

Financial Distress Prediction Model in the Construction Industry in Indonesia

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ABSTRACT

The construction industry in Indonesia is highly sensitive to shifts in government infrastructure budget allocations, which significantly influence corporate financial stability. This study aims to evaluate the effectiveness of several financial distress prediction models in construction companies in Indonesia, especially in responding to changes in government infrastructure budget allocation policies. The models tested included Altman Z-Score, Zmijewski, Springate, Michal Karas, Grover G-Score, as well as Principal Component Analysis (PCA)-based models with logistic regression. The data used includes 33 construction companies listed on the Indonesia Stock Exchange (IDX) during the period 2017–2024 with a total of 258 annual company observations. The confusion matrix and logistic regression methods were used to assess the performance of each model. The results of the analysis showed that the PCA model provided the best performance with an accuracy rate of 94% for the T-1 prediction and 93% for the T-2. Logistic regression also showed that the PCA model had strong predictive clarity (Nagelkerke R^2 of 65.2% for T-1 and 44.9% for T-2). Profitability proved to be a significant predictor, and the government's focus on infrastructure spending strengthened the accuracy of the predictions. This study recommends the PCA model as the main tool for early detection of financial distress in construction companies.

KEYWORDS

Financial Distress, PCA-Logit, Construction Sector, Indonesia, Prediction Model



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INTRODUCTION

Infrastructure development is the main foundation for national economic growth because it increases productivity, smooths the flow of goods and services, and reduces logistics costs (World Bank, 2017; Ministry of Finance of the Republic of Indonesia, 2022). The Government of Indonesia, especially during the 2017–2021 period, placed the infrastructure sector as a top priority in the allocation of expenditure in the State Revenue and Expenditure Budget (*Anggaran Pendapatan dan Belanja Negara* [APBN]) with an average portion of 14.58% of the total annual budget (Bappenas, 2021; Ministry of Finance, 2022). This allocation encouraged the growth of the construction sector, especially toll road service providers, both state-owned (*Badan Usaha Milik Negara*) and private.

However, since 2022, there has been a significant decrease in the state budget allocation for the infrastructure sector (Central Government Financial Report, 2022), which has led to a reduction in funding for national construction projects (BPS, 2023). This change in budget focus has implications for the deterioration of the financial performance of construction companies that previously relied heavily on state spending through State Capital Participation (*Penanaman Modal Negara* [PMN]). According to the Cyclical Fiscal Policy Theory, sharp changes in government fiscal spending can lead to volatility in the private sector that depends on public budgets (Heimberger, 2022).

Figure 1. State Budget Infrastructure Spending Trends

This condition increases the risk of financial distress, which is a situation when a company is unable to meet its financial obligations in a timely manner (Altman, Hotchkiss, & Wang, 2019). Based on POJK No. 2 of 2025, one of the main indicators of financial distress is a negative profit balance for three consecutive years. The impact of the shifting fiscal policy is reflected in the reports of several large construction companies experiencing a decline in revenue and cash flow. Around 2.1 million construction sector workers are even at risk of losing their jobs (Konstruksimedia.com, 2022; Kontan, 2023).

To anticipate these conditions, early detection of financial distress is needed by utilizing accurate prediction models. Altman (1968) stated that the systematic use of historical financial ratios is able to assist management, investors, and creditors in assessing financial risks objectively. However, various studies show differences in the effectiveness of models between industry sectors. For example, Ulfah & Moin (2022) found that Altman is most accurate in the tobacco sector, while Simatupang et al. (2019) suggest Zmijewski for the automotive sector, and Meiliawati (2016) advocates Springate for the cosmetics industry.

In the context of construction, Karas and Srbová (2019) developed the Michal Karas model, which proved to be more accurate than Altman, Springate, and Zmijewski. On the other hand, the research of Hassan et al. (2024) shows that the PCA-Logit model produces the highest accuracy rate (93%) in the non-financial sector in Pakistan. However, the model has not been validated for the Indonesian context, which has different economic characteristics. Therefore, the study re-tested six prediction models—Altman Z-Score, Zmijewski, Springate, Grover, Michal Karas, and PCA-Logit—in the period 2017–2024, taking into account shifts in infrastructure spending allocation. The goal is to identify the most reliable financial distress prediction model in Indonesia's construction sector.

Capital structure refers to the blend of debt and equity a company uses to finance its operations and growth. Initially, Modigliani and Miller theorized that in a world without taxes, this mix does not affect a firm's value. However, in reality, taxes make debt advantageous due to the tax-deductibility of interest, suggesting that an optimal level of leverage can enhance company value. Despite this benefit, excessive debt is avoided as it increases the risk of financial distress, which can disrupt operations, raise costs, and erode trust from customers and suppliers. This is particularly evident in Indonesia's construction sector, where high debt reliance has proven vulnerable amidst decreasing state fiscal support, underscoring the positive relationship between leverage and the probability of financial distress.

In conditions of information asymmetry, the pecking order theory suggests companies prioritize internal financing first, such as retained earnings, before seeking external funds. This approach is considered safer as it avoids sending negative signals to the market and helps maintain financial flexibility, which is crucial for the construction industry with its high project cash flow uncertainty. If internal funds are insufficient, debt is preferred over issuing new equity due to its lower cost and tax benefits. However, debt still adds a fixed liability that can strain future cash flows. Effectively managing this hierarchy of funding sources is key to ensuring a construction company's long-term resilience and solvency amidst dynamic business conditions.

To mitigate information asymmetry, companies use signaling theory to convey hidden information about their health and prospects to the market. Strategic actions, such as dividend increases or debt issuance, can serve as positive signals of management's confidence and strong future cash flows. Conversely, a decline in dividends or a new stock issue might be interpreted negatively. In the long-term and complex construction industry, credible signals like the successful and timely completion of projects are essential for building investor and creditor confidence. The effectiveness of any signal, however, depends entirely on its credibility and the company's consistency in maintaining transparent communication with the public.

Financial distress is a critical state where a company struggles to meet its financial obligations, potentially leading to bankruptcy if not addressed. It is often marked by a prolonged inability to generate sufficient profit to cover basic expenses. Several models have been developed to predict this condition, utilizing key financial indicators across liquidity, profitability, leverage, and efficiency. Traditional models like Altman's Z-Score, Zmijewski, and Springate use various combinations of these ratios, while industry-specific models like Michal Karas's are tailored for construction. Modern techniques like Principal Component Analysis (PCA) are also gaining traction for their ability to simplify complex financial data and improve prediction accuracy, providing vital tools for management and stakeholders to mitigate financial risk. [components\[A1\]](#)

The construction industry serves as a critical engine for Indonesia's economic growth, heavily reliant on government infrastructure expenditure as outlined in the State Revenue and Expenditure Budget (*APBN*). Historical data from Bappenas (2021) and the Ministry of Finance (2022) indicate that infrastructure received an average allocation of 14.58% of the national budget between 2017–2021, fueling sectoral expansion. However, a significant budgetary reallocation away from infrastructure post-2022, as reported in the Central Government Financial Report (2022), has exposed construction firms to heightened financial vulnerability. This volatility aligns with Cyclical Fiscal Policy Theory, which posits that sharp fluctuations in public spending can destabilize private sectors dependent on government contracts (Heimberger, 2022), thereby increasing the risk of financial distress—a condition where a firm cannot meet its financial obligations (Altman, Hotchkiss, & Wang, 2019).

Extant literature offers a variety of models to predict financial distress, yet their efficacy is notoriously context- and sector-specific. For instance, research by Ulfah & Moin (2022) found the Altman Z-Score most accurate for Indonesian tobacco companies, while Simatupang et al. (2019) advocated for the Zmijewski model in the automotive sector.

Specific to construction, Karas and Srbová (2019) developed a tailored model demonstrating superior accuracy over traditional ones. More recently, Hassan et al. (2024) achieved a 93% prediction accuracy in Pakistan's non-financial sector using a sophisticated PCA-Logit model. This disparity in model performance across industries and regions underscores a critical research gap: a comprehensive, comparative validation of these prominent models within the unique and policy-sensitive context of Indonesia's construction sector, particularly during a period of fiscal transition.

The urgency of this research is underscored by the severe economic ramifications of financial distress within the construction industry. Recent reports indicate that approximately 2.1 million workers in the sector are at risk of job loss due to corporate financial instability (Kontan, 2023). Furthermore, POJK No. 2 of 2025 formally categorizes companies with three consecutive years of negative profit as financially distressed, mandating early detection and intervention. The recent shift in fiscal policy therefore represents not merely an academic concern but a pressing socio-economic issue that threatens corporate solvency, employment, and the nation's broader infrastructure development goals. A reliable predictive model is urgently needed to equip stakeholders with tools for proactive risk mitigation.

This study introduces novelty by conducting a direct, empirical comparison of six established prediction models—Altman Z-Score, Zmijewski, Springate, Grover, Michal Karas, and PCA-Logit—applied to a singular, high-stakes context: Indonesian construction companies during a defined period of fiscal policy change (2017–2024). The research innovates by integrating the impact of government infrastructure budget fluctuations as a control variable, testing the hypothesis that external fiscal policy significantly strengthens predictive accuracy. This approach moves beyond mere model comparison to create a more holistic forecasting framework that accounts for crucial macro-environmental drivers.

The primary objective of this research is to identify the most accurate and reliable financial distress prediction model for construction companies listed on the Indonesia Stock Exchange. It aims to rigorously test the predictive power of the six selected models, evaluate the influence of government infrastructure spending on their accuracy, and determine which variables (e.g., profitability, leverage) serve as the most significant indicators of distress within this sector. The study seeks to provide a clear, evidence-based hierarchy of model performance tailored to the Indonesian economic landscape.

The benefits of this research are multifold. For company management, it provides a robust tool for early warning, enabling strategic financial restructuring and debt renegotiation to avert bankruptcy. Investors and creditors can leverage the findings to make more informed capital allocation and lending decisions, mitigating investment risks. For policymakers, the study highlights the tangible impact of fiscal policy on corporate financial health, offering valuable insights for designing more stable and supportive budgetary frameworks. Ultimately, by enhancing predictive accuracy, this research contributes to the stability of the construction sector, safeguards employment, and supports Indonesia's sustainable economic development.

RESEARCH METHODS

This study utilizes audited secondary data from the financial statements of state-owned and private construction companies listed on the Indonesia Stock Exchange (IDX) from 2017 to 2024. This period was intentionally selected to capture the financial health of the sector during a phase of aggressive government infrastructure spending followed by a shift in fiscal priorities. A purposive sampling method was applied, resulting in a final sample of 33 companies that met strict criteria, including being registered with the Ministry of Public Works and having complete, audited financial data for the entire period, yielding 258 observations for analysis. The data encompass key financial ratios across liquidity, leverage, activity, and profitability, which are crucial for assessing financial distress.

The core objective of the research is to evaluate and compare the predictive accuracy of several financial distress models—namely Altman Z-Score, Zmijewski, Springate, Michal Karas, Grover, and a PCA-Logit integration—within the unique context of the Indonesian construction industry. An empirical quantitative approach is employed, processing the data with SPSS version 22 to perform statistical analyses, including logistic regression and discriminant analysis. The performance of each model will be rigorously tested using a confusion matrix to measure its accuracy, sensitivity, and specificity in classifying companies as distressed or healthy.

The methodology is supported by a series of statistical tests to ensure validity. Descriptive statistics first summarize the characteristics of the data, followed by inferential techniques. For the logistic regression elements, three key tests will be conducted: the Goodness of Fit Test to evaluate how well the model fits the data; the Omnibus Test to check the joint significance of all independent variables; and the Hosmer and Lemeshow Test to assess the agreement between predicted and observed probabilities. Each prediction model operates on a distinct formula, combining specific financial ratios to generate a score that indicates a company's risk of financial distress.

Based on a review of conflicting findings in previous literature, seven hypotheses (H1–H7) are formulated to test which of these six prediction models demonstrates the highest accuracy in the Indonesian construction sector. The hypotheses posit the superiority of different models, from the traditional Altman Z-Score to the modern PCA-Logit approach, reflecting the ongoing debate in the field. The outcome of this comparative analysis aims to identify the most reliable tool for stakeholders to conduct early detection of financial distress, thereby mitigating bankruptcy risk.

RESULTS AND DISCUSSION

Sampling Process

The sampling process for this study involved filtering data from construction companies, categorized into state-owned enterprises and local government-owned enterprises, based on the complete availability of their financial statements from 2017 to 2024. This rigorous filtration, which accepted companies with full data and rejected those with incomplete records, resulted in a final sample of 258 observations with a minimal 2.3% unbalanced panel data, a proportion considered acceptable for robust analysis. The subsequent descriptive statistics of key financial ratios revealed a sector with significant internal variability; while the average Quick Ratio indicated sufficient aggregate liquidity,

the high standard deviation pointed to stark differences between individual companies, with some exhibiting very strong and others very weak positions.

A detailed analysis of the Altman Z-Score model components painted a picture of a vulnerable sector. Key findings included negative retained earnings, very low earnings relative to assets, and limited working capital, though the ability to generate sales from assets remained stable. The Zmijewski and Springate models further underscored the industry's challenges, confirming overall low profitability and moderate leverage. While average liquidity appeared adequate, the enormous standard deviations in ratios like Current Assets to Current Liabilities highlighted extreme disparities between companies, meaning these averages masked severe problems within a significant portion of the sample.

The financial profile constructed by the Michal Karas and Grover models reinforced this narrative of sector-wide strain. Both models consistently reported negative or very low averages for profitability ratios like Net Profit to Total Assets and Return on Assets, signaling a critical challenge in generating earnings. Furthermore, an increasing trend in the Current Liabilities to Sales ratio indicated a growing burden of short-term obligations compared to revenue generation. This collective evidence from the descriptive analysis consistently pointed to a construction sector facing substantial profitability pressures and a heightened risk of financial distress.

The predictive power of each model was then rigorously tested using confusion matrix metrics. Traditional models like Altman, Zmijewski, Springate, and Michal Karas demonstrated significant weaknesses. Their accuracy rates were low to moderate, and they consistently suffered from very poor precision and specificity, meaning they frequently misclassified healthy companies as distressed. While their recall (sensitivity) was often high, this came at the cost of a high false positive rate, greatly limiting their practical reliability for predicting financial distress in this context.

In stark contrast, the Grover and PCA models showed markedly superior performance. The Grover model achieved high accuracy (88% and 85%) and outstanding specificity, proving excellent at identifying healthy companies, though its sensitivity was moderate. The PCA model was the top performer, achieving exceptional accuracy (94% and 93%), near-perfect specificity, and high precision. Its main limitation was a recall that decreased over time, indicating it missed some distressed firms, but its overall balance of metrics made it the most effective tool.

The evaluation of predictive models reveals a clear hierarchy of effectiveness for the Indonesian construction sector. The PCA model stands out as the most robust and accurate predictor overall, followed by the Grover model. The traditional models, namely Altman, Zmijewski, Springate, and Michal Karas, demonstrated insufficient performance for reliable application in this specific industry context. This underscores the critical importance of selecting a model with high precision and specificity to avoid the costly errors of misclassifying healthy companies as distressed.

Logistic Regression Results

Table 1. Atman z-score Model Regression Results

Period	Ratio	Coefficients	Probability	Model Accuracy (%)	
				(%) Cox & Snell	Nagelkerke
T-1	WCTA	-0,18	0,88	39,6	61,2
	RETA	-5,79	0,01		
	EBITTA	-10,87	0,05		
	MVEBVD	0,00	0,79		
	STA	-1,00	0,50		
T-2	WCTA	-0,35	0,75	39,2	61,1
	RETA	-7,25	0,00		
	EBITTA	5,98	0,02		
	MVEBVD	0,00	0,89		
	STA	-2,09	0,14		

T-1

Omnibus Tests of Model Coefficients	Chi-square	df	Sig.
Step	75,129	5	0,000
Block	75,129	5	0,000
Model	75,129	5	0,000

Hosmer and Lemeshow Test	Chi-square	df	Sig.
1	21,541	8	0,006

T-2

Omnibus Tests of Model Coefficients	Chi-square	df	Sig.
Step	76,051	5	0,000
Block	76,051	5	0,000
Model	76,051	5	0,000

Hosmer and Lemeshow Test	Chi-square	df	Sig.
1	17,344	8	0,027

The results of the logistic regression test on the Altman Z-score model show that the financial distress prediction model has quite good explanatory power, with a Nagelkerke R-square value of 61.1% in the T-2 period and a slight increase to 61.2% in the T-1 period, which explains that this model is able to predict more than 60% of the probability of financial distress occurring two years before the event. Based on the probability value on the regression coefficient, the ratio of RETA (Retained Earnings to Total Assets) and EBITTA (Earnings Before Interest and Taxes to Total Assets) were significant variables in both study periods, with probability values of 0.01 and 0.05 at T-1 and 0.00 and 0.02 at T-2.

Meanwhile, other variables such as WCTA, MVEBVD, and STA have insignificant probability values (greater than 0.05), which means that they do not have a significant influence on financial distress in this model. The Omnibus Test showed significant results (significance value of 0.000 in both periods), indicating that the independent variables in this model had a significant influence on financial distress

conditions. However, the results of the Hosmer and Lemeshow test showed poor significance values (0.006 at T-1 and 0.027 at T-2), which means that the model's compatibility with the observational data is less than optimal. Thus, although the independent variables in this model are significant in explaining financial distress, the model's fit for empirical data still needs further attention and improvement.

Table 2. Regression Results of the Zmijewski Model

Period	Ratio	Coefficients	Probability	Model Accuracy (%)	
				Cox & Snell	Nagelkerke
T-1	NPTA	-25,45	0,00	30,1	50,1
	TDTA	0,75	0,60		
	CACL	-0,97	0,13		
T-2	NPTA	-2,29	0,07	9,3	15,4
	TDTA	1,44	0,23		
	CACL	-0,83	0,12		

T-1

Omnibus Tests of Model Coefficients	Chi-square	df	Sig.
Step	68,643	3	0,000
Block	68,643	3	0,000
Model	68,643	3	0,000

Hosmer and Lemeshow Test	Chi-square	df	Sig.
1	9,149	8	0,330

T-2

Omnibus Tests of Model Coefficients	Chi-square	df	Sig.
Step	18,915	3	0,000
Block	18,915	3	0,000
Model	18,915	3	0,000

Hosmer and Lemeshow Test	Chi-square	df	Sig.
1	5,189	8	0,737

The results of the logistic regression test on the Zmijewski model show that the financial distress prediction model using the Zmijewski ratio has a moderate level of explanation, with the Nagelkerke R-square value of 50.1% in the T-1 period and decreasing to 15.4% in the T-2 period, which means that in the first period, the model can explain about 50.1% variation in the occurrence of financial distress, but the model's ability to predict the two-year period before the event is very small. that is only 15.4%. From the results of the regression coefficient, the Net Profit to Total Assets (NPTA) ratio became a significant variable in the T-1 period (probability 0.00), but not significant in the T-2 period (probability 0.07).

The other two variables, namely Total Debt to Total Assets (TDTA) and Current Assets to Current Liabilities (CACL), showed insignificant probability values in both periods, meaning that neither had a significant influence on financial distress conditions in this model. The Omnibus Test in both periods showed significant results (0.000), indicating that in general the variables included in the model had a significant effect on financial

distress conditions. Meanwhile, the results of the Hosmer and Lemeshow test showed good results in both periods (significance of 0.330 in T-1 and 0.737 in T-2), indicating that this model has a good fit with the empirical data used.

Table 3. Springate Model Regression Results

Period	Ratio	Coefficients	Probability	Model Accuracy (%)	
				Cox & Snell	Nagelkerke
T-1	WCTA	-1,04	0,46	31,1	49,4
	EBITTA	-5,26	0,64		
	EBTCL	-12,90	0,29		
	STA	-3,43	0,01		
T-2	WCTA	-1,51	0,13	13,4	21,4
	EBITTA	-3,85	0,79		
	EBTCL	2,18	0,88		
	STA	-3,17	0,00		

T-1

Omnibus Tests of Model Coefficients	Chi-square	df	Sig.
Step	62,311	4	0,000
Block	62,311	4	0,000
Model	62,311	4	0,000

Hosmer and Lemeshow Test	Chi-square	df	Sig.
1	8,266	8	0,408

T-2

Omnibus Tests of Model Coefficients	Chi-square	df	Sig.
Step	24,969	4	0,000
Block	24,969	4	0,000
Model	24,969	4	0,000

Hosmer and Lemeshow Test	Chi-square	df	Sig.
1	15,360	8	0,053

The results of the logistic regression test on the Springate model showed that the financial distress prediction model using the Springate model ratio had a moderate explanatory ability, with the Nagelkerke R-square value of 49.4% in the T-1 period but decreased significantly to 21.4% in the T-2 period. This shows that the model has a fairly good ability to predict financial distress conditions in the first period, but is very limited in the two-year period before the event. The Sales to Total Assets (STA) variable proved significant in both study periods, with a probability of 0.01 at T-1 and 0.00 at T-2, indicating that sales efficiency relative to total assets is a strong indicator in predicting financial distress. Other variables, such as Working Capital to Total Assets (WCTA), EBIT to Total Assets (EBITTA), and Earnings Before Tax to Current Liabilities (EBTCL), do not show consistent significance (probability value above 0.05), so they are less significant in predicting financial distress.

The results of the Omnibus Test showed a very good significance value (0.000 in both periods), which indicates that the independent variables simultaneously have a

significant influence on the prediction of financial distress. Meanwhile, the results of the Hosmer and Lemeshow test showed good results with a significance value of 0.408 at T-1 and 0.053 at T-2, indicating that this model has a good match with the empirical data used.

Table 4. Regression Results of the Michal Karas Model

Period	Ratio	Coefficients	Probability	Model Accuracy (%)	
				Cox & Snell	Nagelkerke
T-1	EATTA	-18,46	0,03	38,6	64,3
	EBITA	0,91	0,90		
	RETA	-3,17	0,01		
	CLS	0,62	0,02		
T-2	EATTA	-3,79	0,58	36,3	59,9
	EBITA	5,11	0,46		
	RETA	-3,26	0,00		
	CLS	0,89	0,00		

T-1

Omnibus Tests of Model Coefficients	Chi-square	df	Sig.
Step	93,763	4	0,000
Block	93,763	4	0,000
Model	93,763	4	0,000

Hosmer and Lemeshow Test	Chi-square	df	Sig.
1	8,550	8	0,382

T-2

Omnibus Tests of Model Coefficients	Chi-square	df	Sig.
Step	87,051	4	0,000
Block	87,051	4	0,000
Model	87,051	4	0,000

Hosmer and Lemeshow Test	Chi-square	df	Sig.
1	19,394	8	0,113

The results of the logistic regression test on the Michal Karas model showed that the financial distress prediction model had a good explanatory performance in both study periods, with a Nagelkerke R-square value of 64.3% in the T-1 period and 59.9% in the T-2 period, which suggests that the model is able to explain most of the variation in the likelihood of financial distress even two years before the event. The significant variables in the T-1 period were Earnings After Taxes to Total Assets (EATTA) with a probability of 0.03, Retained Earnings to Total Assets (RETA) with a probability of 0.01, and Current Liabilities to Sales (CLS) with a probability of 0.02.

In the T-2 period, the significant variables changed, where RETA and CLS remained significant (probability 0.00 for both), while EATTA became insignificant (probability 0.58). The Omnibus Test showed excellent results with a significance of 0.000 for both periods, confirming that the variables in this model simultaneously had a significant effect on financial distress. Meanwhile, the Hosmer and Lemeshow test showed a good model

match to the empirical data, with significance values of 0.382 at T-1 and 0.113 at T-2, meaning there was no significant difference between the model's prediction and the actual observations.

Table 5. Results of Grover Model Regression

Period	Ratio	Coefficients	Probability	Model Accuracy (%)	
				Cox & Snell	Nagelkerke
T-1	WCTA	-2,17	0,11	29,5	49,1
	EBITA	-1,71	0,84		
	ROA	-25,18	0,01		
T-2	WCTA	-2,64	0,01	8,4	13,9
	EBITA	2,32	0,76		
	ROA	-4,42	0,55		

T-1

Omnibus Tests of Model Coefficients	Chi-square	df	Sig.
Step	67,117	3	0,000
Block	67,117	3	0,000
Model	67,117	3	0,000

Lemeshow Test	Chi-square	df	Sig.
1	7,354	8	0,499

T-2

Omnibus Tests of Model Coefficients	Chi-square	df	Sig.
Step	16,979	3	0,001
Block	16,979	3	0,001
Model	16,979	3	0,001

Lemeshow Test	Chi-square	df	Sig.
1	14,336	8	0,073

The results of the logistic regression test on the Grover Model showed that this model had the ability to explain the variation in financial distress prediction of 49.1% (Nagelkerke R-square) in the T-1 period, but only 13.9% in the T-2 period, which indicates that the model was more effective in the first period in explaining the financial distress conditions of construction companies. The Return on Assets (ROA) variable became a significant variable in the T-1 period with a probability of 0.01, showing that the profitability of the company's assets is an important indicator in predicting distress conditions in that period.

In the T-2 period, the Working Capital to Total Assets (WCTA) variable became a significant variable with a probability of 0.01, while the other variable did not show strong significance. The results of the Omnibus Test showed excellent significance in both periods (significance values of 0.000 at T-1 and 0.001 at T-2), confirming that the variables in the model together were able to explain the distress condition. The Hosmer and Lemeshow test also showed good results with significance values of 0.499 at T-1 and 0.073 at T-2, indicating a good model match with the actual data.

Table 6. PCA Model Regression Results

Period	Ratio	Coefficients	Probability	Model Accuracy (%)	
				Cox & Snell	Nagelkerke
T-1	AssetEfficiency	-0,16	0,10	39,2	65,2
	leverage	-0,03	0,79		
	profitability	-1,42	0,00		
	liquidity	-0,26	0,37		
	size	0,04	0,70		
	growth	-0,14	0,10		
T-2	AssetEfficiency	-0,11	0,09	27,2	44,9
	leverage	-0,03	0,72		
	profitability	-0,52	0,02		
	liquidity	-0,37	0,09		
	size	-0,05	0,47		
	growth	0,00	0,89		

T-1

Omnibus Tests of Model Coefficients	Chi-square	df	Sig.
Step	95,467	6	0,000
Block	95,467	6	0,000
Model	95,467	6	0,000

Lemeshow Test	Chi-square	df	Sig.
1	3,565	8	0,894

T-2

Omnibus Tests of Model Coefficients	Chi-square	df	Sig.
Step	61,227	6	0,000
Block	61,227	6	0,000
Model	61,227	6	0,000

Lemeshow Test	Chi-square	df	Sig.
1	9,192	8	0,326

The results of the logistic regression test for the PCA model showed good explanatory ability with a Nagelkerke R-square value of 65.2% in the T-1 period, but decreased to 44.9% in the T-2 period, indicating that the model's predictive ability is still strong despite the decline in the second period. The profitability variable proved to be significant in both study periods, with a probability of 0.00 at T-1 and 0.02 at T-2, suggesting that the company's profitability had a significant impact on the prediction of financial distress. Meanwhile, other variables such as asset efficiency, leverage, liquidity, size, and growth did not show consistent significance in both periods, with a probability value greater than 0.05. The results of the Omnibus Test gave excellent results with a significance value of 0.000 in both periods, showing that overall the variables in the PCA model had a significant effect on financial distress. The Hosmer and Lemeshow assays also

showed excellent results, with significance values of 0.894 at T-1 and 0.326 at T-2, indicating an excellent fit of the model to the actual data.

Table 7. PCA Model Regression Results

Period	Ratio	Without Control Variables		With Control Variables		% Dev	
		Cox & Snell	Nagelkerke	Cox & Snell	Nagelkerke	Cox & Snell	Nagelkerke
T-1	Altman Z-Score	39,6	61,2	39,9	61,8	0,8%	1,0%
	Zmijewski	30,1	50,1	31,5	52,4	4,7%	4,6%
	Springate S-Score	31,1	49,4	31,9	50,7	2,6%	2,6%
	Michal Karas	38,6	64,3	39,5	65,7	2,3%	2,2%
	Grover G-Score	29,5	49,1	30,5	50,8	3,4%	3,5%
	PCA	39,2	65,2	39,7	66,1	1,3%	1,4%
T-2	Altman Z-Score	39,2	61,1	40,3	62,9	2,8%	2,9%
	Zmijewski	9,3	15,4	15,5	25,5	66,7%	65,6%
	Springate S-Score	13,4	21,4	17,7	28,1	32,1%	31,3%
	Michal Karas	36,3	59,9	38,2	63,1	5,2%	5,3%
	Grover G-Score	8,4	13,9	13,1	21,7	56,0%	56,1%
	PCA	27,2	44,9	29	47,8	6,6%	6,5%

The table presents the results of a comparison of the strength of financial distress prediction models in construction companies, with and without control variables in the form of the focus of the government state budget. In general, it can be seen that the addition of control variables (the focus of the government state budget) increases the value of the Nagelkerke R-square across the model, which shows that the government's fiscal policy related to the infrastructure budget makes a significant contribution to increasing the model's predictive power against financial distress conditions.

The most significant improvement occurred in the Zmijewski model and the Springate S-Score in the T-2 period, with an increase of 65.6% and 51.3%, respectively, indicating that the impact of government state budget policies is very relevant in explaining the risk of financial distress, especially when there is a change in the focus of government infrastructure spending. Thus, the addition of control variables in the form of the focus of the government state budget has proven to be effective in increasing the predictability of the model against financial distress conditions in construction companies in Indonesia.

CONCLUSION

Based on the comprehensive empirical analysis, this study conclusively determines that the Principal Component Analysis integrated with logistic regression (PCA-Logit) model is the most superior tool for predicting financial distress in Indonesia's construction sector. It achieved the highest accuracy rates of 94% for T-1 and 93% for T-2 predictions, significantly outperforming traditional models like Altman Z-Score, Zmijewski, Springate, Grover, and even the industry-specific Michal Karas model. The PCA model's strength is further validated by its strong explanatory power, evidenced by a Nagelkerke R^2 of 65.2% for T-1, and its ability to identify profitability as a paramount significant variable. Furthermore, the research confirms that external macro-fiscal factors are crucial; the inclusion of the government's state budget allocation for infrastructure as a control variable substantially enhanced the predictive power of all tested models. This underscores that the financial health of construction companies is intrinsically linked to government fiscal policy, and effective prediction models must account for such external volatilities. [results][A1]

For future research, several avenues emerge from these findings. First, the study could be expanded by incorporating a wider range of macroeconomic variables, such as interest rates, inflation, and GDP growth, into the predictive models to build a more robust and multi-faceted early warning system. Second, applying machine learning algorithms and artificial intelligence techniques could potentially yield even higher accuracy rates and better handle complex, non-linear relationships within the data that traditional statistical models may miss. Third, future studies should test the generalizability of the PCA-Logit model's supremacy in other sectors that are also highly sensitive to government policy and budget allocations, such as the energy, agriculture, or healthcare sectors. Finally, a longitudinal study tracking the application of these models in real-time by corporate management could provide invaluable insights into their practical utility and effectiveness in triggering pre-emptive restructuring and avoiding actual financial collapse.

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