



Explaining the Financial Distress Model Based on a Combined Framework of Accounting and Auditing Information: Examining and Comparing the Altman, Zmijewski, and Combined Models



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Abstract: The present study aims to explain the financial distress model based on a combined framework of accounting and auditing information by examining and comparing the Altman, Zmijewski, and combined models. This study is applied in nature, as its results can be used in decision-making processes. Since the data in this research were collected based on real historical information, it is classified as ex-post facto research. Regarding hypothesis inference, this study falls under the category of descriptive-correlational research, as regression and correlation techniques were employed to determine the relationships between variables. Therefore, in terms of reasoning, it belongs to the category of inductive research. Additionally, this study follows a positive theoretical approach, as conclusions are drawn by testing existing data. To achieve the research objective, data from 87 companies listed on the Tehran Stock Exchange between 2013 and 2022 were collected and analyzed using logistic regression based on panel data. The results indicate that the modified Altman and Zmijewski models, based on a combined framework of accounting and auditing information, demonstrate greater predictive power in forecasting corporate financial distress compared to the original Altman (Zmijewski) model. Furthermore, the findings reveal that incorporating a combined framework of accounting and auditing information into the original Altman (Zmijewski) model enhances the ability to predict financial distress in companies.

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1. Introduction

One of the primary concerns of creditors, investors, and governments, which helps mitigate potential financial losses, is the timely identification of companies on the verge of financial distress [1]. Evaluating financial distress is a significant consideration for investors and corporate stakeholders and has been a fundamental concern for investors, creditors, and governments. If companies approaching financial distress can be identified in time, it can substantially prevent potential losses for stakeholders [2]. Financial distress is a critical issue for the economic sustainability of countries. The individual and social costs associated with financial distress make the prediction of financial distress an essential matter for many managers, banks, investors, policymakers,

and auditors [3]. During recent global financial crises, numerous companies have faced financial distress and bankruptcy. Currently, businesses operate in a highly dynamic and competitive environment. Quick and accurate responses to rapidly changing market conditions play a crucial role in the success of enterprises. With the development of monetary and financial markets and the resulting competitive landscape, many bankrupt companies are eliminated from the competition. This situation raises concerns among investors, prompting them to seek methods to predict corporate financial crises to protect both their principal and interest on investments [4].

A company is considered to be in financial distress when it experiences a period in which it is unable to meet its financial obligations, such as paying bills, in a timely manner. Employees of financially distressed companies often suffer from anxiety and low morale. Companies under financial distress typically struggle to secure suitable financing solutions. Financial distress leads to severe financial disruption, operational inefficiencies, and damage to the company's public reputation, and in extreme cases, it can result in bankruptcy and liquidation [5]. Since the 1980s, financial constraints have been a major topic of empirical research [6]. Financial distress is closely related to financial difficulties, occurring when a company lacks sufficient cash flow to meet its current obligations. A financially distressed company is one that faces financial constraints due to an inability to obtain sufficient external funding. Financial constraints imply that certain companies experience limitations in their ability to secure external financing and must rely on internal resources to fund their operations [7].

Ultimately, by forecasting financial crises, investors not only prevent the loss of their capital but also use these predictions as a tool to mitigate investment risks. Business managers, if alerted to the risk of bankruptcy in a timely manner, can take preventive measures. In this way, banks and financial institutions can also mitigate the risk of loan default. Therefore, predicting bankruptcy is a crucial factor for success in economic environments. The significance of this issue stems from the fact that financial distress and bankruptcy impose substantial costs and cause irreparable damage to a country's economy [8]. Thus, one of the effective ways to prevent financial distress is through financial distress prediction.

Given these considerations, previous studies on explaining corporate financial distress using financial ratios and accounting information within various models in Iran and other countries remain insufficient. Comparative research on the major financial distress prediction models, utilizing the Altman, Zmijewski, and combined models, is necessary. This study aims to explain financial distress based on a combined framework of accounting and auditing information by examining and comparing the Altman, Zmijewski, and combined models. Furthermore, due to the adverse consequences of financial distress, employing methods that can predict financial incapacity and prevent wealth destruction is of paramount importance. Although the significance of auditing information is widely acknowledged, there remains a gap in the empirical literature, which this study seeks to address by evaluating the ability of the Altman, Zmijewski, and combined models in explaining financial distress with an emphasis on accounting and auditing information. This research helps companies enhance the quality of their audit information and accurately predict financial distress.

2. Methodology

This study is classified as a quasi-experimental research within the domain of positive accounting research. Due to the lack of control over variables, the present study is considered quasi-experimental, as it is difficult to fully control the variables in natural and social organizational settings. Additionally, in terms of its nature, this research is a descriptive-correlational study. Since the objective of this research is to expand applied knowledge related to

the subject under investigation, it can be categorized as applied research. Furthermore, the research methodology follows an ex-post facto approach.

The statistical population of this study consists of companies listed on the Tehran Stock Exchange over a ten-year period from 2013 to 2022. The sample for hypothesis testing is selected based on the following criteria: (1) the company must have been listed on the Tehran Stock Exchange before 2013, (2) the company should not be an investment, financial, or intermediary firm due to differences in their business models, (3) to ensure comparability, the company's fiscal year must end in March and should not have changed over the study period, as greater homogeneity and comparability among sample companies lead to more reliable hypothesis testing results, and (4) the company should not have experienced a financial reporting gap of more than six months.

Ultimately, based on these criteria, a total of 87 companies from the Tehran Stock Exchange were selected as the research sample. The required data for the study were gathered from Rahavard Novin, Tadbir Pardaz software, and the official website of the Tehran Stock Exchange. The collected data were then classified and calculated using Excel spreadsheets and analyzed using Eviews10 software. In this research, both field and library methods were employed for data collection.

The model used for the first hypothesis:

$$\text{Distress}(p=1) = \beta_0 + \beta_1\text{WCit} + \beta_2\text{REit} + \beta_3\text{EBITit} + \beta_4\text{LEVit} + \beta_5\text{Sit} + \beta_6\text{TNINAIT} + \beta_7\text{STINVit} + \beta_8\text{LTINVit} + \beta_9\text{DTAit} + \beta_{10}\text{INVit} + \beta_{11}\text{CONTINit} + \beta_{12}\text{ACLOSSit} + \beta_{13}\text{INFOMit} + \beta_{14}\text{NEGWCit} + \beta_{15}\text{SUBSEQit} + \beta_{16}\text{REPERit} + \beta_{17}\text{LIABit} + \text{£it}$$

The model used for the second hypothesis:

$$\text{Distress}(p=1) = \beta_0 + \beta_1\text{WCit} + \beta_2\text{REit} + \beta_3\text{EBITit} + \beta_4\text{LEVit} + \beta_5\text{Sit} + \beta_6\text{EMPHA} + \beta_7\text{SCOPE} + \beta_8\text{GAAPV} + \text{£it}$$

The model used for the third hypothesis:

$$\text{Distress}(p=1) = \beta_0 + \beta_1\text{WCit} + \beta_2\text{REit} + \beta_3\text{EBITit} + \beta_4\text{LEVit} + \beta_5\text{Sit} + \beta_6\text{REGULit} + \beta_7\text{ENVIRit} + \beta_8\text{MGMTpit} + \beta_9\text{GCit} + \beta_{10}\text{INPROCit} + \text{£it}$$

The model used for the fourth hypothesis:

$$\text{Distress}(p=1) = \beta_0 + \beta_1\text{WCit} + \beta_2\text{REit} + \beta_3\text{EBITit} + \beta_4\text{LEVit} + \beta_5\text{Sit} + \beta_6\text{AUOPIit} + \beta_7\text{ACCOMit} + \beta_8\text{REGULit} + \text{£it}$$

The model used for the fifth hypothesis:

$$\text{Distress}(p=1) = \beta_0 + \beta_1\text{ROAit} + \beta_2\text{FINLit} + \beta_3\text{LIQit} + \beta_4\text{TNINAIT} + \beta_5\text{STINVit} + \beta_6\text{LTINVit} + \beta_7\text{DTAit} + \beta_8\text{INVit} + \beta_9\text{CONTINit} + \beta_{10}\text{ACLOSSit} + \beta_{11}\text{INFOMit} + \beta_{12}\text{NEGWCit} + \beta_{13}\text{SUBSEQit} + \beta_{14}\text{REPERit} + \beta_{15}\text{LIABit} + \text{£it}$$

The model used for the sixth hypothesis:

$$\text{Distress}(p=1) = \beta_0 + \beta_1\text{ROAit} + \beta_2\text{FINLit} + \beta_3\text{LIQit} + \beta_4\text{EMPHA} + \beta_5\text{SCOPE} + \beta_6\text{GAAPV} + \text{£it}$$

The model used for the seventh hypothesis:

$$\text{Distress}(p=1) = \beta_0 + \beta_1\text{ROAit} + \beta_2\text{FINLit} + \beta_3\text{LIQit} + \beta_4\text{REGULit} + \beta_5\text{ENVIRit} + \beta_6\text{MGMTpit} + \beta_7\text{GCit} + \beta_8\text{INPROCit} + \text{£it}$$

The model used for the eighth hypothesis:

$$\text{Distress}(p=1) = \beta_0 + \beta_1\text{ROAit} + \beta_2\text{FINLit} + \beta_3\text{LIQit} + \beta_4\text{AUOPIit} + \beta_5\text{ACCOMit} + \beta_6\text{REGULit} + \text{£it}$$

A) Dependent Variable of the Study

Distress (Financial Distress): In this study, the following specific criteria are used to measure financial distress. Companies that meet any of the specified criteria are assigned a value of one, while other companies receive a value of zero. A company is classified as financially distressed if it meets at least one of the following conditions (Mansourfar, 2013):

1. The company has reported losses for three consecutive years. Significant operational losses are considered financial indicators of doubt regarding the company's going concern assumption.
2. The company's cash dividend has decreased by more than 40% for three consecutive years. The failure to pay dividends or prolonged delays in dividend payments is a financial indicator that raises doubts about the company's going concern assumption. The decline in profitability and subsequent reduction in dividend distribution in financially distressed companies can be explained in two ways: (a) difficulties in securing external financing, and (b) opportunity costs faced by the company.
3. For two consecutive years, the company's earnings before interest, taxes, and depreciation (EBITDA) are less than 80% of its interest expenses (Asquith, 1994). Additionally, a low interest coverage ratio is used to define financial distress.
4. The company experiences negative stock returns (a decline of more than 30%) along with negative sales growth. Losing a major market for the company's products is an operational indicator of doubt regarding the company's going concern assumption. If this is accompanied by negative stock returns, it is indicative of the company's declining performance in the financial distress cycle. A stock return decline of more than 30% suggests a negative financial outlook, and negative sales growth along with negative stock returns serves as a warning sign of underlying operational difficulties in the company's daily business activities.
5. The company's book value per share remains below its nominal value for three consecutive years. When the book value per share is lower than the nominal value, it indicates accumulated losses in the company. If the company's current earnings do not serve as a strong predictor of future profits and the company faces a high likelihood of operational discontinuation or liquidation, book value becomes an increasingly significant determinant of firm valuation (Mansourfar, 2013).

B) Independent Variables of the Study

WC: Working capital

RE: Retained earnings

EBIT: Earnings before interest and taxes

LEV: Financial leverage (ratio of book value of shareholders' equity to book value of liabilities)

S: Sales revenue

ROA: Return on assets (ratio of net profit to total assets)

FINL: Ratio of total liabilities to total assets (financial leverage)

LIQ: Ratio of current assets to current liabilities (liquidity)

TNINA: A binary variable; if the auditor has provided an opinion on tangible and intangible assets, it takes the value of 1, otherwise 0.

STINV: A binary variable; if the auditor has provided an opinion on short-term investments, it takes the value of 1, otherwise 0.

LTINV: A binary variable; if the auditor has provided an opinion on long-term investments, it takes the value of 1, otherwise 0.

DTA: A binary variable; if the auditor has provided an opinion on deferred taxes, it takes the value of 1, otherwise 0.

INV: A binary variable; if the auditor has provided an opinion on inventories, it takes the value of 1, otherwise 0.

CONTIN: A binary variable; if the auditor has provided an opinion on contingent assets and liabilities, it takes the value of 1, otherwise 0.

ACLOSS: A binary variable; if the auditor has provided an opinion on accumulated losses, it takes the value of 1, otherwise 0.

INFOM: A binary variable; if the auditor has provided an opinion on omitted information, it takes the value of 1, otherwise 0.

NEGWC: A binary variable; if the auditor has provided an opinion on negative working capital, it takes the value of 1, otherwise 0.

SUBSEQ: A binary variable; if the auditor has provided an opinion on post-balance sheet events, it takes the value of 1, otherwise 0.

REPER: A binary variable; if the auditor has provided an opinion on company performance, it takes the value of 1, otherwise 0.

LIAB: A binary variable; if the auditor has provided an opinion on company liabilities, it takes the value of 1, otherwise 0.

Auditor's Report Content (CAR)

Following the study by Muñoz Izquierdo (2020), this research employs three criteria to evaluate audit report content:

1. Total score related to audit report qualifications before issuing a qualified opinion
2. Total score of the auditor's report on each accounting component and element (ACCOM)
3. Total score of the auditor's report on general or environmental conditions (CRALCOM)

The measurement of these three criteria is as follows:

Total Score Related to Audit Report Qualifications Before Issuing a Qualified Opinion (AUOPI):

Following the study by Muñoz Izquierdo et al. (2019), if the auditor has provided an opinion on any of the following matters before issuing a qualified opinion, the value of 1 is assigned; otherwise, the value is 0. The total sum represents the score related to pre-qualified audit report qualifications. The minimum and maximum possible values for AUOPI are 0 and 3, respectively.

$$\text{AUOPI} = \text{EMPHA} + \text{SCOPE} + \text{GAAPV} \text{ (Equation 1)}$$

In this equation:

EMPHA: Emphasis of matter

SCOPE: Limitation on audit scope

GAAPV: Deviation from accounting standards

Total Score of the Auditor's Report on Each Accounting Component and Element (ACCOM):

Following the study by Izquierdo (2020), if the auditor has provided an opinion on any of the following accounting components in the audit report, the value of 1 is assigned; otherwise, the value is 0. The total sum represents the score related to the auditor's report on accounting components (ACCOM). The minimum and maximum possible values for ACCOM are 0 and 12, respectively.

$$\text{ACCOM} = \text{TNINA} + \text{STINV} + \text{LTINV} + \text{DTA} + \text{INV} + \text{CONTIN} + \text{ACLOSS} + \text{INFOM} + \text{NEGWC} + \text{SUBSEQ} + \text{REPER} + \text{LIAB} \text{ (Equation 2)}$$

In this equation:

TNINA: Tangible and intangible assets

STINV: Short-term investments

- LTINV: Long-term investments
- DTA: Deferred taxes
- INV: Inventories
- CONTIN: Contingent assets and liabilities
- ACLOSS: Accumulated losses
- INFOM: Omitted information
- NEGWC: Negative working capital
- SUBSEQ: Post-balance sheet events
- REPER: Company performance
- LIAB: Liabilities

Total Score of the Auditor’s Report on General or Environmental Conditions (CRALCOM):

Following the study by Muñoz Izquierdo et al. (2019), if the auditor has provided an opinion on any of the following general or environmental conditions, the value of 1 is assigned; otherwise, the value is 0. The total sum represents the score related to the auditor’s report on general or environmental conditions (CRALCOM). The minimum and maximum possible values for CRALCOM are 0 and 5, respectively.

$$CRALCOM = REGUL + ENVIR + MGMTP + GC + INPROC \text{ (Equation 3)}$$

In this equation:

- REGUL: Regulatory requirements
- ENVIR: Economic environment in which the company operates
- MGMTP: Management’s plans and strategies for the company’s future
- GC: Going concern
- INPROC: Bankruptcy-related procedures

3. Findings and Results

The results of the descriptive statistics for healthy and distressed companies in the year of financial distress are presented in Table 1 (for quantitative variables) and Table 2 (for qualitative variables).

Table 1 presents the descriptive statistics of the study variables, indicating variations across different financial indicators. The standard deviation, minimum, maximum, median, and mean values for key financial variables such as financial leverage, liquidity ratio, working capital to assets ratio, return on assets, and retained earnings provide insights into financial distress among firms. Notably, the financial leverage ratio has a mean of 0.539, while the return on assets (ROA) has a mean of 0.143, indicating differences in financial stability among firms.

Table 1. Descriptive Statistics of the Variables Used in the Research

Variable	Mean	Median	Minimum	Maximum	Standard Deviation
Book value of equity to debt ratio	0.6342	0.5851	-0.8388	3.8161	0.5643
Current assets to current liabilities ratio (Liquidity ratio)	1.2088	1.0979	0.3149	4.0617	0.6783
Working capital to assets ratio	0.3082	0.0715	0.0456	0.3926	0.8406
Sales to total assets ratio	0.8493	0.8777	0.0196	3.7107	0.8584
Net profit to total assets ratio (ROA)	0.143	0.116	-0.1971	0.4352	0.1947
Retained earnings	0.115	0.1062	-0.052	0.1238	0.1839
Financial leverage (Debt to assets ratio)	0.539	0.544	0.244	0.799	0.3806
Audit fees	6.5946	6.363	4.9416	8.5833	0.9671
Operating profit to assets ratio	0.7513	0.1863	-0.0872	7.4847	0.3142
Discretionary accruals	0.0162	0.0148	-0.0548	0.1856	1.2029

Table 2 presents the qualitative data that reveal key insights into financial distress and auditor opinions. Among the sample of 870 observations, 28% of the companies were classified as financially distressed. Auditor opinions on various financial aspects, such as inventories, liabilities, long-term investments, and tangible and intangible assets, show varied levels of scrutiny, with some factors receiving more attention than others. For example, auditor opinions on legal requirements accounted for 78% positive observations, while opinions on bankruptcy-related actions accounted for 27%.

Table 2. Descriptive Statistics of Qualitative Research Data

Variable	Frequency (0)	Percentage (0)	Frequency (1)	Percentage (1)	Total Frequency	Total Percentage
Financially distressed companies	623	72%	247	28%	870	100%
Auditor's opinion on inventories	782	90%	88	10%	870	100%
Auditor's opinion on company liabilities	768	88%	102	12%	870	100%
Auditor's opinion on long-term investments	803	92%	67	7%	870	100%
Auditor's opinion on tangible and intangible assets	701	80%	169	20%	870	100%
Auditor tenure	502	58%	368	42%	870	100%
Auditor's opinion on post-balance sheet events	798	92%	72	8%	870	100%
Auditor specialization in industry	568	65%	302	35%	870	100%

Given that financial distress is measured using a binary variable (0 or 1), logistic regression was applied to analyze the research models. Table 3 presents the results of the first hypothesis test. Based on the Andrews statistic and the Hosmer-Lemeshow goodness-of-fit test, both of which have significance levels below 0.05, the model for the first hypothesis demonstrates an adequate fit. The coefficient of determination indicates that 38% of the variations in the dependent variable can be explained by the explanatory variables. As observed, the predictive ability of the modified Altman model, incorporating auditor reports on accounting variables, is superior to the original Altman model in forecasting financial distress.

The results of the first hypothesis test indicate significant relationships between financial distress and several explanatory variables. For instance, working capital (WC) has a coefficient of -1.3007 with a significance level of 0.0017, while retained earnings (RE) has a coefficient of -2.0229 with a significance level of 0.0074. Earnings before interest and taxes (EBIT) is highly significant with a coefficient of -8.9007 and a p-value of 0.0002. Financial leverage (LEV) exhibits a positive coefficient of 0.2878, indicating its contribution to financial distress.

The results also highlight the importance of auditor opinions. The auditor's report on tangible and intangible assets (TNINA) has a significant negative coefficient of -0.7144, while short-term investments (SINV) do not show a significant effect. Long-term investments (LTINV) exhibit a strong negative relationship with financial distress, with a coefficient of -0.8567 and a p-value of 0.0002.

Table 3. Results of the First Hypothesis Test

Variable	Coefficient	Standard Deviation	Z-Statistic	Significance Level
Working capital (WC)	-1.3007	4.1508	-3.1301	0.0017
Retained earnings (RE)	-2.0229	0.6708	-3.0157	0.0074
Earnings before interest and taxes (EBIT)	-8.9007	2.3607	-3.7807	0.0002
Financial leverage (LEV)	0.2878	0.0600	4.7976	0.0000
Sales (S)	-6.6408	3.1308	-2.1199	0.0340

Auditor's opinion on tangible and intangible assets (TNINA)	-0.7144	0.2499	-2.8584	0.0043
Auditor's opinion on short-term investments (SINV)	0.3469	0.5361	0.6471	0.5175
Auditor's opinion on long-term investments (LTINV)	-0.8567	0.2272	-3.7701	0.0002

The logistic regression model's goodness-of-fit statistics confirm its validity. The Hosmer-Lemeshow statistic is 52.0931, with a significance level of 0.0000, indicating a well-fitting model. The McFadden coefficient is 0.38, suggesting a reasonable explanatory power. The likelihood ratio (LR) test statistic is 62.01 with a significance level of 0.0000, reinforcing the model's robustness.

These findings confirm that the modified Altman model, incorporating auditor opinions, improves the prediction of financial distress compared to the original Altman model. The inclusion of accounting and auditing information enhances the explanatory power of financial distress models, providing valuable insights for investors, creditors, and regulatory bodies.

After estimating the model for the first hypothesis, the predictive ability of Altman's original model in distinguishing between healthy and distressed companies is presented in Table 4. As shown, the adjusted Altman model, which incorporates the auditor's opinion on accounting variables, has a higher predictive ability for corporate financial distress compared to the original Altman model. Accordingly, it can be concluded that the inclusion of auditor-related variables in the original Altman model improves its ability to predict financial distress. Based on the obtained results, the first research hypothesis is confirmed.

Table 4. Prediction Ability of Altman's Original Model and Altman's Adjusted Model

Prediction Method	Altman's Original Model	Altman's Adjusted Model Using Auditor's Report on Accounting Variables
Correct Predictions	735	752
Incorrect Predictions	132	121
Prediction Accuracy (%)	84.87%	86.14%

Table 5 presents the results of the second hypothesis test. Based on the Andrews statistic and the Hosmer-Lemeshow goodness-of-fit test, both of which have significance levels below 0.05, the model for the second hypothesis demonstrates an adequate fit. The coefficient of determination indicates that 35% of the variations in the dependent variable can be explained by the explanatory variables. As observed, audit report qualifications before issuing a qualified opinion, including **emphasis on a specific matter** and **limitation in audit scope**, have a significant effect on predicting financial distress.

Table 5. Results of the Second Hypothesis Test

Variable	Symbol	Coefficient	Standard Deviation	Z-Statistic	Significance Level
Working capital	WC	-1.0107	5.0408	-1.9959	0.0459
Retained earnings	RE	-6.8509	2.9008	-0.2362	0.8132
Earnings before interest and taxes	EBIT	-9.4807	2.6607	-3.5633	0.0004
Financial leverage	LEV	0.0516	0.0515	1.0033	0.3157
Sales	S	-3.3208	2.0008	-1.6593	0.0970
Emphasis on a specific matter	EMPHA	1.3653	0.2475	5.5165	0.0000
Limitation in audit scope	SCOP	-2.1185	0.3049	-6.9471	0.0000
Constant term	c	-0.6253	0.2289	-2.7316	0.0063

- McFadden R-squared = 0.35
- Hosmer-Lemeshow Statistic = 37.02 (p = 0.0000)
- Likelihood Ratio (LR) Statistic = 139.07 (p = 0.0000)
- Andrews Statistic = 45.63 (p = 0.0000)

After estimating the model for the second hypothesis, the results of the comparison of audit report qualifications before issuing a qualified opinion are presented in Table 6. As shown, the adjusted Altman model, which incorporates these qualifications, has a higher predictive ability for corporate financial distress compared to the original Altman model. Accordingly, it can be concluded that the inclusion of audit report qualification variables in the original Altman model improves its predictive ability. Based on the obtained results, the second research hypothesis is confirmed.

Table 6. Prediction Ability of Altman's Original Model and Altman's Adjusted Model

Prediction Method	Altman's Original Model	Altman's Adjusted Model Using Audit Report Qualifications
Correct Predictions	735	792
Incorrect Predictions	132	85
Prediction Accuracy (%)	84.87%	96.19%

Table 7 presents the results of the third hypothesis test. Based on the Andrews statistic and the Hosmer-Lemeshow goodness-of-fit test, both of which have significance levels below 0.05, the model for the third hypothesis demonstrates an adequate fit. The coefficient of determination indicates that 38% of the variations in the dependent variable can be explained by the explanatory variables. As observed, audit report indicators related to the company's environmental conditions, including the auditor's opinion on the company's economic environment, management's plans for the future, going concern assumption, and bankruptcy-related actions, have a significant impact on predicting financial distress.

Table 7. Results of the Third Hypothesis Test

Variable	Symbol	Coefficient	Standard Deviation	Z-Statistic	Significance Level
Working capital	WC	-8.4308	3.1608	-2.6657	0.0077
Retained earnings	RE	1.1608	3.1608	0.3673	0.7133
Earnings before interest and taxes	EBIT	-8.4607	2.1307	-3.9801	0.0001
Financial leverage	LEV	0.1997	0.0639	3.1261	0.0001
Sales	S	-4.7208	2.4008	-1.9685	0.0490
Auditor's opinion on legal requirements	REGUL	-0.0703	0.2400	-0.2930	0.7695
Auditor's opinion on economic environment	ENVIR	0.6076	0.1836	3.3097	0.0068
Auditor's opinion on management's future plans	MGMT	-0.3751	0.1875	-2.0007	0.0436
Auditor's opinion on going concern	GC	1.0173	0.1945	5.2304	0.0000
Auditor's opinion on bankruptcy-related actions	INPROC	-0.3972	0.1899	-2.0918	0.0450
Constant term	c	-0.9674	0.2955	-3.2735	0.0011

- McFadden R-squared = 0.38
- Likelihood Ratio (LR) Statistic = 59.84 (p = 0.0000)
- Hosmer-Lemeshow Statistic = 39.74 (p = 0.0000)
- Andrews Statistic = 94.96 (p = 0.0000)

These results confirm that the inclusion of environmental audit report indicators in the original Altman model enhances its predictive ability for financial distress. The findings suggest that factors such as the economic environment, management's future plans, the going concern assumption, and bankruptcy-related actions play a crucial role in assessing a company's financial health.

After estimating the model for the third hypothesis, the predictive ability of Altman's original model and the adjusted Altman model, incorporating the auditor's report on the company's environmental conditions, was compared. The results are presented in Table 8. As shown, the adjusted Altman model, which includes auditor reports on environmental conditions, has a greater ability to predict corporate financial distress than the original

Altman model. Accordingly, it can be concluded that adding audit report indicators on economic environment, management’s plans for the future, going concern assumption, and bankruptcy-related actions to the original Altman model improves its predictive ability for financial distress. Based on the obtained results, the third research hypothesis is confirmed.

Table 8. Comparing the Prediction Ability of Altman's Original Model and Altman's Adjusted Model

Prediction Method	Altman's Original Model	Altman's Adjusted Model Using Auditor's Report on Environmental Conditions
Correct Predictions	735	785
Incorrect Predictions	132	82
Prediction Accuracy (%)	84.87%	90.54%

Table 9 presents the results of the fourth hypothesis test. Based on the Andrews statistic and the Hosmer-Lemeshow goodness-of-fit test, both of which have significance levels below 0.05, the model for the fourth hypothesis demonstrates an adequate fit. The coefficient of determination indicates that 43% of the variations in the dependent variable can be explained by the explanatory variables. As observed, the combination of audit report content and accounting information has a significant impact on predicting financial distress.

Table 9. Results of the Fourth Hypothesis Test

Variable	Symbol	Coefficient	Standard Deviation	Z-Statistic	Significance Level
Working capital	WC	-8.4308	3.1708	-2.6591	0.0078
Retained earnings	RE	0.3427	0.1208	2.8370	0.0010
Earnings before interest and taxes	EBIT	-8.2908	2.1007	-3.9522	0.0001
Financial leverage	LEV	0.1941	0.0630	3.0805	0.0008
Sales	S	-4.6608	2.3708	-1.9619	0.0498
Audit report qualifications before issuing a qualified opinion	AUOP	0.2497	0.0493	5.0660	0.0000
Auditor's opinion on accounting components and elements	ACCOM	-0.1799	0.0633	-2.8434	0.0053
Auditor's opinion on legal requirements	REGUL	0.0265	0.2447	0.1083	0.9137
Constant term	c	-0.8495	0.3211	-2.6455	0.0082

- McFadden R-squared = 0.43
- Likelihood Ratio (LR) Statistic = 60.74 (p = 0.0000)
- Hosmer-Lemeshow Statistic = 20.04 (p = 0.0000)
- Andrews Statistic = 29.80 (p = 0.0000)

After estimating the model for the fourth hypothesis, the predictive ability of Altman's original model and the adjusted Altman model, incorporating the combination of audit report content and accounting information, was compared. The results are presented in Table 10. As shown, the adjusted Altman model, which includes both audit report content and accounting information, has a greater ability to predict corporate financial distress than the original Altman model. Accordingly, it can be concluded that adding indicators related to audit report content (including the total score of audit report qualifications before issuing a qualified opinion) and accounting information (including the total score of auditor opinions on accounting components and elements) to the original Altman model improves its predictive ability for financial distress. Based on the obtained results, the fourth research hypothesis is confirmed.

Table 10. Comparing the Prediction Ability of Altman's Original Model and Altman's Adjusted Model

Prediction Method	Altman's Original Model	Altman's Adjusted Model Using Audit Report Content and Accounting Information
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Correct Predictions	735	777
Incorrect Predictions	132	77
Prediction Accuracy (%)	84.87%	90.98%

Table 11 presents the results of the fifth hypothesis test. Based on the Andrews statistic and the Hosmer-Lemeshow goodness-of-fit test, both of which have significance levels below 0.05, the model for the fifth hypothesis demonstrates an adequate fit. The coefficient of determination indicates that 32% of the variations in the dependent variable can be explained by the explanatory variables. As observed, the auditor's report on accounting variables (including tangible and intangible assets, long-term investments, deferred taxes, inventories, contingent assets and liabilities, accumulated losses, omitted information, negative working capital, and post-balance sheet events) has a significant impact on predicting financial distress.

Table 11. The Results of the Fifth Hypothesis Test

Variable	Symbol	Coefficient	Standard Deviation	Z-Statistic	Significance Level
Return on assets (ROA)	ROA	-0.1189	0.0474	-2.5054	0.0122
Financial leverage	FIN	1.5101	0.1968	7.6705	0.0000
Liquidity ratio	LIQ	-0.04714	0.0752	-6.2698	0.0000
Tangible and intangible assets	TNINA	-0.6177	0.2539	-2.4325	0.0150
Short-term investments	SINV	0.8611	0.4854	1.7740	0.0761
Long-term investments	LTINV	-0.5004	0.2220	-2.2533	0.0242
Deferred taxes	DTA	-0.5009	0.2272	-2.2045	0.0275
Inventories	INV	0.6395	0.2237	2.8582	0.0043
Contingent assets and liabilities	CONTIN	-0.6231	0.2539	-2.4540	0.0141
Accumulated losses	ACLOSS	2.0137	0.2301	8.7479	0.0000
Omitted information	INFORM	0.9428	0.2181	4.3226	0.0060
Negative working capital	NEGWC	0.5192	0.2188	2.3728	0.0176
Post-balance sheet events	SUBBEQ	-1.5159	0.2402	-6.3097	0.0008
Constant term	c	0.4455	0.4128	1.0792	0.2805

- McFadden R-squared = 0.32
- Likelihood Ratio (LR) Statistic = 203.87 (p = 0.0000)
- Hosmer-Lemeshow Statistic = 60.41 (p = 0.0000)
- Andrews Statistic = 31.52 (p = 0.0000)

After estimating the model for the fifth hypothesis, the predictive ability of Zmijewski's original model and the adjusted Zmijewski model incorporating the auditor's report on accounting variables was compared. The results are presented in Table 12. As shown, the adjusted Zmijewski model, which includes audit reports on accounting variables, has a greater ability to predict corporate financial distress than the original Zmijewski model. Accordingly, it can be concluded that adding auditor opinions on accounting variables (including tangible and intangible assets, long-term investments, deferred taxes, inventories, contingent assets and liabilities, accumulated losses, omitted information, negative working capital, and post-balance sheet events) to Zmijewski's original model improves its predictive ability for financial distress. Based on the obtained results, the fifth research hypothesis is confirmed.

Table 12: Comparing the Prediction Ability of Zmijewski's Original Model and Zmijewski's Adjusted Model

Prediction Method	Zmijewski's Original Model	Zmijewski's Adjusted Model Using Auditor's Report on Accounting Variables
Correct Predictions	726	746
Incorrect Predictions	141	121

Prediction Accuracy (%)	83.41%	86.04%
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Table 13 presents the results of the sixth hypothesis test. Based on the Andrews statistic and the Hosmer-Lemeshow goodness-of-fit test, both of which have significance levels below 0.05, the model for the sixth hypothesis demonstrates an adequate fit. The coefficient of determination indicates that 22% of the variations in the dependent variable can be explained by the explanatory variables. As observed, audit report qualifications before issuing a qualified opinion (including emphasis on a specific matter, limitation in audit scope, and deviation from accounting standards) have a significant impact on predicting financial distress.

Table 13. The Results of the Sixth Hypothesis Test

Variable	Symbol	Coefficient	Standard Deviation	Z-Statistic	Significance Level
Return on assets (ROA)	ROA	-0.1094	0.0421	-2.5970	0.0094
Financial leverage	FIN	-1.4330	0.1812	-7.9084	0.0000
Liquidity ratio	LIQ	-0.1396	0.0656	-2.1285	0.0431
Emphasis on a specific matter	EMPHA	0.9986	0.2396	4.1673	0.0001
Limitation in audit scope	SCOP	-1.5391	0.2680	-5.7426	0.0000
Deviation from accounting standards	GAAPV	-1.1882	0.2078	-5.7173	0.0000
Constant term	c	1.2235	0.3290	1.7179	0.0002

- McFadden R-squared = 0.22
- Likelihood Ratio (LR) Statistic = 193.15 (p = 0.0000)
- Hosmer-Lemeshow Statistic = 108.18 (p = 0.0000)
- Andrews Statistic = 85.786 (p = 0.0000)

These results confirm that the inclusion of audit report qualifications before issuing a qualified opinion in financial distress prediction models improves their predictive power. The findings suggest that factors such as emphasis on specific matters, limitations in audit scope, and deviations from accounting standards play a critical role in assessing a company’s financial stability.

After estimating the model for the sixth hypothesis, the predictive ability of Zmijewski's original model and the adjusted Zmijewski model, incorporating audit report qualifications before issuing a qualified opinion, was compared. The results are presented in Table 14. As shown, the adjusted Zmijewski model, which includes audit report qualifications (such as emphasis on a specific matter, limitation in audit scope, and deviation from accounting standards), has a greater ability to predict corporate financial distress than the original Zmijewski model. Accordingly, it can be concluded that adding audit report qualifications to Zmijewski's original model improves its predictive ability for financial distress. Based on the obtained results, the sixth research hypothesis is confirmed.

Table 14. Comparing the Prediction Ability of Zmijewski's Original Model and Zmijewski's Adjusted Model

Prediction Method	Zmijewski's Original Model	Zmijewski's Adjusted Model Using Audit Report Qualifications
Correct Predictions	726	743
Incorrect Predictions	141	124
Prediction Accuracy (%)	83.41%	85.70%

Table 15 presents the results of the seventh hypothesis test. Based on the Andrews statistic and the Hosmer-Lemeshow goodness-of-fit test, both of which have significance levels below 0.05, the model for the seventh hypothesis demonstrates an adequate fit. The coefficient of determination indicates that 30% of the variations in

the dependent variable can be explained by the explanatory variables. As observed, the auditor's report on the company's environmental conditions (including legal requirements, the economic environment in which the company operates, and management's future plans) has a significant impact on predicting financial distress.

Table 15. The Results of the Seventh Hypothesis Test

Variable	Symbol	Coefficient	Standard Deviation	Z-Statistic	Significance Level
Return on assets (ROA)	ROA	-0.0932	0.0434	-2.1447	0.0320
Financial leverage	FIN	-1.6807	0.1831	-9.1751	0.0000
Liquidity ratio	LIQ	-0.1577	0.0665	-2.3687	0.0011
Legal requirements	REGUL	1.0312	0.2465	4.1831	0.0007
Economic environment	ENVIR	-0.5265	0.1868	-2.8174	0.0137
Management's future plans	MGMT	-0.5681	0.1924	-2.9520	0.0101
Constant term	c	1.1641	0.3799	3.0637	0.0022

- McFadden R-squared = 0.30
- Likelihood Ratio (LR) Statistic = 151.34 (p = 0.0000)
- Hosmer-Lemeshow Statistic = 371.23 (p = 0.0000)
- Andrews Statistic = 102.43 (p = 0.0000)

After estimating the model for the seventh hypothesis, the predictive ability of Zmijewski's original model and the adjusted Zmijewski model, incorporating the auditor's report on environmental conditions, was compared. The results are presented in Table 16. As shown, the adjusted Zmijewski model, which includes environmental conditions (such as legal requirements, the economic environment, and management's future plans), has a greater ability to predict corporate financial distress than the original Zmijewski model. Accordingly, it can be concluded that adding audit report indicators related to environmental conditions improves the model's predictive ability. Based on the obtained results, the seventh research hypothesis is confirmed.

Table 16. Comparing the Prediction Ability of Zmijewski's Original Model and Zmijewski's Adjusted Model

Prediction Method	Zmijewski's Original Model	Zmijewski's Adjusted Model Using Auditor's Report on Environmental Conditions
Correct Predictions	726	752
Incorrect Predictions	141	115

Table 17 presents the results of the eighth hypothesis test. Based on the Andrews statistic and the Hosmer-Lemeshow goodness-of-fit test, both of which have significance levels below 0.05, the model for the eighth hypothesis demonstrates an adequate fit. The coefficient of determination indicates that 16% of the variations in the dependent variable can be explained by the explanatory variables. As observed, audit report content combined with accounting information (including legal requirements, the economic environment in which the company operates, and management's future plans) has a significant impact on predicting financial distress.

Table 17. The Results of the Eighth Hypothesis Test

Variable	Symbol	Coefficient	Standard Deviation	Z-Statistic	Significance Level
Return on assets (ROA)	ROA	-0.0925	0.0429	-2.1559	0.0311
Financial leverage	FIN	-1.6608	0.1831	-9.0666	0.0000
Liquidity ratio	LIQ	-0.1402	0.0700	-2.0034	0.0105
Adverse audit opinion	AUOPI	0.4975	0.1361	3.6539	0.0001
Accounting components and elements	ACCOM	-0.3366	0.0669	-5.0319	0.0000
Legal requirements	REGUL	1.5533	0.2442	6.3587	0.0000
Constant term	c	1.1270	0.3735	3.0171	0.0026

- McFadden R-squared = 0.16
- Likelihood Ratio (LR) Statistic = 150.82 (p = 0.0000)
- Hosmer-Lemeshow Statistic = 268.84 (p = 0.0000)
- Andrews Statistic = 117.62 (p = 0.0000)

After estimating the model for the eighth hypothesis, the predictive ability of Zmijewski's original model and the adjusted Zmijewski model, incorporating audit report content and accounting information, was compared. The results are presented in Table 18. As shown, the adjusted Zmijewski model, which includes audit report content and accounting information (such as adverse audit opinions, accounting components and elements, and legal requirements), has a greater ability to predict corporate financial distress than the original Zmijewski model. Accordingly, it can be concluded that adding audit report content combined with accounting information to Zmijewski's original model improves its predictive ability for financial distress. Based on the obtained results, the eighth research hypothesis is confirmed.

Table 18. Comparing the Prediction Ability of Zmijewski's Original Model and Zmijewski's Adjusted Model

Prediction Method	Zmijewski's Original Model	Zmijewski's Adjusted Model Using Audit Report Content and Accounting Information
Correct Predictions	726	733
Incorrect Predictions	141	134
Prediction Accuracy (%)	83.41%	84.54%

4. Discussion and Conclusion

The results of the first and fifth hypothesis tests indicate that incorporating auditor opinions on accounting variables—including tangible and intangible assets, long-term investments, contingent assets and liabilities, accumulated losses, negative working capital, company performance, and company liabilities—into the original Altman and Zmijewski models enhances their ability to predict corporate financial distress. These findings suggest that using auditor opinion data on accounting variables is crucial in financial distress prediction, as the audit profession ensures the reliability of financial statements. Auditors must identify any potential signs of financial distress to warn investors and other users of audit reports about possible business failure. Overall, incorporating audit report content on accounting variables into financial distress models can improve their predictive ability. These findings align with the results of Muñoz-Izquierdo et al. (2020) and support the assumptions proposed by Maltz et al. (2003) and Altman & Sabato (2007), who suggested that incorporating non-financial variables into the original Altman model improves its predictive accuracy [9].

The results of the second and sixth hypothesis tests show that the adjusted Altman and Zmijewski models, incorporating audit report qualifications before issuing a qualified opinion, outperform the original models in predicting financial distress. Including variables related to audit report qualifications (such as emphasis on a specific matter and limitation in audit scope) significantly enhanced the models' predictive ability. In other words, audit report qualifications before issuing a qualified opinion improve financial distress prediction models. Since the audit report is the only communication mechanism between auditors and all stakeholders, auditors must highlight any uncertainties in financial statements, including emphasis on specific matters and audit scope limitations. Thus, auditor opinions on these issues can signal potential financial distress. Prior studies also confirm that audit report qualifications provide useful insights into financial distress [2, 8, 10-14].

The results of the third and seventh hypothesis tests indicate that audit report indicators related to the company's environmental conditions (including auditor opinions on the company's economic environment, management's future plans, going concern assumption, and bankruptcy-related actions) significantly impact financial distress prediction. In other words, incorporating these indicators into the original Altman and Zmijewski models enhances their predictive ability. This finding suggests that auditor concerns expressed in audit reports—especially those related to uncertainties about the company's going concern assumption—serve as early warning signals for future financial distress. The fundamental reason behind requiring auditors to assess the going concern assumption is to provide early warnings to financial statement users regarding potential financial difficulties, particularly financial distress.

The results of the fourth and eighth hypothesis tests show that audit report content combined with accounting information significantly improves financial distress prediction models. Specifically, incorporating audit report content (including total scores related to audit report qualifications before issuing a qualified opinion) and accounting information (including total scores related to auditor opinions on accounting components and elements) into the original Altman and Zmijewski models enhances their predictive ability. These findings suggest that the audit process serves as a control mechanism that enhances financial statement credibility and provides valuable information for capital market participants. Audit report content provides important predictive signals by improving the quality of financial information and assisting investors in decision-making.

Given that audit-related indicators improve the predictive ability of financial distress models, the findings of this study confirm that incorporating audit indicators enhances the accuracy of the Altman and Zmijewski models. Accordingly, the audit indicators introduced in this study can provide valuable insights for decision-makers and financial analysts in financial distress prediction. Analysts and users of financial information are advised not to rely solely on accounting indicators but to incorporate audit indicators into their financial distress assessments.

The study findings also suggest that in financial distress prediction, the selection of appropriate variables and indicators is more critical than the choice of statistical methods. If the indicators are selected accurately, using more complex statistical techniques will not significantly improve prediction accuracy. Therefore, complex statistical methods do not necessarily result in more powerful prediction models. Based on this, financial analysts should prioritize selecting appropriate indicators over choosing advanced statistical methods.

Given that combining financial and audit indicators improves financial distress prediction, financial analysts and market participants can utilize the indicators identified in this study for corporate financial decision-making. The study findings highlight the role of audit indicators in enhancing financial distress prediction accuracy, reinforcing the importance of the audit profession and its credibility function. These results underscore the necessity of paying greater attention to auditor opinions. Accordingly, corporate managers, as strategic decision-makers, are advised to consider auditor opinions carefully and, upon detecting signs of financial distress, take proactive measures to prevent bankruptcy.

Future researchers are encouraged to investigate the role of market indicators in financial distress prediction and compare the results with this study. Additionally, due to the existence of hidden values in companies, it is recommended that intellectual capital indicators be considered as a non-audit variable in future research. Future studies may also apply alternative statistical methods, such as genetic algorithms, and compare them with other techniques. Since industries may exhibit different financial distress behaviors, it is suggested that future studies be conducted separately for different industries, and the results be compared.

Researchers in financial distress prediction can use the findings of this study to distinguish between distressed and healthy companies. Moreover, corporate managers are advised to assess their company's financial position accurately and, upon detecting signs of financial distress, implement effective measures to prevent bankruptcy.

Authors' Contributions

Authors equally contributed to this article.

Ethical Considerations

All procedures performed in this study were under the ethical standards.

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Conflict of Interest

The authors report no conflict of interest.

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