Research Paper

BANKRUPTCY PREDICTION USING ALTMAN Z-SCORE MODEL: A CASE OF PUBLIC LISTED MANUFACTURING COMPANIES IN MALAYSIA

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ABSTRACT

Over the years, serious attention has been to bankruptcy prediction models and the problems associated with predicting failure in corporate firms. Corporate failure prediction has become a very vital issue in finance especially given the fact that so many researchers have given so many different types of prediction model. In addition, the multiple discriminant analysis seems to be the best model that achieves a very high result of accuracy levels. In this study, 34 public listed manufacturing companies in Malaysia where used from 2010-2014. Companies were chosen from companies listed under the PN17 companies while healthy companies where matched using paired sample t-test using random stratified sampling method. Initially, the main aim or objective of this study was to examine the reliability and relationship of Altman’ Z-score model to corporate failure and to investigate if all failing companies where listed under the PN-17 on the Kuala Lumpur stock exchange (KLSE) now popularly known as Bursa Malaysia. Findings showed that not all failed companies where listed under PN17 companies in bursa Malaysia. While all but one of the companies under the PN17 companies where in the safe zone in the fifth year. The Study findings showed four out of five financial ratios where significantly related in the prediction of corporate failure under the Z-score model. Also the regression analysis showed that the model is a great fit with significance of 0.000 and accuracy levels of 86% and 99.6%.

Keywords: Financial ratios, MDA, Bankruptcy prediction, Altman, Z-Score, PN17 companies.

1. Introduction

Companies that are financially distressed or that are going bankrupt is more like when a firm is not able to pay off its creditors. The chances of causing bankruptcy is increased when a company's fixed costs are really high, the revenues are sensitive to economic downfall or when the assets cannot be liquidated. Ever since the bankruptcy of Compagnia dei Bardi in 1344, bankruptcy prediction activity has undergone loads of changes which was the desire of firm
owners to keep their corporations afloat. Over time, numerous critical techniques such as the Multiple Discriminant Analysis, Artificial Neural Network Models and the Linear Probability Models has been used to predict possible company failures and those prior studies found that the models are reasonably effective and correct although some of the claims made might not seem credible when they are tested over a long with a different sample and population as well as different sector (Gentry, Newbold and Whitford, 1985).

Meanwhile, Malaysian companies do not have that much of a long history as much as those in the western world and the sizes aren’t as large as the companies in the western world. Also, the access to capital and funds are not easily available when compared to the developed world/country (Kim-soon, 2012). Quite a number of researchers have conducted a number of studies over the years. However, the most notable contributions to bankruptcy prediction that has been published are; William beaver 1966:1968 came up with the univariate model, as time went on, a New York university finance professor, Edward Altman (1968: 1973) came up with the multiple discriminant analysis (MDA), where his work was the first to be published on bankruptcy prediction.

Bankruptcy has become one of the most critical issues in the corporate finance world today. As it refers to the financial health or stability of business entities. The significance of bankruptcy or financial distress was extremely felt during the financial crisis (Taffler, 1983). Shareholders have since then gained interest regarding the level of reliability of companies that are important to them before investing in corporations. So, credit and default rate of companies are of great importance to them before they invest in them.

Research objectives

1. To investigate whether all failed companies are listed under PN17.
2. To examine whether Working capital /Total assets (WC/TA) ratio is a good determinant of bankruptcy under Z-score
3. To examine whether retain earning/total assets (RE/TA) ratio is a good determinant of bankruptcy under Z-scores.
4. To examine whether earnings before interest and tax/ total asset (EBIT/TA) ratio is a good determinant of bankruptcy under Z-score
5. To examine whether market value of equity / total liability (MVE/TL) ratio is a good determinant of bankruptcy under Z-score
6. To examine whether sales / total assets (S/TA) ratio is a good determinant of bankruptcy under Z-score
7. To determine whether Z-score is significant in predicting bankruptcy of the firm.

2. Literature Review

According to Timothy (1991), bankruptcy can be defined as a legal proceeding in which an individual or is unable to pay their bills petition. It is a federally lawful process whereby a defaulter- corporation or individual is dismissed of total liabilities for its obligations by making a court approved preparations for their partial settlement.

While looking into empirically tested models, just like the univariate analysis, every other model comes with its limitations, ranging from the difficulty in the supposed model to a non-development model. According to Aziz (2006) who identified for example that the genetic algorithms are quite hard to tune and has no merging criteria. Likewise, the balance sheet decomposition measure which focuses on the changes in the figures on the balance sheet with little or no care about the direction at which it changes. In addition, the cash management model provides qualitative explanations only based on a corporate failure disregarding the quantitative features of failure in a company. However, the Probit and logit models do its best when the sample size is increased or it is in a large number and the numbers of errors are usually not distributed normally (Joy and Tollefson, 1975). Clearly, the use of statistical method
has dominated the literature of bankruptcy research. 30% of researches have employed the Multiple Discriminant Analysis which falls under the statistical method, while 21% used the logit model. The neural network model was ranked amongst the very first AIES model that accounts for 9% share. Under the theoretic model, the balanced sheet decomposition models (BDSM) is mostly used which is 4.5% in terms of percentage.

Since examining the empirical literature on the topic, According to Green (1978), financial ratios has been viewed as a testing means for the financial health of reporting companies using their financial statements. Beaver (1966) on the other hand suggested that standard financial ratios are capable of predicting a firm’s performance.

On the contrary, Abdullah et al. (2008) conducted a comparative analysis of three different methods which includes the hazard model, multiple discriminant analysis and the logistic regression which was used in tracking companies that are financially distressed firms in Malaysia and they found out that the hazard model estimates was most accurate amongst all three methods that was used with accuracy level of 94.9%. Similarly, Low et al. (2001) as cited by Mohammed and Sandra (2015) who conducted a related study. Later on, Yap, Yong and Poon (2010) developed a model to predict failure for Malaysian based companies and constructed a strong discriminant function with seven different ratios that has predictive accuracy. Furthermore, Bhunia and Mukhuti (2011) developed a model that predicts financial distressed companies in India under the Z-Score model with accuracy classification of 81%.However, Steven et al. (2011) in their study in Malaysia that was carried out using the Z-score in order to determine company’s performance after the financial stress that is derived through environmental stress. Venkataramana, Ramakrishnaiah and Azash, (2012), made analysis in the cement companies in the Indian market and the researchers used three bankruptcy prediction models and also conducted ratio analysis for the companies.

3. Methodology

In an educational research or study, it is popular and usually possible to characterize a research’ methodology as descriptive, explanatory or exploratory, hence for this research descriptive explanatory research will be engaged. This research will be adopting the quantitative research method, as data’ for this study as it gives room for theories and hypothesis and can collect large data which is appropriate in order for the research questions to be answered. In addition, this research is not influenced by personal opinion, neither is it bias but it is rather reliable (Bryman, 2007).

Sampling techniques and sample size.

However, for sample selection, stratified random sampling was used to choose the companies as there are two groups of companies, which in this case is paired sample test as used to make comparison between financially distressed companies and non-financially distressed companies. Altman in his studies used this method in his initial research (Altman, 1993; Ohlson, 1980). In this study, sample size of n=34 will be used, 17 distressed companies and 17 non-distressed where paired within the period of 2010-2014. All the 20 companies are listed in the bursa Malaysia and only the manufacturing companies where chosen as finance companies tend to have a high dependence on economic conditions.

Altman’s model (Z-score)

The Z-score model has undergone quite a number of variations that is aimed at improving the accuracy or predictive power of the model and to provide for both private and non-manufacturing firms since it was introduced in 1968, (Altman 1968;1982 and 2006). Altman' model is a liner combination of financial ratios which would be explained later. For public manufacturing firms;

\[ Z=0.012X_1 +0.014X_2 +0.033X_3 + 0.006X_4 + 0.999X_5 \quad \text{(eqn 1)} \]
For private companies;
\[ Z_1 = 0.717X_1 + 0.847X_2 + 3.107X_3 + 0.420X_4 + 0.998X_5 \ldots \text{(eqn 2)} \]

For emerging market, non-manufacturing firms and general use;
\[ Z_2 = 3.25 + 6.56X_1 + 3.26X_2 + 6.72X_3 + 1.05X_4 \ldots \text{ (eqn 3)} \]
\[ \text{(Altman, 1983; 1993)} \]

Where;
The working capital is the difference between the current liability and current assets. This supposed ratio is a measurement of the net liquidity. The working capital is often found in studies of corporate problems, it is the measure of liquid asset of a company that is relative to total capitalization. Secondly, the leverage ratio and companies with very high retained earnings usually finance their firms through accumulated gains. This financial ratio takes the age of a company into consideration as established firms are more likely to have higher retained earnings over the business life when compared to younger businesses.

Earnings before interest and taxes / Total Assets is a degree at which a company’s profitability that eliminates its interests and taxes. It is the measurement of profit on each penny or dollar of investment made by the company. It is also the measurement of a company's asset productivity which is independent of taxes and interests paid by the firm. This financial ratio is deemed particularly appropriate for research papers that have to deal with corporate failure (Shirata, 1998).

Equity is measured when the market value of all shares of the stock has been combined both preferred and common stocks while its liabilities includes the short and long term, (2000, and 2002). This ratio shows how much a firm’s assets tend to decline in value right before the liabilities exceed its total assets and the business becomes bankrupt. The capital income is a standard financial ratio that exemplifies the ability of a company to generate sales using the firm’s assets as it is one of the measures and entity’s management capacity in dealing with the competitive conditions in the market.

Hypothesis

✓ H1 - Profitability ratio is expected to have a significant relationship to company failure or success
✓ H2 - Leverage ratio is expected to have a significant relationship to a company’s success or failure
✓ H3 - Solvency ratio is expected to have a significant relationship to a company’s failure or success.
✓ H4 - Liquidity ratio is expected to have a significant relationship to a company’s failure or success
✓ H5 - Activity ratio is expected to have a significant relationship with a company’s success or failure.

4. Data Analysis and Findings

Descriptive analysis

<table>
<thead>
<tr>
<th>Variable</th>
<th>Mean</th>
<th>Standard deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Failed companies</td>
<td>Non failed companies</td>
<td>Failing companies</td>
</tr>
</tbody>
</table>

Table 1: Summary of descriptive statistics table
Under the failed companies, WC/TA, RE/TA, EBIT/TA has negative Means which indicates that the companies X1, X2 and X3 are low which is indicates that their debt level is higher than their total assets, they do not have enough retained earnings why the companies failing while the MVE/TL and S/TA are on the positive side. On the contrary, all five ratios under the non-failed companies are all on the positive side which shows their strong predicting ability and indicates that the independent variables for the non-failed companies are clearly stronger than the failed firms. Overall, based on the results shown in table 8, it can be seen that the mean for all the financial ratios for the failed companies are lower than the non-failed companies. Also, the difference between the two set of means are significantly large which indicates that they are good discriminators. However, when there is no significant difference between the both set of means, carrying out the analysis won’t be worthwhile. Given the results shown it is safe to say that the non-failed companies has shown that they have better potential in sustaining for a longer period.

**Correlation Analysis:**

Table 2: Pearson correlation table for both set of companies

<table>
<thead>
<tr>
<th>Factors</th>
<th>Z-Score (Failed Co')</th>
<th>Relationship</th>
<th>Z-Score (non-failed co')</th>
<th>Relationship</th>
</tr>
</thead>
<tbody>
<tr>
<td>X1</td>
<td>0.723**</td>
<td>Strong positive</td>
<td>0.295**</td>
<td>Weak positive</td>
</tr>
<tr>
<td>WC/TA</td>
<td>-0.012</td>
<td>Strong negative</td>
<td>0.238*</td>
<td>Weak positive</td>
</tr>
<tr>
<td>X2</td>
<td>0.0689**</td>
<td>strong positive</td>
<td>0.703**</td>
<td>Strong positive</td>
</tr>
<tr>
<td>RE/TA</td>
<td>0.569**</td>
<td>Moderately positive</td>
<td>0.980**</td>
<td>Very strong positive</td>
</tr>
<tr>
<td>X3</td>
<td>-0.126</td>
<td>Strong negative</td>
<td>0.785**</td>
<td>Strong positive</td>
</tr>
<tr>
<td>EBIT/TA</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>X4</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MVE/TL</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>X5</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>S/TA</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Table 1 Source-SPSS generated
*Correlation is significant at the 0.05 level (2-tailed).
**Correlation is significant at the 0.01 level (2-tailed).

Relationship between working capital/ total assets and Z-score

Under the failed companies the working capital/ total asset shows a strong positive linear relationship with the z-score, while the working capital/total assets where the correlation score is r=0.723, while the non-failed companies shows a weak positive relationship with the Z-score of r=0.295. In summary, there is a positive correlation between working capital/total assets and the Z-score in company failure. Similarly, Siew et al. 2014 conducted a similar study and also found a significant relationship between these two variables.

**Relationship between retained earnings/total assets and Z-score**
The retained earnings/ total assets for the failed companies shows a very strong negative relationship with the z-score in the failed companies, with a correlation of -0.012 which means that X2, has no positive linear relationship with the z-score. On the contrary, the X2, has a weak positive relationship with the Z-score under the non-failed firms with r= 0. 295 which highlights that the relationship between z-score and X2 is weak which may not be too significant but it definitely useful when predicting a company’ failure.

**Relationship between earnings before interest and tax/ total assets and Z-score**

Earnings before interest and tax/total assets however shows a strong positive linear relationship between x3 and the z-score in both set of companies with r= 0.0689 (Failed) and 0.703 (Non-failed). Which means that X3 affects a company’ failure or success and accepts H2 which states that there is a significant relationship between leverage ratios and the probability of a business failure.

**Relationship between market value of equity/ total liabilities and Z-score**

Market value of equity/ total liabilities indicates that there is a moderately strong/strong positive linear relationship between X3 and the z-score in both set of companies. This however, accepts the H3 which states that there should be a significant relationship between solvency ratios and the probability of a firm’s failure.

**Relationship between sales/ total assets and the z-score**

Sales/ total assets show a strongly negative relationship with the z-score in the set of failed companies while it shows a strong positive linear relationship with the z-score under the non-failed companies.

**Regression analysis**

<table>
<thead>
<tr>
<th></th>
<th>Failed Companies</th>
<th>Non-failed companies</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>B - Coefficient</strong></td>
<td>Sig.</td>
<td>T-Value</td>
</tr>
<tr>
<td>Constant</td>
<td>-0.351</td>
<td>-1.012</td>
</tr>
<tr>
<td>X1WC/TA</td>
<td>1.233</td>
<td>0.000</td>
</tr>
<tr>
<td>X2RE/TA</td>
<td>-8.2310E-006</td>
<td>0.504</td>
</tr>
<tr>
<td>X3EBIT/TA</td>
<td>2.810</td>
<td>0.000</td>
</tr>
<tr>
<td>X4MVE/TL</td>
<td>0.605</td>
<td>0.000</td>
</tr>
<tr>
<td>X5S/TA</td>
<td>1.108</td>
<td>0.052</td>
</tr>
<tr>
<td><strong>Adjusted R-square</strong></td>
<td>0.852</td>
<td>0.996</td>
</tr>
<tr>
<td><strong>F-value</strong></td>
<td>97.761</td>
<td>4558.611</td>
</tr>
<tr>
<td><strong>Significance of model</strong></td>
<td>0.000</td>
<td>0.000</td>
</tr>
</tbody>
</table>

1. Dependent factor: Z-SCORE
2. Predictors: (constant) X1, X2, X3, X4, X5.

In table 3, the z-score shows the adjusted R in the failed companies are 0.852, which is 85% of bankruptcy while the non-failed companies have an Adjusted R of 0.996 which is 99.6% almost 100% can be predicted by the independent variables in this study. Therefore this model is considered to be a good tool for prediction. The F-value on the other hand for the failed companies is 97.761and it's relatively high which indicates that regression analysis is a significant model. Lastly, the Significance of the model happens to be a great fit and however, the hypothesis is accepted.
Overall interpretation, of data’s, findings and comparison to prior studies

In this study, the statistical analysis proofs the association between X1-X5 and Z-score. The descriptive statistics shows the difference between the means of the failed and non-failed companies given that the failed companies have a negative mean while the non-failed companies indicates positive means.

The correlation test by Pearson shows that there is significant relationship between all five independent variables under the non-failed companies and the dependent variable (Z-score) while three out of all five independent variables have significant relationship with the dependent variable under the failed companies. In addition, the multiple regression analysis showed .85 and.99 significance level which indicates the model is a great fit for bankruptcy prediction.

5. Conclusions

This study carried out its research for thirty-four companies grouping them into failed and non-failed companies and paired them based on their size, industry and source in order to examine the relationships between the independent variables (WC/TA, RE/TA, EBIT/TA, MVE/TL&S/TA) and the dependent variable (Z-score) in determining a company’s failure and also to investigate whether or not all if all failed companies are listed under the PN-17 in bursa Malaysia. This research used quantitative method and random stratified sampling technique to choose the companies. The failed companies where already listed under the PN17 companies in Bursa Malaysia, formerly known and the Kuala Lumpur stock exchange (KLSE). The companies where analyzed using the descriptive analysis to show the difference between the failed and non-failed company means, which showed a significantly large difference between the two set of companies showing that the non-failed companies have positive mean while the failed companies showed negative means. The correlation analysis showed significant relationship between the independent variables (X1-X5) and the dependent variable (Z-score) in determining business failure. Similarly, the regression analysis carried out in this study showed accuracy of the Z-score between 85% and 99% accuracy levels which is in line with previous studies and their findings.

Recommendations

This study can be more enhanced in the future in several areas, Firstly, researchers that are interested in this topic area can try developing a prediction model for smaller entities, non-publicly traded companies instead of wholly focusing on publicly traded manufacturing companies. Also, increase in much larger sample size, which will be in line with other models to test the overall significance of the model in Malaysia as a whole. Also, future researchers can opt for a different prediction model like the linear, logit or both in comparison to the MDA for accuracy purposes for Malaysian listed companies. In addition, researchers that intend to further the investigation carried out in this paper might want to consider comparing with corporate governance which may or may not be part of a company's failure.
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