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FINANCIAL WARNING SIGNALS: THE ROLE OF Z-SCORE AND A-SCORE IN CORPORATE FAILURE PREDICTION

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Abstract: Corporate Failure Prediction Tools are sophisticated analytical frameworks designed to assess and forecast the probability of financial distress and bankruptcy. These tools provide critical insights for investors, creditors, and financial analysts by evaluating a company's potential risk of economic collapse. The study examines two prominent models: the Altman ZScore and Argenti A-Score methodologies. The Altman Z-Score, developed in 1968, utilises multiple discriminant analyses to evaluate five key financial ratios, categorising companies into safe, grey, and distress zones. The Argenti A-Score complements this approach by incorporating subjective managerial assessments and examining organisational defects, potential mistakes, and early warning symptoms. These prediction tools offer a comprehensive approach to understanding corporate financial health by integrating quantitative financial metrics and qualitative organisational indicators. The research underscores the importance of dynamic, multi-dimensional analysis in predicting and mitigating potential corporate failures.

Keywords: Corporate Failure Prediction, Financial Risk Assessment, Bankruptcy Modeling, Z-Score Analysis, Financial Diagnostics

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Incorporating qualitative factors, including management behaviors, organizational flaws, and early warning indicators of financial distress. These tools offer a robust framework for assessing financial risk and predicting corporate failure.

1.2 Statement of the Problem

Corporate failures have profound economic and social consequences, ranging from job losses to diminished investor confidence and systemic risks to the financial system. Therefore, stakeholders must be able to predict financial distress and take corrective actions. Traditional economic analysis tools often focus solely on quantitative metrics, overlooking qualitative factors that may signal impending failure. This research addresses this gap by analysing the strengths and limitations of the Altman Z-Score and Argenti A-Score models, highlighting their contributions to financial distress assessment and their implications for modern financial diagnostics.

1.3 Objectives of the Study

1. To evaluate the effectiveness of the Altman Z-Score and Argenti A-Score models in predicting corporate financial distress.
2. To compare the quantitative and qualitative aspects of the two models in assessing corporate health.
3. To provide recommendations for integrating these tools into corporate risk management frameworks.
4. To identify potential limitations of the models and suggest avenues for future research.

2.0 Literature Review

2.1 ALTMAN Z-SCORE MODEL

Corporate Failure Prediction Tools in Assessing Bankrupt Companies

The Modified Altman Z score (1993) uses multiple discriminate analysis (MDA) and employs a four-ratio model for service organisations to differentiate between bankrupt and financially healthy firms. The four financial ratios of liquidity, profitability, efficiency, and productivity are expected to explain a firm's bankruptcy through their contribution to the model (Altman, 1993). The modified four-variable "Z-score" model to predict bankruptcy in the service industry is:

2.2 Altman Z-Score Model

The Altman Z-Score, developed by Edward Altman in 1968, is a pioneering tool in bankruptcy prediction. It uses a combination of financial ratios derived from the balance sheet and income statement data to classify firms into safe, grey, and distressed zones.

There are three levels under which companies fall: Distress Zone, Grey Zone, and Safe Zone. In the safe zone, the company is considered to be healthy; in the grey zone, it is likely to become bankrupt within the next two years of operations. Finally, in the distress zone, it is likely to go bankrupt in less than two years of operation. Therefore, a Z-score of less than 1.81 indicates that the company is distressed or has a high risk of bankruptcy.

Before the z-score corporate failure prediction model, corporate failure prediction models employed a univariate methodology, focusing on individual ratios to identify corporate financial problems (Altman, 1968). Beaver (1966) pioneered the univariate method incorporating failure prediction. It uses a weighted formula combining five financial ratios derived from a company's financial statements to assess its financial health. The formula is expressed as follows:

2.2.1 Original Altman Z-Score Formula

Z=1.2×Working CapitalTotal Assets+1.4×Profit After TaxTotal Assets+3.3×Profit Before Int erest and TaxTotal Assets+0.6×Market CapitalizationTotal Liabilities+1.0×RevenueTotal As setsZ = 1.2 \times \frac{\text{Working

Capital}} {\text{Total Assets}} + 1.4 \times \frac{\text{Profit After Tax}} {\text{Total Assets}} + 3.3 \times \frac{\text{Profit Before Interest and Tax}} {\text{Total Assets}} + 0.6 \times \frac{\text{Market Capitalization}} {\text{Total Liabilities}} + 1.0 \times \frac{\text{Revenue}}{\text{Total Assets}} Z=1.2×Total AssetsWorking Capital+1.4×Total AssetsProfit after Tax +3.3×Total AssetsProfit before Interest and Tax+0.6×Total LiabilitiesMarket Capitalization +1.0×Total AssetsRevenue

Z-Score Interpretation

- **Z > 2.99**: "Safe" zone – the company is financially sound and has a low risk of bankruptcy.
- **1.81 < Z < 2.99**: "Grey" zone – the company is at moderate risk of financial distress, requiring closer monitoring.
- **Z < 1.81**: "Distress" zone – the company is at high risk of financial distress or bankruptcy.

2.2.2 Emerging Market Altman Z-Score Model

Recognizing the unique financial and market dynamics of emerging economies, Altman developed an adaptation of the Z-Score model for these markets. The formula remains consistent with the original but applies adjusted interpretation thresholds to reflect the financial environment of emerging markets.

Emerging Market Altman Z-Score Formula

Z=1.2×Working CapitalTotal Assets+1.4×Profit After TaxTotal Assets+3.3×Profit Before Int erest and TaxTotal Assets+0.6×Market CapitalizationTotal Liabilities+1.0×RevenueTotal As setsZ = 1.2 \times \frac{\text{Working Capital}} {\text{Total Assets}} + 1.4 \times \frac{\text{Profit After Tax}} {\text{Total Assets}} + 3.3 \times \frac{\text{Profit Before Interest and Tax}} {\text{Total Assets}} + 0.6 \times \frac{\text{Market Capitalization}} {\text{Total Liabilities}} + 1.0 \times \frac{\text{Revenue}}{\text{Total Assets}} Z=1.2×Total AssetsWorking Capital+1.4×Total AssetsProfit after Tax +3.3×Total AssetsProfit before Interest and Tax+0.6×Total LiabilitiesMarket Capitalization +1.0×Total AssetsRevenue

Z-Score Interpretation for Emerging Markets

- **Z > 2.6**: "Safe" zone – the company is financially stable with a low likelihood of bankruptcy.
- **1.1 < Z < 2.6**: "Grey" zone – the company faces moderate financial risk, warranting attention.
- **Z < 1.1**: "Distress" zone – the company is at high risk of financial distress or bankruptcy.

While the models share the same computational framework, the differences in zone thresholds reflect varying market conditions. The original Altman Z-Score is tailored for developed economies with established markets, whereas the Emerging Market Z-Score accounts for the volatility and risk factors inherent to less mature markets. Both models are invaluable tools for assessing corporate financial health and predicting potential insolvency. The model has undergone various modifications to cater to different industries, including the Modified ZScore (1993) for service organisations.

The Modified Z-Score formula is:

Z=6.56(X1) +3.26(X2) +6.72(X3) +1.05(X4) Where:

- X1 = Working Capital / Total Assets
- X2 = Retained Earnings / Total Assets
- X3 = Earnings Before Interest and Taxes / Total Assets
- X4 = Equity (Book Value) / Total Liabilities

Scores below 1.80 indicate a high risk of bankruptcy, while scores above 1.80 suggest financial health.

2.2.3 Argenti A-Score Model

The Argenti A-Score Model, developed in the 1970s, is a robust framework designed to assess an organization's financial health by integrating qualitative and quantitative analyses. Unlike the Altman Z-Score, which primarily focuses on financial ratios and balance sheet metrics, the Argenti A-Score places significant emphasis on managerial practices and organizational structure as key determinants of financial stability. The model operates on the premise that economic distress often originates from non-financial factors, such as defective management practices, strategic errors, and structural weaknesses. These factors are categorized into three core elements: **defects** (inherent flaws in the organization or its leadership), **mistakes** (poor strategic decisions or operational errors), and **symptoms** (observable consequences that signal potential financial trouble). By identifying these early warning signs, the Argenti A-Score provides a proactive approach to diagnosing organizational risks that may not yet be evident in financial statements. This makes it particularly valuable for stakeholders seeking to understand vulnerabilities and implement corrective measures before financial decline becomes irreversible. The model's comprehensive scope and focus on qualitative factors make it a versatile tool for both corporate governance and strategic decision-making.

2.3 Empirical Evidences

Simic, Kovacevic, and Simic (2012) argued that corporate failure is too complex to be grasped by a method as simplistic as a single ratio model. Altman (1968) also noted that univariate analysis of this nature could result in a faulty interpretation of the failure risk of a company. Altman pointed out that a company with poor profitability and/or solvency ratios could be considered a potential risk for failure; however, if the same company had an above-average liquidity ratio, the situation may be regarded differently, not considered severe. For this reason, Altman (1968) developed a multivariate approach to ratio analysis as an indicator of corporate failure risk. Harber (2006), and Garcia-G. And Mures-Q. (2012), indicate that it was Altman's (1968) work that pioneered the use of multivariate discriminant analysis (MDA) as a statistical technique to predict corporate failure. They further stated that Altman (1968) used a multiple discriminant analysis (MDA) over the multiple regression analysis, which he recognized was more popular. He selected the MDA statistical technique in part because this technique is used to predict situations where the dependent variable is in qualitative form, such as failed and non-failed or bankrupt and non-bankrupt using five variables or ratios retained.

Ohlson (1980) uses a legit regression model based on the maximum likelihood function and cumulative probability function to examine the effect of four factors on the probability of bankruptcy: size, financial structure, performance, and the company's current liquidity. The logit probability model derives the probability of a dependent variable by assigning coefficients to the independent variables. The accuracy of the Ohlson model was 96% for the estimation sample and 85% for the validation sample. The cut-off scores to group firms "at risk for bankruptcy" are as follows:

Bankrupt firms have a score of "Ohlson O" more significant than 0.50, and non-bankrupt firms have an "Ohlson O score" less than 0.50. Ohlson O score has never been applied in the hospital industry.

2.3.1 Zmijewski (1984)

The Zmijewski Model (1984) used ratio analysis to measure a company's performance, leverage, and liquidity for its predictions. Zmijewski applied the analysis to the 40 companies that had gone bankrupt and the 800 that still survived. Advancing Ohlson's work (1980), Zmijewski developed a model based upon probit estimation for

bankruptcy prediction. The process of calculating the Zmijewski score, based upon the probit model results, is summarized below: Zmijewski=-4.3-4.5X1+5.7X2+0.004X3 X1=net income/total assets (NI/TA); X2= total liabilities/total assets (TL/TA); Current assets/ current liabilities (CA/CL); The cut off scores to group firms "at risk for bankruptcy" are as follows: Bankrupt firms have a score of Zmijewski more significant than 0.50, and non-bankrupt firms have a Zmijewski score of less than 0.5. The bankruptcy risk statistics dataset measures the likelihood of a company becoming financially distressed. Conan & Holder Model (1979) Z-score in numbers is computed as = 0.24*Gross outcome of exploitation / Total debts + 0.22*Permanent capital / Total assets+ 0.16*Quick assets / Current liabilities – 0.87*Financial expenses / Sales - 0.10*Staff expenses / Sales. Z<0.04 =>65% bankrupt risk, 0.04<Z<0.16 =30%-65% bankrupt risk and Z>0.16 = <30% Bankrupt risk.NonManufacturing Altman Z-score in numbers is computed as 1.2 [Working Capital/Total Asset] +1.4[Profit after Tax/Total Asset] +3.3[Profit before interest and tax/Total Asset] +0.6[Market Capitalization /Total Liabilities] +1.0[Revenue/Total Asset]. Z > 2.99 – "safe" zone, 1.81 < Z < 2.99 – "grey" zone, and Z < 1.81 – "distress" zone. Tafflers(1983) Model Z-score in numbers is computed as 3.2+12.18*{Z13_Profit Before Tax to Current Asset}+2.5*{Z14_Current Asset divided by Total Liabilities}+10.68*{Z15_Current Liabilities divided by Total Asset}+0.029*{Z16_Quick Asset less Current Liabilities divided Daily Operating Expenses}. Z>0.3 - No bankrupt risk, 0.2<Z<0.3 Grey Zone and Z < 0.2 -Almost Bankrupt risk. Springates Model Z-score in numbers is computed as =1.03*Working Capital/Total Asset + 3.07*EBIT/Total Asset+ 0.66*EBIT / Current liabilities +0.4*Sales/Total Asset. Z>0.826 - No bankrupt risk and Z<0.826 - Bankrupt risk (Machameratios, 2024)

2.4 Theoretical Framework

The research is anchored in the frameworks of Stakeholder Theory and Agency Theory**,** which provide critical insights into the dynamics of organizational governance and financial health. Stakeholder Theory, initially proposed by R. Edward Freeman in 1984, posits that organizations have a responsibility to balance the interests of all stakeholders, not just shareholders. Stakeholders include a broad spectrum of groups, such as employees, investors, creditors, customers, suppliers, and the broader community. The theory emphasizes that maintaining financial stability is paramount to safeguarding these diverse interests. Financial instability can undermine trust and relationships with stakeholders, jeopardizing the long-term sustainability of the organization. In this context, the Stakeholder Theory underscores the importance of robust financial assessment tools, such as the Argenti A-Score, to ensure proactive management and risk mitigation that aligns with stakeholder expectations.

Agency Theory: developed by Michael C. Jensen and William H. Meckling in their seminal 1976 work, focuses on the relationship between principals (shareholders) and agents (management). The theory highlights the potential for conflicts of interest due to the separation of ownership and control within an organization. Managers, as agents, may pursue personal goals that are misaligned with the objectives of the shareholders, leading to inefficiencies and financial risks. Agency Theory underscores the necessity for mechanisms to monitor and predict corporate financial health, such as financial models and early warning systems, to mitigate these risks and enhance organizational transparency and accountability.

Relevance of the Theories to the Study

The integration of Stakeholder Theory and Agency Theory provides a comprehensive lens for understanding the interplay between financial management, governance, and organizational sustainability. Stakeholder Theory theory highlights the importance of financial stability as a foundation for fulfilling organizational obligations to diverse stakeholders. It frames financial health as a broader ethical responsibility, extending beyond mere

profitability to encompass the well-being of employees, investors, creditors, and the community at large. By addressing financial distress proactively, organizations can maintain stakeholder trust and foster long-term success. Agency Theory offers a critical perspective on internal governance and the potential for misalignment between management and shareholder interests. The study leverages this framework to justify the use of predictive tools and models that enhance oversight and accountability, ensuring that management's decisions align with the financial and strategic goals of the organization.

3.0 Methodology

The study employs mixed-methods approach, combining quantitative analysis of financial ratios with qualitative assessments of managerial and organisational factors. Data were sourced from publicly available financial statements, management reports, and case studies of failed and successful firms. The Altman Z-Score applies to historical financial data, while the Argenti A-Score evaluates qualitative factors. Comparative analysis identifies the two models' strengths, weaknesses, and complementarities.

4.0 Findings

Table 1: Original Z-Score Model Variables

Original z-score	Category	Name	Definition
$Z = 0.012X_1$	Liquidity	X_1	Working Capital/Total Assets
$+ 0.14X_2$	Financial Leverage	X_2	Retained Earnings/Total Assets
$+ 0.033X_3$	Profitability	X_3	Earnings before Interest and Taxes/Total Assets
$+ 0.06X_4$	Market	X_4	Market Value of Equity/Book Value of Total Debt
$+ 0.999X_5$	Activity	X_5	Sales/Total Assets

X_1 = working capital/total assets. This variable is a measure of the net liquid assets of a firm (Altman, 1968). Working capital is the difference between a company's assets and liabilities.

X_2 = retained earnings/total assets. This variable measures a company's cumulative profitability over time (Altman, 1968).

X_3 = earnings before interest and taxes/total assets. This variable measures a company's asset productivity before leverage and tax-related costs. It measures the operating efficiency (Altman, 1968).

X_4 = market value of equity/book value of total debt. This variable measures the degree to which a company's assets could decline in value before its liabilities exceed its assets and the company becomes insolvent (Altman, 1968). Thus, the market value of equity is the market value of a company's preferred and common stock and the book value of total debt, including both current and long-term debts.

X_5 = sales/total assets. This variable measures a company's capital turnover ratio, which determines its productivity (Altman, 1968). It measures the company's ability to generate sales from its assets.

4.1 Original Z score Model

Altman's (1968) research demonstrates the predictive power of the Z-Score model in identifying corporate bankruptcy. His findings revealed that companies with a Z-Score below **1.81** were consistently bankrupt, while those with a Z-Score above **2.99** were reliably nonbankrupt. Consequently, the range between **1.81 and 2.99** was labeled the **"zone of ignorance"** or the **"gray area"** signifying an intermediate risk zone where predictions of financial stability were less definitive. The model also emphasises the importance of defining a **cut-off point**, referred to as the **optimum Z-Value**, for practical decision-making. At the time of its development, widespread access to the computer software necessary for conducting multivariate discriminant analysis (MDA) the statistical method underpinning the model was limited. The inclusion of a cut-off point made the model more accessible to practitioners by simplifying its implementation and interpretation. In subsequent years, Altman refined his methodology to address the unique needs of various industries and markets. In **1995**, he introduced the **Z′-Score Model (Z-Prime Score)**, an adaptation tailored for specific contexts, including manufacturers, non-manufacturers, and entities operating in both developed and emerging markets. This adaptation reflects Altman's commitment to enhancing the model's versatility and relevance, ensuring its applicability to a broader range of credit risk assessments and financial environments. Through these refinements, the Altman Z-Score and its derivatives have remained invaluable tools in corporate financial analysis, providing early warnings of financial distress and enabling more informed decision-making by stakeholders worldwide.

Accuracy Prediction of the Altman Z-Score

In his earlier research, Altman demonstrated that the Z-Score was 72% accurate in predicting bankruptcy two years before it occurred. In subsequent tests, the model's accuracy improved significantly, reaching levels between 80% and 90%. Z-Scores have proven to be a more reliable indicator of financial distress compared to credit ratings assigned by rating agencies. This was evident in Altman's analysis of corporate Z-Scores leading up to the 2008–2009 financial crisis in the United States. In 2007, Altman discovered that 50% of companies were at risk of bankruptcy, with a median Z-Score of 1.81—equivalent to a B rating. Despite this, the bond ratings assigned to certain asset-backed securities were far higher than justified, highlighting the limitations of traditional credit ratings.

Criticism of Altman Model

The model depends on the sample taken, so it may be inaccurate for companies in different countries. The business and competitive environment are also continually changing, which exposes the company's financial performance and the rate of bankruptcy. Increased global competition, for example, is putting further pressure on the profitability of many companies. Thus, using the previous score ranges to classify firms is inappropriate. The model does not predict when a company will be legally bankrupt.

4.2 ARGENTI A-SCORE MODEL

Managerial models are much more subjective than MDA models and are based on the analyst's judgment about the firm's overall managerial, financial, and trading position. The best known of these models is the Argenti 'A' score model, in which he attempts to quantify performance by attaching scores to various performance characteristics. Scores are awarded under three major headings in the Argenti framework: defects, mistakes, and symptoms. A maximum of 100 marks may be awarded overall, comprising 43 for the defects section, 45 for mistakes, and 12 for symptoms. The higher the score awarded, the more likely the company is poorly run and heading for failure (Hughes, 1993). In the Argenti model, defects are deemed to be of three major types. The first

is the managerial structure, where Argenti argues that failure is most likely associated with autocratic chief executives, mainly where the chief executive is also the chairman. In addition, if it is accompanied by an unbalanced, passive board with a weak finance director and a lack of professional managers below the board level, the probability of failure will likely increase. The second defect is in weak accounting systems, mainly where there is no proper budgetary control system, an inadequate cash flow planning system, and poor or non-existent product costing. The final defect is management's lack of response, particularly about changing products, processes, markets, and work practices. Out of the 43 marks awarded for the defects section, 19 were awarded for management structure, 9 for accounting controls, and 15 for responsiveness to change. Argenti argues that these managerial and accounting setup defects can lead to three significant mistakes. The first is overtrading, whereby the company's turnover rises faster than its cash availability**,** leading to cash flow problems. The second is where the company's financial structure becomes characterized by high gearing so that the interest on its loans significantly burdens its profits. The third major mistake is the big project, where the company takes on a project of such a scale about the company's size that if the project goes wrong, it can cause the entire company to collapse. These mistakes are regarded as of equal magnitude in the Argenti model and are each awarded 15 marks in his scoring system.The third section of Argenti's model concerns the symptoms that appear as the company lurches toward failure (Argenti's model omitted). These include both financial and non-financial symptoms. Financial symptoms are deteriorating financial ratios or Z scores and creative accounting, which were awarded eight marks. Finally, the final four marks comprise nonfinancial indicators such as declining morale, market share, adverse rumours, and resignations.

4.2.1 Limitation of Argenti Model

The scoring system as devised by Argenti is exceptionally rigid. The allocation of marks is an all-or-nothing procedure, with either the full mark being awarded or a zero mark, the model not allowing any intermediate scores. The overall danger mark above which companies may be in danger of failing is 25, although an individual score of 10 or more for the defects and 15 for the mistakes would also put the company at serious risk. There is plenty of scope for developing models along the Argenti line of thinking. The problem with these models is that they tend to be based upon subjective judgments, not only in terms of the variables to be included in the model but also in the scoring system to adopt. It is an arbitrary judgment regarding the appropriate gearing level or whether existing management is autocratic. An exciting feature of the Argenti model is that it relegates deteriorating financial ratios to a relatively minor role. However, casual empiricism tends to support the significant role played by the three big mistakes of overtaking, overbearing, and the big project causing company collapse (Hughes, 1993).

5.0 Conclusion

The analysis of bankruptcy prediction models emphasises the need for a more integrated and proactive approach to evaluating corporate health. No single model, whether it be the Altman Z-Score or Argenti A-Score, can fully capture the complexity of financial distress. These models demonstrate the importance of combining both quantitative and qualitative factors in a thorough risk assessment. In today’s fast-changing business environment, relying solely on historical accounting data is inadequate; predictions must also take into account economic indicators such as future economic trends and the impact of prolonged high interest rates. The failure to anticipate several high-profile corporate collapses in recent years serves as a reminder that economic fundamentals are often neglected in traditional predictive models. Ultimately, effective bankruptcy prediction requires a comprehensive,

forward-looking approach that integrates financial data, organizational dynamics, and broader macroeconomic conditions.

5.0 Recommendations

(i) Implement the Altman Z-Score as your primary diagnostic tool: Companies should adopt the Altman Z-Score as their primary method for assessing financial health, leveraging its proven 50-year track record of accurately predicting bankruptcy risks. Regularly calculate the Z-Score using the most recent financial statements to get an objective view of the company's financial stability.

(ii) Complement financial analysis with managerial assessment: It is advisable not to rely solely on numerical indicators. Use the Argenti A-Score to evaluate the organization's structural and management-related risks comprehensively. Pay special attention to management structure, accounting systems, and the organization's responsiveness to change.

(iii) Develop a multi-dimensional risk assessment framework: Go beyond traditional financial ratios and create a holistic approach to financial risk evaluation. Integrate quantitative metrics and qualitative insights.

(iv) Establish regular monitoring protocols by implementing a systematic approach to financial health monitoring.

(v) Treat corporate failure prediction as an ongoing, dynamic process that requires continuous attention, sophisticated analysis, and proactive management.

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