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# Evaluation of Corporate Bankruptcy Prediction Models in Indonesia

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**Abstract:** *This study aims to determine the value of various bankruptcy prediction models in the Indonesian business environment and to determine an accurate bankruptcy prediction model in the Indonesian business environment. This study uses data from companies listed on the Indonesia Stock Exchange that have financial statements for the financial year ending in 2015 - 2019. This study processes data with 4 bankruptcy prediction models, namely Altman EM (Altman et al., 1998), Ohlson (1980), Taffler (1983), Zmijewski (1984). In addition, this study also includes re-estimating the coefficients, testing the Chi-Square validity, and calculating type I II errors. This study will produce an analysis of financial performance on the risk of bankruptcy based on these 4 models. The results of this study indicate RE Ohlson has a high level of accuracy and the lowest error I compared to other models and is expected to provide information and become one of the considerations in decision making.*

**Keywords:** Financial Distress, Bankruptcy, Re-estimated Model

## 1. Introduction

Dynamics is one of the characteristics of the business environment. It certainly has an impact on every business actor and forces them to adapt and survive with all kinds of consequences that this dynamism brings. The right strategy is mandatory to be able to gain momentum and turn this into an opportunity or at least survive a business downturn. Of course, a good strategy must be based on a good state analysis of various parameters in order to be able to wisely determine future business steps. An example that is quite clear about this dynamism is the impact of economic globalization and the economic crisis, which has had a positive and negative impact on business. The impact of the failure of global competition to the crisis has greatly affected the economy and business environment and plunged many businesses into financial distress (Altman, 2006). In the form of undesirable consequences, financial distress must be avoided for all business actors to support long-term business sustainability long. In this case, financial distress is an early warning of company problems (Ross, 2015).

In this case, financial distress is quite crucial because it can lead to the bankruptcy of a company. Therefore, by knowing about the prediction of bankruptcy, the company can evaluate the financial health of the company. When a company experiences financial distress, the company is actually dealing with one or more issues/conflicts, such as from the asset side, there is a shortage of cash, or from the liabilities side, too much debt is causing the company to choke. This will urge the company to negotiate with creditors to propose a delay in paying debts in the next restructuring period (Outecheva, 2007). From this, it can be seen that there are many accounting or economic variables that are closely related to financial distress, even

though these variables are very sensitive and have unique characteristics according to their economic environment.

In fact, when viewed from accounting rules, there are quite a number of accounting rules in various countries and at different times as well as various events that make the parameters that a company is experiencing financial distress. This causes a high complexity in defining accurately and precisely about financial distress or bankruptcy (Zhang, 2010). Various researchers and practitioners are aware of this, even though there is a critical need for the accuracy of the definition of bankruptcy. Hence there are several published models that only work in different economic circumstances. In this case, the available bankruptcy prediction models do not generalize to various economic and business environments, such as country differences and even differences in industrial classification.

Therefore, the issue of financial distress, which is a critical condition of the company, to be precise before the bankruptcy occurs, is a challenging and quite important matter to be researched and developed. Even with various variables that are very sensitive and have unique characteristics according to the economic and business environment, knowledge of financial distress conditions will be very helpful in deciding strategic steps to save the company when overcoming conditions that can lead to bankruptcy.

A well-known technique for obtaining an assessment of whether a business is healthy or not is the financial distress prediction model. There are variations in various financial distress models from the variables and factors that are considered vital and what methods are used in the development of these models. In this case, in general, prediction models of financial distress use economic data obtained from the macroeconomic indicators of a country and company financial reports. These various data are processed so that they can classify companies experiencing financial distress and non-financial distress.

Various predictive models are carried out with quite varied techniques because researchers try to criticize in an attempt to develop a model that is considered more accurate. As at first, there was the univariate technique developed by Beaver (1966) which was considered to have a problem with the individual ratio that was not clear enough, so that Altman (1968) tried to develop a multivariate technique, although some researchers criticized it again. There is also an Ohlson (1980) model with a logit approach with a final value of 0 and 1, which is criticized as if an unhealthy company went bankrupt from the start (Abdullah et al., 2008). But there are also those who say the MDA technique is still better than the multivariate technique (Collin and Green, 1982). But there is something interesting, according to Grice and Dugan (2003), which is the relationship between financial ratios and their effect on bankruptcy changes over time and the industry category.

In particular, these prediction models are developed in a country with economic conditions and various assumptions therein. But the problem is that each country has its own uniqueness and raises the question of how each model will perform when applied to different economic conditions. If we take examples such as Ohlson (1980), Zmijewski (1984), and Shumway, the model takes samples from developed countries, not to mention discussing the differences in the composition of major role industries that build economic conditions in a country. From this, the accuracy of the application of several financial distress prediction models in a developing country especially in Indonesia with its unique industrial composition is an interesting thing to study.

## 2. Literature Review

Usually companies experiencing financial distress (financial distress) are more likely to declare bankruptcy (bankruptcy) than companies in general conditions. However, the financial difficulties experienced by the company do not necessarily result in a company declaring bankruptcy. This is because bankruptcy is the combined result of financial difficulties and legal events or actions (Gilbert, Menon, and Schwarts, 1990). Furthermore, financial distress can also be interpreted as a condition in which a company experiences negative net profit for several years. Meanwhile, financial difficulties can cause listed companies to become delisted due to negative net income and book value of equity (Almilia, 2004).

The first Altman model was made to predict the bankruptcy of companies using manufacturing companies in the period 1946 – 1965 with multi-discriminant analysis estimates. The First Altman model then classifies 33 companies that are predicted to go bankrupt and 33 other companies are predicted not to go bankrupt. Then Altman also developed another bankruptcy prediction model. Altman sees developments in emerging markets and makes a bankruptcy prediction model for emerging markets. In the development of this model, not much has changed when viewed on the variables. But Altman himself added a new constant to the equation of the emerging market bankruptcy prediction model. Here is the equation:

$$Z = 6.56\frac{WC}{TA} + 3.26\frac{RE}{TA} + 6.72\frac{OI}{TA} + 1.05\frac{BVE}{TL} + 3.25 \quad \ldots(2.1)$$

Where:

WC/TA = Working Capital/Total Asset
RE/TA = Retained Earning/Total Asset
OI/TA = Operating Income/Total Asset
BVE//TL = Book Value of Equity/ Total Liabilities

Then at another time Ohlson (1980) developed a bankruptcy prediction model. Ohlson (1980)'s model divides the sample of research objects by grouping 105 companies predicted to experience bankruptcy and 2058 companies predicted not to experience bankruptcy. The objects used in this study are industrial companies listed on the stock exchange in the range of 1970 – 1976 using the logistic regression method (Oz, Mugan 2018). The Ohlson (1980) model equation is:

$$Z = -1.32 - 0.407SIZE + 6.03\frac{TL}{TA} - 1.43\frac{WC}{TA} + 0.0757\frac{CL}{CA} - 2.37\frac{NI}{TA}$$
$$-1.83\frac{OCF}{TL} - 1.72OENEG - 0.521CHIN + 0.285INTWO \quad \ldots(2.2)$$

Where:

SIZE = Logarithm of Total Assets to GNP price – Level Index
TL / TA = Total Liabilities to Total Assets
WC / TA = Working Capital to Total Assets
CL / CA = Current Liabilities to Current Assets
NI / TA = Net Income to Total Assets
OCF / TL = Operational Cash Flows to Total Liabilities
OENEG = One if Total Liabilities exceeds Total Assets
CHIN = Change Net Income

Then in 1983 Tafler made a model formulation about bankruptcy prediction for manufacturing companies. The manufacturing company is a company listed on the London Stock Exchange in the period 1969 – 1976. In this regard, this z-score model, if carefully developed and tested, continues to have significant value for users of financial statements who are concerned with the company's credit risk and health. company finances. However, there are still some criticisms of this model, namely as it is known that the prediction of the bankruptcy model is closely related to the company model and of course time, and the nature of this model is quite specific so that misunderstandings often occur (Agarwal, 2007). This misinterpretation often occurs because of the lack of detail in the results, as stated by Gambling (1985) that the finding of the z-score is interesting, but this ratio profile does not provide a theory as to why this company could fall ill and eventually lead to death. The Tafler equation model is as follows:

$$Z = 3.2 + 12.18\frac{PBT}{ACL} + 2.5\frac{CA}{TL} - 10.68\frac{CL}{TA} + 0.003\frac{(CA - INV - CL)}{(SALES - NIBT + DEPR)} \quad \ldots(2.3)$$

Where:

PBT / ACL = Profit Before Tax to Average Current Liabilities
CA / TL = Current Assets to Total Liabilies
CL / TA = Current Liabilities to Total Assets
INV = Inventory
NIBT = Net Income Before Tax
DEPR = Depreciation

There is also a bankruptcy prediction model developed by Zmijewski (1984). The population in this study were all companies listed on the America and New York Stock Exchange in the period 1972 – 1978. This study examines the potential for bias resulting from sample selection or data collection procedures. This bias can then result in asymptotic parameter bias and probability estimates. This sample selection bias was then assessed using the probit bivariate scoring method, which requires the presence of complete data. The results of this study are clear biases are evident but in general do not affect the level of classification or the overall predictive power of the model (Zmiwesky, 1984). The Zmiwesky equation model is as follows:

$$Z = -4.336 - 4.513\frac{NI}{TA} + 5.679\frac{TL}{TA} + 0.004\frac{CA}{CL} \quad \ldots (2.4)$$

Where:

NI / TA = Net Income to Total Assets
TL / TA = Total Liabilities to Total Assets
CA / CL = Current Assets to Current Liabilities

Although the accuracy of the Zmijewski (1984) model appears to be high, there are some lingering criticisms. The probit model is one variable model so that the results are highly correlated with each other (Shumway, 2001). Shumway (2001) suggested that the TL/TA variable was strongly correlated with the NI/TA variable and concluded that because of the high correlation, the Zmijewski (1984) model did not have strong predictive power in bankruptcy prediction. In addition, Platt and Platt (2002) argue that because Zmijewski (1984) only runs one regression for each sample size, the Zmijewski (1984) model cannot test the individual estimated coefficients for bias against population parameters, a more direct test of bias (Kleinert, 2014).

In previous research, namely Mehrani et al. (2005) applied Zmijewski (1984)'s probit Zmijewski (1984) model to companies listed on the Tehran Stock Exchange and showed that the model has the ability to classify bankrupt and non-bankrupt companies. Furthermore, Grice and Dugan (2001) applied the Zmijewski (1984) model to companies from 1988 to 1991 and reported an accuracy rate of 81.3%.

## 3. Methodology

In this study, a research design with seven stages was planned. The first and second stages are the stages of data collection with the objective of obtaining the various data needed and selecting samples according to predetermined data criteria. This study will use secondary data, namely data that will be obtained from other sources. Appropriately, the available data will be collected and then used in this study. The object of this research is all companies listed on the Indonesia Stock Exchange.

The data will be in the form of several accounting variables contained in the company's financial statements for a period of 5 years, from 2015 to 2019. The selection of this year is aimed at describing the more real and latest conditions of companies in Indonesia. Then enter the next stage, the sample will be processed with five bankruptcy prediction models. The next step is to determine the re-estimate of the coefficient and continue with the validity test. After that, the results will be tested with the I and II error test and analyzed, which is then determined the conclusions of the research results.

The research data used came from Thomson Reuters. The population of this research data is all publicly listed companies on the Indonesian Stock Exchange, where there are 490 companies. The research years used were 2015-2019 or for five periods. As a basis for selecting samples, there are several criteria that must be met, namely as follows: (1) The sample of companies used must have complete financial reports throughout the observation period so that the sample can be called firm-year observation data, (2) Each firm-year observation must have complete data from the entire bankruptcy prediction model to be tested, (3) Completeness of data must include companies that have a continuous period, starting from the beginning of the research period to the end of the research period. (4) The elimination of firm-year observational data will be carried out by removing the outlier data at the 95% confidence level so that the data becomes more valid for model estimation.

Based on the criteria for the sample, phase 1 was eliminated related to the completeness of the data. From the population of the company's data as many as 128 companies that do not have adequate data completeness, so that in the elimination phase of completeness of data, the sample companies become 362 companies. Thus, the observations after elimination phase 1 are 1810 firm-years.

In this case, after eliminating all companies whose data were incomplete, it was found that a total of 1810 firm-year observations were found. Descriptive statistical processing in this study was carried out with SPSS Statistics. The findings in the statistical description of all observations on each complete variable are worth 1810 observations (no missing value). However, the data for each variable has a standard minimum and maximum value that is quite diverse. Likewise, it can be seen that each variable has a fairly large standard deviation. Therefore, then the observation data is processed for outlier testing and later some data will be eliminated. Based on the results of outlier elimination, 47 companies have outlier data.

However, to meet the criteria for the third sample where the completeness of the data must include companies that have a continuous period, starting from the beginning of the research period to the end of the research period; then the number of observation data that became the sample in this study were 315 companies or 1575 firm-year observation data.

## 4. Discussion and Conclusion

### 4.1 Result and Discussion

The study re-estimated the Altman EM (Altman et al., 1998), Ohlson (1980), Taffler (1983) and Zmijewski (1984) models. This is done by re-estimating the various coefficients for the variables used in the bankruptcy model. This re-estimation was carried out in the hope of more generalizing the model with the Indonesian business environment. In the table 1, β is the coefficient of the original model, while β̂ is the new coefficient for various variables for various models. All of these coefficient improvements use data from this study, the same as the results that will be listed in the processing of results. In table 1. almost all coefficients on each variable work with 5% significance, only CL/CA and FU/TL for Ohlson (1980) and CA/CL for Zmijewski (1984) which are not significant.

**Table 1: Coefficients of original models and re-estimate models**

| Altman EM | | | Ohlson | | |
|---|---|---|---|---|---|
| **X** | **β** | **β̂** | **X** | **β** | **β̂** |
| WC/TA | 6.52 | *1.565 | SIZE | -0.407 | *0.482 |
| RE/TA | 3.26 | *1.674 | TL/TA | 6.030 | *1.841 |
| OI/TA | 6.72 | *10.352 | WC/TA | -1.430 | *-1.678 |
| BE/TL | 1.05 | *-0.032 | CL/CA | 0.076 | 0.235 |
| (Constant) | 3.25 | *-1.031 | OENEGG | -2.370 | - |
| | | | NI/TA | -1.830 | *-44.432 |
| | | | FU/TL | 0.285 | 0.004 |
| | | | INTWO | -1.720 | *2.832 |
| | | | CHINN | -0.521 | *0.51 |
| | | | (Constant) | -1.320 | *-4.568 |

| Taffler | | | Zmijewski | | |
|---|---|---|---|---|---|
| **X** | **β** | **β̂** | **X** | **β** | **β̂** |
| PBT/ACL | 12.18 | *1.891 | NI/TA | -4.513 | *-22.755 |
| CA/TL | 2.50 | - | TL/TA | 5.670 | *1.154 |
| CL/TA | -10.68 | *-1.034 | CA/CL | 0.004 | -0.016 |
| X4 | 0.03 | *-1.25 | (Constant) | -4.336 | *-1.211 |
| (Constant) | 3.20 | *-0.224 | | | |

*Represent Statistical significance at 5%

**Table 2: Accuracy Result of original models and re-estimate models**

| | Altman EM | Ohlson | Taffler | Zmijewski |
|---|---|---|---|---|
| **Original** | 82.00% | 70.00% | 86.00% | 82.00% |
| **Re-estimate** | 86.00% | 92.00% | 87.00% | 89.00% |
| **Chi-square** | *691.625 | *23.604 | *339.384 | *714.86 |

*Represent Statistical significance at 5%

There are quite unique results in Altman for Emerging Markets (Altman et al., 1998) where quite a lot of companies are categorized as healthy companies. As for the Ohlson (1980) model and Ohlson's re-estimate, the results are quite interesting because it can be seen that there are quite large differences in the companies assessed by FD. As for Taffler (1983) and the re-estimated model, it is quite directly proportional. This is also reflected in the results of Zmijewski (1984) and its re-estimate.

For the Altman model for Emerging Markets (Altman et al., 1998), Ohlson (1980) estimating, Taffler (1983), Taffler re-estimate, Zmijewski (1984), and Zmijewski re-estimate models, the results of the sample are mostly healthy. Meanwhile, Altman's re-estimate for Emerging Market itself is more of the opinion that most of the firmyears are in financial distress but can still be saved. As for the real condition of the companies that are being compared. And it is in accordance with Altman's (2007) statement. Altman's (2007) says that companies experiencing financial distress are companies that have accumulated negative net income for 2 consecutive years. Namely 328 Firm-years experiencing FD from 1575 firm-years.

In this case, from table 2 it is quite visible that some of the original models have a fairly good level of accuracy and vice versa. When viewed in the case of Altman EM (Altman et al., 1998) with the re-estimate model, there is an increase in accuracy. Ohlson (1980) has the lowest level of accuracy and on the contrary Ohlson's re-estimate has the highest level of accuracy. This shows that there are indeed several indicators of financial ratios that are suitable in categorizing a company experiencing FD. The collapse of accuracy in the Ohlson (1980) model is reflected because quite a lot of companies that should be in the healthy category are categorized as unhealthy. In addition, when viewed from the Taffler (1983) model and the re-estimated Taffler, there is indeed an increase, but it is not too big. In this case, the increase in accuracy between Taffler (1983) and Taffler's re-estimate is 1%. In addition, when viewed from the Zmijewski (1984) model and the Zmijewski re-estimate model, there is a significant increase. This is reflected in an increase of about 7%. All models have a fairly good Chi-square value indicating the model's re-estimate works at the 95% confidence level.

When viewed from e I Altman for Emerging Markets (Altman et al., 1998), the error rate is quite high. This should be fatal since e I define companies that are considered not to have experienced financial distress, in fact, are experiencing financial distress. While for the smallest e I obtained by Ohlson re-estimation. In this case, it is quite important to assess e I because this error condition is quite fatal when compared to e II. As for e II, the minimum was achieved by Altman EM (Altman et al., 1998). The discrepancy between the results of e I and e II in Altman EM (Altman et al., 1998) is because Altman EM (Altman et al., 1998) quite a lot assesses companies experiencing financial distress, when in fact companies experiencing financial distress are only about 328 firm-years.

**Table 3: Error Type I & II Result of original models and re-estimate models**

| Model | Original | | Re-estimate | |
|---|---|---|---|---|
| | e I | e II | e I | e II |
| Altman EM | 84.50% | 0.72% | 57.30% | 2.49% |
| Ohlson | 53.00% | 23.58% | 31.70% | 2.17% |
| Taffler | 39.60% | 6.60% | 54.30% | 2.17% |
| Zmijewski | 69.20% | 4.41% | 41.50% | 2.41% |

In this case, Table 3 shows a decrease in error type I for the Altman EM re-estimation model. Meanwhile, if we look at the results of Ohlson's re-estimation, the decrease occurs in errors I and II. This is quite good, considering that the Ohlson re-estimation model does experience a significant increase in the level of accuracy as well. As for the Taffler re-estimation model itself, the decrease in the error rate occurs in type II errors. As for the Zmijewski re-estimation model, the decrease in the error rate occurs in type I and II errors.

### 4.2 Conclusion

This study contributes to helping to see the good relationship of various models when re-estimation is carried out. This is proven by the results of all re-estimation models that have a better accuracy rate than the original model. In addition, most of the re-estimated models experienced a decrease in the level of error type I and error type II from the original model. In this case, the best performance is achieved by the Ohlson re-estimation model due to the highest level of accuracy, the smallest type I error, and the 2nd smallest type II error.

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