Macroeconomic Variables and the Prediction of Financial Distress Companies in the Manufacturing Sector in Malaysia

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Abstract: ***This study attempts to predict financial distress companies in the manufacturing sector in Malaysia using PN4 and PN17 companies as the dependent variable and financial ratios and macroeconomic variables as the independent variables. Logit Analysis was used as the analysis procedure. This study found that the independent variables that can be used to predict financial distress companies in the manufacturing sector in Malaysia were total assets turnover ratio, current ratio, net income to total assets ratio and money supply (M2). The findings from the internal validation showed that the prediction model provided a more than 50% chance that the model is accurate. In addition, the findings from the external validation also showed that the model might be able to be used outside the time period that the model was estimated because the overall percentage accuracy were more than 50% for five years before distress. This study provides the prediction model of financial distress companies in the manufacturing sector in Malaysia and it also validate the findings internally and externally. Internal and external validations were seldom conducted in previous studies on the prediction of financial distress in Malaysia due to lack of data.***

Index Terms: Keywords: Financial Distress; Macroeconomic Variables; Malaysia; Manufacturing Sector.

I. INTRODUCTION

Prediction of financial distress companies have been one of the most popular area of research in finance. The ability to predict financial distress is important to the companies themselves, the potential and current investors and the stock market regulators in any particular country. In Malaysia, the stock market regulator is Bursa Malaysia (formerly known as Kuala Lumpur Stock Exchange before April 20, 2004).

However, the literature has shown that no studies have been conducted in predicting financial distress companies in the manufacturing sector in Malaysia using a combination of macroeconomic variables and financial ratios. Furthermore, most of the previous studies that were conducted in the area of prediction of financial distress did not conduct any validations in their studies. Some of the previous studies only conducted either internal or external validations only in their studies. This is due to unavailability of data.

This study aims to develop financial distress prediction model in the manufacturing sector in Malaysia using macroeconomic variables and financial ratios. The prediction model is developed using Logit Analysis. Previous studies in Malaysia combined consumer products and industrial products sectors and consider them as representing the manufacturing sector (Chin, 2005; Fauzias & Chin, 2001; Zulkarnain & Karbhari, 2004; Zulkarnain, Mohamad Ali, Annuar, & Zainal Abidin, 2001). The performance of the prediction model is evaluated based on its overall percentage accuracy through estimation sample, its classification ability through internal validation and its prediction ability through external validation.

The rest of the paper is organized as follows. Section 2 discusses the literature review of financial distress prediction. Section 3 explains the independent variables, data collection and data analysis procedures that are used in this study. Section 4 provides the findings of the study from using Logit Analysis. Last but not least, Section 5 summarizes the findings of the study and provides some suggestions for future research.

II. LITERATURE REVIEW

Earlier studies on the prediction of bankruptcy and financial distress had used statistical models such as Multiple Discriminant Analysis (MDA) and Logit Analysis. In general, bankruptcy and financial distress prediction models have been successful in classifying companies as bankrupt/non-bankrupt or financial distress/non-financial distress by using multivariate statistical techniques. Multivariate statistical techniques have become very popular among researchers with the availability of modern computer facilities and due to its ability to deal with several variables simultaneously (Ganesalingam & Kuldeep, 2001).

A number of studies had been conducted in the mixed sector in Malaysia using MDA (Chin, 2005; Karbhari & Zulkarnain, 2004; Mohamed, Ang, & Sanda, 2001; Nur Adiana, Rohani, & Abd. Halim, 2007). Mohamed et al. (2001) conducted internal validations only in their study while Chin (2005) and Karbhari and Zulkarnain (2004) conducted external validations only in their study. Nur Adiana et al. (2007) did not conduct either internal or external validations in their study. The lack of validations in previous studies is due to unavailability of data.

Besides studies in the mixed sector, other previous studies in Malaysia had been conducted in the manufacturing sector using MDA (Chin, 2005; Fauzias & Chin, 2001; Karbhari & Zulkarnain, 2004; Zulkarnain & Karbhari, 2004; Zulkarnain, et al., 2001). Zulkarnain et al. (2001) conducted internal validations

Revised Manuscript Received on 04 May 2019
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MDA works on the assumptions that the group dispersion (variance-covariance) matrices are equal for failed and non-failed companies and the population must be distributed in a multivariate fashion. However, it had been found that these assumptions are often violated by the data set under study and MDA procedure will only be optimal if the normality conditions are met (Karels & Prakash, 1987). They concluded that MDA do not necessarily provide better results if the ratios that are used depart from the normality assumptions.

Due to the weaknesses of MDA, a number of studies had been conducted in the mixed sector in Malaysia using Logit Analysis (Low, Fauzias, & Yatim, 2001; Mohamad Isa, Annuar, Shamsher, & Taufiq, 2005; Mohamed, et al., 2001; Mohmad Isa, 2004; Nur Adiana, et al., 2007; Tew & Enylina, 2005). Low et al. (2001), Mohamed et al. (2001), Mohmad Isa (2004), Mohamad Isa et al. (2005) and Tew and Enylina (2005) conducted internal validations only in their study whereas Nur Adiana et al. (2007) did not conduct either internal or external validations in their study. The lack of validations in previous studies is due to unavailability of data.

Besides the mixed sector, Fauzias and Chin (2001) had also conducted a study in the manufacturing sector in Malaysia using Logit Analysis. However, they did not conduct either internal or external validations in their study due to unavailability of data.

Logit Analysis may be preferable in bankruptcy and financial distress prediction studies where it is not only classification that is required but rather the probability of occurrence of failure (Barnes, 1987). Logit Analysis provides the probability of occurrence of an outcome described by a dichotomous (or polytomous) dependent variable using coefficients of the independent variables (Zavgren, 1985). In addition, Logit Analysis does not require the independent variables to be multivariate normal and they have the ability to determine the significance of individual variables. Furthermore, Logit Analysis does not have the same demanding assumptions as MDA (Keasey & Watson, 1991).

Numerous studies had been conducted to identify the determinants of bankruptcy and financial distress. In general, the determinants of bankruptcy and financial distress can be divided into four main groups of financial ratios that are asset management (activity or efficiency) ratios, leverage ratios, liquidity ratios and profitability ratios. Financial ratios are calculated using items from the Income Statements and Balance Sheets. The four main groups of financial ratios that are used in this study is based on a previous study in Malaysia (Mohmad Isa, 2004).

In general, the findings of previous studies in Malaysia showed that their models can be used for predicting bankruptcy or financially distressed companies. However, all studies in Malaysia used financial ratios only in their studies except for Mohmad Isa (2004). Mohmad Isa (2004) also considers macroeconomic varibles in his study and he found that Gross Domestic Product (GDP) is a significant variable in predicting financially distressed companies in Malaysia. However, his study was conducted in the mixed sector only. GDP was also found to be significant in predicting financial distress companies in other previous studies (Al-Darayseh, 1990; Bunn & Redwood, 2003; Hol, 2007; Kritzer, 1985). Other macroeconomic variables that had been found to be significant in predicting financially distressed companies were stock price index (Al-Darayseh, 1990; Mitchem, 1990) and money supply (Hol, 2007).

The literature shows that no studies have been made in the manufacturing sector in Malaysia using macroeconomic variables and financial ratios. A survey on previous studies on the prediction of financial distress companies showed that there is a lack of studies on prediction models for companies in individual sectors due to the unavailability of data (Aziz & Dar, 2006).

Furthermore, the literature shows that previous studies did not conduct any validations at all or they conducted minor internal and/or external validations in their study. This is mainly due to unavailability of data. In general, it was difficult to conduct internal and external validations due to the lack of companies being financially distressed. Therefore, this study hopes that by using a bigger sample of financial distress companies in the manufacturing sector, we are able to conduct internal and external validations in order to further improve the validity of the financial distress prediction models in the manufacturing sector in Malaysia.

III. METHODOLOGY/MATERIALS

Section 3 is divided into four sub-sections. Section 3.1 explains the independent variables that are used in this study along with the hypothesis while Section 3.2 explains the population and the sample selection of this study. Section 3.3 and 3.4 describe the data collection and data analysis procedures that are used in this study respectively.

A. Independent Variables and Hypothesis

Most researchers selected financial ratios as predictor variables based on their popularity and predictive ability in the previous bankruptcy research studies (Altman, 1968; Beaver, 1966; Ohlson, 1980). Other criterions that were used to choose financial ratios were their simplicity and relevancy to the local environment (Low et al., 2001; Mohamed et al., 2001). In this study, we select the financial ratios that have been found to be useful in at least ten previous studies on the prediction of financial distress companies whereas macroeconomic variables were selected if they were found to be useful in at least one previous study.

Leverage ratios represent the proportion of capital of a company that is raised by fixed interest borrowings. A company that has a high level of borrowings is considered to be highly geared while a company that is mainly financed by equity capital is said to be lowly geared. A highly geared company has to generate more income in order to pay its obligations and debts and vice versa. Therefore, this study expects that there is a positive relationship between leverage ratios as represented by the debt ratio and financial distress.

Asset management or

activity ratios represent the relationship between a company's level of operations and the assets that are required to sustain its operating activities. It shows the ability of a company in using its assets effectively in order to generate sales. High activity ratios show that a company is able to generate a high amount of sales per unit ringgit of sales and vice versa. Thus, this study expects that there is a negative relationship between asset management or activity ratios as represented by the total assets turnover ratio and financial distress.

Liquidity ratios represent the ability of a company to pay its debt when it comes due. High liquidity ratios show that a company is able to pay its debt when it comes due and vice versa. Hence, this study expects that there is a negative relationship between liquidity ratios as represented by current ratio, quick ratio and working capital ratio and financial distress.

Profitability ratios represent a measure of return on a company's investment and it also shows the health of a company. High profitability ratios show that companies are profitable and vice versa. Therefore, this study expects that there is a negative relationship between profitability ratios as represented by net income to total assets ratio and financial distress.

Base lending rate is used to represent the cost of borrowing in any country and an increase in base lending rate will result in a higher cost of borrowing. A high cost of borrowing is not good for any company because it increases its expenditure and reduces its profits and vice versa. Therefore, this study expects that there is a positive relationship between base lending rate and financial distress.

Gross Domestic Product (GDP) is used as a proxy for economic growth and it is normally used to represent the general economic condition of any country. Companies tend to do well when the economy is good and face a financial problem when the economy is bad. Therefore, this study expects that there is a negative relationship between GDP and financial distress.

Money supply is used to represent the liquidity of any country. An increase in money supply will increase the liquidity of any country and cause a decrease in interest rate. A decrease in interest rate will result in a lower cost of borrowing. A low cost of borrowing is good for any company because it reduces its expenditure and increases its profits and vice versa. Therefore, this study expects that there is a negative relationship between money supply and financial distress.

Consumer Price Index (CPI) is used as a proxy for inflation of any country. An increase in CPI means that there is an increase in inflation of a country and also an increase in the use of debt among companies to support their daily operations and vice versa. Therefore, this study expects that there is a positive relationship between CPI and financial distress.

Kuala Lumpur Composite Index (KLCI) is used to represent the stock market performance in Malaysia. In general, KLCI will be high when the economy is performing well and vice versa. Therefore, this study expects that there is a negative relationship between KLCI and financial distress.

B. Population and Sample Selection

The population of this study is companies listed as financial distress by Bursa Malaysia under the requirements of PN4, PN17 and Amended PN17 respectively from 15 February 2001 until 31 December 2015. Standard practice in financial distress prediction studies involves pooling data across different years in order to obtain a sufficiently large sample of bankrupt companies for analysis (Mensah, 1984). Therefore, this study also pool data for five years before a company was listed as financial distress by Bursa Malaysia under the requirements of PN4, PN17 and Amended PN17 respectively.

This study uses two types of samples that are the basic or estimation sample and the holdout or validation sample. The estimation sample is used to develop the prediction models while the holdout sample is used to evaluate the predictability of the model developed (Doumpos & Zopounidis, 1999).

The estimation sample includes approximately half of the companies that were listed in the PN4 category from 15 February 2001 until 2 January 2005. This was the last day before PN17 was introduced on 3 January 2005. Approximately half of the companies that were listed in the PN4 category from 15 February 2001 until 2 January 2005 are used as holdout sample for internal validation purposes. All companies that were listed under PN17 and Amended PN17 from 3 January 2005 until 31 December 2015 are used as holdout sample for external validation purposes.

The model is tested for internal and external validity before any generalisations can be made. Internal validity refers to whether an experiment's conclusion is warranted and the conclusion is justified. Therefore, they should first discriminate effectively in-sample. However, external validity refers to whether the results of an experiment can be generalised beyond the specific situation. Therefore, in order to provide value to practitioners, models must also predict well out-of-sample (Karbhari & Zulkarnain, 2004; Zulkarnain & Karbhari, 2004; Zulkarnain, et al., 2001).

C. Data Collection Procedures

Financial statements for financial distress companies and non-financial distress companies will be collected for the five fiscal years prior to being listed under the PN4, PN17 and Amended PN17 categories by Bursa Malaysia. The five years relative to the financial distress date are defined as year's t-1, t-2, t-3, t-4, and t-5 that are consistent with previous studies. It would produce a serious bias if ratios were calculated for one reporting period prior to financial distress for the whole sample (Nam & Taehong, 2000).

Every year prior to financial distress is denoted as year's t-1, t-2, t-3, t-4, and t-5 in order to facilitate the presentation and discussion of the results. The "first year before financial distress" or "t-1" is defined as the year that was included in the most recent financial statement prior to the date that the company was considered to be financially distressed. The "second year before financial distress" or "t-2" is the fiscal year before the first year. The third, fourth and fifth years are similarly defined. The financial statements of the non-financial distress companies were obtained for

the same fiscal years as those of their financial distress mates.

The list of companies that are listed under PN4, PN17 and Amended PN17 were obtained from the Media Releases and Companies Announcements from the Bursa Malaysia website (www.bursamalaysia.com) from January 2001 to December 2015. The annual reports of the selected companies were obtained from Datastream database that can be assessed through the website of Perpustakaan Tun Abdul Razak, Universiti Teknologi Mara and also Annual Companies Handbook (various editions).

D. Data Analysis Procedures

Logit Analysis is used in this study. It is an alternative parametric approach to MDA that has been widely used in financial distress prediction to overcome MDA's limitations (multivariate normality and equality in dispersion matrices among groups). Logit Analysis provides the probability of occurrence of an outcome by a dichotomous (or polytomous) dependent variable using coefficients of the independent variables. The developed Logit Analysis model has the form of the cumulative logistic probability function.

In contrast to the difficult interpretation of the *Z*-score in MDA, Logit Analysis results in a value that can be interpreted as the conditional probability of failure. If this value, P(Z), instead of the logistic cumulative function, is placed into the normal cumulative probability function, the model is called a probit model. Due to the non-linearity of the model, coefficients are often estimated by the maximum likelihood method instead of the least squares method (Laitinen & Kankaanpaa, 1999).

The value of the probability P(Z) is always between 0 and 1 with all values of Z, i.e. instead of resulting in a group membership like the MDA model, it generates the probability of a group membership since its value changes between 0 and 1. If Z approaches minus infinite, P(Z) approaches zero, and if it approaches plus infinite, P(Z) approaches the value of 1. When the value of Z is 0, the probability of failure P(Z) is 0.5, which is a commonly used critical value in classifying financial distressed and non-financial distressed companies. If misclassification costs for both error types are used when defining the critical value, it is often lower than 0.5 (misclassification costs for the Type I error are usually estimated to be higher than those of the Type II error) (Laitinen & Kankaanpaa, 1999). Based on the probability, a company is classified as financially distressed or non-financially distressed, using a cut-off probability. Maximum likelihood estimation procedures are employed to determine the parameters.

Under Logit Analysis, the dichotomous dependent variable is simply the logarithm of the odds that a particular event (financial distress / non-financial distress) will occur. That is, here modelling of the 'log odds' of belonging to a group is pursued, rather than modelling the group membership itself. Although it would be possible to model the odds, it is simpler to model the log (natural log, ln) of the odds [ln (odd) = ln (P / 1-P)]. This transformation into natural log, allows the dependent variable to take any value between negative infinity and positive infinity. In this way, the dependent variable becomes continuous too, rather than discrete.

In order to present the idea, let us start by considering the following model:

$$Y_i = \alpha + \beta_1 X_1 + \beta_2 X_2 + \mu \quad (1)$$

where,

Xi = the explanatory variable (s)

Yi = 1 if the event occurs (say a company is financially distressed)

Yi = 0 if the event does not occur (say a company is not financially distressed)

Now, Equation 1 can be written in the logistic regression functional form as:

$$\ln (P/1\text{-}P) = \alpha + \beta_1 X_1 + \beta_2 X_2 + \mu \quad (2)$$

Hence, the probability that an event may occur, company become financial distress in this case, is given by:

$$P = \frac{1}{1 + e^{-(\alpha + \beta_1 X_1 + \beta_2 X_2 + \ldots + \beta_n X_n)}} \quad (3)$$

Equation 3 is estimated using Maximum Likelihood method. Assuming that 1 indicates financial distress, the greater the resulting decimal fraction is above 0.5 (which implies an equal chance of a company being financially distressed or non-financially distressed), the higher chance there is of the subject company being financially distressed. It should be stated that the negative coefficients of ratios in the developed logit model indicate that these ratios are negatively correlated with the probability of financial distress (they decrease the risk of financial distress), while the ratios with positive coefficients have a positive effect on the probability of financial distress (they increase the risk of financial distress).

In order to get reliable results in Logit Analysis, it is necessary to find major explanatory financial ratios that can discriminate between the two groups. The stepwise procedure is applied to finalize the appropriate explanatory variables to be used in the maximum likelihood estimate. The score and p-value of the ratios must be statistically significant. An overall significance test of the variables based on likelihood ratio is also done to confirm the significance of the variables. Maximum likelihood estimates of the variables should also be obtained (Nam & Taehong, 2000).

Optimal p (weights) can be estimated where the likelihood value is maximized. The probability of bankruptcy is obtained by substituting p into the cumulative probability function. If the calculated probability from the Logit Analysis model is over 0.5, the company is classified as financial distress, otherwise as non-financial distress (Nam & Taehong, 2000; Nur Adiana, et al., 2007; Ohlson, 1980).

Pearson correlation analysis procedure is used to test for multicollinearity. The rule of thumb that are used in this study is that the correlations among the independent variables ranging from -0.80 to 0.80 would not cause a problem of multicollinearity (Gujarati, 1995). However, before Pearson correlation analysis procedure is conducted, a t-test is run to test whether there is significant difference between the independent variables for the financial distress and

non-financial distress companies. Only independent variables that are significantly different are selected for testing of multicollinearity.

The cut-off probability is determined using the basic or estimation sample. A 0.5 cut-off point is used because data on Malaysia's average cost of bankruptcy is not available (Chin, 2005). This is consistent with previous studies on the prediction of financial distress and bankruptcy (Fauzias & Chin, 2001; Low et al., 2001; Mohamad Isa et al., 2005; Mohmad Isa, 2004; Nam & Taehong, 2000; Nur Adiana et al., 2007; Ohlson, 1980; Tew & Enylina, 2005).

Companies that are financially distressed are matched with non-financially distressed companies that are selected within the criteria that they are from the same industry or sector as the financial distress companies and they are approximately similar in terms of total asset size (Alkhatib & Al Bzour, 2011; Lakshan & Wijekoon, 2012; Li, 2012; Monti & Garcia, 2010; Wang & Campbell, 2010). These criteria will be set as control factors to guarantee the lowest amount of bias in choosing the basic or estimation sample that is employed in the development of the financial distress prediction model (Chin, 2005; Karbhari & Zulkarnain, 2004; Zulkarnain & Karbhari, 2004). The construction of the matched sample based on industry or sector and company size based on total assets will enhance the validity and reliability of the analysis. This is because if the matched sample consisted mostly of big companies without matching in terms of size, the prediction accuracy of the model will be overstated due to the sample bias (Nam & Taehong, 2000).

Logit Analysis (the stepwise procedure) is used in this study to predict financial distress companies in the manufacturing sector in Malaysia. The analysis is conducted using Statistical Package for Social Sciences (SPSS) Version 16.

IV. RESULTS AND FINDINGS

This section is divided into three sub-sections. Section 4.1 describes the findings in the estimation sample while Sections 4.2 and 4.3 explain the findings in the internal and external validations respectively.

A. Estimation Sample

The data for the manufacturing sector includes a total of 52 companies involving 26 PN4 companies and 26 non-PN4 companies for the period from 2001 to 2005. Table 1 show that the mean for all accruals-based ratios for the PN4 companies are lower than the mean for all accruals-based ratios for the non-PN4 companies. It also shows that the mean for all macroeconomic variables for the PN4 companies are similar to the mean for all macroeconomic variables for the non-PN4 companies. This is due to the matching procedure used in this study.

Table I: Means of Ratios

IV	PN4	Non-PN4	t-value	p-value
DR	1.7946	2.6323	-1.761	0.081*
TAT	0.5071	0.7766	-5.280	0.000***
CR	0.7443	2.0465	-7.841	0.000***
QR	0.5298	1.2984	-6.367	0.000***
WCR	-1.1253	0.1688	-3.892	0.000***
NITA	-0.4437	-0.0069	-4.489	0.000***
BLR	-2.4914	-2.4914		
CPI	2.9532	2.9532		
GDP	9.3458	9.3458		
KLCI	-1.4659	-1.4659		
M2	11.587	11.587		

***statistically significant at 1% level
*statistically significant at 10% level

Based on the t-test analysis in Table 1, all accruals-based ratios are significantly different at 1% level except for debt ratio that is significant at 10% level. No t-test is conducted on the macroeconomic variables because the values for the distress and non-financial distress companies are the same due to the matching procedure used in this study. Therefore, all accruals-based ratios are included in the next analysis that is the Pearson correlation test for multicollinearity.

Once the t-test is completed, Pearson correlation test is conducted to test for multicollinearity among the independent variables. Based on Pearson correlation test for multicollinearity, quick ratio is excluded from the next analysis that is the stepwise Logit Analysis due to its high multicollinearity with current ratio (0.94). However, none of the macroeconomic variables are highly correlated to each other or to the accruals-based ratios. Therefore, the independent variables that are chosen in the stepwise Logit Analysis are debt ratio, total assets turnover ratio, current ratio, working capital ratio and net income to total assets ratio.

Stepwise logit analysis was conducted to evaluate the impact of a number of independent variables on the likelihood that will be financially distressed. The final model contained four independent variables that are total assets turnover ratio, current ratio, net income to total assets ratio and money supply (M2). The final model was statistically significant whereby the chi-square value is 127.684 with four degrees of freedom and $p<0.005$. This indicated that the model was able to distinguish between financial distress and non-financial distress companies.

The chi-square value for the Hosmer and Lemeshow test of this model is 13.732 with a significance level of 0.089 that is greater than 0.05 which indicate support for the model. The Cox & Snell R Square and the Nagelkerke R Square values for this model are 0.388 and 0.517 respectively. It means that 38.8% and 51.7% of the variability is explained by this set of variables.

The model correctly classified 81.5% of overall cases or also known as the percentage accuracy in classification which is higher than the 50% when the analysis was conducted without any of the independent variables that are used in the model. The classification table is shown in Table II.

Table II: Classification Table for Manufacturing Sector

Observed	Predicted Distressed 0	1	Percentage Correct

Distressed	0	103	27	79.2
	1	21	109	83.8
Overall Percentage				81.5

As shown in Table 3, only four independent variables made a statistically significant contribution to the model. The four independent variables are total assets turnover ratio, current ratio, net income to total assets ratio and money supply. This is based on the Wald test that is a test that shows the contribution or importance of each of the predictor or independent variables. Variables that contribute significantly to the models should have significance value of less than 0.05 (Pallant, 2007). Based on Table 3, all the three accruals-based ratios that are total assets turnover ratio, current ratio and net income to total assets ratio have negative B coefficient values which means that companies in the manufacturing sector in Malaysia with high total assets turnover ratio, current ratio and net income to total assets ratio are less likely to be in financial distress. Furthermore, the findings indicate that one of the macroeconomic variables that is money supply (M2) is significant and it has a positive B coefficient value which means that high money supply (M2) may lead companies in the manufacturing sector in Malaysia to financial distress.

Table III: Estimation results of Logit Analysis for manufacturing sector

IV	B	S.E	Wald	df	p-value
TAT	-2.144	0.512	17.567	1	0.000***
CR	-1.59	0.312	25.952	1	0.000***
NITA	-0.013	0.006	5.55	1	0.018**
M2	0.056	0.021	6.886	1	0.009***
Constant	2.347	0.481	23.812	1	0.000***

***statistically significant at 1% level

**statistically significant at 5% level

Therefore, based on Table IV, the equation for the manufacturing sector and using accruals-based ratios and macroeconomic variables is:

$$P = \frac{1}{1+e^{-(2.347-2.144X_1-1.59X_2-0.013X_3+0.056X_4)}} \quad (4)$$

Where,

X1 = Total assets turnover ratio

X2 = Current ratio

X3 = Net income to total assets ratio

X4 = Money supply (M2)

For instance, assume that the values of total assets turnover ratio, current ratio, net income to total assets ratio and money supply (M2) for a company that can be considered under the manufacturing sector category are 0.5, 0.71, -0.95 and 20.9 respectively. By inserting those values in Equation 4, the P value is 0.93 which is greater than 0.5. Therefore, in this example, the company has the possibility of going into financial distress. Equation 4 will be used for internal and external validation purposes.

The accruals-based ratios that had been found to be significant in the manufacturing sector in Malaysia are total assets turnover ratio, current ratio and net income to total assets ratio. Total assets turnover ratio had also been found to be significant in the manufacturing sector in other previous studies (Altman, 1968; Chin, 2005; Gombola, Haskins, Ketz, & Williams, 1987; Holmen, 1988; Zhang, Hu, Patuwo, & Indro, 1999). In this study, the total assets turnover ratio has a negative B coefficient value. This is consistent with the hypothesis of this study which stated that there is a negative relationship between total assets turnover ratio and financial distress. However, the sign of the total assets turnover ratio in previous studies was not reported and therefore, it cannot be compared with the findings of this study. One reason that it was not reported was that previous studies did not use Logit Analysis in their studies. Another reason is that even if Logit Analysis was used, it was used for comparison purposes with other methodologies and the sign of the independent variables were not important and were not reported.

Current ratio had also been found to be significant in the manufacturing sector in other previous studies (Papoulias & Theodossiou, 1992; Zhang, et al., 1999). In this study, the current ratio has a negative B coefficient value and this is consistent with the findings of Papoulias and Theodossiou (1992). Zhang et al. (1999) did not report the sign of the independent variable because Logit Analysis was used for comparison purposes with Artificial Neural Network and the sign of the independent variables was not important and not reported. The negative B coefficient value for the current ratio is also consistent with the hypothesis of this study which stated that there is a negative relationship between current ratio and financial distress.

Net income to total assets ratio had also been found to be significant in the manufacturing sector in other previous studies (Gombola, et al., 1987; Ohlson, 1980; Papoulias & Theodossiou, 1992; Theodossiou, 1991). In this study, the net income to total assets ratio has a negative B coefficient value and this is consistent with the findings of other previous studies (Ohlson, 1980; Papoulias & Theodossiou, 1992; Theodossiou, 1991). Furthermore, it is also consistent with the hypothesis of this study which stated that there is a negative relationship between net income to total assets ratio and financial distress.

Furthermore, one of the macroeconomic variables that is money supply (M2) was found to be significant in predicting financial distress companies in the manufacturing sector in Malaysia. However, based on the literature, no study had found money supply (M2) to be significant in predicting financial distressed companies in the manufacturing sector. In this study, money supply (M2) has a positive B coefficient value but it cannot be compared with any other previous studies. However, this finding is inconsistent with the hypothesis of this study which stated that there is a negative relationship between money supply (M2) and financial distress. This study would like to suggest that money supply (M2) has a positive B coefficient value because companies in the manufacturing sector in Malaysia reacted differently to the movement in money supply. Although an increase in money supply will lead to a decrease in interest rate and hence lower cost of borrowing, companies in the manufacturing sector in

Malaysia do not react by borrowing more to expand their businesses and this should be an interesting issue for future research.

The findings of this study show that accruals-based ratios and macroeconomic variables can be used to predict financial distress companies in the manufacturing sector in Malaysia. The accruals-based ratios that are significant are total assets turnover ratio, current ratio and net income to total assets ratio while the macroeconomic variable that is significant is money supply (M2).

B. Internal Validation

The data for internal validation purpose for the manufacturing sector includes a total of 40 companies involving 20 PN4 companies and 20 non-PN4 companies for the period from 2001 to 2005. The findings for internal validation is summarised in Table 4 to show the trend of the overall percentage accuracy. Table 4 shows that the overall percentage accuracy for the manufacturing sector using accruals-based ratios and macroeconomic variables are more than 50% for five years before distress. A low overall percentage accuracy in t-4 and t-5 and a high overall percentage accuracy in t-2 and t-1 is consistent with the findings of Al-Darayseh (1990).

Table IV: Overall Percentage Accuracy

	t-5	t-4	t-3	t-2	t-1
Overall Percentage	55.00	65.00	70.00	75.00	77.50

C. External Validation

The data for external validation purpose for the manufacturing sector includes a total of 58 companies involving 29 PN17 companies and 29 non-PN17 companies for the period from 2005 to 20015. The findings for external validation is summarised in Table 5 to show the trend of the overall percentage accuracy. Table 5 shows that the overall percentage accuracy for the manufacturing sector using accruals-based ratios and macroeconomic variables is more than 50.00% for five years before distress. However, this finding cannot be compared with the findings of previous studies because none of the previous studies specifically stated that they were conducted on the manufacturing sector using accruals-based ratios and macroeconomic variables.

Table V: Overall Percentage Accuracy

	t-5	t-4	t-3	t-2	t-1
Overall Percentage	55.00	65.00	70.00	75.00	77.50

V. CONCLUSION

This study develops a prediction model of financial distress companies in the manufacturing sector in Malaysia using accruals-based ratios and macroeconomic variables. The accruals-based ratios that were chosen were debt ratio, total assets turnover ratio, current ratio, quick ratio, working capital ratio and net income to total assets ratio. They were chosen on the basis that they had been found to be useful in at least ten previous studies. The macroeconomic variables that were chosen were BLR, GDP, CPI, KLCI and M2. They were chosen on the basis that they had been found to be useful in at least one previous study.

This study found that the most useful accruals-based ratios for the prediction of financial distress companies in the manufacturing sector in Malaysia were total assets turnover ratio, current ratio, net income to total assets ratio. Furthermore, money supply (M2) was also found to be useful in predicting financial distress companies in the manufacturing sector in Malaysia.

The findings from the internal validation of this study showed that the prediction model provided a more than 50% chance that the model is accurate for five years before distress. In addition, the findings from the external validation of this study also showed that the model might be able to be used outside the time period that the model was estimated because the overall percentage accuracy more than 50% for five years before distress.

This study uses accruals-based ratios and macroeconomic variables in predicting financial distress companies in the manufacturing sector in Malaysia. Therefore, this study would like to suggest that future studies should be conducted on the prediction of financial distress companies in other individual sectors in Malaysia. In addition, this study would also like to suggest that cash-flow-based ratios should be considered as the independent variables in predicting financial distress companies in Malaysia.

ACKNOWLEDGMENT

This research work is supported by the Research University Grant, Vot No. 13J15, the Malaysian Ministry of Higher Education and Universiti Teknologi Malaysia.

REFERENCES

[1] Al-Darayseh, M. M. (1990). Corporate failure for manufacturing industries using financial ratios and macroeconomic variables with logit analysis. Unpublished Ph.D., The University of Nebraska - Lincoln, United States -- Nebraska.
[2] Alkhatib, K., & Al Bzour, A. (2011). Predicting corporate bankruptcy of Jordanian listed companies: Using Altman and Kida Models. International Journal of Business and Management, 6(3), 208-215.
[3] Altman, E. I. (1968). Financial ratios, discriminant analysis and the prediction of corporate bankruptcy Journal of Finance, 23(4), 589-609.
[4] Aziz, A., & Dar, H. (2006). Predicting corporate bankruptcy: Where we stand? Corporate Governance, 6(1), 18-33.
[5] Barnes, P. (1987). The analysis and use of financial ratios: A review article Journal of Business Finance & Accounting, 14(4), 449-461.
[6] Beaver, W. H. (1966). Financial ratios as predictors of failure. Journal of Accounting Research, 4(3), 71-111.
[7] Bunn, P., & Redwood, V. (2003). Company accounts based modelling of business failures and the implications for financial stability. Bank of England Quarterly Bulletin, 43(4), 462-462.
[8] Chin, N. S. (2005). Prediction of corporate failure: A study of the Malaysian corporate sector. Unpublished Ph.D. Dissertation, Multimedia University, Malaysia.
[9] Doumpos, M., & Zopounidis, C. (1999). A multicriteria discrimination method for the prediction of financial distress: The case of Greece. Multinational Finance Journal, 3(2), 71-101.
[10] Fauzias, M. N., & Chin, Y. F. (2001). Z-Score revisited: Its applicability in the prediction of bankruptcy in the Malaysian environment. Paper presented at the Malaysian Finance Association Third Annual Symposium, Malaysia.
[11] Ganesalingam, S., & Kuldeep, K. (2001). Detection of financial distress via multivariate statistical analysis. Managerial Finance, 27(4), 45-55.
[12] Gombola, M. J., Haskins, M. E., Ketz, E., & Williams, D. D.

(1987). Cash flow in bankruptcy prediction. Financial Management 16(4), 55-65.
[13] Hol, S. (2007). The influence of the business cycle on bankruptcy probability. International Transactions in Operational Research, 14(1), 75-90.
[14] Holmen, J. S. (1988). Using financial ratios to predict bankruptcy: An evaluation of classic models using recent evidence. Akron Business and Economic Review, 19(1), 52-63.
[15] Karbhari, Y., & Zulkarnain, M. S. (2004). Prediction of corporate financial distress: Evidence from Malaysian listed firms during the Asian financial crisis. Unpublished Working Paper. Social Science Research Network.
[16] Karels, G. V., & Prakash, A. J. (1987). Multivariate normality and forecasting of business bankruptcy Journal of Business Finance & Accounting, 14(4), 573-593.
[17] Keasey, K., & Watson, R. (1991). Financial distress prediction models: A review of their usefulness. British Journal of Management, 2(2), 89-102.
[18] Kritzer, A. J. (1985). Financial ratios, macroeconomic variables and their interaction effects in models of firm-specific financial distress Unpublished Ph.D., University of Colorado at Boulder, United States -- Colorado.
[19] Laitinen, T., & Kankaanpaa, M. (1999). Comparative analysis of failure prediction methods: The Finnish case. European Accounting Review, 8(1), 67-92.
[20] Lakshan, A. M. I., & Wijekoon, W. M. H. N. (2012). Predicting corporate failure of listed companies in Sri Lanka. GSTF Business Review (GBR), 2(1), 180-185.
[21] Li, J. (2012). Prediction of corporate bankruptcy from 2008 through 2011. Journal of Accounting and Finance, 12(1), 31-41.
[22] Low, S. W., Fauzias, M. N., & Yatim, P. (2001). Predicting corporate financial distress using logit model: The case of Malaysia. Asian Academy of Management Journal, 6(1), 49-62.
[23] Mensah, Y. M. (1984). An examination of the stationarity of multivariate bankruptcy prediction models: A methodological study. Journal of Accounting Research, 22(1), 380-395.
[24] Mitchem, C. E. D. (1990). A cash flow and macroeconomic model of financial distress. Unpublished Ph.D., Virginia Commonwealth University, United States -- Virginia.
[25] Mohamad Isa, H., Annuar, M. N., Shamsher, M., & Taufiq, H. (2005). Prediction of corporate financial distress of PN4 companies in Malaysia: A logistic model approach. Journal of Restructuring Finance, 2(2), 143-155.
[26] Mohamed, S., Ang, J. L., & Sanda, A. U. (2001). Predicting corporate failure in Malaysia: An application of the logit model to financial ratio analysis. Asian Academy of Management Journal, 6(1), 99-118.
[27] Mohmad Isa, H. (2004). Determination of capital structure and prediction of corporate financial distress in Malaysia. Unpublished Ph.D. Dissertation, Universiti Putra Malaysia.
[28] Monti, N. E., & Garcia, R. M. (2010). A statistical analysis to predict financial distress. Journal of Service Science and Management, 3(3), 309-335.
[29] Nam, J. H., & Taehong, J. (2000). Bankruptcy prediction: Evidence from Korean listed companies during the IMF crisis. Journal of International Financial Management & Accounting, 11(3), 178-197.
[30] Nur Adiana, H. A., Rohani, M. R., & Abd. Halim, A. (2007). Factors contributing to financially distressed companies. Paper presented at the Malaysian Finance Association 9th Annual Conference, Malaysia.
[31] Ohlson, J. A. (1980). Financial ratios and the probabilistic prediction of bankruptcy. Journal of Accounting Research, 18(1), 109-131.
[32] Pallant, J. (2007). SPSS survival manual: A step by step guide to data analysis using SPSS (Third ed.). New South Wales: Allen & Unwin.
[33] Papoulias, C., & Theodossiou, P. (1992). Analysis and modeling of recent business failures in Greece. Managerial and Decision Economics (1986-1998), 13(2), 163-169.
[34] Tew, Y. H., & Enylina, N. (2005). Predicting corporate financial distress using logistic regression: Malaysian evidence. Unpublished Working Paper. Universiti Teknologi Mara.
[35] Theodossiou, P. (1991). Alternative models for assessing the financial condition of business in Greece Journal of Business Finance & Accounting, 18(5), 697-720.
[36] Wang, Y., & Campbell, M. (2010). Business failure prediction for publicly listed companies in China. Journal of Business and Management, 16(1), 75-88.
[37] Zavgren, C. V. (1985). Assessing the vulnerability to failure of American industrial firms: A logistic analysis Journal of Business Finance & Accounting, 12(1), 19-45.
[38] Zhang, G., Hu, M. Y., Patuwo, B. E., & Indro, D. C. (1999). Artificial neural networks in bankruptcy prediction: General framework and cross-validation analysis. European Journal of Operational Research, 116(1), 16-32.
[39] Zulkarnain, M. S., & Karbhari, Y. (2004). Bankruptcy prediction during the IMF crisis: Evidence from Malaysian listed industrial companies. Unpublished Working Paper. Social Science Research Network.
[40] Zulkarnain, M. S., Mohamad Ali, A. H., Annuar, M. N., & Zainal Abidin, M. (2001). Forecasting corporate failure in Malaysian industrial sector firms. Asian Academy of Management Journal, 6(1), 15-30.

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