

Bankruptcy Prediction Model Under Uncertainty in Indonesia



Ika Yuanita¹, Novirwan Trinanto², Elni Sumiarti³, Yenida⁴

^{1,2,3,4}Business Administration Department, Padang State Polytechnic, West Sumatera, Indonesia

¹ORCID ID: 0000-0002-0302-0854

ABSTRACT: This paper assesses three issues in predicting of the bankruptcy under uncertainty in the COVID-19 pandemic within the Textile and Garment companies listing in the IDX Stock Exchange. First, it determines the industry characteristics that categorizes potential to bankrupt or non-bankrupt. Second, it identifies predictors as the benchmark model's that can indicate a company's potential to bankrupt. Third, it assesses the bankruptcy prediction panels are more significant than the benchmark model's that concerning the financial ratios, firm characteristics, and macroeconomic. Using the panel data for five years within eighteen companies, we found the financial ratios of the listed companies within asymmetric distribution. Overall, the firm characteristics during those periods did not differ but were dominated by the companies that had potential to bankrupt compared to those that were non-bankrupt. The cumulative liquidity and profitability ratios become more potential to reduce probabilities of company categorized bankrupt. However, the profitability and solvability ratios have an effect size on propensity of the listed companies to determine whether they are potential to bankrupt than non-bankrupt. The COVID-19 pandemic as an uncertainty period contributes to increasing the accuracy of predicting the probability of companies that are potentially bankrupt or other types of failures.

KEYWORDS: Bankruptcy, Financial Ratio, Macroeconomic, Uncertainty, COVID-19, Textile and Garment.

I. INTRODUCTION

The COVID-19 pandemic has caused significant uncertainty in the financial markets both national and global. The COVID-19 pandemic can be a multidimensional predictor of financial difficulties in almost all sectors of the economy (Shen et al., 2020). One of them is the consumer cyclical industries, which operates in the miscellaneous industry sector or manufacturing sectors. It produces and distributes non-primary goods that are vulnerable to economic fluctuations and business environment in a particular country. Not only did global economic growth decline, but many countries have also experienced bankruptcy and job losses (Fu & Shen, 2020).

At the industry level, the COVID-19 pandemic can also affect its financial and operational performance in emerging countries (He et al., 2020; Khatib & Nour, 2021; Shen et al., 2020) including Indonesia (Devi et al., 2020; Roosdiana, 2021). In general phenomena, a business failure is more often caused by financial factors than non-financial factors (Ross et al., 2004). In spite of the COVID-19 pandemic has a significant impact as a non-financial predictor (uncertainty periods) on the potential for company bankruptcy in the secondary goods industry sectors, especially the Textile and Garment sub-sector (Armenda & Hertina, 2023). It is said to be affected, because this industrial sub-sector are labor-intensive, processing, spinning and weaving textiles, e.g. as yarn, fabric, leather, fur, and knitted textiles. It is also most affected by production, operations and sales in Indonesia (API, 2020; BPS, 2022; LPEM, 2021). Observing the uncertainty periods due to the COVID-19 Pandemic, an in-depth study is needed to develop a bankruptcy prediction model in the consumer cyclical industries in Indonesia.

The previous models were practised, i.e., the univariate analysis (Beaver, 1966, 1968); the discriminant analysis (Altman, 1968; Blum, 1974); the CAMEL bank-rating system (FFIEC, 1979; Gilbert et al., 2000); logit model (Ohlson, 1980); probit model (Zmijewski, 1984); and credit scoring model (Altman & Saunders, 1997; Desai et al., 1996); even neuralistic network (Desai et al., 1996; Salchenberger et al., 1992), only rely on financial performance analysis based on financial ratios. However, Ross et al. (2004), argues that in addition to the effect of financial ratio indicators around 36.0 percent; a business can also experience failure due to economic factors of 55.1 percent; fraud factors, conflicts, and management errors of 7.1 percent; the other factors of 1.8 percent. The COVID-19 pandemic phenomena tends to have a systemic impact because it is uncontrollable and unpredictable, only the specific characteristics of an industry are capable and differentiating in overcoming it. The relatively smaller income scale will cause a more substantial loss effect on the financial performance (Shen et al., 2020). It is relevant to the Real Options

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Theory (Kester, 1984; Myers, 1977), which argues that stakeholders tend to consider the company's operational activities under uncertainty, for risk avoidances (Fu & Shen, 2020).

This paper will assess three main issues to predict the bankruptcy model under uncertainty within the Textile and Garment sub-sector industries in the Indonesia Stock Exchange (IDX) using the panel data with five-year periods during the COVID-19 pandemic as the uncertainty condition. First, it determines the characteristics of the listing companies categorized as bankrupt or non-bankrupt. Second, it identifies the determining all predictors that can indicate a company's potential bankruptcy through the financial ratios as the benchmark model's. Third, it assesses which the bankruptcy prediction panels are more significant than the benchmark model's concerned by the financial ratios, firm characteristics, and macroeconomic variables under the uncertainty condition.

II. RESEARCH FRAMEWORK

The word of *bankrupt* comes from the Italian “*banco rotto*” (broken bench) which compries of the classical Latin terms “*bancus*” (bench) and “*ruptus*” (broken), symbolizing one whose place of business was broken or gone. The high failure rate of business activities is well-known, yet many parties alike have all but neglected the failure phenomena (Ross et al., 2004). Only recently has any serious attempt been made to study business failures and their causes, e.g. Beaver (1966); Altman (1968); Blum (1974); FFIEC (1979); Ohlson (1980); Zmijewski (1984); and Desai et al. (1996); even Salchenberger et al. (1992) have been encouraging. Based on The Statistic & Failure Report (2024), around of 18.4 percent of businesses fail within the first year, 49.7 percent fail within the five years firstly, 65.6 percent fail within the ten years firstly, or 25 percent make it beyond the fifteen years. Thus, rather than accepting things as they come, we need to develop a systematic study of failure that will enhance the knowledges and reduce their probabilities. Eventually, it will lead to identifying predictors of failures and the development of statistical models to predict failures.

The first multivariate bankruptcy prediction model was developed by Altman (1968) with Multiple Disriminant Analysis. Using financial statements, Altman (1968) compiled a list of 22 potentially important financial ratios for evaluation, i.e., classified these variables into five standard ratio categories: liquidity, profitability, leverage, solvency, and activity. These ratios were chosen based on their popularity in the literature and their potential relevance to the study, particularly in public firms. The original Z-Score model was based on the market value of the firm and was thus applicable only to publicly traded companies. Altman (1983) emphasized that the Z-Score model is intended for publicly traded firms and that ad hoc adjustments are not scientifically valid. Altman (1973) advocated a complete re-estimation of the model, substituting the book value of equity for the market value, particularly in private firms. But, in the other complex financial situtations, the failure or distress is detrimental to investor returns, then risk may provide opportunities for high returns on short-sale strategies.

Thus, Altman (1983) suggested that the management of distressed firms can utilize the Z-Score model as a guide to financial turnaround, which even though they are occasionally outperformed by other models, do not rely on the market data. However, because the private firms' database is relatively limited and does not apply to secondary data, Altman (1983) then only tested the accuracy of 4 financial ratios by excluding the activity ratio. Other considerations of Altman (1983) that are reinforced by Z-beta Score revisited in Altman et al. (2016) are the application of the model to various conditions and types of companies (public or private), panel data, and macroeconomic data, even in the manufacturing and non-manufacturing sectors. In addition, when the economic conditions are unstable or in crisis such as global financial crisis during 2008-2009, because conditions like this (uncertainty) will potentially occur especially in emerging market countries.

III. RESEARCH METHODS

The population are consumer cyclical industry with 20 units of the Textile & Garment industry, sub-sector listed in the IDX during 2019-2023 (IDX, 2024). Thus, the observations used are panel data or repeated on observations within the same period. The endogenous model validation will be separated between population and sample. The model should be evaluated by testing the prediction accuracy based on the design and validation sample. As long as the data used for validation accuracy is different from the data to form the prediction function, the error rate obtained is unbiased (Rencher, 1995). Using the multi-stage purposive sampling approach by taking the population not based on strata, random and certain regions or companies but require any criteria with several stages (Sekaran, 2006), e.g., listing on the IDX and publishing annual and financial reports per December 31, during 2019-2023, not included in the program for rehabilitating and supervising business competition in Indonesia; and not experiencing consecutive losses in the last three years or suffering losses below 75 percent (Yuanita, 2010; 2012).

To obtain a more valid sample, the Original Z-Score (Altman, 1983), $Z_{1983} = 3.25 + 6.56 X_1 + 3.26 X_2 + 6.72 X_3 + 1.05 X_4$ is used. Criteria for companies that have $Z_{\text{score}} > 2.60$ classified as non-bankrupt or $Z_{\text{score}} < 1.10$ classified as potential to bankrupt. Furthermore, the score between $1.10 < Z_{\text{score}} < 2.60$ classified into grey area. The performance of the Original Z-Score classification is assessed based on the AUC (Area Under Curve) taken from the ROC (Receiver Operating Characteristic). Because, the reason AUC has a close relationship with the Accuracy Ratio (AR), where $AR = 2(AUC) - 1$, if $AR = 0$ then a random model is used; $AR = 1$ is used for a full model, and $AR = 0.5$ for a model with an average classification performance approach (Engelman et al.,

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2003; Altman et al., 2016; Janssens & Martens, 2020). Based on the criteria in these stages, the estimated sample sizes are 18 units (estimated samples) of the Textile & Garment Sub-sector listed on the IDX during 2019-2023 and 2 units are included in special treatment or delisting. Thus, if these proxied into a panel data, it becomes 90 units per 5 periods during 2019-2023, where 46 of them are potential to go bankrupt and 44 others non-bankrupt.

This study uses Z_{-1983} Beta Revisited (Altman, 1983) with *Logistic Regression* (LR-Model) to test a bankruptcy prediction model, because of the endogenous is a binary. In addition, the classification accuracy of LR-Model is better than other models and is not sensitive to the same number or distribution of samples (Maddala, 2006). The uncertainty conditions (COVID-19 pandemic) in this study are accordance with PP. No. 21/2020 (April 10, 2020) that concerning *The Large-Scale Social Restrictions* (PSPB), Instruction of the Minister of Home Affairs. R.I. No. 24/2021 (July 25, 2021) about *The Implementation of Community Activity Restrictions* (PPKM), and Instruction of the Minister of Home Affairs. No. 51/2022 (December 30, 2022) about *The Revocation of PPKM Regulations* about COVID-19 pandemic period (See in the Table 1 below).

Table 1. Variables in The Model

Variables	Code	Measurements
Endogen (Binary) :		
Bankruptcy Probability	<i>bankrupt</i>	1 = “potential to bankrupt” 0 = “non-bankrupt”
Financial Ratios :		
Liquidity	<i>nwct_ta</i>	working capital/total assets (IDR, annual)
Cumulative Profitability	<i>re_ta</i>	retained earnings/total assets (IDR, annual)
Profitability	<i>ebit_ta</i>	earnings before interest and taxes/total assets (IDR, annual)
Solvability	<i>be_bvlt</i>	market value of equity/book value of total tiabilities (IDR, annual)
Firm Characteristics :		
Size of Firm	<i>size</i>	logarithm 10 by the total aset (annual)
Market Share	<i>market_share</i>	ratio of sales to total market sales (annual)
Ownership	<i>share_holder</i>	1 = “national corporation” 0 = “national + foreign corporation”
Macroeconomic :		
Economic Growth	<i>growth</i>	national economic growth (% , year to year)
Inflation	<i>inflation</i>	national inflation rate (% , year to year)
Exchange Rate	<i>currency</i>	logarithm 10 by the IDR to \$US exchange rate (year to year)
Interest Rate	<i>bi_rate</i>	Interest rate by Central Bank of Indonesia (% , year to year)
Uncertainty :		
COVID-19 Pandemic	<i>uncertainty</i>	1 = “pandemic” 0 = “non-pandemic”

Then, LR-Model of bankruptcy prediction used in this study is:

$$g(x) = \ln \left(\frac{\pi(x)}{1 - \pi(x)} \right) = g(x) = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \dots + \beta_k X_k \quad \dots\dots\dots (1)$$

$$\text{bankrupt} = \beta_0 + \beta_1 \text{nwc_ta} + \beta_2 \text{re_ta} + \beta_3 \text{ebit_ta} + \beta_4 \text{be_bvlt} + \beta_5 \text{size} + \beta_6 \text{market_share} + \beta_7 \text{share_holder} + \beta_8 \text{growth} + \beta_9 \text{inflation} + \beta_{10} \text{currency} + \beta_{11} \text{bi_rate} + \varepsilon \quad \dots\dots\dots (2)$$

Where: P_i is estimation probability with observation- i ($i = 1, \dots, n$); $g(x)$ is linear logistic regression model; and ε is disturbance. In addition, *Odds-Ratio* (OR) of the LR-Model in the equation (2) is the difference between the probability of one outcome (default) and other outcome (non-bankrupt) occurring or expected outcome if $x = 1$ is $[\pi(1)/1-\pi(1)]$ dan if $x = 0$ adalah $\pi[\pi(0)/1-\pi(0)]$, thus $OR = (\pi(1)/[1-\pi(1)])/(\pi(0)/[1-\pi(0)])$. This study uses *Average Marginal Effect* (AME) to interpretate LR-Model and the reduction of unobserved heterogeneity. AME is the average effect of exogenous ($x = 1, 2, 3, \dots, x_i$) on the endogenous probability, if P_i ($y = 1$), P ($y = 0$) using the probability distribution function of each observation estimate, multiplying it by the coefficient of x and averaging it across all observations (Hair et al., 2015).

Because this study using longitudinal approach or repeated observations within same period, LR-Model in the equation (1) supposed to be panel analysis, written in :

$$g(x_{it}) = \ln \left(\frac{\pi(x_{it})}{1 - \pi(x_{it})} \right) = g(x_{it}) = \beta_0 + \beta_1 X_{1it} + \beta_2 X_{2it} + \dots + \beta_k X_{kit} \quad \dots\dots\dots (3)$$

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Where : i = observation- i dan t = period- t . In the general form of LR-Model within panel analysis, the equation (3) required at least two LR-function are *Fixed Effect* (FE) and *Random Effect* (RE). Nevertheless, period- t in this study is control variables, its need to be proxy become dummy period- t , i.e., 1 = “pandemic” (during 2020-2022) and 0 = “non-pandemic” (2019 and 2023). It can be estimated by the attrition approach or exclude units of analysis from entire randomly assigned observation that appear to resemble randomized controlled trial (Fitzmaurice & Clifford (1995; Altman et al., 2016).

IV. RESULTS AND DISCUSSIONS

The Characteristics of The Textile and Garment Industry in Indonesia

Table 2 shows descriptive statistics of all variables in the model with observation periods from 2019 (baseline) to 2023 on average from the Original Z_{Score} or $Z_{\text{-1983}}$ Beta Revisited model. The variations of the four financial ratios, i.e., NWC/TA, RE/TA, EBIT/TA, AND BE/BVTL are significantly different on average within mean and standard error of the 18 Textile and Garment companies listed in the IDX during 2019-2023 period (asymmetric distributions). In addition, the distribution of companies that have the potential to go bankrupt is more negatively skewed than those that non-bankrupt. There are two financial ratios that have the potential to differentiate their characteristics, e.g., surplus obtained by the firm (RE/TA) and the solvency ratio (BE/BVTL). Both are implicitly related, because the RE/TA ratio is the cumulative profitability to total equity and liabilities. While the BE/BVTL ratio of firm that classified non-bankrupt is much larger than potential to go bankrupt because of their assets have a sharper decline in relation to its equity and liabilities before technical insolvency occurs (the company's inability to pay debts). However, the general characteristics of both companies have a negative skewed EBIT/TA value or the ability of both to generate profits is very low and the company's productivity in increasing its assets is not comparable to the value of equity and liabilities obtained (the beginning of technical insolvency).

Table 2. Characteristics of The Textile and Garment Industry in Indonesia, 2019-2023

Variables	Total (N = 90)	Potential to Bankrupt (N ₁ = 46)	Non- Bankrupt (N ₂ = 44)	Mean Difference	Std. Error
Liquidity (NWC/TA)	-0,186	-0,722	0,374	-1,096***	0,206
Cumulative Profitability (RE/TA)	-1,165	-2,352	0,076	-2,428***	0,477
Profitability (EBIT/TA)	-0,052	-0,094	-0,094	-0,088*	0,027
Solvability (BE/BVTL)	15,311	0,100	31,214	-31,114*	14,194
Size of Firm (SIZE)	12,162	12,192	12,132	-0,059	0,116
Marjet Share (MARKET_SHARE)	5,556	4,878	6,264	-1,384	1,384
Ownership (SHARE_HOLDER)	0,889	0,848	0,932	-0,084	0,066
Economic Growth (GROWTH)	3,402	3,746	3,042	0,704	0,594
Inflation (INFLATION)	2,878	2,719	3,044	-0,325	0,292
Exchange Rate IDR to \$US (CURRENCY)	4,166	4,167	4,164	0,003	0,005
Interest Rate (BI_RATE)	4,750	4,739	4,761	-0,022	0,206
UNCERTAINTY	60,00	58,69	61,36	-2,67	0,104
Period 2019 (D ₂₀₁₉)	20,00	13,04	27,27	-14,23*	0,084
Period 2020 (D ₂₀₂₀)	20,00	13,04	27,27	-14,23*	0,084
Period 2021 (D ₂₀₂₁)	20,00	30,43	9,09	21,34*	0,081
Period 2022 (D ₂₀₂₂)	20,00	15,22	25,00	-9,78	0,085
Period 2023 (D ₂₀₂₃)	20,00	28,26	11,36	16,90*	0,082

Source : Author Estimations.

Note : *) $p < 0.01$; **) $p < 0.05$; ***) $p < 0.001$.

In addition, Table 2 also presents the characteristics of firms during the COVID-19 pandemic, that the size of firm (total assets), market share (total sales), and ownership (shareholders) are not significant different on average. Although, it dominated by firms that have potential to go bankrupt compared to those non-bankrupt, the average of the total assets of both is around IDR 1,452 billion, the market share around 5.56 percent, and the company's ownership is most nationally around 88.89% percent. It means relevant to the $Z_{\text{-1983}}$ Beta Revisited, that only the characteristics of a nation like country of origin's are able to be a differentiating aspect for companies in facing uncertain conditions such as COVID-19 pandemic. These can be compared to the macroeconomic conditions during pandemic periods which were not very stable in Indonesia's economic performance, with an average economic growth about 3.4 percent, national inflation reaching its lowest point of 2.9 percent, the average of exchange rate around IDR.

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14,655.48, and BI-rate around 4.75 percent. With these macroeconomic conditions, it is impossible for a nation to survive during the unpredictable and uncontrollable periods. Because in the reality, the average firm has potentially bankrupt around 58.69 percent, even though around 61.36 percent are non-bankrupt. During the COVID-19 pandemic, the average Textile and Garment in the IDX was indeed categorized as having potential to go bankrupt on average around 20 percent, yearly. However, in the baseline period (2019) it was indicated that it had experienced technical insolvency first until in 2021 and 2023 the highest probability of bankruptcy occurred at 30.43 percent and 28.26 percent respectively.

The LR-Model (Benchmark) of The Textile and Garment Industry in Indonesia

Robustness check of the LR-Model estimation shows that only the liquidity ratio (NWC/TA) and cumulative profitability (RE/TA) are predictors of a company's bankruptcy or can be classified become as potentially bankrupt or non-bankrupt in the Textile and Garment industry during 2019-2023 period. Meanwhile, the profitability ratio (EBIT/TA) and solvency (BE/BVTL) are not significant. The coefficient of each financial ratio predictor is negative because it uses the LR-Model with outcomes, while the Z_{Score} uses the MDA approach which has a coefficient that tends to be positive. In this study, the NWC/TA and RE/TA coefficients have decrease proportionally, while the EBIT/TA and BE/BVTL coefficients are relatively smaller (closer to zero) compared to the Z_{1983} Beta Revisited estimation. Based on the AME of each predictor has the potential to reduce the probability of a company not going bankrupt, if the company is able to improve its performance. However, NWC/TA and RE/TA are more potential or reliable predictors to reduce the chances of bankruptcy of the Textile and Garment company. If we refer to their Odds Ratio in the LR-Model, EBIT/TA and BE/BVTL have the largest effect size effect to determine whether they have the potential to go bankrupt or non-bankrupt. Overall model fit shows that the resulting LR-Model is significant with a Pearson-Chi² of 45.93. Also, after the log-pseudolikelihood iterations show the value decreased. The partial fit model shows that only two predictors determine whether a company has tendency to go bankrupt and default significantly, e.g., NWC/TA and RE/TA. Then, the determination coefficient of 0.58, means that overall the predictors are able to contribute about 58.00 percent to the variability of changes in the determinant of a company potentially bankrupt or non-bankrupt while the remaining 42.00 percent is determined by other factors out of the LR-Model (disturbance) (See in the Table 3 below).

Tabel 3. LR-Model (Benchmark) of The Textile and Garment Industry in Indonesia, 2019-2023

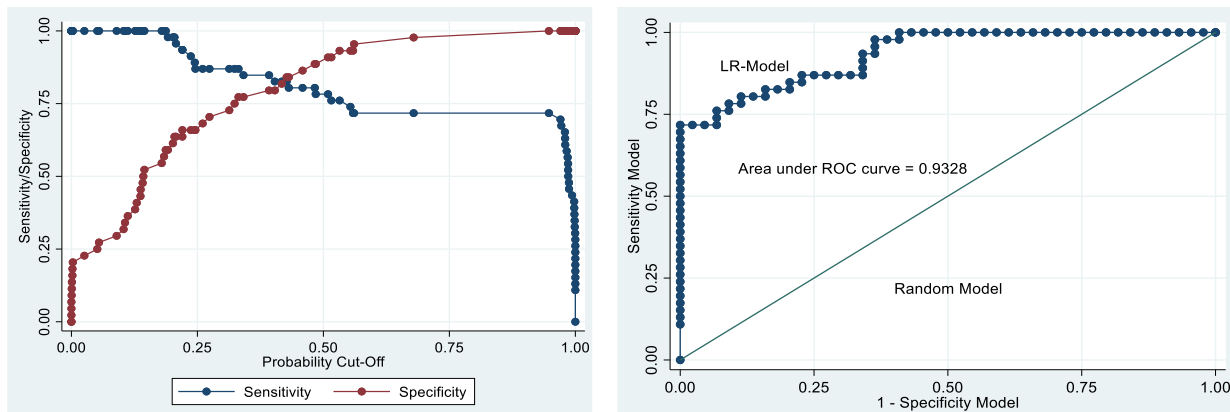
Predictors	Z_{1983}	Coefficient (β)	Robust Std. Err	AME (dy/dx*)	Δ Method Std. Err	Odds Ratio
Constant (β_0)	3,25	0,754	0,565	-	-	2,126
Liquidity (NWC/TA)	6,56	-4,117*	1,764	-0,390	0,161	0,163
Cumulative Profitability (RE/TA)	3,26	-2,803*	1,180	-0,266	0,101	0,061
Profitability (EBIT/TA)	6,72	-0,348	3,326	-0,033	0,316	0,706
Solvability (BE/BVTL)	1,05	-0,570	0,546	-0,054	0,052	0,566
Wald-Chi ² (4)	=	31,47***	Pearson-Chi ² (85)			= 45,93***
Pseudo-R ²	=	0,5800	Log-Pseudolikelihood			= -26,190

Source : Author Estimations.

Note : * $p < 0,01$; ** $p < 0,05$; *** $p < 0,001$.

Figure 1. below of the left-side shows the ability of LR-Model (Benchmark) to determine companies potentially bankrupt is 78.26 percent (sensitivity model) and to determine companies non-bankrupt is 90.91 percent (specivicity model). However, if we re-estimated the LR-Model in actual conditions, there is inclusion error around 20.00 percent, because of the observations should not have been classified as potentially bankrupt become non-bankrupt. Meanwhile, the exclusion error is 10.00 percent, because of the observations that should not have gone bankrupt become potentially bankrupt. Then, there is an error in the observation of non-bankrupt about 9.09 percent, which classifies 4 out of 40 observations as potentially bankrupt. In additions, the observation error of potentially bankrupt about 21.74 percent, which classifies 10 out of 50 observations as non-bankrupt during 2019-2023. Thus, the LR-Model re-estimation classifies 40 observations as potentially bankrupt and 50 observations are classified as non-bankrupt actually with a classification accuracy around 84.44 percent

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Source : Author Estimations.

Figure 1. Accuracy Ratio of The Bankruptcy Prediction (LR-Model) Under ROC and AUC

The prediction results are clarified by the area under the ROC curve or called as the AUC about 0.9328, as well as the intersection of sensitivity and specificity that means the probability cut-off of a company being classified as potentially bankrupt or non-bankrupt. The LR-Model shows that the Accuracy Ratio (AR) = $2(AUC) - 1 = 2(0.9328) - 1 = 0.8656$, with a probability cut-off : $0 < AUC < 1$. It means the area under the ROC Curve in Figure 1 above of the right-side indicates that the re-estimation in the LR-Model has good predictive ability (accurate).

The Bankruptcy Predictions Model Under Uncertainty of The Textile and Garment Industry in Indonesia

Table 4 below presents all forms of the logit function for predicting bankruptcy of Textile and Garment companies on the IDX during the 2019-2023 period based on a number of predictors included in the LR-Model (Benchmark). If the LR-Model adds company characteristic predictors that indicate the size of operational risk (risk measure), then *Model-1* is obtained. The *Model-1* reflects of the four financial ratios in the LR-Model which are not significant different between companies that have potentially bankrupt and those non-bankrupt. The positive coefficient of SIZE and MARKET_SHARE reflects the relatively smaller effect of both and will be better as predictors if they are able to achieve the maximum average value of the company's aggregate acquisition of around IDR 1,452 billion (total assets) and 5.56 percent (market share), respectively. Meanwhile, the average aggregate value of corporate ownership of 88.90 percent is one of the good predictors to reduce the probability of the company exiting bankruptcy as indicated by the negative SHARE_HOLDER coefficient.

The Model-2 to Model-6 are early indications of an increase in the Benchmark-Model prediction accuracy ratio, while also showing a decline in the performance of financial ratios and firm characteristics in general. During the baseline period (2019), the performance of the four financial ratios was still indicated to be almost the same as the LR-Model. However, in mid-2020 since the enactment of PP No. 21/2020 about PSPB, the impact of uncertainty conditions (pandemic) has been felt as a risk of financial failure as indicated by a decline in their performances (risk measures). Until the peak of pandemic in 2021, then the impact of the decline in all predictors with a dummy coefficient being positive or potentially increasing the probability of a firm going bankrupt was more felt. Moreover, after the issuance of the Instruction of the Minister of Home Affairs. R.I. No. 24/2021 (July 25, 2021) about PPKM. This situation certainly has direct implications for the industry's ability to increase its assets, equity, and liabilities which are not commensurate with the ability to generate profits because mostly the company operations have stopped and cash outflows are getting higher. Although the COVID-19 pandemic has ended and the New Normal era has begun (the beginning of the recovery of the company's operational stability), since the Minister of Home Affairs Instruction. No. 51/2022 (December 30, 2022) about the Revocation of PPKM Rules was enforced, the 2023 dummy coefficient is positive even though the performance of several bankruptcy predictors has started to improve.

Tabel 4. LR-Model Under Uncertainty of The Textile and Garment Industry in Indonesia, 2019-2023

Predictors	Z- 1983 5	LR- Model	Model- 1	Model- 2	Model- 3	Model -4	Model -5	Model -6	Model -7	Model -8
CONSTANT	3,2 5	0,754	-4,013	-2,668	-4,014	- 12,020	-6,555	-1,634	41,529	56,260
NWCT/TA	6,5 6	-4,117*	-3,758*	-4,292*	-4,931*	- 7,691*	- 4,704*	-3,688	- 4,663*	- 4,720*
RE/TA	3,2 6	-2,803*	-3,773*	-3,826*	-4,804*	- 7,068*	- 5,227*	- 3,296*	- 4,102*	- 4,263*

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EBIT/TA	6,7 2	-0,348	-0,090	-1,090	-1,122	1,698	0,266	-2,095	-0,735	-0,849
BE/BVTL	1,0 5	-0,570	-0,562	-0,824	-0,901	-0,949	-0,553	-1,028	-0,590	-0,616
SIZE			0,398	0,347	0,490	0,991	0,643	0,214	0,491	0,503
MARKET_SH ARE			0,032	0,031	0,039	0,089	0,038	0,021	0,037	0,039
SHARE_HOLD ER			-0,344	-0,433	-0,453	0,349	-0,147	-0,691	-0,207	-0,219
D_2019				- 2,460* *						
D_2020					- 3,965* **					
D_2021						4,820* **				
D_2022							- 4,104* *			
D_2023								2,532* *		
GROWTH									0,318* *	0,390* *
INFLATION									Omitte d	Omitte d
CURRENCY									- 11,461	- 15,167
BI_RATE									Omitte d	Omitte d
UNCERTAINT Y										0,566
Wald-Chi²		31,47***	23,64* *	21,40* *	21,99* *	31,10* *	17,44* *	31,77* *	22,12* *	21,25* *
Pearson-Chi²		45,93***	45,69* **	40,07* **	36,95* **	35,54* **	40,39* **	47,84* **	41,58* **	39,97* **
Pseudo-R²		0,5800	0,5891	0,6254	0,6621	0,7414	0,6471	0,6478	0,6229	0,6264
AUC		0,9328	0,9338	0,9506	0,9610	0,9748	0,9605	0,9466	0,9496	0,9486
AR		0,8656	0,8676	0,9012	0,9220	0,9496	0,9210	0,8932	0,8992	0,8972

Source : Author Estimations.

Note : * p < 0,01; ** p < 0,05; *** p < 0,001.

Original Z₋₁₉₈₃ = 3,25 + 6,56 NWC/TA + 3,26 RE/TA + 6,72 EBIT/TA + 1,05 BE/BVTL

LR-Model = 0,754 -4,117 NWC/TA – 2,803 RE/TA – 0,348 EBIT/TA – 0,570 BE/BVTL

Model-1 = LR-Model (Benchmark) adds with SIZE, MARKET_SHARE, dan SHARE_HOLDER predictors.

Model-2 to Model-6 = Model-1 adds with dummy periods (d_2019; d_2020; d_2021; d_2022; d_2023), partially.

Model-7 = Model-6 adds with macroeconomic (GROWTH; CURRENCY), where INFLATION and BI_RATE have multicollinearities.

Model-8 = Model-7 adds with UNCERTAINTY (d_2020; d_2021; d_2022 are COVID-19 pandemic periods).

Model-7 also shows the increasing risk of firm failure because the situation is not only caused by the COVID-19 pandemic, but exacerbated by the sharp decline in the stability of the Indonesian economy since 2020-2023. With an average economic growth of 3.4 percent, inflation reaching its lowest point of 2.9 percent, an average of IDR 14,655.48 to \$US exchange rate, and an BI-rate around 4.75 percent, it is impossible for a nation to survive the pandemic. Model-7 shows a positive constant value and a

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multiple contribution from the LR-Model or 41.53 times the potential to cause a company to be classified as bankrupt. However, Indonesia's advantages in handling the COVID-19 pandemic have a direct impact on the risk of failure of firms, including the Textile and Garment Industry, becoming increasingly significant. With a positive economic growth coefficient, the low inflation rate and BI-rate certainly disrupt national economy stability. But, refers to the statement of Altman et al. (2016) on the almost similar case of uncertainty, e.g. the 2008-2009 global crisis and Subprime Mortgage (bankruptcy of the global property industry), that firm characteristics such as ownership and stability of exchange rate are one of the advantages in anticipating the impact of the COVID-19 pandemic on the real sector, especially the operationalization of the Textile and Garment industry in Indonesia.

Model-8 also reflects that are almost similar to Model-7, even the constant value is getting higher and positive or 56.26 times, potentially increasing the probability of a company being classified as bankrupt. Its caused by the uncertainty conditions being added to the LR-Model (benchmark), aggregately. The addition of the uncertainty predictor to the LR-Model is become more different from the accuracy of dummy predictions certainly (d_2019; d_2020; d_2021; d_2022; and d_2023). Because the UNCERTAINTY predictor in the Model-8 can explain the probability of a company's potential bankruptcy before and after the COVID-19 pandemic, simultaneously. That uncertainty conditions, e.g. the COVID-19 pandemic which are unpredictable and uncontrollable provide a positive effect to the probability or tendency of a company become non-default or experiencing the risk of failure. The Model-8 shows a higher coefficient of determination than the initial LR-Model (benchmark) of 62.62 percent with an increasingly high level of accuracy of 89.72 percent.

In general, uncertainty conditions can affect the development, stability, and business decisions in a company. Uncertainty, everything that is not known about the outcome when decision making is determined. Because the uncertainty case in this study is different from general uncertainty in company valuation, the negative effects cannot be calculated and estimated in real terms. The COVID-19 pandemic is mostly different from general uncertainty conditions, e.g., market disruption, availability of input data or information, and choice of method or model. It is even significantly different from the 1998 monetary crisis due to fluctuations in the IDR currency which ultimately became a financial crisis, especially for the banking world due to high expectations of foreign exchange trading and the large number of bad debts or non performing loans are getting higher. Even, the global crisis of 2008 and 2009 due to the financial difficulties of the Lehman's Brother and the AIG Insurance (2 world financial giants in the world), where Indonesia was affected by the domino's effect. However, the COVID-19 pandemic has a multi-sector impact because it is caused by non-financial or non-measurable variables or a kind of disaster. These become a condition of unobservable and pure uncertainty, e.g., economic stability is disrupted, production factor operations are stopped, layoffs, and requires high costs or high cost recovery.

V. CONCLUSIONS

During the COVID-19 pandemic and non-pandemic periods, variations of the four financial ratios of Textile and Garment companies in the IDX were quite significant, with asymmetric distribution. The average of companies with the potential to go bankrupt is more negatively skewed than non-bankrupt ones. Except, for the surplus obtained by the companies and the solvency ratio which tend to differentiate their characteristics. Their characteristics in the scale value (risk measure), market share (sales portion), and ownership (shareholder) are not significantly different on average. However, it is dominated by companies that have the potentially bankrupt compared to those non-bankrupt. Liquidity financial ratio and cumulative profitability are more potential or reliable predictors to reduce the probability of failure. However, the profitability ratio and solvency have the largest effect size to the tendency of companies to determine whether they have the potential to go bankrupt or other ones. The uncertainty condition contributes to increasing the accuracy of the probability prediction of Textile and Garment companies which potentially going bankrupt or non-bankrupt. Because, its unpredictable and uncontrollable makes a positive effect to the tendency of companies not to default or experiencing the risk of failure. Future recommendations based on the results are that the LR-Model is much more accurate in predicting bankruptcy or experience the risk of failure compared to MDA method. Uncertainty conditions has broader and multi-sector structural effects so that anticipation and recovery that must be carried out are not only from the demand and supply side of the real and financial sectors alone but require a holistic approach, mainly in the Textile and Garment sub-sector as a non-primary needs industry that has inter-linkages from various sectors. The interesting and special estimation results are challenge for the firm in the future, in improving the core of firm characteristics based on the origin's country, and local and national business ownership. These characteristics can differentiate and advantage the domestic industries, particularly in the COVID-19 pandemic (non-financial) in the secondary manufacturing sector which is sensitive, depends on global trends, and requires operational inter-linkages. There are three best scenarios for the revival of Textile and Garment in Indonesia for the future after the pandemic are repeat, regain, and renegotiate.

REFERENCES

- 1) Altman, Edward I. (1968). Financial Ratios and Discriminant Analysis and the Prediction of Corporate Bankruptcy. *Journal of Finance*, Vol. 23(4), p. 589-609.

Bankruptcy Prediction Model Under Uncertainty in Indonesia

- 2) _____. (1973). Predicting Railroad Bankruptcies in America. *The Bell Journal of Economics and Management Science*, Vol. 4(1), p. 184-211.
- 3) _____. (1984). *Corporate Financial Distress*. John Wiley & Sons.
- 4) _____. (1993). *Corporate Financial Distress and Bankruptcy*. John Wiley & Sons.
- 5) Altman, E. I., Iwanicz-Drozdzowska, M., Laitinen, E. K., & Suvas, A. (2016). Financial Distress Prediction in an International Context: A Review and Empirical Analysis of Altman's Z-Score Model. *Journal of International Financial Management & Accounting*, Vol. 28, p. 131-171.
- 6) API. (2020). Rapat Dengar Pendapat (RDP) Asosiasi Pertekstilan Indonesia Dengan Komisi VI DPR-RI. *Buletin APBN*, Volume 5, No. 10, Juni 2020.
- 7) _____. (2024). Sengkarut Industri Tekstil, Tenaga Kerja, Tekstil Menciut. *Pusat Strategi Kebijakan Pengawasan*. PE.12.01/ND-495/RJ/2/2024. Analisis Isu Pengawasan, Volume 1, No. 2, Desember 2024.
- 8) Armenda, D. & Hertina, D., (2023). Analisis Financial Distress Dampak Pandemi Covid-19 Berdasarkan Model Grover, Springate dan Zmijewski pada Perusahaan Tekstil dan Garmen. *Fair Value: Jurnal Ilmiah Akuntansi Dan Keuangan*, 5(6), p. 2835-2844.
- 9) Beaver, W. (1966). Financial Ratios as Predictors of Failures. in *Empirical Research in Accounting Selected Studies*. Supplement to *Empirical Research in Accounting: Selected Studies*. *Journal of Accounting Research*, Vol. 4, p. 71-111.
- 10) _____. (1968). Market Prices, Financial Ratios, and the Prediction of Failure. *Journal of Accounting Research*, Vol. 6 No. 2, p. 179-192.
- 11) Blum, M. (1974) Failing Company Discriminant Analysis. *Journal of Accounting Research*, Vol. 12(1), p. 1-25.
- 12) BPS, Indonesia. (2022). *Statistik Indonesia 2022*. Badan Pusat Statistik. Jakarta.
- 13) _____. Indonesia. (2023). *Statistik Indonesia 2023*. Badan Pusat Statistik. Jakarta.
- 14) _____. Indonesia. (2024). *Statistik Indonesia 2024*. Badan Pusat Statistik. Jakarta.
- 15) Desai, V., Crook, J., Overstreet, G. (1996). A Comparison of Neural Networks and Linear Scoring Models in the Credit Union Environment. *European Journal of Operational Research*, 95(1), p. 24-37.
- 16) Devi, S., W, Made, S., Masdiantini, P, R., & Musmini, L. S. (2020). The Impact of Covid-19 Pandemic on the Financial Performance of Firms on the Indonesia Stock Exchange. *Journal of Economics, Business, and Accountancy Ventura*, Vol. 23(2), 226-242.
- 17) Engelmann, B., Hayden, E., & Tasche, D. (2003). Measuring the Discriminative Power of Rating Systems. *Social Science Research Network*.
- 18) FFIEC. (1979). *The Federal Financial Institutions Examination Council Annual Report 1979*. Washington D.C. : The House of Representative, United State of America.
- 19) Fitzmaurice, Garrett M., Anthony F. Heath, Peter Clifford. (1996). Logistic Regression Models for Binary Panel Data with Attrition. *Journal of the Royal Statistical Society Series A : Statistics in Society*, Vol. 159, Issue 2, p. 249-263.
- 20) Fu, M., & Shen, H. (2020). COVID-19 and Corporate Performance in the Energy Industry. *Energy Research Letters*, Vol. 1, No. 1, p. 1-5.
- 21) Gilbert, R., Meyer, A., Vaughan, M. (2000). The Role of a CAMEL Downgrade Model in Bank Surveillance. *FRB*.
- 22) Hair. Joseph F. Jr. R E. Anderson. R L. Tatham. WC. Black. (2015). *Multivariate Data Analysis (International Edition)* 8th Edition. Prentice Hall. New Jersey.
- 23) ILO, (2021). *COVID-19, Vaccinations and Consumer Demand: How Jobs Are Affected Through Global Supply Chains*. Bangkok.
- 24) Janssens, ACJW, & Martens FK. (2020). Reflection on Modern Methods: Revisiting the Area Under the ROC Curve. *International Journal Epidemiol*, Vol. 49(4), p. 1397-1403.
- 25) Kester, W. (1984). Today's Options for Tomorrow's Growth. *Harvard Business Review*, Vol. 62, p. 153-160.
- 26) Khatib, S. F., & Nour, A. (2021). The Impact of Corporate Governance on Firm Performance During the COVID-19 Pandemic: Evidence from Malaysia. *Journal of Asian Finance, Economics and Business*, Vol. 8(2), p. 0943-0952.
- 27) LPEM, FEB-UI. (2021). *Buku Statistik Survei Dampak Pandemi Covid-19 2021*. Lembaga Penyelidikan Ekonomi dan Masyarakat, Fakultas Ekonomi dan Bisnis Universitas Indonesia. Jakarta.
- 28) Maddala, G S. (2006). *Limited Dependen and Quality Variable in Econometrics*. New Cambridge University Press.
- 29) Myer, S. (1977). Determinants of Corporate Borrowing. *Journal of Financial Economics*, 5(2), p. 147-175.
- 30) Ohlson, J.A. (1980). Financial Ratio and the Probabilistic Prediction of Bankruptcy. *Journal of Accounting Research*, Vol. 18(1), 109-131.
- 31) Rencher, Alvin. C. (1995). *Methods of Multivariate Analysis*. John Wiley & Sons. Inc.
- 32) Roosdiana. (2021). Dampak Pandemi Covid-19 Terhadap Kinerja Perusahaan Property dan Real Estate. *IKRA-ITH Ekonomika*, Vol. 3(6), p. 133-141.
- 33) Ross, Stephen, Westerfield R., & Jaffe J. (2004). *Corporate Finance*. Mc. Graw Hill.

Bankruptcy Prediction Model Under Uncertainty in Indonesia

- 34) Salchenberger. L., Cinar, E., Lash, N. (1992). Neural Networks: A New Tool for Predicting Thrift Failures. *Decision Sciences*, 23(4), p. 899-916.
- 35) Shen, H., Fu, M., Pan, H., Yu, Z., & Chen, Y. (2020). The Impact of the COVID-19 Pandemic on Firm. *Emerging Markets Finance and Trade*, Vol. 56(10), p. 2213-2230.
- 36) The Statistic & Failure Report. (2024). What Percentage of Businesses Fail? Averages by Time, Industry and Locale. US Bureau of Labor Statistics. Office of Publications and Special Studies, Suitland Federal Center, Washington, D.C.
- 37) Yuanita, Ika. (2010). Prediksi Financial Distress Dalam Industri Textile dan Garment (Bukti Empiris di Bursa Efek Indonesia). *Jurnal Akuntansi dan Manajemen*. Politeknik Negeri Padang, Vol. 6(2), p.101-119.
- 38) _____. (2012). Determinan dan Model Prediksi Potensi Kebangkrutan Industri Properti di Pasar Modal. *Prosiding Seminar Nasional Manajemen Bisnis di Indonesia (SNMBI) FE UNP*. ISBN : 978-602-18867, p. 1-7.
- 39) _____, Ika & Nurhayati. (2016). Model Prediksi Potensi Kebangkrutan Bank Perkreditan Rakyat di Sumatera Barat dengan Menggunakan Rasio Keuangan, Karakteristik BPR, Variabel Makroekonomi Regional. *ASCNI-tech Conference (National Conference of Applied Science Engineering Business and Informtion Technology) ke-2*, Padang.
- 40) Zmijewski. M. (1984). Methodological Issues Related to the Estimation of Financial Distress Prediction Models. *Journal of Accounting Research*. Vol, 22. p. 59-82.



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