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Financial Distress and Bankruptcy Prediction:

A Comparison of Three Financial Distress Prediction Models in Acute Care Hospitals

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ABSTRACT

The purpose of this study is to examine and compare the accuracy of three financial distress prediction models: modified Altman Z score (1993), Ohlson O score (1980) and Zmijewski score (1984) and their ability to predict bankruptcy for US acute care hospitals. We pose two research questions: 1) What is the more accurate model in predicting financial distress resulting in bankruptcy, and 2) What financial ratios in each of those models differentiate bankrupt hospitals from financially healthy hospitals?

We analyzed 106 hospitals (53 hospitals that filed for bankruptcy and 53 that were financially stable) between the years 2006 and 2017 to compare the accuracy of the three models in predicting bankruptcy. We found that the modified Altman Z score (1993) was more effective in predicting financial distress resulting in bankruptcy of US acute care hospitals when compared to the Ohlson O score (1980) and Zmijewski (1984). However, we did not find significance regarding the financial ratios among the three models in differentiating bankrupt hospitals from non-bankrupt hospitals. In other words, a single financial ratio was not found to be consistent that separated bankrupt hospitals from non-bankrupt for all three years prior to a bankruptcy. Thus, managers should not rely on just one financial ratio as an indicator of financial distress.

Keywords: financial distress, bankruptcy, modified Altman Z score, Ohlson O score, Zmijewski score

INTRODUCTION

A recent report,"Distress Indices Special Report: Causes of Healthcare Distress in 2014" found that bankruptcies within the health care industry were up 38% between 2010 and 2014. Similarly, according to a report from Bloomberg, healthcare bankruptcies had tripled in 2017 and comprised 7.25% of all the bankruptcy filings as compared to 5.25% in 1997 [1]. The same Bloomberg report stated that eighteen hospitals/hospital systems filed for bankruptcy protection in 2017.

Accounting-based models are standard approaches for measuring financial distress and bankruptcy. For this study, three accounting-based financial distress prediction models, modified Altman Z score (1993), Ohlson O score (1980) and Zmijewski (1984) are employed to compare the accuracy of these models in predicting bankruptcy of US acute care hospitals.

This study will one be the first to employ the accounting-based models of Ohlson O score (1980) and Zmijewski score (1984) in US acute care hospitals. By comparing three different accounting based models, this study will answer following research questions:

1) What is the more accurate financial distress model in predicting bankruptcy in US hospitals, and

2) Which financial ratios in each of those models differentiate bankrupt hospitals from financially healthy hospitals?

REVIEW OF LITERATURE

According to Ninh et al (2018), a corporation goes through four stages before filing for bankruptcy [2]. Stage 1 involves incubation of the firm's financial condition. In Stage 2, the management of the corporation becomes aware of the fact that the firm is financially distressed. Stage 3 is financial insolvency, in which a firm lacks funds to meet its financial obligations. This is followed by Stage 4 in which insolvency is confirmed.

"Financial distress" may also be defined as the late stage of organizational decline that precedes bankruptcy [3]. Financial distress, therefore differs from bankruptcy; as it refers to a period when a borrower is unable to meet a payment obligation to lenders [4]. Whereas, bankruptcy is an official declaration of a firm's financial state in which it may cease business activities or reorganize. When financial distress remains unresolved, it may lead to bankruptcy, but that outcome is not a certainty.

In the case of acute care hospitals, financial distress is not a rare phenomenon. From 1995 to 2010, 15% to 30% of hospitals were classified as financially distressed, as measured by their negative operating margins [5]. A manifestation of financial distress is that the number of hospitals that have filed for bankruptcies has risen over the past few years [6]. Although numerous measures have been used to predict financial distress in acute care hospitals there remains a gap in our knowledge as to which measures and/or models more accurately predicts the movement from financial distress to bankruptcy.

Financial distress prediction measures in hospitals

There is no formal definition of financial distress. Previous studies have used various financial instruments to define and measure financial distress in acute care hospitals. Bazzoli and Andes (1995) defined financial distress as those hospitals with a BBB credit rating, based on a three year average. However, usefulness of credit ratings is limited as bond rating upgrades and downgrades are determined by external organizations like Standard & Poor's and Moody's, and their ratings may lag behind the onset of actual financial distress or recovery [7, 8]. Other studies have used cash flow [9] and profit margins [7, 10-12] as measures of financial distress. But cash flow and profit margins may not be the best measures of financial distress as they are not able to capture the four domains of hospital finance: profitability, liquidity, solvency and asset efficiency [13]. Cleverly's Financial Strength Index (FSI) captures more than one domain of a hospital's financial health and has been used as a measure of financial distress in hospitals. Richards (2014) validated FSI while studying hospital closures [5]. Another composite score used to measure financial distress that captures more than one domain of hospital finance is the Altman Z score. Although the Altman Z score (1968) was originally developed as a bankruptcy prediction model, there is no clarity whether prediction of bankruptcy is different from the prediction of financial distress [14]. Thus, bankruptcy prediction models are alternately referred to as financial distress prediction models. Although the use of financial distress prediction models in hospitals has been limited, a few studies have used the modified Altman Z score (1993) to measure financial distress using a sample of hospital closures [5, 15]. Two other prediction models that covers more than one domain of hospital finance are Ohlson O score (1980) and Zmijewski (1984). Although, the modified Altman Z score, Ohlson O score & Zmijewski are widely used accounting based financial distress prediction models in various industries, their use in the hospital industry has been limited. This study will be the first to apply these three models in the hospital industry using a sample of hospital bankruptcies.

Review of financial distress prediction models (see Figure 1)

Modified Altman Z score (1993)

Modified Altman Z score (1993) uses multiple discriminate analysis (MDA) and employs a four-ratio model suited for service organizations to differentiate between bankrupt firms from financially healthy firms. The four financial ratios of liquidity, profitability, efficiency and productivity are expected to explain the bankruptcy of a firm through their contribution to the model (Altman, 1993).

The modified four-variable "Z-score" model to predict bankruptcy in the service industry is:
Z= 6.56(XI) + 3.26(X2) + 6.72(X3) + 1.05(X4) (Altman, 1993) with *Xl = working capital / total assets (WC/TA)*; *X2 = retained earnings / total assets (RE/TA)*; *X3 = earnings before interest and taxes / total assets (EBIT/TA)*; *X4 = equity (book value) / total liabilities (BVOE/BVOL)* and Z = overall index (Altman, 1993). The recommended cutoff scores to group firms "at risk for bankruptcy" are as follows: firms at a risk of bankruptcy have a score of Z less than 1.80; financially healthy firms have a Z score greater than 1.80.

Ohlson O score (1980)

Ohlson (1980) uses a logit regression model based on maximum likelihood function and cumulative probability function to examine the effect of four factors on the probability of bankruptcy: size, financial structure, performance and the current liquidity of the company.
The logit probability model derives the probability of a dependent variable by assigning coefficients to the independent variables. The process of calculating the logit function is summarized below:

Ohlson = (–1.32 – 0.407 X1+ 6.03 X2 – 1.43X3 + 0.0757 X4 – 2.37 X5 – 1.83 X6 + 0.285 X7 – 1.72X8 – 0.521X9)

X1 = log (Total assets to GNP price – level index) (Size); X2 = Total liabilities to total assets (TL/TA); X3 = Working capital to total assets (WC/TA); X4 = Current liabilities/Current assets (CL/CA); X5= 1 if total liabilities > total assets (TL>TA), 0 otherwise ; X6 = Net income to total assets (NI/TA); X7 = EBITDA to total liabilities (EBITDA/TL); X8 = 1 if net income (NI) is negative for the last two years, 0 otherwise X9 = (Nit – Nit-1)/(| Nit | + Nit-1), Nit is net income for the most current period. The accuracy of the Ohlson model was 96% for estimation sample and 85% for validation sample.

The cutoff scores to group firms "at risk for bankruptcy" are as follows: bankrupt firms have a score of " Ohlson O" greater than 0.50 and non-bankrupt firms have a "Ohlson O score" less than 0.50. Ohlson O score have never been applied in the hospital industry.

Zmijewski (1984)

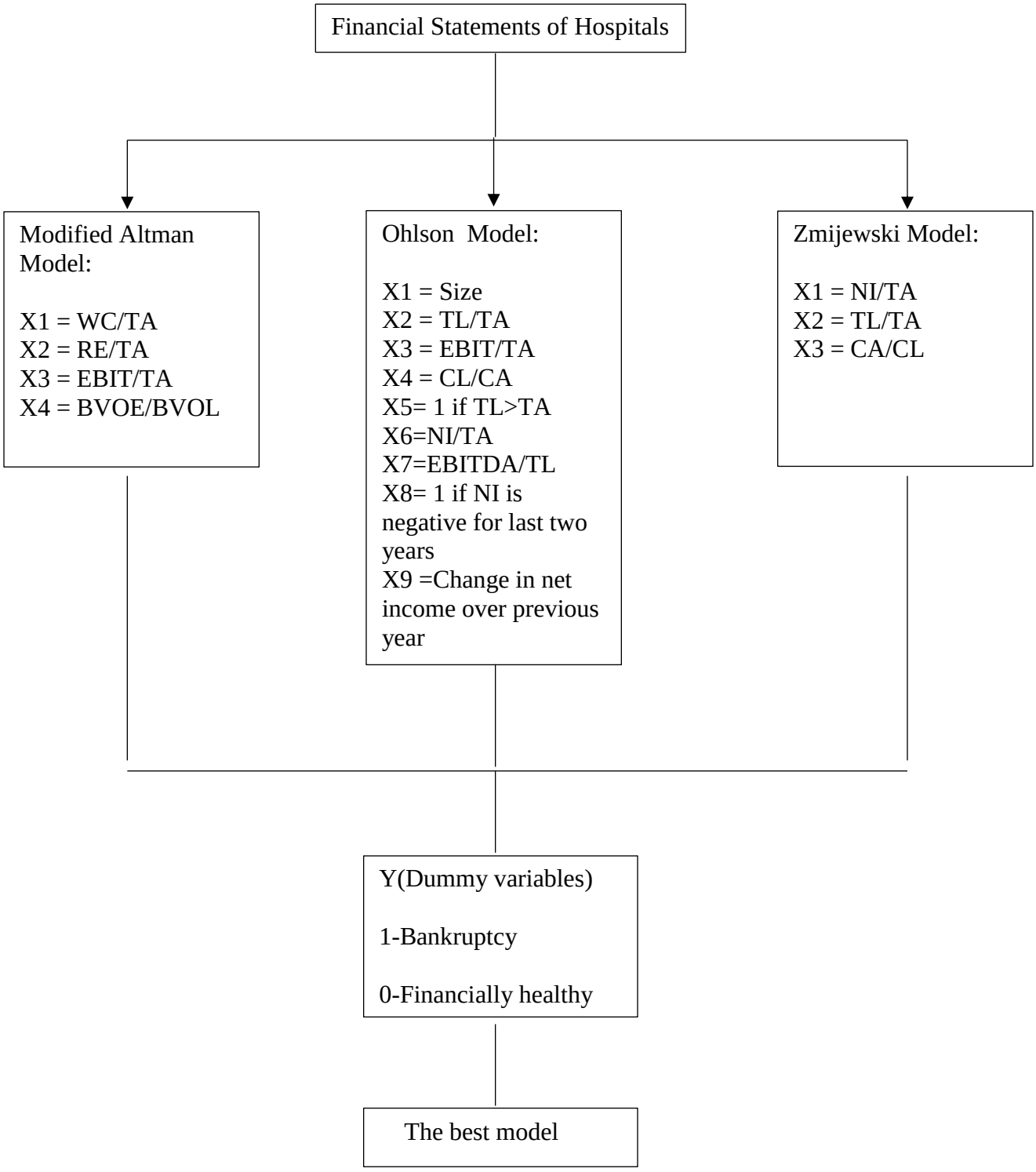
Advancing Ohlson's work (1980), Zmijewski developed parameters for a model based upon probit estimation for bankruptcy prediction. The process of calculating the Zmijewski score, based upon the probit model results is summarized below:

Zmijewski=-4.3-4.5X1+5.7X2+0.004X3

X1=netincome/total assets (NI/TA);
X2= total liabilities/total assets (TL/TA);
X3=current assets/ current liabilities (CA/CL);

The cutoff scores to group firms "at risk for bankruptcy" are as follows: bankrupt firms have a score of Zmijewski greater than 0.50 and non-bankrupt firms have a Zmijewski score less than 0.5.

Figure 1


Financial Statements of Hospitals
Modified Altman Model:
X1 = WC/TA
X2 = RE/TA
X3 = EBIT/TA
X4 = BVOE/BVOL
Ohlson Model:
X1 = Size
X2 = TL/TA
X3 = EBIT/TA
X4 = CL/CA
X5= 1 if TL>TA
X6=NI/TA
X7=EBITDA/TL
X8= 1 if NI is negative for last two years
X9 =Change in net income over previous year
Zmijewski Model:
X1 = NI/TA
X2 = TL/TA
X3 = CA/CL
Y(Dummy variables)
1-Bankruptcy
0-Financially healthy
The best model

METHODOLOGY

Data sources

A review of Modern Healthcare which is a hospital trade publication like was used to identify hospitals filing for bankruptcy during the period between 2006 and 2017. The American Hospital Association (AHA) Annual Survey provided general organizational information about hospitals from 2006 to 2017. Medicare cost reports (CMS) provided the financial information of all the hospitals between 2006 and 2017.

Sample selection

The aim of this study was to determine the accuracy of three financial distress prediction models as applied to acute care hospitals in the US. These models were applied to hospitals that had filed for bankruptcy between 2006 and 2017. Previous literature has used matched-pair technique for business failure prediction [16-18]. Studies have found equal number of bankrupt and non-bankrupt firms (matched-pair technique) to have better predictability [19, 20]. As such, this study used matched-paired technique with a sample of 53 bankrupt hospitals and 53 non-bankrupt hospitals matched by bed-size, asset size, ownership status, county and calendar year selection. This pair-matched sample of 106 acute care hospitals was used for testing the modified Altman Z-score (1993) model, Ohlson O score (1980) and Zmijewski score (1984). The pair-matched sample was achieved by first identifying a group of acute care general and surgical hospitals between 2006 and 2017 that have filed for bankruptcy and then matching them with an equal number of hospitals that have not filed for bankruptcy matched by bed-size, asset size, ownership status, county and calendar year.

Bankrupt hospitals

The first step was to select the acute care hospitals that have filed for bankruptcy. Conditions for inclusion in the bankrupt category were (a) hospitals with available financial statements with at least three consecutive years prior to filing of bankruptcy, (b) filed for bankruptcy between 2006 and 2017 due to financial problems, and (c) acute care general and surgical hospitals. The first criterion was to ensure that at least three years of financial statement are available for calculating the prediction scores of modified Altman Z, Ohlson O and Zmijewski; the second was to ensure that all hospital bankruptcies are after the Bankruptcy Abuse Prevention and Consumer Protection Act of 2005 (BACPA); and the third was to ensure that the financial data are comparable. The changes in the bankruptcy law (BAPCA) affected how not for profit entities filed for bankruptcy by increasing legislative burden. We initially identified 60 hospitals that had filed for bankruptcy between 2006 and 2017. However, lack of financial data for those seven hospitals resulted in 53 hospitals that were used in the sample.

Non-bankrupt hospitals

After the 53 bankrupt hospitals were identified, and each hospital's characteristics were retrieved, the next step was to match the hospitals that have not filed for bankruptcy. For each bankrupt hospital, a non-bankrupt hospital was matched by bed size, total asset size, county, ownership

status and calendar year. If the exact bed size and total asset size could not be matched, the hospital with the closest bed and asset size was chosen with same ownership status, county and calendar year. The four matching parameters help control the environment in which hospitals are operating.

Financial distress prediction models

Dependent variables

The dependent variable "bankruptcy" is binary and will have values non-bankrupt and bankrupt (0 and 1,respectively).

Independent variables

The independent variables in this study will use various accounting ratios contained in the models of modified Altman (1993), Ohlson (1980) and Zmijewski (1984) models. For Ohlson, we will use the ratio EBITDA/Total Liabilities as a substitute for the ratio FFO/Total liabilities due to the unavailability of cash flow statements in not-for-profit [21].

Statistical analysis for bankruptcy prediction models

The technique used by modified Altman (1993) is multiple discriminant analysis (MDA), Ohlson's model (1980) uses logit regression and Zmijewski model (1984) employs probit regression. We used all original models to identify the accuracy of those models.

Evaluation of financial distress prediction models

Accuracy rate

The important factors for classifying hospital financial distress/predict bankruptcy include the cut-point that indicates if hospitals are financially distressed or not and the time period used to measure the financial condition of the hospital [5]. The modified Altman Z-score, Ohlson O score and Zmijewski score have recommended cut-points for classifying organizations as financially distressed. The modified Z score cut-point is 1.80, Ohlson O score cut-point is 0.50 and Zmijewski also has a cut-point of 0.5. With the help of these cut-points, we calculated the overall accuracy rate of the models in predicting bankruptcy. The percentage of correct classification to total classifications is referred to as overall accuracy rate or the general efficiency of the model.

General efficiency of the model (%) = $(A + D) / (A + B + C + D) * 100$

Where: A – number of correctly classified (predicted) insolvent companies (companies in bankruptcy);

B – number of incorrectly classified insolvent companies (companies in bankruptcy);

C – the number of incorrectly classified solvent, or ('healthy') companies and

D – number of correctly classified solvent, or ('healthy') companies

RESULTS

Univariate analysis

Table 1 reports the descriptive statistics of the bankrupt and non-bankrupt hospitals in the sample. A comparison of the accounting variables is made between the bankrupt and non-bankrupt groups. A t-test (with a confidence level of 95%) of differences in variable means between the bankrupt and non-bankrupt hospitals was conducted.

The *p*-value for the test of mean differences between bankrupt and non-bankrupt hospitals is significant for the ratios SIZE and INTWO at 0.05 level. Furthermore, the ratios WC/TA, RE/TA, TL/TA, CL/CA, OENEG, CHIN and CA/CL are significant at 0.01 level. This implies that there is a difference between the means of these ratios between the bankrupt and non-bankrupt firms in the estimation sample.

Table 1 Descriptive statistics of the sample

Accounting variable	Bankrupt hospitals (N=53)		Non-bankrupt hospitals (N=53)		
	Mean	St.dev	Mean	St.dev	p-value
A:Altman					
WC/TA	-0.2516	0.096	0.2746582	0.037	0.00***
RE/TA	-.0.1234	0.1136	0.6710014	-.0885	0.00***
EBIT/TA	-17.42	17.1128	-0.07813	0.0423	0.313
BVOE/TL	0.2983	0.754	1.515	0.29	0.1359
B:Ohlson					
SIZE	12.366	0.2079	12.93	0.1897365	0.04**
TL/TA	1.16696	0.114	0.52765	0.096	0.00***
WC/TA	-0.25	0.096	0.2808	0.037	0.00***
CL/CA	1.96	0.46	0.517	0.075	0.0025***
OENEG	0.60377	0.067	0.0943	0.0405	0.00***
NI/TA	-1.4455	1.281	0.058	0.019	0.2432
FU/TL	0.4994	0.524	0.167	0.047	0.5295
INTWO	0.36922	0.067	0.18867	0.05425	0.0187**
CHIN	-0.27163	0.0723	0.1430985	0.0818	0.00***
C:Zmijewski					
NI/TA	-1.4455	1.281	0.058	0.019	0.2432
TL/TA	1.16696	0.114	0.52765	0.096	0.00***
CA/CL	1.2834	0.4029	2.7846	0.1899	0.0011***

Note: The independent variables used for this test are from the year t-1.

[a] *p*-Value of pooled *t*-test (with a confidence level of 95%) of differences in variable means between the bankrupt and non-bankrupt groups. Because the *p*-value of the Levene's test is greater (for exceptions see b) than the α-level of 0.05, the null hypothesis is accepted. This means that I will assume that the variances between the bankrupt and non-bankrupt group are equal.

[b] The *p*-value of the Levene's test is lower than the α-level of 0.05.

* Statistical significance at 0.10 level ** Statistical significance at 0.05 level *** Statistical significance at 0.01 level

Accuracy rate

Table 2 shows the accuracy rate of all the prediction models. The Discriminant Analysis model of modified Altman Z score was able to predict correctly 49 non bankrupt hospitals out of 53 (92.45%), and 45 bankrupt hospitals out of 53 (84.9 %) one year prior to the event. In general it classifies correctly 94 hospitals out of 106 (88.67 %). However, accuracy of classification declines to 83.01% for two years before the event, which reflects 88.67% accuracy for non-bankrupt hospitals and 77.35% for the bankrupt hospitals. The accuracy of classification declines to 76.41% for the three years before the event, which reflects 84.9% accuracy for non-bankrupt hospitals and 67.92% for the bankrupt hospitals. In summary, we find that Discriminant Analysis classification results shows an increasing power of prediction from 67.92% three years before the event to 83.01% for the period of two years, and finally to 88.67% for one year before the event.

The O score developed by logit model is able to predict correctly or classify 48 non bankrupt hospitals out of 53, i.e. 90.56%, and 32 bankrupt hospitals out of 53 (60.37%) one year prior to the event. In general it classifies correctly 80 hospitals out of 106 (75.47%). However, accuracy of classification declines to 69.81% for two years before the event, which reflects 96.22% accuracy for non-bankrupt hospitals and 43.39% for the bankrupt hospitals. The accuracy of classification declines to 60.37 % for the three years before the event, which reflects 96.22% accuracy for non-bankrupt hospitals and 22.64% for the bankrupt hospitals. In summary, we find that O score cut off point of 0.5 shows an increasing power of prediction from 60.37% three years before the event to 69.81% for the period of two years prior to the event, and finally to 75.47% for one year before the event.

The Zmijewski score developed by probit model is able to predict correctly or classify 47 non bankrupt hospitals out of 53 (88.67%), and 39 bankrupt hospitals out of 53 (73.58%) one year prior to the event. In general it classifies correctly 86 hospitals out of 106 (81.13%). However, accuracy of classification declines to 72.64% for two years before the event, which reflects 96.22% accuracy for non-bankrupt hospitals and 49.05% for the bankrupt hospitals. The accuracy of classification declines to 70.75% for the three years before the event, which reflects 92.45% accuracy for non-bankrupt hospitals and 49.05% for the bankrupt hospitals. In summary, we find that Zmijewski score cut off point of 0.5 classification results shows an increasing power of prediction from 70.75% three years before the event to 72.64% for the period of two years prior to the event, and finally to 81.13% for one year before the event.

Table 2: Accuracy rate of Bankruptcy Prediction models

	One year prior to bankruptcy	Two years prior to bankruptcy	Three years prior to bankruptcy
Modified Altman Z score	88.67%	83.01%	76.41%
Ohlson O score	75.47%	69.81%	60.37%
Zmijewski score	81.13%	72.64%	70.75%

Financial ratios

Independent variables in modified Altman Z score are represented by the four financial ratios that may predict financial distress. In the Discriminant Analysis, these ratios are referred to as Discriminant coefficients. Each coefficient represents the particular ratio's contribution in the overall Discriminant function. Value of coefficient above 0.30 is usually considered to be a good predictor of dependent variable [22]. As the value of coefficient increases, it becomes a better predictor of the dependent variable and contributes more to the prediction power of the model. Table 3 shows the standardized Canonical Discriminant Coefficients results for one, two, and three years before the event. The table shows that liquidity ratio and profitability ratio were more importance in discriminating between two groups one year prior to the event. For two years prior to the event, liquidity ratio and net worth ratio were more effective. For three years prior to the event, liquidity ratio, profitability and efficiency ratio showed importance.

Table 3 Summary of the Standardized Canonical Discriminant Function Coefficients for Three Years Using Study Financial Ratios

Ratio	One year	Two years	Three years
Liquidity Ratio	0.4143458	0.6677528	0.9643714
Profitability Ratio	0.6589835	0.2951157	-1.516696
Efficiency Ratio	-0.0354894	0.246591	-0.3047953
Net Worth	0.14183787	0.4524436	.0189157

Independent variables in Ohlson O score are represented by nine variables that may predict financial distress. Table 4 shows analysis of Ohlson logit model. The variable size having a negative sign in the models shows that smaller hospitals are more likely to go bankrupt for all three years prior to the event. However, SIZE is not an important factor in predicting bankruptcy in acute care hospitals, because it is not significant in the models. Similarly, the variable TL/TA is not significant predictor of bankruptcy in acute care hospitals. Although long term solvency has been an important factor in other industries for predicting bankruptcy, long term solvency is insignificant at all three time periods in case of acute care hospitals. The variables WC/TA is a significant predictor of bankruptcy for acute care hospitals for two models: one year prior to the event and three years prior to the event. WC/TA is a liquidity ratio that indicates if hospitals will be able to fund its current operations. Another liquidity ratio CL/CA is a significant predictor of bankruptcy for acute care hospitals for two models: two years prior to the event and three years prior to the event. FU/TL is another measure of liquidity which has shown significance for a model two years prior to the event. So liquidity became a more important factor in prediction of bankruptcy for acute care hospitals. OENEG plays the role of a discontinuity variable to balance the effect of TL/TA and is a significant predictor of bankruptcy for acute care hospitals for all the three models. A variable by name NI/TA is a profitability ratio and has shown significance for a model two years prior to the event.

Table 4. In-sample analysis for logit model of Ohlson (1980)

	One year		Two years		Three years	
	Estimate	p-value	Estimate	p-value	Estimate	p-value
Intercept	2.98228	0.352	-1.012487	0.765	4.155329	0.143
SIZE	-0.24417	0.2345	-.0828897	0.714	-.2651196	0.175
TL/TA	-0.07499	0.911	-.2133268	0.727	1.360995	0.154
WC/TA	-2.95	0.033**	1.12095	0.612	-3.250295	0.069*
CL/CA	-0.346	0.261	2.320088	0.051*	-1.83109	0.013**
OENEG	2.49	0.038**	2.606231	0.072*	4.056611	0.044**
NI/TA	-3.812	0.177	5.831641	0.080*	-1.000138	0.690
FU/TL	0.3275	0.420	-1.915972	0.065*	.0941081	0.393
INTWO	0.213	0.780	.4409965	0.544	-.1639528	0.818
CHIN	-0.86696	0.099*	-.8066945	0.0822*	.553214	0.215
Pseudo R2	0.4153		0.3664		0.2271	

**p ≤0.1; **p ≤ 0.05; ***p ≤ 0.01*

Independent variables in Zmijewski score are represented by three variables that may predict financial distress. Table 4 shows analysis of Zmijewski's probit model. A variable by name NI/TA is a profitability ratio and has shown significance for a model which is one years prior to the event. The variable TL/TA which is a measure of long term solvency is a significant predictor of bankruptcy for all three time periods in case of acute care hospitals. Another liquidity ratio CL/CA is a significant predictor of bankruptcy for acute care hospitals for one models: two years prior to the event and three years prior to the event.

Table 5. In-sample analysis for probit model of Zmijewski (1984)

	One year		Two years		Three years	
	Estimate	p-value	Estimate	p-value	Estimate	p-value
Intercept	-0.2572	0.320	.2261512	0.410	.1739945	0,540
NI/TA	-4.2377	0.00***	-.3317646	0.360	-.0874772	0.929
TL/TA	-0.436	0.071*	.4559462	0.025**	.3846023	0.092*
CA/CL	-0.25726	0.101	-.2666757	0.001***	-.21087	0.01**
Pseudo R2	0.3060		0.1649		0.1055	

**p ≤0.1; **p ≤ 0.05; ***p ≤ 0.01*

DISCUSSION

Many financial distress measures used in hospital industry do not tap into more than one domain of hospital finance. We applied three different measures of financial distress: modified Altman Z score (1993), Ohlson O score (1980) and Zmijewski score (1984) into the hospital industry that tap into more than one domain of hospital finance. All three measures are strongly associated with hospital bankruptcy. However, as one would expect none of them predicted hospital bankruptcy accurately all the time. The measures of predictive ability that may be most relevant are correctly classified positive predictive value and negative predictive value. These measures assess how well the modified Altman Z score, Ohlson O score and Zmijewski score predict hospital bankruptcy. Negative Predictive Value is 89.90% for modified Altman Z score, 95.33% for Ohlson O score and 92.44% for Zmijewski score for an average of 3 years. This means that for all hospitals classified as being not financially distressed, close to 90% of them did not go bankrupt for all the three measures. Positive Predictive Value ranged from 79.65% for modified Altman Z score, 42.13% for Ohlson O score and 57.22% for Zmijewski score for an average of 3 years. This means that among the hospitals classified as being financially distressed by modified Altman Z score, 79.65% went into bankruptcy. Modified Altman Z score showed more accuracy in predicting bankruptcy in this study. Also, all financial ratios from the three models did not show significance in differentiating bankrupt hospitals from non-bankrupt hospitals. This suggest that a combination of various ratios from all the three models can be used to create a new financial distress prediction model.

CONCLUSION

Empirical researchers have frequently employed traditional financial distress prediction models in various industries. However, reliability of those models in the hospital industry was not tested. This poses a question of the applicability and the prediction accuracy of distress prediction models in acute care hospitals. In this study, we compared three financial distress and bankruptcy prediction models in US acute care hospitals. All three measures tap into more than one domain of hospital finance. Researchers have developed different financial distress prediction models being aware of the fact that an ability to predict an organization's movement towards failure early is advantageous for all stakeholders of the business [23]. We captured the predictive ability of the three distress prediction models at least 3 years prior to the event of bankruptcy and compared the accuracy prediction of all the models.

Although no one measure predicted the hospital bankruptcies one hundred percent of the time, modified Altman Z score had a higher accuracy rate of predicting hospital bankruptcy one, two and three years prior to the event as compared to Ohlson O score and Zmijewski score. The Modified Altman Z score had an accuracy rate of 88.67% as compared to 75.47% for Ohlson O score and 81.13% for Zmijewksi score one year prior to bankruptcy. The accuracy rate decreased for all the three models as the years before the event increased. However, modified Altman Z score still remained the most accurate with highest positive predictive value. Modified Altman Z score can be regularly used to do financial stress tests in hospital industry. Also, not a single financial ratio was not found to be consistent that separated bankrupt hospitals from non-bankrupt for all the three years prior to a bankruptcy. Thus, hospital managers can't rely on just one financial ratio as an indicator of financial distress.

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