy that induce a multiplier effect which spreads bankruptcy from firm to firm and industry to industry.

Table V presents the changes in the decile distributions of the debt-asset ratio (DT/MKTEQ), which is measured using book value of debt to market value of equity. The change in the debt-equity ratio is very striking. In the base year, 1988, it surpassed unity, which is the value at which the firm is considered to be insolvent in the 8th decile. After the first year of the "recession," 50% of the sample had a debt-asset ratio greater than one. In year 2 of the "recession" there was a slight reversal, the severity of the "recession" lessened, and the debt-asset ratio surpassed unity in the 6th decile. These increases indicate how extremely vulnerable to a major recession a highly leveraged corporate debt structure is.

"1980–1982 Recession"

Again, starting with 1988 as the base year, after the first year in the 1980–82 recession simulation, there were 713 firms categorized as bankrupt. Making the proper adjustments, 42 of these would have been bankrupt. This number almost doubles the 1988 level, 22. In the second year, there were 1002 firms classified as bankrupt, but after adjustments 60 were bankrupt. This produces an increase in bankruptcy of over 170% when compared to the base year. In the third year of the recession, the economy is still experiencing a strong downturn which causes the number classified as bankrupt to rise to 1165 which, after adjustments, leaves 69 firms bankrupt. The progression of the bankruptcy rate for this recession simulation—2.6% the first year, 3.7% the second year and 4.3% the final year—shows the recessionary impact to have peaked in the second year, yet, by the final year, the bankruptcy rate has more than tripled.

The decile distribution of the debt-asset ratio due to this "recession" was not altered as dramatically as it was in the 1974–75 "recession."[19] In the first year of the 1974–75 simulation, the

debt-equity ratio in the 5th decile was pushed to a value greater than one, yet in year 1 of the 1980–82 simulation that value was 0.42. This is only a minor change from the base year value of 0.41. The succeeding years, however, indicate relatively large increases in financial deterioration.

In "recession" year 1, the debt-asset ratio exceeded unity in the 8th decile, as it did in the base year. In each succeeding year of the simulation, it jumped forward one decile. Therefore, in the final year of the simulation the debt-asset ratio exceeded unity in the 6th decile. This finding indicates that 40% of the economy's firms would be insolvent by the end of the third year.[20] Even though the deterioration is slower and weaker in this "recession," it indicates an increased and a larger degree of financial vulnerability than previously existed and stands in marked contrast to B&C's results.

In both "recessions," the bankruptcy rate had tripled by the final year of the downturn. These bankruptcy growth rates exceeded the average rates experienced in all the U.S. recessions from 1950 to 1980. In the 1950s, the average bankruptcy rate grew 18% in the recession; in the 1960s, it grew 10%; and in the 1970s it grew 15%. Contrasting these rates to the simulated ones emphasizes how financially fragile the 1988 U.S. financial structure is.

These relatively small average rates of bankruptcy growth in the post-World War II U.S. came to a halt in the 1980s; the average increase in the bankruptcy rate in the 1980s recession was 237%. In 1978 a new bankruptcy law went into effect which produced a major structural change.[21] It is estimated that the new law was responsible for an annual increase in bankruptcies by 6,500 firms [Hudson, 1989]. This change in the level of bankruptcies is not minor; it is equal to doubling the number of failures that occurred in 1978, the year of the new law [Dun & Bradstreet]. When the actual bankruptcy rates for the 1980s recession were adjusted for this change, they showed an average increase of 174%.[22] While this increase is much higher than any other post-World War II period, it is still much less than the estimated increase of 300% in the "1980–1982 recession" simulation.

IN CONCLUSION

In contrast to the results obtained by B&C, this study shows that an economic disruption having a magnitude of either the 1974–75 or 1980–82 recession would throw the corporate industrial structure into a more vulnerable financial position and would lead to a major rise in the incidence of bankruptcy. The emergence of short-term debt ratios as important bankruptcy determinants highlights the change in the structure of the U.S. economy and underscores the economy's increase in financial fragility. This analysis suggests that, since bankruptcy is not a costless economic disturbance, policies leading to a reduction in financial exposure would be economically advantageous.

NOTES

1. See the following for an overview of the domestic private debt problem: Friedman [1986a], Kaufman [1986], Caskey and Fazzari [1989], Bernanke and Campbell [1988], Fazzari, Hubbard and Petersen [1988], Wolfson [1986] and the sustained coverage in various issues of *Business Week* and the *Wall Street Journal.*
2. Modigliani and Miller (M-M) [1958] argued, that via the activities of arbitragers, the financial policy of the firm would have no effect on the value of the firm. Stiglitz [1974] effectively moves this argument beyond the partial equilibrium model of M-M into a general equilibrium framework.
3. This notion of costs is not uncontested. Stiglitz [1974] reproduces the M-M results in a general equilibrium framework in which he assumes the costs of bankruptcy to be zero. This is the usual theoretical treatment.
4. The early work of Friedman [1986b; 1985] and the contributions of Ciccolo and Baum [1985], Ciccolo [1987] and Taggart [1985] situated the current trend of rising debt usage by corporations and governments onto an historical continuum. Their argument is that the current debt ratios are no higher than those of the pre-World War II era.
5. David Ravenscraft and F.M. Scherer [1987] found that the predictions of efficient market theory failed to be supported. Rather than an increase in efficiency resulting from increased merger activity, there was a decline. They also detected a negative impact on research and development expenditures. Du Boff and Herman [1989] found historical as well as current evidence to support their hypothesis that mergers produce not greater efficiency, but greater fees for their promoters and financiers.
6. At the heart of market valuations of assets and debt is the assumptions of efficient markets. Friedman [1988] prefers book valuation for debt due to its callability while others—Wolfson [1986] and Mitchell [1983]—use the book value of debt (historical cost) because it reflects the actual remaining debt commitment on the part of the firm. Bernanke and Campbell prefer the efficient market approach so that changes in market phenomena affect firms' valuations.
7. A discriminant function that was appropriate to and discriminated well in 1968 will not have the same results in 1989. Altman, Haldeman and Narayanan [1977] make this point when they compare Altman's earlier Z-score model with their current ZETA model.
8. The *Economic Report of the President, 1988* records a decline in real GNP measured in 1982 dollars of 0.2% in 1980. *Survey of Current Business* dates the recession in 1980 as beginning in January and ending in July.
9. For this study, the bankruptcy category is defined as having filed for bankruptcy with the court. This implies that the court has jurisdiction over the firm and that it may or may not continue to operate. COMPUSTAT uses each firm's self-designated definition of its operating position.
10. These discriminant functions were constructed by SAS PC, Version 6.02. The coefficients in the discriminant function are considered to be the maximum likelihood estimators and to be asymptotically efficient, as long as the sample is multivariate normal [Judge, Griffiths, Hill, Lutkepohl and Lee, 1985]. Further details are available on request from the author.
11. Using Altman's variables in the hold-out method produced these results: correct bankruptcy classification of 38% (10/26) and correct solvency classification of 81% (21/26). The overall correct classification rate was 60% (31/52).
12. According to the *Economic Report of the President, 1988,* the business failure rate only reached the 1% bankruptcy rate in 1983. In the years thereafter, 1984–1987, the rate remains at least equal to 1%, but the method changes, so the data are not comparable to the pre-1984 period.
13. Morrison's [1969] statistic for determining the probability of a correct classification is based on population proportionality and actual classification or prior probabilities if they are used.

$$P(\text{Correct}) = p\alpha + (1 - p)^*(1 - \alpha) \tag{1}$$

where p is the true proportion of Type I individuals and α is the proportion classified as Type I. Equation (1) is the chance correct classification. The probability of correct classification for our two discriminant functions is 50%:

$$P(\text{Correct}) = (0.01)^*(0.5) + (0.99)^*(0.5) = 0.5.$$

When the chance correct classification is 50%, there is only 50% probability remaining before there would be 100% correct classification. This discriminant function's overall rating of 69% means that 19% of the remaining 50% has been correctly classified which is a 38% improvement over chance.
14. The similarity in classification rates for each method supports the robustness of the results. However, the individual category and overall classification rates are not as high as those found in other studies. A major factor contributing to this study's lower classification rates is the lag between the last solvent balance sheet and the date of bankruptcy. On average, COMPUSTAT has a 27 month lag [Standard and Poor's, 1988:190]. Other bankruptcy studies have data sets with only a one year lag. This difference is very important as the Altman Z-score results on the 1960s economy shows. The predictive rate begins at 95% one year prior to bankruptcy, drops to 72% using data from two years prior to bankruptcy, and continues falling to 48% when data from three years prior to bankruptcy are used. Our results are comparable with the 2 to 3 year lag in the data.
15. These bankrupt firms were still actively operating after having filed bankruptcy petitions. The bankrupt firms used to construct the discriminant function were no longer in operation, so this difference adds another dimension to the bankrupt firms in the 1988 sample.
16. Three factors are important when analyzing these results. First, these bankrupt firms were still in operation, so they had filed for bankruptcy at a date earlier than 1988. Second, since they were still operating, the creditors in the court-guided bankruptcy proceedings had to believe that there was a good chance the firm could return to financial health if a corporate restructuring was undertaken. This continued operation also meant that the firm was provided with the potential for upgrading its financial position. Finally, discriminant analysis has usually been applied to choice-based, variable-matched data sets. The simulation section of this study deviates from using this type of data set, and the classification results reflect this change.
17. *Business Conditions Digest* charts the start of the mid-1970s recession in November 1973 and the trough in March 1975. Since 1975 experienced a higher unemployment rate than either 1973 or 1974 and a lower growth rate, 1974 rather than 1973 was chosen as the first year of the recession.
18. The values of the financial ratios that Bernanke and Campbell produced reflect variable aggregation and then ratio construction. The value of each variable for all the companies was summed and then the ratios were constructed as equation (2) indicates. This ratio construction technique produces a macroeconomy that is one big firm, and it under-represents the impact of small firms.

$$(2) \qquad \frac{\sum_{i=1}^{n} a_i}{\sum_{i=1}^{n} b_i} = a/b$$

Constructing the ratios at the level of the firm, aggregating and then averaging them, produces a ratio that reflects the average firm's financial position in the economy. Equation (3) reflects this technique. In such a construction small firms have equal weight with large firms and instead of one big firm, the emphasis is on the average firm in the economy. This latter method is utilized in this study.

$$(3) \qquad \frac{\sum_{i=1}^{n} (a/b)_i}{n} = a/b$$

19. Bernanke and Campbell explain this difference in the impacts of the two recession simulations on the debt-to-market value equity ratio by noting the reaction of the stock market in each recession. In the 1973–74 recession, the stock market experienced a major loss in value. This loss, in conjunction with an increase in debt usage, would cause the debt-equity ratio to rise reflecting both affects. On the other hand, in the 1980–82 recession, the stock market maintained its value, so increases in the debt-asset ratio were strictly due to increases in debt usage. Thus, it was the different stock market behaviors, not only behavior towards debt usage, that produced the odd results in the two recessions and simulations.
20. This result stands in marked contrast to B&C's. "[W]e find little evidence of an upward trend in corporate debt-asset ratios, whether they are measured at book values or at market values. . . . [T]here has been no clear tendency for the upper tail of the debt-asset distribution to increase" [1988:122].
21. Hudson [1989] summarizes statistics on the annual number of firms being reorganized as reported by the Administrative Office of the U.S. Courts in the Annual Report of the Director. The effect of the law can be seen in the following data on the number of firms that were reorganized between 1975 and 1984.

YEAR	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984
FIRMS	3506	3235	3046	3266	3042	5302	7828	14059	21207	19913

22. Another factor affecting the 1980s, which was not a problem at any other time in the post-World War II U.S. economy, is the savings and loan crisis.

REFERENCES

Altman, Edward. 1968. "Financial Ratios, Discriminant Analysis and the Prediction of Corporate Bankruptcy" *The Journal of Finance* 23#4(September) 589–609.

_____; Avery, Robert; Eisenbeis, Robert; and Sinkey, Joseph. 1981. *Application of Classification Techniques in Business, Banking and Finance.* JAI Press, Inc.: Greenwich, CT.

_____; Haldeman, Robert; and Narayanan, P. 1977. "ZETA Analysis" *Journal of Banking and Finance.* 1(June) 29–54.

Bernanke, Ben. 1983. "Nonmonetary Effects of the Financial Crisis in the Propagation of the Great Depression." *American Economic Review,* 73#3, 257–76.

Bernanke, Ben and Campbell, John. 1988. "Is There a Corporate Debt Crisis?" *Brookings Papers on Economic Activity* (1) 83–125.

Business Conditions Digest. October 1978.

Caskey, John and Fazzari, Steven. 1989. "Rising Debt in the Private Sector: A Cause for Concern?" A paper delivered at the "Profits and Instability" conference, Jerome Levy Economics Institute, Bard College. March 16–18.

_____. 1987. "Aggregate Demand Contractions With Nominal Debt Commitments: Is Wage Flexibility Stabilizing?" *Economic Inquiry,* 25(Oct) 583–97.

Ciccolo, John. 1987. "Changing Balance Sheet Relationships in the U.S. Manufacturing Sector, 1926–77," in *The Changing Roles of Debt and Equity in Financing U.S. Capital Formation,* edited by B.M. Friedman. University of Chicago Press: Chicago.

_____ and Baum, Christopher. 1985. "Changes in the Balance Sheet of the U.S. Manufacturing Sector, 1926–1977," in B.M. Friedman (1985).

Clarke, W.R.; Lachenbruch, P.; and Broffit, B. 1978. "Robustness of the Quadratic Discriminant Function to Non-normality." Submitted to *Communications in Statistics.*

Council of Economic Advisers. 1988. *Economic Report of the President.*

DeLong, J.B. and Summers, L.H. 1986. "Is Increased Price Flexibility Stabilizing?" *American Economic Review,* 76#5(December) 1031–1044.

Du Boff, R.B. and Herman, Edward. 1989. "The Promotional-Financial Dynamic of Merger Movements," *Journal of Economic Issues.* 23#2(March) 107–133.

Dun & Bradstreet Corp. 1987. *Business Failure Record.* New York.

Eisenbeis, Robert. 1977. "Pitfalls in the Application of Discriminant Analysis in Business, Finance and Economics." *The Journal of Finance* 32#3, 875–900.

Fazzari, Steven; Hubbard, Glenn; and Petersen, Bruce. 1988. "Financing Constraints and Corporate Investment" *Brookings Papers on Economic Activity* (1) 141–195.

Fisher, Irving. 1933. "The Debt-Deflation Theory of Great Depressions." *Econometrica* 1#4(October) 337–357.

Friedman, Benjamin. 1988. "Comment." *Brookings Papers on Economic Activity.* (1) 126–130.

_____. 1986a. "Increasing Indebtedness and Financial Stability in the United States" in *Debt, Financial Stability, and Public Policy.* Federal Reserve Bank of Kansas City.

_____, editor. 1986b. *Financing Corporate Capital Formation.* University of Chicago Press: Chicago.

_____, editor. 1985. *Corporate Capital Structures in the United States.* University of Chicago Press: Chicago.

Gilbert, Ethel S. 1969. "The Effect of Unequal Variance-Covariance Matrices on Fisher's Linear Discriminant Function." *Biometrics* 25(September) 505–515.

Hudson, John. 1989. "The Impact of Changing Profitability on the Supply Side of the Economy." A paper for the Conference on Profits and Instability, Jerome A. Levy Economics Institute, Bard College. March 16–18.

Judge, George; Griffiths, W.E.; Hill, R.C.; Lutkepohl, H.; and Lee, T. 1985. *The Theory and Practice of Econometrics.* John Wiley and Sons: New York.

Kaufman, Henry. 1986. "Debt: The Threat to Economic and Financial Stability" in *Debt, Financial Stability, and Public Policy.* Federal Reserve Bank of Kansas City.

Lachenbruch, Peter. 1967. "An Almost Unbiased Method of Obtaining Confidence Intervals for the Probability of Misclassification in Discriminant Analysis." *Biometrics* 23(December) 639–645.

_____ and Goldstein, M. 1979. "Discriminant Analysis." *Biometrics.* 35(March) 69–85.

_____; Sneeringer, Cheryl; and Revo, Lawrence. 1973. "Robustness of the Linear and Quadratic Discriminant Function to Certain Types of Non-normality." *Communications in Statistics* 1#1(March) 39–56.

Marks, Sidney and Dunn, Olive. 1974. "Discriminant Functions When Covariance Matrices Are Unequal." *Journal of the American Statistical Association* 69#346 (June) 555–559.

Minsky, Hyman. 1986. *Stabilizing an Unstable Economy.* Yale University Press: New Haven, CT.

Mitchell, Karlyn. 1983. "Trends in Corporation Finance." *Economic Review,* Federal Reserve Bank of Kansas City, (March) 3–15.

Modigliani, F. and Miller, M. 1958. "The Cost of Capital, Corporation Finance and the Theory of Investment." *American Economic Review.* 48(June) 261–297.

Morrison, Donald. 1969. "On the Interpretation of Discriminant Analysis." *Journal of Marketing Research* 6(May) 156–163.

Ravenscraft, David and Scherer, F.M. 1987. *Mergers, Sell-Offs, and Economic Efficiency.* Brookings Institution: Washington, D.C.

Standard and Poor's, Inc. 1988. *COMPUSTAT PC Plus.* Standard and Poor's Compustat Services, Inc.

Stiglitz, J.E. 1974. "On the Irrelevance of Corporate Financial Policy." *American Economic Review,* 64#6(December) 851–866.

_____ and Weiss, A. 1981. "Credit Rationing in Markets with Imperfect Information." *American Economic Review,* 71(June) 393–410.

Survey of Current Business. Bureau of Economic Analysis. 69#2(February 1989).

Taggart, Robert. 1985. "Secular Patterns in the Financing of U.S. Corporations," in B.M. Friedman (1985).

Wolfson, Martin. 1986. *Financial Crises.* M.E. Sharpe, Inc.: Armonk, NY.