



# Bankruptcy Risk Analysis in Manufacturing Companies in Indonesia using the Conan & Holder Model, J-UK Model, and Taffler Model

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## Abstract

This study aims to analyze the bankruptcy risk of manufacturing companies in Indonesia using three different bankruptcy prediction models: the Conan & Holder Model, the J-UK Model, and the Taffler Model. To predict the bankruptcy risk with each model, historical financial data from several manufacturing companies listed with the Financial Services Authority (OJK) is used. This research concludes that the combination of these three models provides valuable insights in efforts to enhance the resilience and stability of the manufacturing sector in Indonesia by offering a more comprehensive approach to identifying and managing bankruptcy risks in manufacturing companies. This research is expected to contribute to the development of more effective risk management strategies for the manufacturing industry in Indonesia.

*Keywords:* Bankruptcy Risk, Insurance, Bankruptcy Prediction, Conan & Holder Model, J-UK Model, Taffler Model

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## 1. Introduction

Bankruptcy is one of the biggest risks for companies in various industries, including manufacturing. Bankruptcy can have a significant impact on various stakeholders such as shareholders, creditors, employees, and other stakeholders. The risk of bankruptcy is a real threat to Indonesian manufacturing companies, especially considering global market trends, commodity price fluctuations, economic uncertainty, and evolving regulations. Therefore, bankruptcy risk analysis is important for company managers to make strategic decisions to prevent bankruptcy or minimize its negative impact.

In an effort to anticipate bankruptcy, various bankruptcy prediction models have been developed by scientists and experts in the field of finance. Several widely used models include the Conan & Holder Model, the J-UK Model, and the Taffler Model. These models aim to identify companies at risk of bankruptcy based on the analysis of historical financial data. Each model uses different approaches and variables to predict bankruptcy, thus providing different insights into the financial health of the company. The Conan & Holder model is a model that combines several financial ratios to measure the risk of a company's bankruptcy. This model evaluates the liquidity, profitability, and solvency of the company as the main factors in determining the potential for bankruptcy. This model is widely used in various countries because it simplifies financial risk analysis through relevant indicators and can be applied to various types of industries.

Additionally, the J-UK Model is also one of the well-known models in bankruptcy risk analysis. This model was developed to assess the financial performance of companies. The J-UK Model uses financial indicators that are more specific to certain industries and considers macroeconomic conditions that may affect the stability of the company. This makes the J-UK Model a flexible and adaptive tool for various market conditions.

On the other hand, the Taffler Model focuses more on a statistical approach to predicting bankruptcy. This model uses multivariate analysis to identify financial patterns that lead to bankruptcy. Taffler has developed a series of indicators to detect early signs of financial distress, allowing companies to take preventive measures sooner. The strength of the Taffler Model lies in its predictive ability, which has been proven in various empirical studies.

This research aims to analyze the bankruptcy risk of the manufacturing industry in Indonesia by considering the three models. By comparing the Conan & Holder Model, the J-UK Model, and the Taffler Model, this study aims to provide a more comprehensive picture of the effectiveness of each model in predicting manufacturing bankruptcies. Furthermore, the results of this research can also provide recommendations for companies on more effective bankruptcy risk management.

Based on Table 1, this research topic has not been widely explored, thus increasing the urgency of the study.

**Table 1:** Research Gap

Author(s)	Year	Study Focus	Methodology	Conan & Holder Model	J-UK Model	Taffler Model	Comparison
Putri & Wijaya	2019	The effectiveness of bankruptcy models in predicting failure	J-UK, Altman Z-score models		√		
Nugroho & Santoso	2020	Predicting corporate bankruptcy using Conan & Holder model	Conan & Holder model	√			
Kurniawan et al.	2020	Bankruptcy prediction using Taffler model in ASEAN	Taffler Model			√	
Haryanto & Dewi	2021	Bankruptcy risk in Indonesian manufacturing sector	J-UK Model		√		
Hakim & Prasetya	2021	Bankruptcy risk prediction using Conan & Holder and Altman models	Conan & Holder, Altman models	√			
Siregar & Lubis	2022	Bankruptcy risk analysis using Taffler Model	Taffler Model			√	
Aditya et al.	2022	Predictive power of various bankruptcy models	Altman, Ohlson, Taffler models			√	

Yusof & Halim	2022	Comparative Analysis of Bankruptcy Models in Indonesia	Conan & Holder, Zmijewski	√			
This research				√	√	√	√

## 2. Literature Review

### 2.1. Risk

In a business context, risk is the possibility of an event occurring that can affect the company in achieving its goals, both positively and negatively. According to Anthony and Govindarajan (2011), risk is the uncertainty that affects the financial and operational performance of a company. From a financial perspective, risk is often associated with income volatility, market uncertainty, and economic instability. In the manufacturing sector, risks can be caused by various factors, such as fluctuations in raw material prices, technological developments, government regulations, and uncertain market demand. These factors can affect the financial stability of the company and, in extreme cases, potentially lead to bankruptcy.

The risk of bankruptcy is one of the most critical forms of risk in the business world. In the development of the bankruptcy prediction model, Altman (1968) emphasized that a company's inability to meet its financial obligations is one of the main indicators of bankruptcy risk. In manufacturing companies, the risk of bankruptcy can be caused by several factors, such as a decline in operational efficiency, excessive debt burden, or insufficient liquidity. This makes bankruptcy risk analysis an important aspect of financial management. Bankruptcy prediction models, such as the Conan & Holder Model, the J-UK Model, and the Taffler Model, were developed to identify risks earlier using specific financial indicators. (Altman, 1968). These models provide a quantitative approach to evaluating the financial health of a company, which can contribute to the management and design of effective risk mitigation strategies.

### 2.2. Bankruptcy

Bankruptcy is a condition in which a company cannot operate financially because it does not have sufficient funds to pay its obligations when they are due. According to Brigham and Houston (2019), bankruptcy occurs when a company is no longer able to meet its short-term or long-term obligations, which can ultimately result in the cessation of operations and liquidation of assets. The status of bankruptcy usually reflects serious problems in a company's financial management, which can be caused by various factors, including poor cash management, a significant decline in revenue, and uncontrolled debt increase. Additionally, bankruptcy often involves a company's inability to adapt to market changes or macroeconomic pressures.

Usually, the bankruptcy process does not happen suddenly, but rather through various initial stages that can be determined by carefully analyzing the company's financial statements. Early signs of bankruptcy include a decline in liquidity and solvency ratios, as well as the inability to pay interest on debt on time. (Altman, 2018). According to Beaver (1966), financial ratio analysis can be used as a tool to predict bankruptcy, and indicators such as the debt-to-equity ratio, current ratio, and profit margin can provide early signals of potential financial problems. Further research also shows that negative trends in profitability and operating cash flow are among the most significant signals for detecting future bankruptcy risk. (Taffler, 1983). Therefore, companies facing such signs should immediately take strategic steps to improve their financial condition before reaching a critical point of bankruptcy.

### 2.3. Manufacturing Companies

In the book "Financial Literacy Applications for Business Actors," Christian Herdinata states that manufacturing is a type of business that operates machines, equipment, and labor to transform raw materials into finished products with market value. This definition illustrates the crucial role of the process of transforming raw materials into finished products, which can then be sold in the market to generate revenue. This process involves various stages, starting

from the processing of raw materials, assembly of components, to the packaging of the product. Manufacturing activities often require the use of advanced technology and production systems to ensure the efficiency and quality of the products produced.

Furthermore, manufacturing companies can also be classified according to the type of goods produced, such as consumer goods, semi-finished goods, and capital goods. The manufacturing industry makes a significant contribution to the national economy by absorbing a large workforce and producing goods that meet the needs of society. In addition, this sector also plays a role in increasing exports and innovation, as well as strengthening domestic and global supply chains. Herdinata emphasized the importance of financial literacy for manufacturing business actors, as good financial management is one of the keys to facing operational challenges and market competition in this industry. (Herdinata, 2020).

### **3. Materials and Methods**

#### **3.1. Materials**

This research uses a quantitative approach with a descriptive method to analyze the bankruptcy risk of manufacturing companies in Indonesia. The data used is secondary data obtained from the financial statements of companies listed on the Indonesia Stock Exchange (IDX) during the period 2019-2023.

The population in this study is all manufacturing companies listed on the IDX. The sampling technique used is purposive sampling, with criteria for companies that have complete financial statement data during the study period, have conducted an initial public offering (IPO) before 2019, and come from different sectors. The total sample used in this study is five manufacturing companies: Adaro Energy Indonesia Tbk (ADRO) from the energy sector, United Tractors Tbk (UNTR) from the industrial sector, Aneka Tambang Tbk (ANTM) from the raw materials sector, Indofood CBP Sukses Makmur Tbk (ICBP) from the primary consumer goods sector, and Kalbe Farma Tbk (KLBF) from the health sector.

#### **3.2. Methods**

##### **3.2.1. Data Collecting**

Data was collected through the company's financial reports accessed from the official BEI website and official websites of each chosen company.

##### **3.2.2. Data Analysis**

Data analysis is conducted using three bankruptcy prediction models, namely the Conan & Holder Model, the J-UK Model, and the Taffler Model. The steps of data analysis are as follows:

- Conan & Holder Model: Calculating the bankruptcy score based on financial ratios determined by this model, such as liquidity, profitability, and leverage ratios.
- J-UK Model: Using relevant financial ratios to calculate the bankruptcy score according to the formula developed by this model.
- Taffler Model: Applying the financial ratios used in this model to calculate the company's bankruptcy score.

##### **3.2.3. Model Conan & Holder Model**

The Conan & Holder (1979) model was developed to analyze the decline in the financial condition of small and medium enterprises. The determination of values for the proposed score function is based on an initial set of 50 indicators studied according to categories: asset structure, financial dependency, cash, working capital, exploitation, profitability, and others. Then, the formulation and results of the model are based on the analysis of 31 ratios (financial variables), applied to 190 small and medium enterprises operating in various fields: industry, trade, services, and transportation during the years 1970 - 1975.

Out of the 190 selected companies, 95 went bankrupt, and the other 95 are healthy businesses with activities similar to those of the bankrupt companies.

The model developed by Conan & Holder falls under the category of statistically tested methods and has the advantage of simplifying calculations, which is why it is still used to this day.

The Conan & Holder model is as shown in equation 1.

$$Z_{Conan\ and\ Holder} = 0.24 X_1 + 0.22 X_2 + 0.16 X_3 - 0.87 X_4 - 0.10 X_5 \quad (1)$$

with:

$Z_{Conan\ and\ Holder}$  : Overall Index of Conan & Holder

$X_1$  : Gross Operating Surplus/Total Debt, describing profitability by creditors, that is, the profit obtained by using borrowed capital.

$X_2$  : Permanent Capital/Total Liabilities, describing the company's long-term solvency, a measure of debt guarantee through permanent capital.

$X_3$  : (Current Assets – Inventory)/Total Liabilities, describing the company's liquidity, the ability to pay debts by converting receivables, short-term investments, cash, and cash equivalents into cash.

$X_4$  : Financial Expenditure/Net Sales, describes the level of financial expenditure, the portion of financial expenditure in net sales.

$X_5$  : Personnel Expenditures/Added Value, expresses the rate of personnel costs, i.e., the share of remuneration of the personnel by the added value of the company.

The interpretation of the Z-Score function by Conan & Holder is as follows:

$Z_{Conan\ and\ Holder} < 0.04$  : a probability of a bankruptcy risk of  $> 65\%$ ;

$0.04 \leq Z_{Conan\ and\ Holder} \leq 0.16$  : a probability of a bankruptcy risk between  $30 - 65\%$ ;

$Z_{Conan\ and\ Holder} > 0.16$  : a probability of a bankruptcy risk of  $< 30\%$ .

### 3.2.4. Model J-UK

In 2015, Jeehan Almamy, John Aston, and Leonard N. Ngwa developed the J-UK Model based on companies in the UK. With this model, they evaluate the health of companies in England. They contributed to Altman's first Z-Score Model (1968) and added a sixth variable, namely cash flow from operations/total liabilities.

When applied in the UK, Almamy and his colleagues found that the Altman model successfully classified 54.4% of all companies based on a paired sample basis. The J-UK model, on the other hand, correctly classified 82.9% of all companies.

In addition, both models were tested using Wilks' Lambda to assess which one has a higher discriminatory ability. Lambda Wilks is a value between 0 and 1. The result explains the portion of variability that remains unexplained.

The original Altman approach has a Wilks' Lambda score of 0.995, while the updated J-UK model reaches 0.983. This shows that the J-UK model indeed has a higher predictive value.

The J-UK model is as in equation 2.

$$J = 1.484J_1 + 0.043J_2 + 0.390J_3 + 0.004J_4 - 0.424J_5 + 0.75J_6 \quad (2)$$

with:

$J_1$  : Working capital/total assets.

$J_2$  : Retained earnings/total assets

$J_3$  : Earnings before interest and taxes/total assets

$J_4$  : Market value equity/total liabilities

$J_5$  : Sales/total assets

$J_6$  : Cash flow from operations/total liabilities

### 3.2.5. Model Taffler

The Taffler Model was first published by R. J. Taffler in 1977. This model was developed to have 5 ratio indicators. Then, this model was further modified to produce 4 ratio indicators using MDA analysis techniques with a very high level of accuracy. Taffler proposed a model based on a comprehensive survey of various types of data. The

original model was developed to analyze industrial companies (manufacturing and construction) only, with separate models developed for retail and service companies. Taffler explains that to measure a company's potential for bankruptcy, it is important to compare the company's report analysis with that of other companies in the same industry.

The Taffler equation (1984) is given in equation 3.

$$Z_{Taffler} = 0.53 X_1 + 0.13 X_2 - 0.18 X_3 + 0.16 X_4 \quad (3)$$

with:

$Z_{Taffler}$  : Taffler Overall Index

$X_1$  : Earnings Before Tax/Current Liabilities is a measure of the true productivity of a company's assets, regardless of debt factors.

$X_2$  : Current Assets/Total Liabilities, describes the company's short-term payment capacity, namely the ability of current assets to be converted into cash to meet payment obligations. This ratio estimates the company's liquidity by showing that the company can pay creditors with current assets if the company's assets need to be liquidated.

$X_3$  : Current Liabilities/Total Assets, indicates the portion of the company's assets financed through short-term debt. If the ratio is low, most of the company's assets are financed through equity and long-term debt. If the ratio is high, most of the company's assets are financed through short-term debt.

$X_4$  : Sales/Total Assets, depicting the company's total assets when generating profit from sales. The higher this ratio, the better the company's performance.

The interpretation of the Taffler Model Z-Score is as follows:

$Z_{Taffler} > 0.3$ : The company has a good chance of performing well;

$0.2 \leq Z_{Taffler} \leq 0.3$ : Gray zone (undefined area);

$Z_{Taffler} < 0.2$ : The company is categorized as bankrupt.

### 3.2.6. Results Interpretation and Comparison

The scores generated by the three models are visualized, interpreted, and compared to analyze the movement of bankruptcy risk levels. This section contains tables and graphs to easier view and compare bankruptcy risk levels of the five manufacturing companies within the five years of observation.

## 4. Results and Discussion

The calculation results from the three models on five manufacturing companies are presented in the following table and graph. In its interpretation, the Z-Score and J-Score are inversely related to the company's bankruptcy risk. If the score increases, the bankruptcy risk decreases, which means the company's risk of bankruptcy decreases—there is a smaller chance of the company going bankrupt.

**Table 2:** Results of the Conan & Holder Model on Adaro Energy Indonesia Tbk (ADRO)

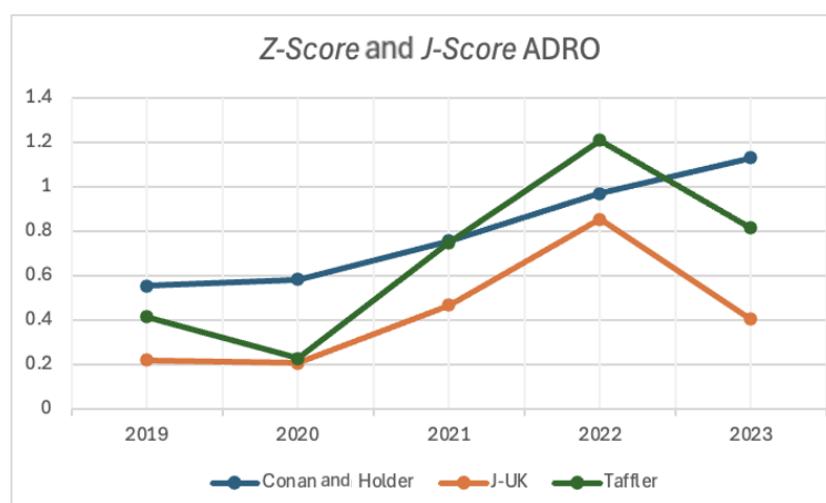
Year	2019	2020	2021	2022	2023
$X_1$	0.3390022	0.2681795	0.8530609	1.4799035	1.3925692
$X_2$	1.8506619	2.1551284	1.9898153	1.9588380	2.7211433
$X_3$	0.6518246	0.7118766	0.9064760	1.2496441	1.4033863
$X_4$	0.0191880	0.0352783	0.0208715	0.0110232	0.0167857
$X_5$	0.2257765	0.3718696	0.1114725	0.0510914	0.1135683
$Z_{Conan \text{ dan Holder}}$	0.5535268	0.5845125	0.7582247	0.9713650	1.1314495

**Table 3:** Results of the J-UK Model on Adaro Energy Indonesia Tbk (ADRO)

Year	2019	2020	2021	2022	2023
$J_1$	0.1215616	0.0919749	0.1946206	0.2663435	0.2068995
$J_2$	0.3171073	0.3677876	0.3668800	0.4156303	0.4984526
$J_3$	0.0913251	0.0348136	0.1958961	0.4151448	0.2190725
$J_4$	2.4167855	3.2163208	2.4979643	1.8367193	2.5506798
$J_5$	0.4790223	0.3972132	0.5262622	0.7514532	0.6223370
$J_6$	0.2836627	0.3030765	0.4590943	0.9081744	0.3762313
$J$	0.2205923	0.2073295	0.4662602	0.8540764	0.4047928

**Table 4:** Results of the Taffler Model on Adaro Energy Indonesia Tbk (ADRO)

Year	2019	2020	2021	2022	2023
$X_1$	0.5347253	0.1940436	1.0915811	1.8288854	1.0744879
$X_2$	0.6524778	0.7127459	0.9071511	1.2501405	1.4040756
$X_3$	0.1707888	0.1794110	0.1794609	0.2269934	0.2038855
$X_4$	0.4790223	0.3972132	0.5262622	0.7514532	0.6223370
$Z_{Taffler}$	0.4141281	0.2267602	0.7483666	1.2112012	0.8148829

**Figure 1:** The Z-Scores and J-Scores of ADRO

From Table 2, it can be seen that for Adaro Energy Indonesia Tbk (ADRO), in the Conan & Holder Model, the Z-Score increased from 0.55 in 2019 to 1.13 in 2023, indicating an overall improvement in ADRO's financial performance. This increase reflects an improvement in the company's profitability, long-term solvency, and liquidity, with a consistently low and stable financial burden. Although there are slight fluctuations in some variables, such as a small decrease in profitability  $X_1$  and an increase in personnel expenditure costs  $X_5$ , the overall effect of the company's improved solvency and liquidity is stronger, driving an increase in the Z-Score over the past five years. A good Conan & Holder Z-Score since 2019, which is  $>0.16$ , indicates a company bankruptcy risk level of  $<30\%$ . Additionally, the company's bankruptcy risk level has decreased over time, as seen from the increasing Z-Score.

From Table 3, it can be seen that for Adaro Energy Indonesia Tbk (ADRO), in the J-UK Model, the resulting J-Score shows a significant increase in financial performance in profitability, liquidity, and operational efficiency of the company in 2021 and 2022, which were the peak years with much higher J-UK results. However, it declined again in 2023, influenced by a decrease in operating cash flow, working capital liquidity, operational profitability, and sales efficiency relative to assets. The J-Score provided by the J-UK Model shows slight fluctuations in the company's bankruptcy risk level over 5 years: an increase in 2019-2020, a decrease in 2020-2022, and finally, an increase again in 2022-2023. Overall, over the 5 years, the J-Score has increased, indicating a decrease in the bankruptcy risk level over the 5 years.

From Table 4, it can be seen that for Adaro Energy Indonesia Tbk (ADRO), the Taffler Model produces a Z-Score that indicates fluctuations in the company's bankruptcy risk level. Over the 5 years of observation, the Z-Score

generally shows that the company has a good chance of performing well, except in 2020, where the Z-Score indicates an undefined area. This undefined area can be interpreted as the boundary between high and low bankruptcy risk levels. According to this model, the bankruptcy risk level of Adaro Energy Indonesia Tbk (ADRO) during 2019-2023 fluctuated slightly: there was a significant increase from 0.41 in 2019 to a peak of 1.21 in 2022, before slightly decreasing in 2023. The sharp increase from 2021-2022 reflects a significant improvement in ADRO's financial performance, particularly in terms of profitability, liquidity, and operational efficiency. The decline in 2023 could signal that the company's financial performance is starting to weaken slightly due to a decrease in efficiency in generating profits and sales from its assets, although liquidity conditions remain stable, still at a good level. From Figure 1, it can be seen that the J-UK Model and the Taffler Model produce similar trends in Z-Score and J-Score.

Overall, all three models indicate that ADRO has had strong financial performance from 2019 to 2023. Despite a slight decline in some variables in 2023, such as profitability and liquidity, ADRO remains in good condition and far from bankruptcy. The Conan & Holder and Taffler models show an overall positive trend, while the J-UK model shows a slight decline at the end of the period.

**Table 5:** Results of the Conan & Holder Model on United Tractors Tbk (UNTR)

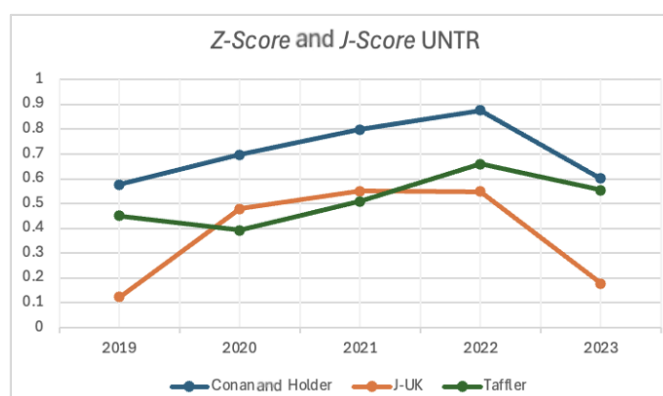
Year	2019	2020	2021	2022	2023
$X_1$	0.4692119	0.3241174	0.5980371	0.9220760	0.5597816
$X_2$	1.5636894	2.1514028	2.0146038	1.9315606	1.5857364
$X_3$	1.0043460	1.2056601	1.4875410	1.5486560	0.8952846
$X_4$	0.0276413	0.0255176	0.0094909	0.0061480	0.0146163
$X_5$	0.1688912	0.2581552	0.1863016	0.1312303	0.1325000
$Z_{Conan\ dan\ Holder}$	0.5763809	0.6959866	0.7978610	0.8755548	0.6004890

**Table 6:** Results of the J-UK Model on United Tractors Tbk (UNTR)

Year	2019	2020	2021	2022	2023
$J_1$	0.1632878	0.2329833	0.2675416	0.2626218	0.1274364
$J_2$	0.4212557	0.4959115	0.5034857	0.5077195	0.4341499
$J_3$	0.1385410	0.0702517	0.1284833	0.2096129	0.1864615
$J_4$	1.9994726	2.7604192	2.4836376	1.9853059	1.4455784
$J_5$	0.7557777	0.6046714	0.7059306	0.8799048	0.8348031
$J_6$	0.1864698	0.5062797	0.5715674	0.6453836	0.3764229
$J$	0.1232175	0.4782124	0.5509289	0.5476727	0.1770047

**Table 7:** Results of the Taffler Model on United Tractors Tbk (UNTR)

Year	2019	2020	2021	2022	2023
$X_1$	0.4749619	0.3347615	0.4743398	0.7004724	0.6673205
$X_2$	1.0044198	1.2057619	1.4876326	1.5487292	0.8953379
$X_3$	0.2916887	0.2098559	0.2708675	0.2992450	0.2794182
$X_4$	0.7557777	0.6046714	0.7059306	0.8799048	0.8348031
$Z_{Taffler}$	0.4507249	0.3931460	0.5089851	0.6595059	0.5533470



**Figure 2:** The Z-Scores and J-Score of UNTR



Table 5 shows that for United Tractors Tbk (UNTR), the Conan & Holder Model provides a good Z-Score since 2019, which is  $>0.16$ , indicating a company bankruptcy risk level of  $<30\%$ . Additionally, the company's bankruptcy risk level has decreased over time (as seen from the increasing Z-Score), indicating an improvement in financial stability, and experienced a significant increase in 2022 reflecting improved profitability, liquidity, and operational efficiency with consistently low and stable financial burdens. However, it declined again in 2023 due to a decrease in liquidity, debt utilization efficiency, and long-term solvency.

As shown in Table 6, it can be seen that for United Tractors Tbk (UNTR) in the J-UK Model, the J-Score peaked at 0.55 in 2021, indicating a significant improvement in the company's financial performance in terms of profitability, liquidity, and operational efficiency, before drastically dropping to 0.18 in 2023. This is a sign of increased bankruptcy risk in 2023 due to the weakening of working capital, asset profitability, and operational cash flow, although the company had been in a more stable condition in the previous years.

From Table 7, it can be seen that for United Tractors Tbk (UNTR), the Taffler Model produces a Z-Score that shows fluctuations in the company's bankruptcy risk level, although, over the 5 years of observation, the Z-Score indicates that the company has a good chance of performing well (as seen from its consistently  $>0.3$  Z-Score). The bankruptcy risk level of United Tractors Tbk (UNTR) during 2019-2023 fluctuated: it increased in 2019-2020, then decreased in 2020-2022, and finally increased again in 2022-2023. Although the Z-Score value remained relatively stable above the safe threshold due to increased profitability, long-term solvency, and company liquidity, with financial burdens remaining low and stable over the past 5 years, the decline in 2023 could be an early indication that the company might be experiencing slight financial pressure and a decrease in liquidity efficiency and the company's ability to generate pre-tax profit. However, overall, UNTR is still in the safe zone according to the Taffler model. From Figure 1 and Figure 2, it can be seen that the trend of bankruptcy risk levels given by the Taffler Model for United Tractors Tbk (UNTR) has a similar shape to Adaro Energy Indonesia Tbk. (ADRO).

Overall, all three models indicate that UNTR experienced a significant improvement in financial performance until 2022. However, in 2023, there are signs of a decline in operational efficiency and liquidity. Nevertheless, UNTR is still far from bankruptcy, although it needs to be cautious in maintaining financial growth momentum for the long term.

**Table 8:** Results of the Conan & Holder Model on Aneka Tambang Tbk (ANTM)

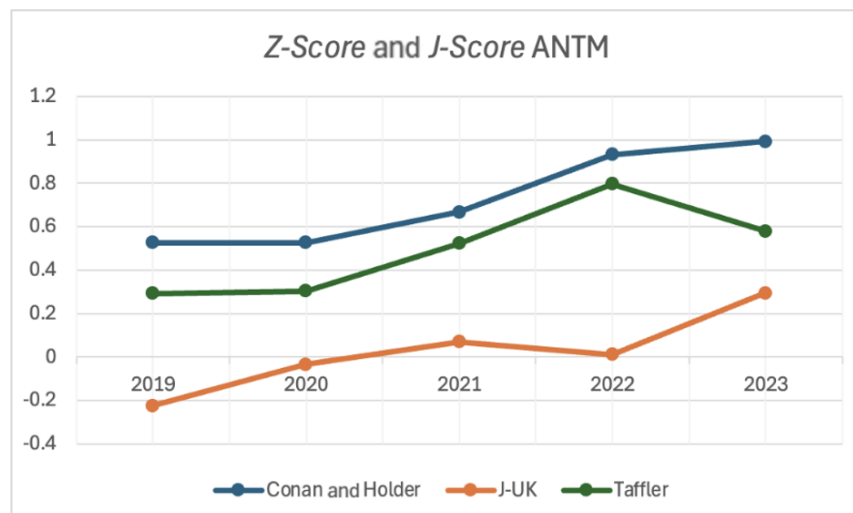
Year	2019	2020	2021	2022	2023
$X_1$	0.0946141	0.2167362	0.3335999	0.7791626	0.5083948
$X_2$	2.0645602	1.9051324	2.1817741	2.7874076	2.9330728
$X_3$	0.6335212	0.7191834	0.9689592	1.1244956	1.7149666
$X_4$	0.0071324	0.0206577	0.0093403	0.0082971	0.0052413
$X_5$	0.4603246	0.4268318	0.3998307	0.4081373	0.4535398
$Z_{Conan\ dan\ Holder}$	0.5260364	0.5255598	0.6669786	0.9321158	0.9917715

**Table 9:** Results of the J-UK Model on Aneka Tambang Tbk (ANTM)

Year	2019	2020	2021	2022	2023
$J_1$	0.0785563	0.0503397	0.1569369	0.1551427	0.2680922
$J_2$	0.2620566	2.6311801	0.3120506	0.3907128	0.3358039
$J_3$	0.0227533	0.0517240	0.0924625	0.1550296	0.0899501
$J_4$	2.7892967	2.6511348	2.7852401	3.3896580	2.8790050
$J_5$	1.0835782	0.8626814	1.1679856	1.3654602	0.9579095
$J_6$	0.1354590	0.1748355	0.4174718	0.4138992	0.3728760
$J$	-0.2235118	-0.0335121	0.0696446	0.0111319	0.2951007

**Table 10:** Results of the Taffler Model on Aneka Tambang Tbk (ANTM)

Year	2019	2020	2021	2022	2023
$X_1$	0.1297947	0.2172807	0.4637811	0.8740361	0.4494267
$X_2$	0.6355135	0.7210771	0.9709486	1.1269168	1.7170231
$X_3$	0.1753024	0.2380516	0.1993666	0.1773720	0.2001441
$X_4$	1.0835782	0.8626814	1.1679856	1.3654602	0.9579095
$Z_{Taffler}$	0.2932260	0.3040785	0.5230190	0.7962850	0.5786487

**Figure 3:** The Z-Scores and J-Score of ANTM

From Table 8, it can be seen that for Aneka Tambang Tbk (ANTM), the Conan & Holder Model has provided a good Z-Score since 2019, which is  $>0.16$ , indicating a company bankruptcy risk level of  $<30\%$ . Additionally, the company's bankruptcy risk level has decreased over time (as seen from the increasing Z-Score), showing that the improvement in the company's solvency and liquidity has contributed to this positive trend. Although profitability slightly decreased in 2023, it still indicates that ANTM is in good condition and far from bankruptcy risk.

As shown in Table 9, it can be seen that for Aneka Tambang Tbk (ANTM) in the J-UK Model, there is a slight fluctuation in the company's bankruptcy risk level over the 5-year period: a decrease from 2019-2021, an increase from 2020-2022, and finally, a significant decrease from 2022-2023. The results started at  $-0.22$  in 2019, indicating potential problems at the beginning of the period, but gradually increased to  $0.295$  in 2023, showing a decrease in bankruptcy risk and improvement in financial performance during this period, particularly with better working capital and increased operating profit and reduced bankruptcy risk, despite its high leverage and liquidity decrement at the end of the period.

Table 10 shows that for Aneka Tambang Tbk (ANTM), the Taffler Model produces a Z-Score indicating that the company's bankruptcy risk level decreased from 2019 to 2022 but significantly increased from 2022 to 2023. According to the Taffler Model, in 2019, Aneka Tambang Tbk (ANTM) was in an undefined area. The undefined area can be interpreted as the boundary between high and low levels of bankruptcy risk. However, over time, its Z-Score increased and indicated that the company had better prospects for performance (its Z-Score consistently  $>0.3$ ).

Overall, from the analysis of the three models, it can be concluded that ANTM showed significant financial improvement from 2019 to 2022, with peak financial performance in 2022. Profitability, liquidity, and solvency of the company increased during this period, indicating solid financial conditions. However, in 2023, there are several signs of decline, particularly in short-term profitability and liquidity, reflecting the challenges in maintaining financial growth momentum. Overall, the three models indicate that ANTM is in a strong financial condition and far from the risk of bankruptcy during the 2019-2023 period. However, in 2023, ANTM needs to pay attention to the decline in short-term profitability and liquidity in order to maintain its financial stability in the future.

**Table 11:** Results of the Conan & Holder Model on Indofood CBP Sukses Makmur Tbk (ICBP)

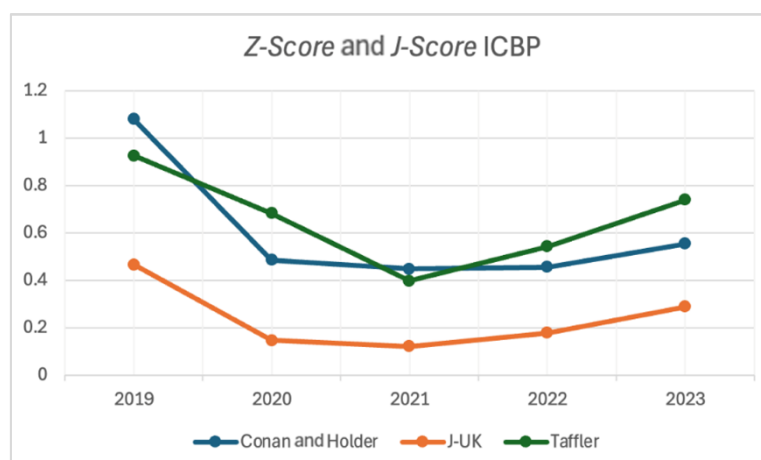
Year	2019	2020	2021	2022	2023
$X_1$	1.2013834	0.2472802	0.2463488	0.2591736	0.2862253
$X_2$	2.6709083	1.7723236	1.5656168	1.8202835	1.9033775
$X_3$	1.3800443	0.3886701	0.5365408	0.5370456	0.6431044
$X_4$	0.0038169	0.0143767	0.0346066	0.0954506	0.0298147
$X_5$	0.1471553	0.1484816	0.1221118	0.1094680	0.1122105
$Z_{Conan\ dan\ Holder}$	1.0787027	0.4840898	0.4470870	0.4546025	0.5531740

**Table 12:** Results of the J-UK Model on Indofood CBP Sukses Makmur Tbk (ICBP)

Year	2019	2020	2021	2022	2023
$J_1$	0.2601071	0.1114031	0.1279066	0.1824408	0.2205910
$J_2$	0.4777973	0.2179416	0.2279853	0.2544772	0.2860056
$J_3$	0.1921236	0.0961368	0.0841494	0.0652647	0.0959585
$J_4$	12.0123888	2.7146034	2.2829389	2.5004554	2.5297404
$J_5$	1.0926751	0.4502539	0.4811159	0.5619636	0.5693935
$J_6$	0.6145566	0.1752719	0.1261239	0.1522412	0.2171859
$J$	0.4656895	0.1460645	0.1195542	0.1778239	0.2869460

**Table 13:** Results of the Taffler Model on Indofood CBP Sukses Makmur Tbk (ICBP)

Year	2019	2020	2021	2022	2023
$X_1$	1.1343143	1.0852734	0.5257812	0.7499934	1.0936971
$X_2$	1.3810130	0.3888890	0.5367249	0.5372472	0.6433084
$X_3$	0.1693742	0.0885830	0.1600464	0.0870204	0.0877378
$X_4$	1.0926751	0.4502539	0.4811159	0.5619636	0.5693935
$Z_{Taffler}$	0.9250590	0.6818462	0.3966085	0.5415891	0.7385998

**Figure 4:** The Z-Scores and J-Score of ICBP

From Table 11, it can be seen that for Indofood CBP Sukses Makmur Tbk (ICBP), the Conan & Holder Model produces a Z-Scores that are  $>0.16$  over the 5 years of observation, which means the company's bankruptcy risk level is  $<30\%$ . Additionally, the company's bankruptcy risk level increased from 2019-2021 due to a decline in profitability, solvency, and liquidity, although financial and personnel expenditures were relatively low. Then, its bankruptcy risk decreased from 2021-2023 due to an increase in profitability, solvency, and liquidity.

It can be seen in Figure 4 that the J-Score provided by the J-UK Model, with a trend similar to the Z-Score of the Conan & Holder Models, indicates that the company's bankruptcy risk level increased from 2019 to 2021, then decreased from 2021 to 2023 due to an increase in working capital, operating profit, liquidity, operating cash flow, and a reduction in reliance on debt to finance operations.

As seen in Table 13, the Taffler Model produces a Z-Score with a trend similar to the other two models, where the bankruptcy risk level increased from 2019 to 2021, then decreased from 2021 to 2023. Despite the inconsistencies, this company has always had a good opportunity to perform well over the 5 years of observation due to improvements in profitability and liquidity, resulting in its Z-Score consistently being above 0.3.

Indofood CBP Sukses Makmur Tbk (ICBP) is the only company in this study that produces similar trends in Z-Score and J-Score for the three models used, as shown in Figure 4. And overall, from the analysis of the three models, it can be concluded that ICBP shows improved profitability performance. Although ICBP has a good solvency ratio, fluctuations in liquidity indicate challenges in managing cash flow. The high leverage in several years indicates that the company relied on debt to finance its operations, despite a decline at the end of the period. All models indicate that ICBP was at a higher risk of bankruptcy in 2020, although there are signs of recovery, so the bankruptcy risk from 2021 to 2023 in all three models shows decreasing risk.

**Table 14:** Results of the Conan & Holder Model on Kalbe Farma Tbk (KLBF)

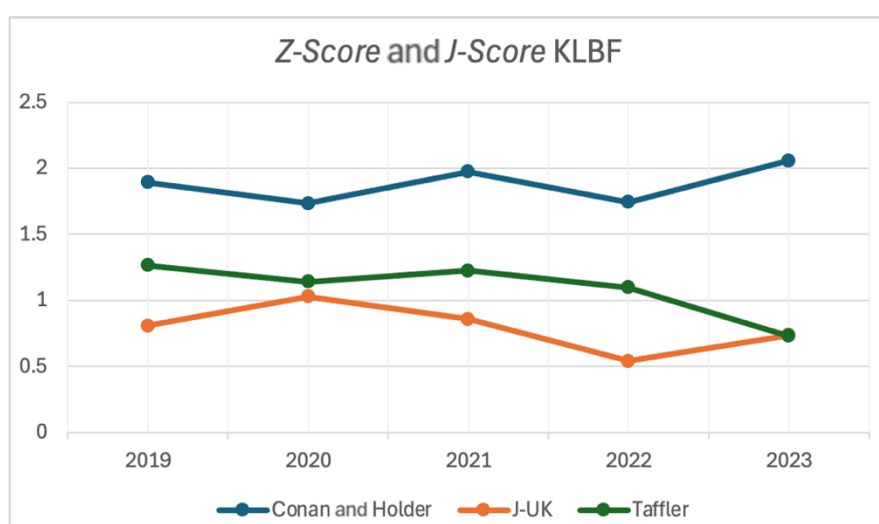
Year	2019	2020	2021	2022	2023
$X_1$	1.3054237	1.1319387	1.3103399	1.1056152	0.4051967
$X_2$	4.9696264	4.5211259	5.0291296	4.4343588	6.0464950
$X_3$	3.1399726	3.0381982	3.5596905	3.2393864	4.0296211
$X_4$	0.0017859	0.0038758	0.0021851	0.0019030	0.0028636
$X_5$	0.1257931	0.1358154	0.1260215	0.1223807	0.1064001
$Z_{Conan\ dan\ Holder}$	1.8948821	1.7354712	1.9759374	1.7453148	2.0590842

**Table 15:** Results of the J-UK Model on Kalbe Farma Tbk (KLBF)

Year	2019	2020	2021	2022	2023
$J_1$	0.4266222	0.4386844	0.4744507	0.4507562	0.4684292
$J_2$	0.7580226	0.7478925	0.7303976	0.7524505	0.7948524
$J_3$	0.1679083	0.1607687	0.1614261	0.1636814	0.0405048
$J_4$	22.9163820	19.0201872	18.5337899	15.8559396	20.7088374
$J_5$	1.1168903	1.0243019	1.0231647	1.0621185	0.2908303
$J_6$	0.7032501	0.9844531	0.6421500	0.2472575	0.0506586
$J$	0.8064032	1.0275380	0.8561590	0.5389162	0.7375759

**Table 16:** Results of the Taffler Model on Kalbe Farma Tbk (KLBF)

Year	2019	2020	2021	2022	2023
$X_1$	1.3203233	1.1419406	1.1721832	1.0062871	0.3379295
$X_2$	3.1531429	3.0491293	3.5703422	3.2484990	4.0415228
$X_3$	0.1271721	0.1407855	0.1377140	0.1626588	0.1198618
$X_4$	1.1168903	1.0243019	1.0231647	1.0621185	0.2908303
$Z_{Taffler}$	1.2654914	1.1401622	1.2243194	1.0962974	0.7294583



**Figure 5:** The Z-Scores and J-Score of KLBF

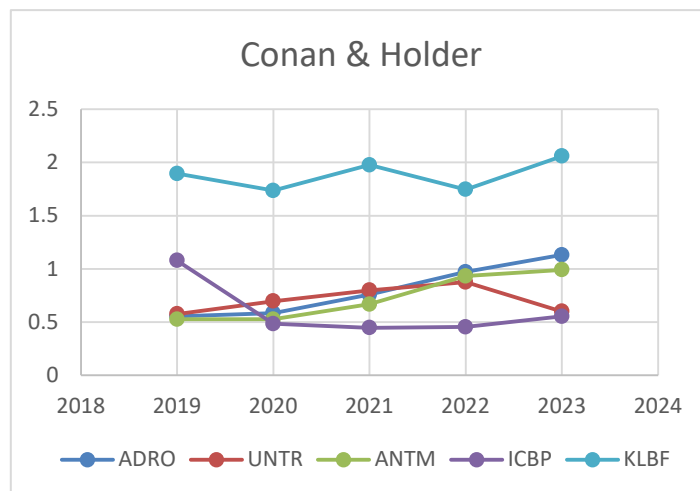
Table 14 shows that for Indofood CBP Sukses Makmur Tbk (ICBP), the Conan & Holder model produces Z-Scores that are quite large and consistently  $>1.0$ , indicating that the company is in a better position to avoid bankruptcy

compared to previous years, with a score above 1 signifying financial stability, thus clearly having a Z-Score > 0.16. This indicates that the company's bankruptcy risk level is <30%. Although the Z-Score has been consistently good, the company's bankruptcy risk level has fluctuated up and down over the 5 years of observation. This model also shows that KLBF has good long-term solvency with stable liquidity, but there is a decline in profitability that needs to be addressed.

From Table 15, we can see that the J-Score provided by the J-UK Model shows that the company's bankruptcy risk level is quite fluctuating: decreasing in 2019-2020, increasing in 2020-2022, and decreasing again in 2022-2023. Over the 5 years, the J-Score shows a decline, leading to an increased bankruptcy risk over 5 years due to KLBF experiencing a decline in performance in terms of profitability and operational efficiency, especially in 2023, although the company still has relatively good capacity in generating cash flow from operations.

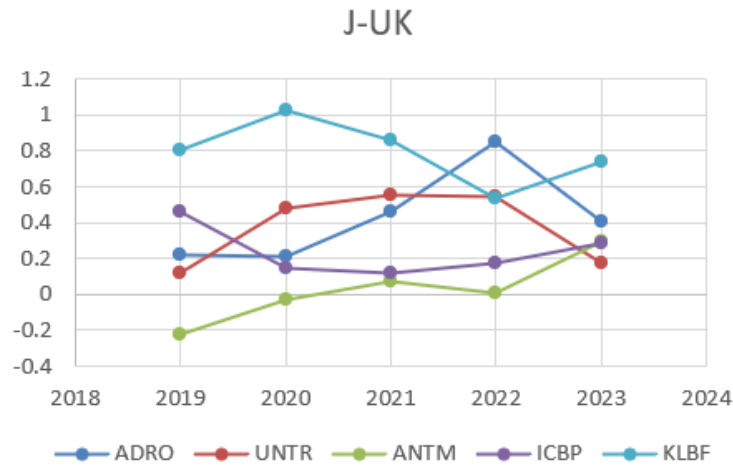
Lastly, as seen in Table 16, the Taffler Model produces a Z-Score indicating a significant decline over 5 years in the company's financial performance, particularly in aspects of productivity and asset capability in generating sales. so the risk of bankruptcy is increasing even though its Z-Score consistently remains >0.3, which actually indicates that this company always has a good chance of performing well for 5 years.

Figure 5 shows that the three models produce different trends in Z-Score and J-Score, although the Conan & Holder Model and the Taffler Model have general similarities. Overall, based on the three models, it is evident that the company's profitability has significantly declined, especially in 2023. The company's liquidity remains strong, so KLBF still has a good ability to meet its short-term obligations. From a solvency perspective, the company is still in a good position to face its long-term obligations. There is a sharp decline in the company's efficiency in utilizing its assets to generate sales, especially in 2023.



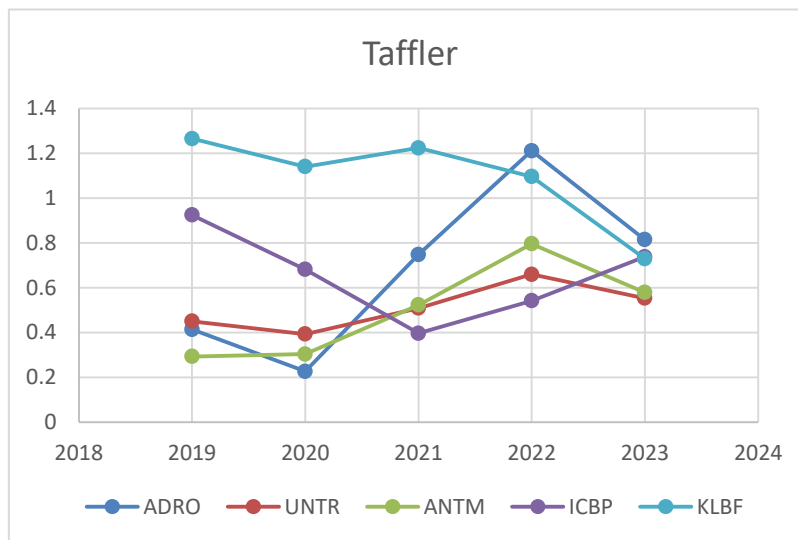
**Figure 6:** Conan & Holder Z-Scores for the Five Manufacturing Companies

Figure 6 shows the Conan & Holder Z-Score trends among the five manufacturing companies through the five years of observation. In 2023, KLBF had the highest Z-Score of 2.059 with a fluctuating but increasing trend over 5 years, indicating stability and improved solvency or profitability. ADRO had a Z-Score below KLBF with a value of 1.13 and an increasing trend up to 2023, indicating consistent improvement, signaling better financial health. ANTM had a Z-Score of 0.99 with an increasing trend with slight fluctuations, indicating stable improvement in solvency or profitability. UNTR had a Z-Score of 0.60 with an increasing trend until 2022 and a decrease in 2023, showing a less consistent trend with a decline in the last year, which could indicate increased financial risk or performance decline. Finally, ICBP had a Z-Score of 0.55 with a decreasing trend in 2020 and an increasing trend from 2021 to 2023, indicating improvement in ICBP's financial health over the past 4 years. Out of five companies, all have a bankruptcy probability of < 30%.



**Figure 7:** J-UK J-Scores for the Five Manufacturing Companies

The J-UK J-Score trends among the five manufacturing companies through the five years of observation are as seen in Figure 7. In 2023, KLBF had the highest Z-Score of 0.73 with a fluctuating trend, indicating good liquidity, profitability, and solvency. ADRO had a Z-Score below KLBF at 0.40 with a fluctuating trend, showing significant improvement until 2022 but a decline in 2023, which could indicate volatility in liquidity or profitability. Next, ANTM had a Z-Score of 0.29 with a consistently increasing trend, indicating a consistent improvement from negative to positive, signifying significant improvement in liquidity and profitability. ICBP had a Z-Score of 0.28 with a fluctuating trend, indicating instability in liquidity or profitability. Finally, UNTR had a Z-Score of 0.177 with a fluctuating trend, indicating instability in liquidity or profitability. ADRO and UNTR experienced an increase in bankruptcy risk in 2023, while ANTM, ICBP, and KLBF experienced a decrease in bankruptcy risk in 2023.



**Figure 8:** Taffler Z-Scores for the Five Manufacturing Companies

Figure 8 visualizes the Taffler Z-Score trends among the five manufacturing companies, within the five year observation. In 2023, ADRO had the highest Z-Score of 0.81 with a fluctuating trend, indicating good asset efficiency. ICBP had a Z-Score of 0.73, below ADRO, with a fluctuating trend, indicating a good score but with fluctuations showing instability in asset efficiency. KLBF had a Z-Score of 0.72 with a fluctuating trend, indicating a good score but with fluctuations showing instability in asset efficiency. ANTM had a Z-Score of 0.57 with a fluctuating trend, indicating lower asset efficiency and fluctuations that may indicate instability in asset usage to generate sales. UNTR had a Z-Score of 0.55 with a fluctuating trend, indicating lower asset efficiency and fluctuations that may indicate instability in asset usage to generate sales. Of the five companies, all have a low probability of bankruptcy and a good chance of performing well.

## 5. Conclusion

This research reveals that the obtained bankruptcy risk levels can vary, considering the relevant variables in the bankruptcy risk models used. Each model emphasizes different variables and financial aspects in analyzing bankruptcy risk, so by adding more bankruptcy models, the analysis results will improve. This also results in the suitability of a bankruptcy risk model for companies in certain sectors.

The results of this study indicate that, in general, all sample companies are financially healthy and far from bankruptcy. KLBF overall shows strong financial performance with the highest scores in Conan & Holder and J-UK, and fairly good in Taffler. Despite some fluctuations, the general trend is positive. ADRO performs well in all models, especially with a consistently improving trend in Conan & Holder and the highest score in Taffler. ANTM performs well in Conan & Holder and J-UK, although Taffler shows lower asset efficiency. ICBP performs lower compared to KLBF, ADRO, and ANTM, with some negative fluctuations in Conan & Holder and J-UK. UNTR shows the lowest performance in J-UK and Taffler, as well as negative fluctuations in Conan & Holder, indicating a higher potential financial risk.

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