A multivariate analysis on bankruptcy predictions: accrual-based earnings vs. cash flows

Tae G. Ryu
Metropolitan State University of Denver

Gregory Clifton
Metropolitan State University of Denver

Chul-Young Roh
Yonsei University

ABSTRACT:

The Financial Accounting Standards Board (FASB) states that accounting information should help investors and creditors assess firms' past and future ability to generate net cash inflows (FASB 2021). In its Statement of Financial Accounting Concept (SFAC) No. 1, the FASB contends that accrual-based historical earnings and its components are superior to cash flows in predicting future cash flows (FASB 1978). Since then, many researchers have addressed the importance of accounting data, especially net income and cash flows, in the predictive and forecasting processes. The central question of these studies is: whether net income or operating cash flow is a better predictor of future cash flows. In this study, we empirically re-examined the predictive ability of accrual-based net income and cash flows from operating activities in the context of bankruptcy prediction. Unlike many previous studies, we conducted a binary logit regression with a total of 222 sample firms (111 bankrupt and 111 non-bankrupt firms). We found that the accrual-based net income is good as a short-term predictor of bankruptcy while the cash flow from operations serves as a long-term warning signal for corporate failures. As a control variable, the current ratio (current assets/current liabilities) is a powerful bankruptcy indicator, but the asset turnover (net sales/total assets) and debt to asset ratio (total liabilities/total assets) do not have any predictive ability.

Keyword: multivariate analysis, predictive ability, bankruptcy, accrual-based net income, cash flows

INTRODUCTION

This paper presents some empirical results of a study predicting corporate failure as evidenced by bankruptcy. We performed a multivariate analysis to assess the predictive ability of the two widely used indicators, accrual-based net income (NI) and cash flows from operating activities (CFO). The research question addressed in this study is which indicator, NI or CFO, is more accurate and faster in predicting firms' bankruptcy.

The FASB's conceptual framework for financial reporting provides the underlying foundation for accounting standards in the United States although it does not establish the Generally Accepted Accounting Principles (GAAP). The framework focuses on providing information that is useful in making economic decisions (decision-usefulness) as the fundamental objective of financial reporting. The FASB's Statement of Financial Accounting Concepts (SFAC) No. 8 (2018) states that "the objective of general-purpose financial reporting is to provide financial information about the reporting entity that is useful to existing and potential investors, lenders, and other creditors in making decisions about providing resources to the entity."

According to SFAC No. 8, if financial information is to be useful, it must be relevant and faithfully represent what it intends to represent, and relevant financial information can make a difference in users' economic decisions. SFAC No. 8 further states that financial information can make a difference in decisions if it has predictive value, confirmatory value, or both. The predictive value is contained in financial information if information users can use it as an input to predict future outcomes. Also, Francis and Schipper (1999) indicate that "financial information is value relevant if it contains the variables used in a valuation model (e.g., discounted cash flow valuation model) or assists in predicting those variables." So, the predictive value of accounting information and forecasting process have come to play a very important role in the accounting profession.

Since Ball and Brown's seminal paper (1968), the issue of information usefulness (information content) has attracted many researchers' attention. Accounting information is considered to have informational usefulness (i.e., predictive value) if it leads to a change in users' assessments of the probability distribution of future events (Beaver 1968). Especially, after the FASB's assertion, in its SFAC No. 1 (1978), that accrual earnings and its components provide better information for the prediction of future cash flows than information about cash flows themselves, many empirical studies have engaged in comparative analyses on the predictive value of accrual-based earnings and cash flows. These studies fall into two categories: (1) prediction of bankruptcy (Beaver 1966, Altman 1968 &1982, Deakin (1972), Edmister 1972, Altman and McGough 1974, Blum 1974, Altman et al. 1977, Moyer 1977, Ohlson 1980, Largay and Stickney 1980, Casey and Bartczak 1984 & 1985, Gentry et al. 1985, among others) (2) prediction of operating cash flows (Bowen et al. 1986, Murdoch and Krause 1989, Finger 1994, Francis and Schipper 1999, Barth et al. 2001, Kim and Kross 2005, Ball and Nikolaey 2022, among others). Most bankruptcy prediction studies were conducted before the mid-1980s and many of the cash flow prediction studies started after the mid-1980s.

The results of these studies were inconclusive, especially in the test of bankruptcy prediction. The bankruptcy prediction studies address the question of which one, accrual-based earnings or cash flows from operating activities, is a more accurate predictor of bankruptcy. Beaver (1966) showed that the ability to predict bankruptcy was strongest in the cash flow to total debt ratio and that net income to total assets ratio predicted second best. Deakin (1972)

conducted a multivariate analysis by duplicating Beaver's (1966) model for the 14 financial ratios and concluded that the cash flow to total debt ratio was the best predictor, same results as Beaver's (1966). In Ohlson's (1980) mean-variance analysis, the net income to total assets ratio was slightly better than funds provided by operations to total debt ratio in predicting financial distress. Casey and Bartczak (1984, 1985), however, came up with a quite different result and reported that accrual-based multivariate models were superior to cash flows from operations. They argued that the value of cash flow data for predicting a firm's financial distress was questionable. Gentry et al. (1985) also found results similar to Casey and Bartczak (1984, 1985) in that cash flows from operations did not improve the classification results of bankrupt and non-bankrupt firms. In their study, they tested the classification ability of eight cash-based funds flow ratios such as funds from operations/total net flow, but none of them was statistically significant even one year before bankruptcy filings.

Many of these bankruptcy studies were conducted more than 40 years ago, and not many empirical studies have been done in this field in recent years. In the past 40 years, however, there have been many changes in accounting and auditing standards and several enactments of laws, such as the Sarbanes-Oxley Act (SOX) of 2002. In this study, we empirically re-examine this issue to see if there has been any change in the predictive ability of accrual-based earnings and cash flows from operating activities. Unlike previous bankruptcy prediction studies such as Beaver (1966) based on multiple discriminant analysis (MDA) with pooled data across different years, we used a dichotomous logit model that allowed the statistical significance of each variable in the model to be evaluated independently. Mensah (1984) argued that previous bankruptcy studies using MDA exhibited a lack of consistency in the coefficient values and relative importance of various financial ratios, suggesting that a logit model would produce consistent and efficient estimates of the variables of interest. Based on Mensah's suggestions, we performed a logit regression analysis to examine which indicator, NI or CFO, is more accurate and faster in predicting firms' failure.

SAMPLE SELECTION

A total of 111 firms that went bankrupt from 2014 to 2019 were found from the FactSet database (https://www.factset.com) using a term search (terms of "bankruptcy", "Chapter 11" and "Chapter 7"). In order to avoid any confounding factors, firms that filed for bankruptcy during the COVID-19 pandemic were not included. Then, from these firms' 10-K reports filed with the Securities and Exchange Commission (SEC), necessary data such as NI and CFO were collected for five years (t-5 through t-1) prior to their bankruptcy filings. We also obtained a matched pair of non-bankrupt firms with a similar size in the same or similar industry. Financial data for the non-bankrupt firms spanned the same period as for the bankrupt firms. Table 1 reports firms that filed for bankruptcy from 2014 to 2019.

RESEARCH METHODOLOGY AND MOEL SPECIFICATION

Our main variables are accrual-based net income (net income/total assets) and cash flows from operations (cash flows from operating activities/total liabilities). Also, four variables are included in our logistic regression to control any confounding factors: (1) current ratio = current

assets/current liabilities (2) asset turnover = net sales/total assets (3) debt to asset ratio = total liabilities/total assets (4) Altman's Z-score. Abundant previous bankruptcy studies used these variables in their model specifications. As a liquidity ratio, the current ratio measures the ability of a firm to convert its current assets to cash to pay its current liabilities. The asset turnover, a key activity measure, indicates how efficiently a firm utilizes its assets to generate revenues. The debt-to-asset ratio is a measure of long-run solvency, an ability to pay debts as they mature.

Additionally, Altman's original Z-score was included to measure firms' level of financial distress. Using the multiple discriminant analysis technique, Altman (1968) developed the Z-score model as a linear combination of 5 financial ratios as follows:

$$\text{Z-score} = 1.2*(\text{WCAP/AT}) + 1.4*(\text{RE/AT}) + 3.3*(\text{EBIT/AT}) + .6*(\text{MKTEQUITY/TL}) + .999*(\text{SALE/AT}) \quad (1)$$

where WCAP/AT= working capital/total assets, RE/AT = retained earnings/total assets, EBIT/AT = earnings before interest and taxes/total assets, MKTEQUITY/TL = market value of equity/total liabilities, and SALE/AT = total sales/total assets.

Although the model is not based on a strong theoretical framework, it has performed very well in bankruptcy prediction. As Equation (1) shows, the model does not consider the size of the firm as a determining factor in bankruptcies, but it has the advantage of including a stock market variable (market value of equity) to derive the scores. The higher Z-score indicates greater financial strength, and the lower Z-score indicates financial distress with 2.675 being the cutoff point best discriminating between bankrupt and non-bankrupt firms. The Z-score is used as a measure of firms' financial distress in abundant previous bankruptcy studies such as Rose et. al (1982), Castanias (1983), Fleak and Wilson (1994) and Frost (1994), Grice and Ingram (2001), Chava and Jarrow (2004), among others.

A dichotomous logit regression was conducted with a total of 222 sample firms (111 bankrupt and 111 non-bankrupt firms) for 5 years before bankruptcy filings (t-5 through t-1 for bankrupt firms and same time spans for non-bankrupt firms). The main purpose of this study is to investigate which variable, NI or CFO, is more accurate and faster in predicting firms' bankruptcy. The logit model for 5 years before bankruptcy was not statistically significant (not reported). The specific form of the logistic regression model used in this study is as follows:

$$Y_i = \beta_0 + \beta_1 NI_i + \beta_2 CFO_i + \beta_3 CR_i + \beta_4 AT_i + \beta_5 DA_i + \beta_6 Z_i + \varepsilon_i \quad (2)$$

where Y = 1 for bankrupt firms and 0 for non-bankrupt firms. The two main variables and 4 control variables are as follows:

NI = net income/total assets
CFO = cash flows from operating activities/total liabilities
CR = current ratio = current assets/current liabilities
AT = asset turnover = net sales/total assets
DA = debt to asset ratio = total liabilities/total assets
Z = Altman's Z-score

There are a total of 6 independent variables including 2 main variables in our logit model. The number of independent variables is somewhat small compared to previous empirical research, but, according to Bellovary et al. (2007), a higher bankruptcy prediction accuracy is not guaranteed with a large number of variables.

DESCRIPTIVE STATISTICS

Table 2 presents descriptive statistics and univariate tests from t-4 to t-1. This univariate test shows that NI is consistently significant from t-4 to t-1. CFO is significant at t-4 and t-3 but loses its significance at t-2 and t-1 as bankruptcy approaches. Also, there is a significant difference in means for CR, DA, and Z, but the activity ratio, AT, is not statistically significant at all. Especially, the t-value for DA is significant at t-2 and t-1and this finding is in line with Deakin (1972). Deakin showed that bankrupt firms tend to expand rapidly in the third and fourth years before bankruptcy by increased debt (and preferred stock).

The correlation analysis is provided in Table 3. A significant (but not serious) correlation, as measured by Pearson Correlation Coefficients, exists between NI and CFO at t-4, t-3, and t-1. Three pairs of variables, NI – DA, NI–Z, and CR – Z, are also highly correlated to each other. The high correlation is a little concerning for the multicollinearity problem, but this is generally in line with prior literature (Huizinga and Laeven 2008, Simone et al. 2017). According to Judge et al. (1980), a rule of thumb for a serious multicollinearity problem is when the correlation coefficient is higher than 80%. These high correlations suggest that a multivariate analysis is necessary to investigate the simultaneous effects of the independent variables.

The results of the logit regression are shown in Table 4. The chi-square statistics indicate that the logit model is statistically significant at the 5% level at t-4 and 1% level at t-3 through t-1. The percentage of firms correctly classified is low at 27.6% at t-4 but goes up high ranging from 69.0% at t-3 to 78.4% at t-1. The R^2 level is fairly high, ranging from 25% to 32%.

The examination of the simultaneous effects of the two main variables, NI and CFO, show results quite different from the univariate test and many previous studies conducted in the 1980s and 1990s. The two variables exhibit an opposite pattern in terms of the predictive ability for bankruptcy. NI is significant at t-1, one year before bankruptcy, but insignificant at t-4 through t-2, so NI seems to be a short-term predictor of bankruptcy. As mentioned by Deakin (1972), bankrupt firms are "unable later to generate the sales and net income to support their heavier debt, and so they lost their assets rather rapidly after the third year prior to failure." CFO, on the other hand, is insignificant at t-1 although this cash flow variable is significant at t-4 through t-2. This is generally consistent with the univariate test results. Bankrupt firms seem to have cash flow problems 3 or 4 years before their bankruptcy by not having enough actual cash to replenish their inventory or pay various operating expenses. Then, these firms probably made every effort to avoid the bankruptcy stigma by increasing net cash flows, and, as a result, their operating cash flows would be temporarily improved right before bankruptcy (at t-1). As control variables, CR is a good indicator of bankruptcy, significant at t-4, t-3, and t-1 and Z is significant at t-2, but AT and DA are not significant at all probably due to the multicollinearity problems.

Many previous bankruptcy prediction studies address the question of which data, accrual-based earnings, or cash flows from operations, are a more accurate predictor of bankruptcy, but, as previously mentioned, the results of these studies were mixed. We also could not find a clear-cut answer to this question, either. The accrual-based net income is good as a short-term predictor while the cash flow from operations serves as a long-term warning signal for corporate failures.

SUMMARY AND CONCLUSION

SFAC No. 8 stated that financial information need not be a prediction or forecast to have predictive value, but financial information is capable of making a difference in decisions if it can help accounting users predict the ultimate outcome of past, present, and future events (FASB 2021). Beaver (1966) also mentioned that "accounting data can be evaluated in terms of their utility and that utility can be defined in terms of predictive ability." In many previous studies, there has been substantial movement toward articulating the importance of financial data in the predictive process. In line with empirical research in the 1980s and 1990s, our study was conducted to assess the ability of NI and CFO to predict firms' bankruptcy.

The primary finding from our study is quite different from previous research. We found that the accrual-based net income predicted bankruptcy only one year before bankruptcy filings, but it did not provide any bankruptcy predictive ability 4, 3, or 2 years before bankruptcy. The cash flow from operations, on the other hand, exhibited a significant predictive power 2, 3, or even 4 years before bankruptcy, but it failed to show any significance right before bankruptcy (at t-1).

Bankruptcy prediction is of importance to many investors, creditors, and the public because it can result in substantial losses to them. The results of our study suggest that accounting users must pay attention to firms' trends in net income and cash flows equally, net income as a short-term predictor and cash flows as a long-term predictor.

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APPENDIX

Table 1
Bankrupt Firms

Years	Bankrupt Firms
2014	16
2015	14
2016	16
2017	18
2018	23
2019	24
Total	111

Table 2
Descriptive Statistics and Univariate Tests

Variables[a]	Bankrupt Firms		Non-Bankrupt Firms		t-value[b]
	Mean	Std. Deviation	Mean	Std. Deviation	
(t-1)					
NI	-.734	1.195	-.168	.487	-4.234***
CFO	-.217	.639	.093	2.164	-1.382
CR	1.273	1.607	2.557	3.005	-3.763***
AT	.743	1.283	1.752	8.999	-1.120
DA	1.403	1.681	.679	.616	3.900***
Z	-8.054	18.866	.971	10.438	-4.061***
(t-2)					
NI	-986	3.604	-.053	.488	-2.438**
CFO	-.235	.568	-.001	2.381	-1.011
CR	1.657	1.564	2.866	3.586	-3.223***
AT	.740	1.067	.980	1.355	-1.416
DA	1.855	4.993	.634	.508	2.310**
Z	-4.011	11.510	2.637	12.621	-3.916***
(t-3)					
NI	-581	1.585	-.101	.473	-2.902***
CFO	-.358	1.134	.160	.717	-3.909***
CR	2.282	3.089	3.007	3.441	-1.619
AT	.664	.804	2.449	12.145	-1.566
DA	1.463	4.340	1.458	4.550	.009
Z	-3.415	11.392	1.555	9.894	-3.374***
(t-4)					
NI	-507	1.496	-.115	.433	-2.429**
CFO	-.564	2.432	.089	1.279	-2.325**
CR	2.649	2.983	3.571	5.406	-1.546
AT	.686	.648	.763	.788	-.773
DA	1.757	6.743	.591	.453	1.655
Z	-.266	11.888	1.366	10.294	-1.037

a.
NI = net income/total assets
CFO = cash flows from operating activities/total liabilities
CR = current ratio = current assets/current liabilities
AT = asset turnover = net sales/total asset

DA = debt to asset ratio = total liabilities/total assets
Z = Altman's Z-score
b. ***, **, * designates significance at the .01, .05 and .1, levels, respectively.

Table 3
Correlations

Variable[a]	t-1	t-2	t-3	t-4
NI - CFO	.206***	.049	.184***	.233***
NI – CR	.120*	.111	.137**	.044
NI - AT	.028	-.038	.019	.090
NI - DA	-.730***	-.779***	-.501***	-.509***
NI – Z	.612***	.157**	.303***	.201***
CFO – CR	.403***	-.113	-.299***	-.100
CFO – AT	-.397***	.084	.038	.083
CFO – DA	-.045	-.006	.005	.016
CFO – Z	.103	-.309***	.255***	.009
CR – AT	-.009	.190***	-.004	-.179
CR – DA	-.247***	-.164**	-.093	-.076
CR – Z	.249***	.424***	.182***	.161**
AT – DA	-.059	.040	.076	-.011
AT – Z	.125*	.083	.026	.015
DA - Z	-.767***	-.172**	.044	-.077

a.
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Z = Altman's Z-score
***, **, * designates significance at the .01, .05 and .1, levels, respectively.

Table 4
Estimation Results of Logit Regression

Variable[a]	Expected Sign	t-1	t-2	t-3	t-4
Constant	?	.5671***	.5907***	.5800***	.5922***
NI	-	-.1197**	-.0191	-.0546	-.0367
CFO	-	.0093	-.0453**	-.1296***	-.0368**
CR	-	-.0467***	-.0208	-.0246**	-.0140*
AT	-	-0043	-.0204	-.0053	-.0379
DA	+	-.0152	.0012	-.0079	.0062
Z	-	-.0034	-.0097***	-.0039	-.0013
Pseudo R^2		.308	.323	.296	.252
Chi-square		50.936***	55.948***	53.279***	21.396**
% Correct		78.4%	75.9%	69.0%	27.6%

a.
Y = 1 for bankrupt firms and 0 for non-bankrupt firms.
NI = net income/total assets
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