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Predicting Corporate Financial Distress Using Logistic Regression: Malaysian Evidence

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ABSTRACT

This study attempts to construct and test financial distress prediction model for Malaysian Companies. The sample for this study consists of 84 companies listed on Bursa Malaysia that became financially distressed in 2001 and 2002 and a matched (by industry and firm size) sample of 84 financially healthy companies. The model is constructed by employing logistic regression analysis based on pooled data of 5 years prior to financial distress. The model is first derived using the estimation sample and then tested using the validation sample. Adding to the existing research on financial distress prediction models, the current model utilizes measures of shareholders' equity to total liabilities, shareholders' equity to total assets, current liabilities to total assets, total borrowings to total assets and inventory turnover. The results are encouraging, as the model developed for predicting corporate financial distress in Malaysia is reliable up to 5 years prior to financial distress. It is also believed that the prediction model can be useful to different groups of users such as policy makers, financial institutions, creditors, managers, bankers, investors and shareholders.

Keywords: *Bursa Malaysia, Financial distress prediction models, logistic analysis*

Introduction

Traditional ratios have long been used as predictors of bankruptcy or financial distress. Many researches have developed financial distress prediction models in order to predict financial distress of a company. Over the years, the developed models have moved from the relatively simple method to more sophisticated statistical analysis such as multivariate discriminant analysis (e.g. Altman, 1968), logit analysis and probit analysis (e.g. Ohlson, 1980) and neural network analysis (e.g. Abid and Zouari, 2002).

This study employs the logistic (logit) analysis to develop a financial distress prediction model. The logit model is used because it is easier to estimate bankruptcy probability as compared to other models. Accordingly to Kahya (1997), the logit model is at least as good as the probit or discriminant analysis. In addition, the logit model does not impose any distribution requirement on the explanatory variables and it can directly provide the probability of bankruptcy (Nam and Jinn, 2000).

Problem Statement

In Malaysia, many corporate firms collapsed since the 1997 Asian financial crisis. As a result, many investors have also suffered major losses in their share investment. This means that financial distress and business failure have critical impact on the business community and the society as a whole.

To enhance the integrity of the Malaysia capital market as an investment center, Bursa Malaysia [formerly known as Kuala Lumpur Stock Exchange (KLSE)] has issued Practice Note 4/2001 (PN4) and its effective date was 15 February 2001 in tandem with its revamped listing requirements. The KLSE recognizes a firm as a PN4 firm when one or more of the criteria below are fulfilled:

- a. the company has deficit in the adjusted shareholders' equity on a consolidated basis.
- b. receivers and/or managers have been appointed over the company's property, or over the property of its major subsidiary or major associated company. The property should account for at least 70 percent of the company's total assets employed on a consolidated basis.
- c. the auditors have expressed adverse or disclaimer opinion in respect of the company's going concern in the company's latest accounts.
- d. special administrators have been appointed over the company or a major subsidiary or associated company under the Pengurusan Danaharta Berhad Act 1998.

In addition, PN4 companies must fulfill detailed requirements in relation to disclosure, regularization of financial condition and suspension, PN4 companies that fail to comply with any of the obligations set out under the Practice Note may be suspended from trading. Then the affected listed companies that fail to revert to a financial condition that warrants continued trading and listing within the time frame stipulated by the KLSE may be de-listed from the KLSE listing.

The total number of PN4 companies as at 1 September 2002 was 99 (out of 861 listed companies) (The Edge Malaysia, 9 September 2002). In early 2003, the KLSE started delisting procedures on sixteen PN4 companies in order to protect investors and shareholders. This is because they have not made their respective requisite announcement and have announced their restructuring plan but pending submission.

The issues of delisting procedures of the PN4 companies has highlighted the importance and the needs of developing an early warning model in order to alleviate the incidence of corporate failure of financial distress among Malaysian corporations and to protect investors and shareholders.

Objectives of the Study

In light of the above, the objective of this study is to build and test financial distress prediction model by using logit analysis.

Research Methodology

The current study defines firms as financially distressed if they satisfy the criteria of the PN4. The final sample for this study comprises 84 PN4 firms and 84 healthy firms. A financially healthy firm is chosen to match each company in the group of financially distressed firms. The matching firms are selected based on the industry and size (market capitalization) of the firm.

The financial data of each financially distressed firm are collected for 5 financial years prior to the year it is classified as PN4 firm. The data for the same period are used for each matching healthy firm. The data are collected from the companies annual reports, the Bursa Malaysia website at www.klse-ris.com.my and investors digests.

The sample of 84 PN4 firms and 84 healthy firms are divided into estimation sample (consists of 500 observations) and validation sample (consists of 340 observations). The estimation sample is used to construct the model while the validation sample is used to test the model.

The following logit model is estimated using financial ratios of the firms to see which of the variables were related to financial distress:

$$P(Y) = \frac{e^z}{1 + e^z} = \frac{1}{1 + e^{-z}}$$

- where
- Y = 1 if a firm is PN4 firm
 - Y = 0 if a firm is non-PN4 firm
 - P(Y) = probability of a firm becoming PN4
 - e = the base of the natural logarithms
 - Z = $\beta_0 + \beta_1 X_1 + \beta_2 X_2 + \dots + \beta_n X_n$
 - β_0 = the intercept
 - β_n = the regression coefficients of independent variables
 - X_n = the independent variables

Table 1 lists the 40 independent variables that have been selected for this study.

Table 1: Lists of Variables Used for the Study

Liquidity Ratios
Current Ratio
Quick Ratio
Cash Flow to Total Liabilities
Cash Flow to Shareholders' Equity
Cash Flow to Long Term Liabilities
Cash Flow to Total Assets
Cash Flow Per Share
Leverage Ratios
Debt Ratio
Current Debt to Shareholders' Equity
Total Debt to Shareholders' Equity
Fixed Assets to Shareholders' Equity and Long Term Liabilities
Reserves to Shareholders' Equity
Interest to Revenue
Profit Before Tax and Interest to Interests
Shareholders' Equity to Total Liabilities
Shareholders' Equity to Total Assets
Long Term Liabilities to Total Assets
Current Liabilities to Total Assets
Total Borrowings to Total Assets
Profitability Ratios
Net Profit Margin
Return on Shareholders' Equity
Revenue Per Share
Operating Income to Revenue
Profit Before Extraordinary Item to Revenue

continued

Table 1 – *continued*

Revenue to Total Cost
Profit Before Tax and Interest to Revenue
Net Income Plus Depreciation and Interest to Borrowings and Interest
Profit Before Extraordinary Item to Total Assets
Net Incomes to Total Assets
Profit Before Tax and Interest to Total Assets

Activity Ratios

Current Assets Turnover
Fixed Assets Turnover
Total Assets Turnover
Inventory Turnover
Shareholders' Equity Turnover
Debtor Turnover
Creditor Turnover

Growth Ratios

Revenue Growth
Profit Growth

For the purpose of the current study, a firm is classified as financially distressed if the calculated probability from the logit model is equal or more than 0.5 ; otherwise a firm is classified as healthy.

Analysis of Findings

The results of the Mann Whitney U test show that at 5 percent level, the mean of 7 ratios are not significantly different between financially distressed and healthy firms. They are cash flow to shareholders' equity, fixed assets to shareholders' equity and long-term liabilities, long-term liabilities to total assets, return on shareholders' equity, revenue per share, shareholders' equity turnover and profit growth ratios. Therefore, these 7 variables are excluded from further analyses in searching for the best variables to predict financial distress.

The trend analysis done on the mean of the 33 significant ratios for financially distressed group of the estimation sample from one year to five years prior to becoming PN4 shows that current ratio, quick ratio, shareholders' of equity to total liabilities, shareholders' equity to total assets, current liabilities to total assets, total borrowings to total assets, revenue to total costs, retained profit to total assets, total assets turnover and inventory turnover are consistent over the five-year period with the correct directions. Therefore, these ratios are

included in constructing the financial distress prediction model using logit analysis.

Table 2 presents the results of the stepwise logistic regression using the estimation sample. The shareholders' of equity to total liabilities, total borrowings to total assets and inventory turnover ratios are significant at 1 percent level of significance. Meanwhile shareholders' equity to total assets and current liabilities to total assets ratios are significant at 5 percent level of significance.

The signs of the coefficient (B) of each significant variable are as expected. The coefficient of shareholders' of equity to total liabilities (SETTL), shareholders' equity to total assets (SETTA), current liabilities to total assets (CLTTA), total borrowings to total assets (TBTTA) and inventory turnover (INVTO) are -1.706, -0.121, 1.532, 2.322 and -0.033 respectively. Therefore, the financial distress equation can be written in the following form:

$$Z = -1.706 * SETTL - 0.121 * SETTS + 1.532 * CLTTA + 2.322 * BTTA - 0.033 * INVTO$$

Table 2: Results of Logistic Regression of Financially Distressed Firms and Healthy Firms

Variables	Estimates (B)	Standard Error	Significance	Odds Ratio
Current ratio	-0.163	0.271	0.547	0.849
Quick ratio	0.490	0.376	0.192	1.632
Shareholders' of equity to total liabilities	-1.706	0.510	0.001**	0.182
Shareholders' equity to total assets	-0.121	0.049	0.012*	0.886
Current liabilities to total assets	1.532	0.721	0.034*	4.626
Total borrowings to total assets	2.322	0.793	0.003**	10.197
Revenue to total cost	-1.305	0.666	0.050	0.271
Retained profit to total assets	-0.145	0.474	0.760	0.865
Total assets turnover	0.033	0.351	0.926	1.033
Inventory turnover	-0.033	0.009	0.000**	0.968
Constant	0.347	0.913	0.704	1.415
Model Chi Square	248.380 (DF 10 and Significance 0.000)			
Nagelkerke R-Square	0.555			
Model Classification	81%			
N	500			

*Note: ** and * indicate significant at 1 percent and 5 percent respectively*

The numerical signs of the respective coefficient shows that firms with lower level of shareholders' equity to total liabilities, shareholders' equity to total assets, inventory turnover and higher level of current liabilities to total assets and total borrowings to total assets are associated with a higher probability of financial distress.

The Model Chi-square value of 248.38 (significant at 1 percent) implies that the coefficients of the independent variables are significantly different from zero. The Nagelkerke R-square of the model indicates that the five financial ratios accounted for 55.5 percent of the variance in becoming financially distressed. The Model Classification accuracy rate for the current study is 81 percent which can be deemed adequate.

The predicted probability of financial distress for a firm can be calculated by substituting the values of the five significant variables of each firm into the following equation:

$$P = \frac{1}{1 + e^{-(-1.706 \cdot \text{SETTL} - 0.121 \cdot \text{SETTA} + 1.532 \cdot \text{CLTTA} + 2.322 \cdot \text{TBTTA} - 0.033 \cdot \text{INVTO})}}$$

For example, suppose that the values of the five variables of a firm are given as follows:

$$\text{SETTL} = 0.210, \text{SETTA} = 0.050, \text{CLTTA} = 0.508, \text{TBTTA} = 0.746, \text{INVTO} = 0.497$$

$$\text{Then, } P = \frac{1}{1 + e^{-(-1.706 \cdot 0.210 - 0.121 \cdot 0.050 + 1.532 \cdot 0.508 + 2.322 \cdot 0.746 - 0.033 \cdot 0.497)}} = 0.89$$

The calculated predicted probability is greater than the cut off point of 0.5. Hence, the firm is predicted to be financially distressed in the future.

Table 3 presents the prediction accuracy of the developed model with Type I and Type II errors from year 1 to year 5 prior to financial distress for both estimation and validation samples. In estimation sample, the prediction accuracy for the financially distressed firms increases from 70 percent in year 5 to 98 percent in year 3 and finally to 100 percent in year 1. Meanwhile, the healthy firms are correctly classified at between 56 percent to 62 percent. The prediction accuracy for the healthy firms is lower than that of the financially distressed firms in the estimation sample. The overall prediction accuracy for both groups of firms improves as the firms approach financial distress, i.e. from 66 percent in year 5 to 80 percent in year 1.

With respect to the validation sample, the accuracy of the model in predicting the financially distressed firms is 73.5 percent in year 5 and increases drastically to 97.1 percent in year 4 but declines to 91.2 percent in year 1. However, the prediction accuracy of the healthy firms of the validation sample for year 1 to year 5 is moderate that varies between 58.8 percent and 70.6 percent. The overall prediction accuracy for both groups of firms in the validation sample improves as the firms approach financial distress. The prediction rate increases from 69.1 percent in year 5 to 80.9 percent in year 1.

Finally, the Chi-square test results show that there is an association between the number of predicted financially distressed and healthy firms and the number

Table 3: Prediction Accuracy of the Model and Results of Chi-Square Test

Samples and Type of firms	Year 1		Year 2		Year 3		Year 4		Year 5	
	n	No. Correct								
Estimation										
Sample	50	50	50	49	50	49	50	43	50	35 (70.0)
Distressed Firms	50	(100.0)	50	(98.0)	50	(98.0)	50	(86.0)	50	31 (62.0)
Healthy Firms	100	30	100	28	100	28	100	28	100	66 (66.0)
Total		(60.0)		(56.0)		(56.0)		(56.0)		15 (30.0)
Type I Error		80		77		77		71		19 (38.0)
Type II Error		(80.0)		(77.0)		(77.0)		(71.0)		
Significant Value of Chi-Square Test		0 (0.0)		1 (2.0)		1 (2.0)		7 (14.0)		0.000
		20 (40.0)		22 (44.0)		22 (44.0)		22 (44.0)		
		0.000		0.000		0.000		0.000		
				0.000						
Validation										
Sample	34	31	34	31	34	32	34	33	34	25 (73.5)
Distressed Firms	34	(91.2)	34	(91.2)	34	(94.1)	34	(97.1)	34	22 (64.7)
Healthy Firms	68	24	68	21	68	20	68	21	68	47 (69.1)
Total		(70.6)		(61.8)		(58.8)		(61.8)		9 (26.5)
Type I Error		55		52		52		54		12 (35.3)
Type II Error		(80.9)		(76.5)		(76.5)		(79.4)		
Significant Value of Chi-Square Test		3 (8.8)		3 (8.8)		2 (5.9)		1 (2.9)		0.000
		10 (29.4)		13 (38.2)		14 (41.2)		13 (38.2)		
		0.000		0.000		0.000		0.000		
				0.000						

Note 1: Figure in parentheses are in percentage

Note 2: Year 1 – one year prior to financial distress, Year 2 – two years prior to financial distress and so on.

of observed financially distressed and healthy firms at 1 percent level of significance for both the estimation sample and the validation sample.

Conclusion

The current study has successfully developed a financial distress prediction model that is unique to the Malaysian business environment by using logit analysis. The signs of the coefficient of the significant variables indicate that firms with higher leverage ratios and lower activity ratio have a higher probability of becoming financially distressed and vice versa.

The goodness of fit statistics of the model show that the model developed is fit in predicting financial distress of firms listed on Bursa Malaysia during the period of study. Moreover, the overall prediction accuracy of the developed model improves from moderate to excellent as firms approach financial distress.

Hence, it can be concluded that the developed model can predict financial distress of a firm up to 5 years prior to financial distress.

It is believed that the findings of the current study is useful to different groups of users such as policy makers, financial institutions, creditors, managers, bankers, investors and shareholders. The model developed can help investors and shareholders in making investment decisions. More importantly, it can be useful for the other groups of users in taking corrective action in order to reduce the effect of the firm experiencing future financial difficulties before it is too late to be rescued. Besides that, the findings of the current study can aid auditors in determining the going concern of a company.

A number of limitations have been noted in the current study. Firstly, this study only employs financial ratio variables in developing the financial distress model. Secondly, the current study only uses logit analysis in determining which ratios are good predictors of financial distress. It does not attempt to make comparison between the logit model and other statistical techniques such as multiple discriminant analysis, neural network analysis and probit analysis. Hence, this study is unable to determine which analysis could produce a more reliable discriminatory model. Finally, firms with missing or incomplete data are excluded from the sample of the current study and only public listed companies are used in the current study. As a result, the sample size of the study becomes smaller.

Some of the limitations above open up opportunities for future research. Firstly, it is suggested that future research should include more quantitative variables (firm size, age and market ratios) as well as qualitative variables (leadership, reputation and type of ownership) that are important in predicting financial distress of a firm. Secondly, future research can be extended to focus on comparative analysis between logit model and other prediction models such as multiple discriminant analysis, neural network analysis and probit model. Further, a financial distress study can be conducted on Malaysian private limited companies since this group of companies is badly affected by the financial crisis in the late 1990s. The findings may provide the required information and benefit in making better policy decisions.

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