Is the Scaling Measure Used for Cash Flows Important in Predicting Financially Distressed Firms?

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Abstract

This paper attempts to determine whether the measure used to scale the three net cash flows reported on a statement of cash flows affects binary financial distress prediction results. The results of this study suggest that the scaling measure used does affect the incremental predictive ability of each cash flow. Results indicate that one should scale cash flow from operating activities by current assets, cash flow from investing activities by sales, and cash flow from operating activities by owners' equity.

Introduction and Methods

In 1987, the Financial Accounting Standards Board (FASB) required that companies generate a statement of cash flows. The FASB based its decision to require a statement of cash flows in part on the belief that cash flow information should help creditors predict future firm financial distress.

Creditors and researchers must now determine the best scaling measures for developing cash flow ratios to predict financial distress. Although academic researchers have tended to scale cash flows by total liabilities (e.g., Casey and Bartczak in 1984 and 1985), many other scaling measures exist. The purpose of this paper is to determine whether the measure used to scale cash flows affects financial distress prediction results. This paper also attempts to identify the best scaling measure for each three net cash flows reported on a statement of cash flows.

Scaling Measures Used

The author scaled each cash flow by total liabilities, total assets, sales, owners' equity, current liabilities, and current assets. Obviously, many other scaling measures exist. The author selected the above scaling measures because: (1) they were the most common scaling measures used in prior financial distress research by Beaver (1966), Altman et al. (1977), Mensah (1983), and Casey and Bartczak (1984 and 1985); and (2) each measure can be obtained easily from published accounting financial statements.

Dependent Variable

This study uses a healthy versus distressed response for financial distress. A firm was financially distressed if it experienced a loan principal/interest default, debt accommodation, or filed for Chapter XI protection during 1988 or 1989. The author chose this response because the occurrence of a loan default/accommodation or bankruptcy by a firm should result in a financial loss to creditors. Since Giroux and Wiggins (1984) found that loan defaults and debt accommodations normally occur before bankruptcy, creditors should be especially interested in predicting loan default/accommodation firms. Thus, the author used a healthy versus loan default/accommodation and bankrupt response instead of a bankrupt versus nonbankrupt response. This financial distress response is the dependent variable in this study and is coded as follows:

DIST= 0 if firm was healthy (no event of financial distress) during 1988 or 1989, and
= 1 if firm experienced a loan/interest default, debt accommodation, or filed for Chapter XI protection during 1988 or 1989.

Independent Variables

The independent variables in this study consist of six accrual ratios found important by Casey and Bartczak (1984 and 1985), Gentry et. al. (1987), and Gilbert et. al. (1990) in prior financial distress studies; a control variable for firm size recommended by Ohlson (1980); and the three net cash flows reported on the statement

of cash flows. The independent variables are as follows:

SIZE	=	log(total assets),
NITA	=	net income/total assets,
SALESCA	=	sales/current assets,
CACL	=	current assets/current liabilities.
TLOE	=	total liabilities/owners' equity,
CATA	=	current assets/current total assets,
CASHTA	=	cash + marketable securities/total assets,
CFFO	=	cash flow from operating activities,
CFFI	=	cash flow from investing activities, and
CFFF	=	cash flow from financing activities.

The author computed the independent variables from *Compustat Industrial, Primary, Supplementary, Tertiary, Research,* and *Full Tapes* (*Compustat Tapes*).[1]

Logistic Regression and Validation of Models (Classification Ability)

The author constructed the financial distress prediction models using binary logistic regression (LR), proportional odds variation. This procedure fits a regression model to the binary response based on a transformed logit. (Hosmer and Lemoshow (1991) provide a thorough discussion of logistic regression.)

The models were validated by determining the ability of each model to classify firms correctly as healthy or financially distressed one, two, and three years before the event. The author used a jackknife approximation technique found in SAS (1990, p. 1092) to generate the predicted probabilities for classification. This procedure reduces the bias resulting from predicting observations also used to generate the prediction models.

Since dichotomous financial distress studies use nonrandom techniques to select bankrupt and nonbankrupt firms, previous researchers argued that binary logistic bankruptcy models generate biased parameter estimates. However, the logit models used in this study do not produce biased parameter estimates, even when the sample is nonrandomly selected. According to Maddala (1992), for logit models, only the constant term is affected. The constant term simply needs to be decreased by log p_0 - log p_1 to develop classification cutoffs using prior probabilities equaling the sample proportions. Thus, the author of this study used prior probabilities equaling the sample proportions to calculate classification rates.[2]

Sample Selection

Sample firms were selected using the following sampling scheme (the sample excluded firms in the finance, banking, and utility industries). The author used *Compact Disc Disclosure* and *Wall Street Journal Index* to identify firms that, during 1988 or 1989, defaulted on loan principal/interest payments, renegotiated loan terms that extended cash payment schedules or reduced interest rates or principal payments, or declared bankruptcy. Healthy firms for 1988 and 1989 were randomly selected from *Compustat Tapes*. Healthy firms selected were in the same four-digit industry code as a financially distressed firm but had not been identified as financially distressed during 1988 and 1989. This study dropped firms not included in *Compustat* and firms with incomplete data from the sample.

The author examined all sample firms' SEC 10-Ks and annual reports (healthy and distressed firms) to validate the occurrence of a financial distress event, the date of the event, and other important information. Companies not meeting specific criteria were eliminated from the samples. Firms were dropped if the author could not verify the event, or if the date of the event could not be determined. The author also dropped firms from the sample if management was under investigation for fraudulent activities related to the misstatement of financial statement information, or if firms had unreliable data (firms with unaudited financial statements, firms incorporated outside the United States that failed to follow U. S. GAAP procedures, and firms created by mergers, thus resulting in noncomparable statements for part of the estimation period).

The final sample contained 346 firms of which 275 were healthy and seventy-one financially distressed (thirty-seven firms defaulted on a loan or negotiated a debt accommodation and thirty-four firms filed for bankruptcy). For some firms, the bankruptcy announcement comes before financial reports for the preceding year are issued. Consequently, these financial reports include information about a firm's bankruptcy. This problem also can occur for firms experiencing a default or debt accommodation. Therefore, this study substitutes reports from the previous fiscal year as the most current year of interest for firms releasing financial reports after the date of financial distress.

Results

Statistical Significance of Cash Flows

The author first added the cash flow variables separately to the base accrual ratios to determine the incremental explanatory power of each cash flow. A different scaling measure was used each time. Thus, a cash flow model was run six times for each year (total of forty-eight models). The Change in -2Log Likelihood was used to test the incremental predictive ability of each cash flow variable. The Change in -2Log Likelihood follows a χ^2 distribution and is comparable to a partial F test in ordinary least squares regression. See Hosmer and Lemeshow (1989, pp. 11-18 and 223-226) for a

discussion of techniques used in logistic regression to assess the significance of predictor variables. Table 1 contains the results for the cash flow models.

Table 1 shows that results are dependent on the scaling measure used. CFFO is never significant when scaled by sales or owners' equity. CFFI is never significant when scaled by total assets or current liabilities. CFFF is never significant when scaled by total liabilities, current liabilities, or current assets.

Determining the best scaling measure for each cash flow variable is difficult since the scaling measures resulted in significance for different years. However, the strength of significance for each variable (largest chi-square), shows that: (1) the best scaling measure for CFFO is current assets, (2) the best scaling measure for CFFI is total liabilities, and (3) the best scaling measure for CFFF is owners' equity.

Classification Accuracy

The author calculated the classification rates for the base accrual model and the cash flow models. These classification rates were used to validate the statistical results reported in Table 1. Table 2 contains the percentages of firms correctly classified by the models.

If a cash flow has incremental predictive ability over accrual information, then the cash flow model should out-predict the accrual model. Results show that the incremental predictive ability of each cash flow is dependent on the scaling measure used. After adding each cash flow to the accrual model, classification rates often decrease when the cash flows are scaled by certain measures.

The classification rates basically agree with the statistical results reported earlier for CFFO and CFFF.

Table 1
Explanatory Power of Each Cash Flow, Scaled By Six Different Measures

		Scaling Measure Used					
Year	Model[1]	Total liabilities	Total assets	Sales	Owners' equity	Current liabilities	Current assets
Year-1:							
	CFFO	16.33*	9.69*	1.12	1.87	20.90*	22.513*
	CFFI	7.30*	1.39	.09	1.72	3.28	.20
	CFFF	.44	.13	.13	3.88*	.73	.02
Year-2:							
	CFFO	11.00*	19.64*	.25	.03	13.51*	17.76*
	CFFI	6.80*	1.34	6.79*	.01	3.08	4.52*
	CFFF	.02	6.63*	4.07*	.09	1.20	.01
Year-3:							
	CFFO	4.49*	3.46	.14	.89	4.02*	4.43*
	CFFI	3.45	.70	.57	5.80*	1.44	.06
	CFFF	.20	.01	.02	2.27	.03	.27

[1] Each cash flow, scaled by a different measure six times, was added separately to a base accrual model. Then, the Change in -2Log Likelihood chi-square was calculated. This chi-square is the difference in the chi-square of the accrual model and the chi-square of the model with the cash flow added. A significant Change in -2Log Likelihood chi-square would indicate that the added cash flow has incremental explanatory power above the accrual variables alone.

*Significant at p-value $\leq$ .05.

Table 2
Applied Predictive Ability of Each Cash Flow Scaled By Different Measures: Percentage of Firms Classified Correctly

Year	Model[1]	Scaling Measure Used: Total liabilities	Total assets	Sales	Owners' equity	Current liabilities	Current assets
Year-1:							
	Accrual	85.8	85.8	85.8	85.8	85.8	85.8
	CFFO	85.8	87.3**	86.1**	85.8	86.4**	87.0**
	CFFI	84.7	85.8	85.5	85.5	84.7	85.3
	CFFF	85.8	85.8	85.5	86.1**	85.0	85.5
Year-2:							
	Accrual	80.6	80.6	80.6	80.6	80.6	80.6
	CFFO	81.5**	82.4**	80.9**	80.6	82.1**	83.2**
	CFFI	81.5**	80.3	82.1**	80.3	81.8**	81.2**
	CFFF	80.1	80.9	80.6	80.3	79.8	80.6
Year-3:							
	Accrual	70.5	70.5	70.5	70.5	70.5	70.5
	CFFO	68.8	70.5	70.2	70.8	69.4	71.4**
	CFFI	69.7	70.5	70.2	70.8	69.7	69.7
	CFFF	69.4	70.5	70.2	71.7**	69.7	71.1**

[1] Accrual model = SIZE + NITA + SALESCA + CACL + TLOE + CATA + CASHTA.
CFFO model = above accrual variables plus CFFO.
CFFI model = above accrual variables plus CFFI.
CFFF model = above accrual variables plus CFFF.

SIZE = log(total assets). NITA = net income/total assets. SALESCA = sales/current assets. CACL = current assets/current liabilities. TLOE = total liabilities/owners' equity. CATA = current assets/total assets. CASHTA = cash + marketable securities/total assets. CFFO = cash flow from operating activities. CFFI = cash flow from investing activities. CFFF = cash flow from financing activities.

**Cash flow model out-predicted accrual model.

The classification rates for CFFO and CFFF normally exceed the accrual model's classification rates when CFFO is scaled by current assets and when CFFF is scaled by owners' equity.

However, the classification results for CFFI are different from the statistical results reported in Table 1. The results in Table 1 suggested that total liabilities was the best scaling measure for CFFI. However, the classification rates reported in Table 2 suggest that sales may be the best scaling measure for CFFI. (The classification rates for CFFI scaled by sales were normally higher than the classification rates for CFFI scaled by other measures.)

Further Validation of Scaling Measures

To provide additional insights into the impact of scaling measures on prediction results, the author ran full models with all three cash flows together added to the accrual model. First, all three cash flows were scaled by the same scaling measure (six full models each year). Then, the author developed two best full models with each cash flow scaled by the best scaling measure, according to the results in Tables 1 and 2. The best full one model contained CFFO scaled by current assets, CFFI scaled by total liabilities, and CFFF scaled by owners' equity. The best full two model differed from model one only in that CFFI was scaled by sales instead of total liabilities. Table 3 contains the results for the full models.

The results suggest that one should not scale each cash flow by the same scaling measure. The two full models with scaling measures differing for each cash flow (best full one model and best full two model) normally out-predict the full model with all three cash flows scaled by the same scaling measure. Also, the best full model with CFFI scaled by sales (best full two model) is the strongest model; this model always out-predicts all other models.

Combined, the results in Tables 1, 2, and 3 suggest that the scaling measure used does affect the incremental predictive ability of the three net cash flows. When scaled by certain scaling measures, the cash flows do not have incremental predictive ability over accrual information. Classification rates often decrease after each cash flow is added to the accrual model.

Results suggest that one should scale CFFO by

Table 3
Percentage of Firms Classified Correctly by Full Models with All Cash Flows Included

		Scaling Measure Used						
Year	Model[1]	Best scaling measures	Total liabilities	Total assets	Sales	Owners' equity	Current liabilities	Current assets
Year-1:								
	Accrual		85.8	85.8	85.8	85.8	85.8	85.8
	Full		85.8	85.5	87.6**	85.5	86.7**	87.0**
	Best full one	87.0**						
	Best full two	88.4**						
Year-2:								
	Accrual		80.6	80.6	80.6	80.6	80.6	80.6
	Full		82.1**	82.4**	81.5**	80.3	81.5**	83.2**
	Best full one	82.9**						
	Best full two	83.8**						
Year-3:								
	Accrual		70.5	70.5	70.5	70.5	70.5	70.5
	Full		68.8	70.2	70.5	70.8	69.9	70.2
	Best full one	71.7**						
	Best full two	73.1**						

[1] Accrual model = SIZE + NITA + SALESCA + CACL + TLOE + CATA + CASHTA.
Full model = above accrual variables plus all three cash flows scaled by the same scaling measure (model was run six times each year).
Best full one model = above accrual variables plus CFFO/current assets, CFFI/total liabilities, and CFFF/owners' equity.
Best full two model = above accrual variables plus CFFO/current assets, CFFI/sales, and CFFF/owners' equity.

SIZE = log(total assets). NITA = net income/total assets. SALESCA = sales/current assets. CACL = current assets/current liabilities. TLOE = total liabilities/owners' equity. CATA = current assets/current total assets. CASHTA = cash + marketable securities/total assets. CFFO = cash flow from operating activities. CFFI = cash flow from investing activities. CFFF = cash flow from financing activities.

**Cash flow model out-predicted accrual model.

current assets, CFFI by sales, and CFFF by owners' equity to obtain the strongest predictions of financial distress. A full model with cash flows scaled by these three measures always out-predicts a full model with all three cash flows scaled by the same measure and also always out-predicts an accrual model.

Conclusions

This study analyzed the impact of six scaling measures on results concerning the incremental predictive ability of cash flow information. The author developed many univariate and multi-variate logistic cash flow models, using six different scaling measures for the three net cash flows.

This study shows that results can vary substantially depending on the scaling measures used. This study's results suggest that the best cash flow ratios are as follows: (1) cash flow from operating activities scaled by current assets, (2) cash flow from investing activities scaled by sales, and (3) cash flow from financing activities scaled by owners' equity. A full model incorporating the three net cash flows scaled by the above measures always out-predicts all other models. This full model also always out-predicts a base accrual model.

Suggestions for Future Research

Previous financial distress researchers typically scaled all cash flows by the same scaling measure. The results of this study suggest that the researcher should use different scaling measures for the three net cash flows reported on the statement of cash flows. Future research should address whether the predictive ability of the various gross cash flows that make up the three net cash flows also depend upon the scaling measure used.

This study used a distressed (loan principal/interest default, debt accommodation, or bankrupt) versus nondistressed dependent variable for financial distress. Results may differ if a bankrupt versus nonbankrupt dependent variable is used for financial distress. Future researchers may wish to replicate this study using a bankrupt versus nonbankrupt financial distress variable.

*****Footnotes*****

1. The author calculated the cash flows using the following formulas based on Compustat line items: CFFO = Income before extraordinary items + depreciation and amortization + deferred taxes (deferred tax expense and investment tax credit) + equity in net loss (earnings) + loss (gain) from sale of property, plant, and equipment and investments + funds from operations-others + accounts receivable-decrease (increase) + inventory-decrease (increase) + other current assets-decrease (increase) + current liabilities other than current debt-increase (decrease). CFFI = sale of property, plant and equipment - capital expenditures - acquisitions - increase in investments + sale of investments + short-term investments-change. CFFF = change in current debt-increase (decrease) + change in long-term debt-increase (decrease) + sale of common and preferred stock - purchase of common and preferred stock - cash dividends.
2. This adjustment will result in overall classification rates slightly lower than rates obtained with the unadjusted models. However, the unadjusted models' classification rates reported in this study are unbiased and more accurate than reported in prior binary financial distress studies that used logit regression.

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