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

by

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The role of debt/credit in a market economy has recently received an unusually disproportionate 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 as well as other debt ratios. This empirical phenomenon is caught in the conundrum of economic theory. Modigliani-Miller [1958] allows that the actors in the financial markets will accurately convey this information to the markets and the markets will make the proper value adjustments for risk. However, in this market system the additional risk that debt induces will be born by arbitragers, so debt's affect is neutral. This approach is a theoretical counter to fears implicit in the empirical situation. An alternative theoretical approach denies the neutrality of debt emphasizing instead the connection between the financial and production sectors. This connection is a conduit through which the disruptions in the financial sector are transmitted to the nonfinancial sector [Fisher, 1933; Minsky, 1986].

This study is a continuation of the empirical research on the impacts of debt; it argues that debt-usage is not neutral and that the currency of its cost is bankruptcy. A financially fragile economy is feared because of its potential harm. In the public sector the large and lingering deficit is not a problem in and of itself. It is only when future scenarios of budget item trade-offs or recession-fighting fiscal policy options are conjured up that the problem emerges. The same is true for the corporate debt. As long as the debt is incurred in an expanding economy, there is no economic problem. It is only when a contraction ensues that the problem emerges. The problem is encapsulated in bankruptcy and the costs that accompany it. Some of these costs are private and can be born by the managers and owners. However, in a recession this burden

grows and spreads beyond the private; the costs become socialized.

While previous researchers have indicated the extent of consumer and producer indebtedness, this study uses discriminant analysis to simulate the impact of a recession on the manufacturing sector so that a measure of our current financial vulnerability is produced. In the first section background material on the current financial structure of the United States is reviewed. The second section delineates the social costs of bankruptcy. The construction and characteristics of the discriminant function are specified in the third section. The fourth section details the simulation and its results.

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.[2] More recently the business press in concert with a new set of economists have noted the alarming changes in the use of "junk bonds", the higher than heretofore expected default risk associated with them and increasing incidence of these financial instruments in the portfolios of individuals and financial institutions.[3] 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.[4]

The more commonly noted problem which is also associated with the large public debt lies in the shorter term. The advent of a recession would increase the likelihood of default on outstanding debt. Such defaults would throw the

borrowers into bankruptcy, thus causing a decline in the expected income of the lenders. In the case of a strong recession, the incidence of bankruptcies among borrowers would be even higher possibly inducing a wave of bankruptcies among the lenders. Given the present weakened position of many financial institutions such a scenario is highly credible.

In a recent article Bernanke and Campbell [1988] produced 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[5] they found that debt-asset ratios were higher on average in the 1980s than in the late 1960s and early 1970s. However, the average debt-asset ratios 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 frame Bernanke and Campbell attempt to gauge the severity of the corporate financial position. They use Altman's Z-score model which is based on a discriminant function that was constructed in 1968. The results from using this model on each sample between 1969 and 1986 were inconclusive. As Bernanke and Campbell noted this type of analysis is time period dependent. Given that it reflects the economic structure of the late 1960s, it is unreasonable to expect it to provide telling results when applied over a 17 year time span. The method has been pushed beyond its capabilities.[6]

Given the inconclusive outcome of the Z-score analysis, Bernanke and Campbell proceeded to simulate the effects of recessions on the 1986 corporate

financial structure. The impact of the simulated results was gauged by the changes in the population's distribution. Their simulation was run using only 3 variables, debt-asset ratios, ratio of interest expense to cash flow and the ratio of interest expense to current assets. The values of the simulated recessionary changes in these variables were derived from their changes 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.[7] 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 reflect 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.

In the summary they state that solvency, as measured by debt-asset ratios, has been relatively stable in recent years, but there has been a deterioration in some measures of corporate liquidity. This divergence between the behavior of their solvency and liquidity ratios in the 1980s arose from the stock market's stable behavior. As a contrast to the early 1980s in the 1973-74 period the market value of firms declined precipitously, sending market-valued debt-asset

ratios up. Bernanke and Campbell's message is as long as there is no downturn as strong as the 1973-74 recession and the stock market holds its value, then the solvency of the system is not threatened.

The problem with this type of analysis is its assumption of efficient markets.[8] The stock market valuation of the firm is expected to reflect the real value of the firm, therefore being reflective of its income-earning capabilities. The point in "time" that this valuation is supposed to capture is a perfectly competitive equilibrium, so that it is not disturbed by disequilibrating forces. However, market valuation at any point in time rather than providing an equilibrium value of a firm's expected income is affected by speculative frenzies that afflict the buying public, the uncompetitive power of institutional actors, asymmetrical informational flows and tax laws, a less than perfect equilibrium position.

While market valuation may not reflect the true value of the firm, it is important to the firm since its shares are sold on both primary and secondary markets, and the value of the financial instruments that it holds in its own portfolio is determined in the market. The value of these financial investments, while not necessarily forming the core of the firm's value, are important. They are a portion of the current assets of the firm and they are converted to cash when operating expenses must be paid. The form that these financial investments take will determine their susceptibility to market fluctuations, hence their susceptibility to value changes. The liquidity of the firm can experience rapid alterations due to the stock market's fluctuations.

The following analysis of the U.S. corporate financial structure and its vulnerability builds on the groundwork laid down by Bernanke and Campbell. Instead of depending upon an obsolete discriminant function, a function that is

reflective of the current economic structure is created. The variables that emerge from the discriminant analysis as important 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 Costs of Bankruptcy

In general, economic theory neglects the concept of bankruptcy. When approached it is usually from an oblique angle which views it as a positive result because it means that the competitive market is working in a manner that will eradicate inefficient producers. Those who go bankrupt do so for the economic good. The costs in such a case are negative which means a positive economic outcome. Those who approach bankruptcy from the opposite oblique angle do so through its repercussion: unemployment. These costs are positive for they lead to increased demands upon the social safety net: unemployment insurance, health and family care plans, and welfare and job training programs. In addition to the unemployment cost of bankruptcy is the decline in aggregate demand and in aggregate supply.

A decrease in aggregate demand due to a decrease in wealth [Hudson, 1989] and/or income which arises from the increase in unemployment in a Keynesian framework leads to production declines. These demand and output reductions are supposed to be stabilized via price effects. However, Caskey and Fazzari [1988] indicate that this traditional assumption fails to hold in certain cases. Instead of inducing stability, price flexibility may be responsible for producing greater variation in output. So, a decrease in aggregate demand leads to production reductions and to price effects that may exacerbate these reductions.

In Hudson [1989] while acknowledging the demand side effects from

bankruptcy 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 (scrap value) rather than resold. While the real estate market for used buildings is deeper and broader than that for used capital equipment, even the 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 the increased probability that when demand turns up, there will be a lag in the supply response.[9]

In addition to capital destruction, Hudson follows in the tradition of the financial approach to recession, debt deflation, when he promotes the idea of a bankruptcy multiplier. 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: the economy blindly working its way back towards equilibrium. They are indicative of the excessive costs that accompany the bankruptcies arising from economic disruption.

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.[10] There were 52 bankrupt firms that met these requirements. Each solvent firm was chosen so as

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.

Previous discriminant analyses of bankruptcy have utilized ratios that capture the liquidity, profitability, solvency, leverage and activity of the firm.[11] In these analyses short term debt financial ratios, other than the current ratio, have not been found to be of any merit in discriminating bankrupt from solvent firms in the existent economies. While short term debt was not instrumental in these studies, some debt ratio was always significant. Altman [1968] used the market value of equity to book value of debt ratio; Altman, Haldeman, and Narayanan [1977] used the interest-coverage ratio; and Deakin [1972] used the cash flow to debt ratio. The determinations of the best variables for each of these models were based on univariate F-statistics and a search process that would evaluate each variable's individual contribution to the discrimination process. These determinations are historically dependent; the particular variables that produce the best discriminant function change along with the structure of the economy.

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 shows the 8 best variables, their univariate F's and the reduction of the Wilk's lambda F-statistic. In Table 1 the first row of numbers for each variable refers to the

TABLE 1

Discriminant Function Variables

VARIABLE	UNIVARIATE F STATISTIC	CHANGE IN WILKS' LAMBDA F-STATISTIC
ICBT	1.88 *1.13*	0.11 *0.35*
QUIK	4.64 *5.95*	2.61 *1.37*
WCAT	17.55 *19.95*	0.60 *2.38*
CUR	4.19 *6.48*	3.16 *1.03*
DLCAT	13.04 *12.83*	0.43 *0.17*
DLCDT	20.92 *18.52*	3.13 *5.64*
LCTAT	12.25 *20.19*	0.35 *1.54*
NPM	2.36 *0.01*	4.85 *0.00*

discriminant function generated for the hold-out method and in the second row, the italicized numbers refer to the discriminant function generated for the simulations. While the change in the Wilks' Lambda F-statistic does not always appear as a large number, the Wilks' Lamdba F-statistic for each of these variables was significant at the 0.001 level.

These financial ratios are a combination of those that have been found to be significant for discriminating between failed and nonfailed firms in previous studies and those that have never been significant in previous studies. The ratios that fall into the former category include interest-times earnings (ICBT), quick ratio (QUIK), current ratio (CUR), working capital to total assets (WCAT), current liabilities to total assets (LCTAT) and net profit margin (NPM). The other ratios, short term debt to total assets (DLCAT) and short term debt to total debt (DLCDT), are in the latter category. All of these ratios are interesting because they are all indicators of a short period view of the firm's liquidity, profitability and debt position. DLCAT and DLCDT are even more interesting because instead of a total debt to assets or equity ratio being the significant variable, indicators of the firm's short term debt position take on a pivotal role. As the scores in Table 1 indicate, both of these variables were found to be strongly significant in both the univariate and multivariate tests. The immediate implication of this roster of ratios is obvious, there has been a dramatic change in the financial structure of the U.S. corporation. The previous section pointed in this direction and the importance of these ratios to the discriminant function supports those descriptive statistics.

In order to test the robustness of these variables, two different discriminant methods were used. First, the hold-out method was used. This method requires that the sample be subdivided into two subsamples each with equal

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. U-METHOD

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

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 U-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 as well as it does not produce a single discriminant function [Altman, Avery, Eisenbeis and Sinkey, 1981]. Each iteration produces a new discriminant function, for the included observations are always different by one. Since there is not just one, but n discriminant functions produced in this method, using it to predict bankruptcy in other samples, such as in our simulations, is impossible. Therefore, the two methods simply act to check the robustness of these financial ratios in separating the solvent from the failed. The Appendix details distributional characteristics of the samples in the study and the properties of the two discriminant techniques.

Table 2 reproduces the classification results from each of these estimating techniques. 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 1 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 proportional chance criterion is 50% [Morrison, 1969], the discriminant function is out-performing chance by almost 40%.[13]

The U-method produces classification results similar to the hold-out method's. It correctly classified bankrupt firms 58% (30/52) of the time and nonfailed 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 indicates that the discriminant function is out-performing chance by 32%.

The similarity in classification results that was obtained from the two different discriminant techniques indicates the robustness of the these particular variables in separating failed from solvent firms. While they are robust, the overall correct classification rate and individual category classification rates are not as high as that found in other studies [Altman, 1968; Beaver, 1966; and Blum, 1974]. The probable reason for this lies in the Compustat data set. Most of the bankrupt firms were taken from Compustat's research file. The deletion date which is their indicator of date of liquidation or bankruptcy is on average 27 months after the last income statement or balance sheet has been received from the firm [Standard and Poor's, 1988:190]. This lag indicates that the most recent data on the firm is on average over two years old. The stronger results of the other studies were based on data which had at most a one year lag. The percentage of correct classifications in these other studies was comparable to this study's results when the discriminant function was based

TABLE 3

1988 SAMPLE: MEANS AND DECILE DISTRIBUTION

MEAN	0	1	2	3	4	5	6	7	8	9
ICBT										
5.49	-103.22	-2.04	0.82	1.93	2.98	4.28	5.99	8.68	14.73	114.70
CUR										
2.54	0.68	1.21	1.48	1.69	1.92	2.18	2.48	2.94	3.74	8.12
DLCAT										
0.11	0.00	0.01	0.02	0.03	0.04	0.06	0.09	0.14	0.21	0.64
DLCDT										
0.32	0.00	0.04	0 08	0.13	0.19	0.26	0.37	0.52	0.74	0.97
NPM										
-25.81	-310.30	-8.26	-0.62	1.56	2.84	4.01	5.19	6.55	8.65	65.34
DT/MKEQ										
0.99	0.01	0.07	0.14	0.22	0.30	0.41	0.56	0.81	1.34	7.01

TABLE 4

RESULTS FROM DISCRIMINANT ANALYSIS ON 1988 SAMPLE

	BANKRUPT	SOLVENT	N
BANKRUPT	10	12	22
SOLVENT	363	1226	1589
	373	1236	1611

on data 2 to 3 years prior to bankruptcy.

The Simulations

In a recession it is the reduction in production and investment and the bankruptcy of firms that produces the short term social ills of decreased aggregate demand and income, deflation and unemployment. By using a discriminant function to simulate the effects of a recession, a partial indication of a recesion's potential impact is hypothesized via the change in the incidence of bankruptcy. In this simulation there is no attempt to imply that the economic structure in 1974-75 or in 1980-1982 is exactly like that in 1988. The economy has changed since 1982 and certainly since 1975. The point of the simulation is to provide an indicator of a recession's impact on the current highly leveraged economy.

The structure of the 1988 manufacturing sector of the economy was represented by a sample of 1611 firms drawn from Compustat. The selection of these firms was based on having a SIC code between 2000 and 3999 and complete information for the 8 variables. Of these firms, 1589 were solvent and 22 were bankrupt, but still in operation.[14] This produces an inherent structural proportionality of 0.01 and 0.99 in the sample that is to be classified. The financial structure of the 1988 sample is presented in Table 3. The mean values of five of the discriminant functions variables and the decile distribution of these variables describe the 1988 financial position.[15] Given the economic significance that is ascribed to the debt-equity ratio, it, too, is included in the structural description, even though it was not significant in the discriminant analysis. The weight of the large valued ratios in the sample drives up the values of the means, so that they fall into deciles greater than the 5th.

Prior to running the recession simulations, the discriminant function was used on the 1988 sample to determine its ability to separate bankrupt and solvent firms in this initial sample. The technique used was a variation on the hold-out method. The discriminant function was constructed from the entire matched-pair sample consisting of 104 firms, 52 solvent and 52 failed. This discriminant function was then used to classify the 1988 sample of 1611 firms. Table 4 shows the classification scheme produced by the discriminant analysis. Of the 22 bankrupt firms, 10 were correctly identified; and of the 1589 nonfailed 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.

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. The discriminant functions ability to correctly classify the solvent firms, however, is less than dramatic. A chance solvent classification based on population proportionality would be 99% in this sample. However, the correct classification rate was only 77%.[16] Obviously, the power of the model lies in its ability to detect bankrupt firms.

Using recession-modified values of the 1988 corporate financial structure, the simulation consisted of classifying these firms into bankrupt and solvent categories. The average annual changes of the variables for each firm in the 1974-75 and 1980-82 recessions were determined; the base years were 1973 and 1979, respectively. The firms' variables in the 1988 sample were modified by these annual average recession changes, and then the discriminant function was

TABLE 5

SIMULATIONS OF 1980-82 AND 1973-74 RECESSIONS
ON THE 1988 SAMPLE

A. 1973-74 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 6

Decile Distribution

Base Year: 1988

	0	1	2	3	4	5	6	7	8	9
ICBT	-103.22	-2.04	.82	1.93	2.98	4.28	5.99	8.68	14.73	114.70
CUR	0.68	1.21	1.48	1.69	1.92	2.18	2.48	2.94	3.74	8.74
DLCAT	0.00	0.01	0.02	0.03	0.04	0.06	0.09	0.14	0.21	0.64
DLCDT	0.00	0.04	0.08	0.13	0.19	0.26	0.37	0.52	0.74	0.97
NPM	-310.30	-8.26	-0.62	1.56	2.84	4.01	5.19	6.55	8.65	65.34
DT/ MKTEQ	0.01	0.07	0.14	0.22	0.30	0.41	0.56	0.81	1.34	7.01

1973 - 1974 Recession Simulation

Year 1:	0	1	2	3	4	5	6	7	8	9
ICBT	-85.46	-1.69	.68	1.60	2.46	3.54	4.96	7.19	12.20	94.97
CUR	.69	1.23	1.50	1.72	1.95	2.21	2.52	2.98	3.79	8.24
DLCAT	0.00	0.03	0.07	0.11	0.17	0.26	0.38	0.59	0.91	2.72
DLCDT	0.01	0.09	0.14	0.31	0.46	0.64	0.90	1.27	1.79	2.36
NPM	-161.97	-4.31	-0.33	0.81	1.48	2.09	2.71	3.42	4.52	34.11
DT/ MKTEQ	0.04	0.18	0.36	0.56	0.78	1.04	1.42	2.06	3.41	17.8

Year 2:	0	1	2	3	4	5	6	7	8	9
ICBT	-82.39	-1.63	.65	1.54	2.38	3.41	4.78	6.93	11.76	91.55
CUR	.79	1.41	1.72	1.96	2.23	2.53	2.88	3.41	4.33	9.42
DLCAT	0.00	0.04	0.10	0.16	0.25	0.38	0.57	0.87	1.35	4.01
DLCDT	0.01	0.12	0.26	0.42	0.61	0.87	1.22	1.71	2.42	3.19
NPM	-88.11	-2.34	-0.18	.44	.81	1.14	1.47	1.86	2.46	18.55
DT/ MKTEQ	0.03	0.15	0.29	0.45	0.62	0.83	1.14	1.65	2.73	14.30

TABLE 6 (cont'd)

1980 - 1982 Recession Simulation										
Year 1:	0	1	2	3	4	5	6	7	8	9
ICBT	-145.74	-2.89	1.15	2.73	4.20	6.04	8.46	12.26	20.80	161.96
CUR	0.74	1.33	1.62	1.85	2.10	2.38	2.71	3.21	4.08	8.88
DLCAT	0.00	0.01	0.04	0.06	0.09	0.14	0.21	0.33	0.50	1.51
DLCDT	0.01	0.06	0.12	0.20	0.30	0.42	0.59	0.83	1.17	1.55
NPM	-255.59	-6.00	-0.45	1.13	2.06	2.92	3.77	4.76	6.29	47.50
DT/ MKTEQ	0.02	0.08	0.15	0.23	0.32	0.42	0.58	0.84	1.40	7.33
Year 2:	0	1	2	3	4	5	6	7	8	9
ICBT	-263.93	-5.23	2.09	4.94	7.61	10.94	15.33	22.19	37.67	293.31
CUR	.80	1.42	1.73	1.98	2.25	2.55	2.90	3.43	4.37	9.49
DLCAT	0.00	0.03	0.09	0.15	0.23	0.35	0.52	0.80	1.24	3.69
DLCDT	0.01	0.11	0.25	0.42	0.61	0.86	1.20	1.70	2.39	3.16
NPM	-147.98	-3.94	-0.30	0.74	1.35	1.91	2.47	3.12	4.13	31.16
DT/ MKTEQ	0.02	0.10	0.20	0.30	0.42	0.56	0.78	1.12	1.86	9.74
Year 3:	0	1	2	3	4	5	6	7	8	9
ICBT	-268.42	-5.32	2.12	5.03	7.74	11.13	15.59	22.57	38.31	298.30
CUR	0.85	1.52	1.85	2.12	2.41	2.73	3.10	3.67	4.68	10.16
DLCAT	0.01	0.06	0.17	0.28	0.43	0.65	0.97	1.49	2.30	6.85
DLCDT	0.02	0.17	0.38	0.62	0.91	1.28	1.81	2.54	3.59	4.73
NPM	-143.54	-3.82	-0.29	0.72	1.31	1.86	2.40	3.03	4.00	30.23
DT/ MKTEQ	0.03	0.15	0.29	0.44	0.61	0.82	1.12	1.62	2.69	14.11

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 a new decile distribution based on these modified values was produced for each "recession" year.

The simulation results are shown in Table 5 and the new distributions in Table 6. In the first year of a recession as strong as that experienced in 1973 there were 968 firms classified as bankrupt and 643 as solvent. This is more than 2.5 times the number classified as bankrupt in the initial sample and a little more than one half of those categorized as solvent. In this first year of the recession 60% of the firms were classified as bankrupt compared to the base year's 23%. However, not all of the firms classified as bankrupt or solvent were. Given the knowledge of the initial 1988 discriminant analysis, adjustments were made to the recession prediction which produced a more accurate illustration of a recession's impact.

The adjustment factors are 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 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 a 250% increase in bankruptcy.

The second year of the 1973-74 recession simulation shows 1081 firms classified as bankrupt and 530 as solvent. This level of bankruptcy classification is almost 3 times that in 1988 and so is the number of actual bankruptcies. Using the same adjustment factors there are 64 bankruptcies and 1547 remain solvent. The bankruptcy rate in the sample population has 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 a an economy that induce a multiplier effect which spreads bankruptcy from firm to firm and industry to industry.

Table 6 presents the complement to the 1973-74 recession simulation, changes in the decile distributions of some salient financial ratios. The most outstanding among these is the increases in the debt ratios. The DLCAT and DLCDT ratios never surpassed unity in 1988, however after recession year 1 DLCAT is greater than 1 in the 9th decile and after recession year 2 in the 8th decile. DLCDT is greater than unity in the 7th decile after year 1 and in the 6th decile in year 2. The change in the debt-equity ratio is even more striking. In 1988 it surpassed unity in the 8th decile, after year 1 in the recession the 5th decile was greater than unity. In year 2 of the recession there was a slight reversal, and the debt-equity ratio surpassed unity in the 6th decile. It is obvious from these ratios that the major surge in the debt-equity ratio came from the increase in short term usage. These increases indicate the extreme vulnerability of a highly leveraged corporate debt structure to a major recession.

Bernanke and Campbell concluded from their simulations that the effects from the 1973-74 recession produced the strongest impacts and a recession like

that of 1981-82 was not truly worrisome. As the results in Table 5 indicate, their conclusion is only valid when 1980 is used as the base year for the simulation. Using 1980 as the first year of a three year recession effects different results. By the end of the third year of such a recession the indications are that the economy would suffer a very large disruption, one that would surpass the impact of 1973-74.

This result coincides with the macroeconomic measures of recessionary impact, unemployment rates and rates of GNP growth in each of the two periods. The civilian unemployment rates for the 1979-82 period were 5.8%, 7.1%, 7.6% and 9.7%, respectively. This compares to the 1973-75 period's 4.9%, 5.6% and 8.5% unemployment rates. The real rates of growth of GNP for the two periods are equally as skewed. The 1979-80 period experienced real growth rates of 2.5%, -0.2%, 1.9%, and -2.5%, respectively. While the 1973-75 period's were 5.2%, -0.5% and -1.5%, respectively.

After year 1 in the 1980-82 simulation, there were 713 firms categorized as bankrupt, 42 of these would have probably been bankrupt. This number almost doubles the 1988 level. In the second year there were 1002 firms classified as bankrupt. Of these 60 were probably bankrupt. Compared to the 1973-74 simulation in its second year this recession produces a weaker impact. 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, fully 72% of the sample, and the number of probably bankrupt to rise to 69. 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 taken longer, but in the final instance it has a more damaging impact on the economy. By the final year the bankruptcy rate has more than tripled.

The decile distribution of variables as seen in Table 6 reflect this same temporal pattern of development for most of the variables. The DLCAT and DLCDT variables have steadily increasing values over the 3 years of the simulated recession. Comparing the 5th decile in each simulation shows the 1980-82 simulation in year 2 to have values comparable to the 1973-74 simulation in year 2. By year 3 these values exceed the peaks of the 1973-74 simulation. This heavy use of short term debt is conveyed by the rise in DLCDT's 5th decile and in DLCAT's 7th decile to a value greater than unity. The rationale for this debt usage is seen in the changing value of NPM. The net profit margin declines from 4.01 in the 5th decile in 1988 to 2.92 in recession year 1, 1.91 in year 2 and 1.86 in year 3. This NPM value in year 3 is not as low as that in the second year of the 1973-74 simulation, but the decline from the base year is still very damaging.

The "recession's" impact on the debt-to-market value equity ratio, while heavy, did not have as strong of an impact as the 1973-74 recession.[17] In the first year of the 1973-74 simulation the debt-equity ratio in the 5th decile was pushed to a value greater than unity. In year 1 of the 1980-82 simulation that value was 0.42. This is not much of change from the base year value of 0.41. The succeeding years indicate relatively large increases in total debt usage. While year 1 has the debt-equity value exceeding unity in the 8th decile just as it does in the base year, it jumped forward one decile in each additional year of the simulation. Therefore, in the final year of the simulation the debt-equity ratio exceeded unity in the 6th decile. Irrespective of which simulation has the debt-equity ratio that surpasses unity in the lowest decile, the fact remains that the economic impact of almost 40% of the economy's firms being categorized de facto as insolvent would be devastating.

The recessionary behavior of ICBT and CUR ran counter to the other variables. As in the 1973-74 simulation, CUR increased in value. The expected behavior, however, would be a decrease in its value reflecting the firm's deteriorating financial position. Traditional wisdom in a recession dictates that inventories will rise and debt will decline. Such behavior would cause the current ratio to decrease in value. As has been apparent from this study, debt, especially short term debt, has risen and one of the "modern" techniques firms' have employed to shield them against the deleterious impacts of recessions is inventory control. With both of these variables moving in directions opposite to what is expected the result would be a rising current ratio.

Of the two ratios the unexpected behavior of ICBT in the 1980-82 simulation is the more curious. The key to such behavior might be found in the relationship between inflation and the interest rate on short term debt. The average 6 month commercial paper (CP) rate in 1979 was 10.91%, inflation as measured by the change in the industrial Producer's Price Index was 13% [CEA, 1988]. In the recession years both prices and interest rates rose, but prices rose faster than interest rates: in 1980 the change in the PPI was 16% and the CP interest rate was 12.29%; in 1981 the change in the PPI was 11% and the CP interest rate was 14.76%; and in 1982 the change in the PPI was 3% while the CP interest rate had dropped to 8.5% by the end of 1982. Inflationary increases, in general, were outstripping interest rate increases. As long as the price increases were not overwhelmed by declines in sales, before tax income plus interest payments would grow faster than interest payments.

In Conclusion

The discriminant analysis simulations and the distributional analysis have indicated not only that the corporate sector is in a financially vulnerable

position, but that there has been a structural change in terms of debt usage. Financial ratios that had previously been found useful in discriminant analysis were found to be no longer so, and the importance of new ratios that reflect the ascendence of liquidity and short term debt positions over solvency and profitability was established.

The results from the simulations afford only one conclusion, if a recession with the strength of either of the contractions that the economy has experienced since 1971 were to strike, the corporate industrial sector would be thrown into an even more highly vulnerable financial position that would lead to a major rise in the incidence of bankruptcy. These simulations could only calculate the individual bankruptcies that would arise from each firm's internal financial problems, however, the bankruptcy pattern is a dynamic, systemic one. There are intra-firm linkages and multiplier effects that this study fails to capture, yet it is understood that their inclusion would serve to exacerbate these results.

APPENDIX

These discriminant functions were constructed by SAS for the 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]. So, the results of this analysis are based on the sample meeting the assumptions of normalcy: variables with a multivariate normal distribution and covariance matrices that are equal [Eisenbeis, 1977]. In discriminant analysis the classification procedure utilizes these parameters when it categorizes each observation, so the character of the distribution may affect the results of the analysis.

Both samples, the 1988 corporate structure and the discriminant function, were tested for normality. In both cases the distributions exhibited signs of kurtosis and skewness. Given the non-normality of the samples in this study, a discriminant technique was chosen that would be the least susceptible to these biases. Two different techniques were initially used. The hold-out method produces consistent, unbiased estimates with large samples, but they may be less efficient than other methods. The U-method is supposed to be more efficient than the hold-out method, insensitive to sample size and insensitive to normality assumptions [Altman, Avery, Eisenbeis and Sinkey, 1981]. Having these qualities, it acts as a check on the hold-out method.

As the results from the two methods in Table 2 show, on average their performance is quite similar. At the margin the hold-out method out-performed the U-method, but these marginally better results may be due to the hold-out method's biases. Overall the results would indicate that the sample size for the hold-out method is large enough to produce consistent, unbiased estimates. Adding to the level of confidence that accompanies these results is the increase in the size of the sample that was used to construct the discriminant function that analyzed the 1988 sample and the simulations. The number of variables remained constant and the number of observations doubled.

A test of the equality of the covariance matrices found them to be unequal, so a quadratic rather than a linear discriminant function was used.[18] The use of the quadratic function under these conditions produces better results than the linear function. There is an increase in misclassification in the smaller group, bankrupt, and a decrease in the larger group, solvent, leaving the average overall misclassification rate only slightly changed [Lachenbruch, Sneeringer and Revo, 1973].

ENDNOTES

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. The early work of Friedman [1986b; 1985] and the contributions of Ciccolo and Baum [1985], Ciccolo [1987] and Taggart [1985] have researched the current trend toward rising debt usage by corporations and governments. These empirical studies situate this current phenomenon onto an historical continuum. In this context they argue that the current debt ratios are no higher than those of the pre-World War II era.

3. Several articles on the growing use of "junk bonds" for corporate finance have appeared in the press: Rohatyn [1989], New York Times, October 30, 1988 and Wall Street Journal, March 15, 1988, October 25, 1988, November 25, 1988, December 5, 1988, January 3, 1989 and March 29, 1989.

4. David Ravenscraft and F.M. Scherer [1987] found that the expected increases in efficiency due to increased merger activity that efficient market theory predicted were not attained. In fact, there was a decline in efficiency. 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 much greater fees for their promoters and financiers.

5. At the heart of market valuations of assets and debt is the assumptions on 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. Another aspect of their technique is the aggregation of the debt and asset variables across all firms before the ratios are generated. This method implicitly gives greater weight to large firms in their analysis.

6. The method of discriminant analysis is not what is under discussion here, it is the appropriate use of the method. The structural change that has ensued in the U.S. between 1968 and 1989 will be reflected in the changing financial structure, so that variables which were useful determinants in previous time periods may not be in the current period. Therefore, a discriminant function that discriminates well in 1968 is probably not able to do the same in 1989. Altman, Haldeman and Narayanan [1977] make this point when they compare Altman's earlier Z-score model with the Zeta model.

7. 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.

8. Efficient market theory has been the basis for much of the recent work done in applied financial economics. See the following for an introduction: Malkiel [1985; 1987] and Jensen [1968].

9. Schumpeter's concept of creative destruction views capital destruction as the first step in a two step process. Recession induces bankruptcy which is the destruction of capital, but he sees new capital which is more technologically advanced replacing the old, obsolete capital while the economy is still in recession. This circumvents the production lag that Hudson foresees when the expansion begins.

10. The bankruptcy categorization is defined for this study as having filed for bankruptcy with the court. This implies that the court has jurisdiction over the firm and it may or may not continue to operate. Compustat uses each firm's self-designated definition of its operating position.

11. While many of the studies on bankruptcy using discriminant analysis have found debt ratios to be instrumental in separating bankrupt from non-bankrupt firms, the results have shown total debt rather than either long or short term debt to be the important variable [Beaver,1967; Altman, 1968; Altman, Haldeman, and Narayanan, 1977; Deakin, 1977; and Elam, 1975].

12. As described in the Economic Report of the President, 1988, the business failure rate only reaches 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.

$$(1)\quad P(\text{Correct}) = P(\text{Correct}|\text{Classified Type I})*P(\text{Classified Type I}) + P(\text{Correct}|\text{Classified Type II})*P(\text{Classified Type II})$$

or

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

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

15. 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 reduces the impact of small firms.

$$(2)\quad \frac{\Sigma_{i=1}^{n}\, a_i}{\Sigma_{i=1}^{n}\, b_i} = a/b$$

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 is the method utilized in this study.

$$(3)\quad \frac{\Sigma_{i=1}^{n}\, (a/b)_i}{n} = a/b$$

16. A Baynesian analysis of this outcome offers a different view. The probability of a solvent firm being chosen from the sample and classified as solvent is 0.99, while the probability of a bankrupt firm being chosen from the sample and classified as bankrupt is 0.03. Using this approach the confidence in outcome would be in the solvent classifications. Irrespective of which classification is the more statistically significant, the adjustments can be made to provide a view of expected bankruptcies in a recession.

17. 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 maintained its value, so that increases in the value of debt would be monotonically reflected in the debt-equity ratio. Contrarily, the stock market in the 1980-82 recession experienced a major loss in value, so the increases in debt were partially offset by the decline in market value of equity. Thus, it was the different stock market behavior, not behavior towards debt usage, that produced the varied results in the two recessions and simulations.

18. Eisenbeis [1977] cites Gilbert [1968] and Marks and Dunn [1974] as the two studies providing the rationale behind the use of the quadratic function. These studies find that when this assumption is met, then the linear discriminant function produces reduced results when compared to the results of a quadratic function. Lachenbruch and Goldstein [1979] cite Clarke, Lachenbruch and Broffitt [1978] who conclude that a quadratic function was not affected by heavy kurtosis,

actual error rates were larger than optimal rates and individual error rates were affected more than average error rates. Relating to unequal covariance matrices they found that the between-sample variability of the individual error rates irrespective of normalcy was large. This accords with Marks and Dunn who found that with small sample sizes the quadratic function did poorly.

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