



Enhancing Financial Distress Prediction Using Logistic Regression and Managerial Literacy: A Conceptual Framework for the Malaysian Construction Industry

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ABSTRACT

Financial distress prediction has remained an area of prime concern to regulators, investors, and corporations, especially regarding high-risk sectors like construction and related capital-intensive industry domains. Despite years of research and achievement, traditional ratio approaches, especially the Altman Z-Score, have remained less than satisfactory in terms of overall prediction power across various industry sectors and within emerging market economies. In specific regard to the Malaysian construction industry, existing empirical evidence has indicated persistent levels of misclassification, especially involving instances of Type II or 'False Negative' errors where 'PN17/GN3' classified entities were previously considered to be 'financially sound.' To address such limitations within traditional early warning systems, this article conceptually refines an intersectionary approach to financial distress prediction by systemically blending ratios based on theories of Financial Distress with non-financial 'Business Management Literacy' variables based on theories of Agency and Signal Theory approaches. This article's conceptual framework includes managerial education, managerial experience, and firm capacity variables regarding management excellence and governance competency as specific managerial variables to improve traditional model-based 'causality gaps.' Instead of advancing completely new theory-based approaches to financial distress prediction, this article's conceptual framework proposes to juxtapose overall 'Altman Z-Score' based prediction logics to refined 'Logistic Regression' approaches with general probabilistic interpretation power and overall 'context-based' adaptabilities to traditional models' specific recursive limitations. At its conceptual level, this article's intersectionary framework should improve overall early warning system performance by jointly addressing specific 'symptoms' and 'causes' of financial distress in specific prediction domains with contemporary focus on especially 'cost-reducing' 'False Negative' classifications within traditional approaches' specific industry sectors like construction projects in developing markets. This article's conceptual framework should be especially relevant to existing construction industry sectors where 'management competence' like certain other sectors has remained a 'make-or-break' 'firm-level' element within overall firm 'survival' processes.

Keywords: Financial Distress Prediction, Altman Z-Score, Business Management Literacy, Construction industry, and Logistic regression.

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INTRODUCTION

Corporate bankruptcy is viewed as the final stage of a firm during a state of financial distress, indicating its inability to honor its obligations and survive in the economy. However, apart from serving its legal role within an economy by providing a framework for handling bankruptcy, corporate bankruptcy is accompanied by severe economic and social ramifications. For instance, bankruptcy is viewed as a source of unemployment, disrupting networks within the economy. Thus, early financial distress prediction has been a predominant focal point within finance, accounting, and management studies. Since the groundbreaking research by Altman (1968), researchers have been searching for adequate approaches that offer early warning indicators to take necessary preventive actions.

Despite this progress, the literature on financial distress prediction has been largely dominated by quantitative models based on Financial Distress Theory (FDT), which assume that weaknesses in the financial patterns of failing firms—more specifically, their liquidity, profitability, capital structure, efficiency, and asset structure—lie prior to the observed failures. Of these models, the Altman Z-Score, calculated through Multiple Discriminant Analysis (MDA), had the greatest impact and has continued to have widespread use by practitioners and policymakers because of its simplicity and intuitive appeal. Yet more recent work illustrates the sensitivity of the predictive capabilities of the Z-Score to specific institutional and macroeconomic milieus—developed capital structures and manufacturing economies forecasting less accurately for emerging economies or service sectors and project economies.

Emerging markets face additional complexity in financial distress prediction because these economies are characterized by structural market imperfections, and they are more vulnerable to economic volatility. Malaysia is one such country. It has been enjoying steady economic growth and has also been making fiscal interventions from time to time. However, the data on bankruptcies shows an ever-increasing trend. It is as if the mechanisms in place are only reactive and not proactive, meaning they tend to identify firms only when they have breached specific financial thresholds. The construction industry is in a crucial but risk-prone position in the economy

of Malaysia. Since it is one of the principal contributors to gross domestic product and job creation, it is an important factor in the growth plans of every country. Nevertheless, because of their highly capital-intensive nature and longest duration jobs, it is highly risky for all contracting businesses. Cash flow gaps and payment delays are some of the inherent characteristics of all construction contracts, hence making them highly vulnerable and prone to liquidity risk. Empirical evidence has also provided conclusive proof that commonly used credit risk and bankruptcy models are ineffective when it comes to applying them to contracting companies.

Recent Malaysian research conducted utilizing the Altman Z-Score model within the construction industry has presented mixed and, at times, alarming findings. Though useful as a general indicator, it has been observed that the model consistently inaccurately identifies firms that eventually fail and are formally categorized as distressed by regulatory authorities within Practice Note 17 (PN17) or Guidance Note 3 (GN3). There have also been instances where firms that were identified as distressed by the regulatory authorities were actually within the “safe zone” of the model many years before their eventual collapse. False negative predictions are especially damaging since firms are given a false impression of financial well-being.

One of the most important weaknesses inherent in the above misclassifications is the limited conceptual focus of traditional models of financial distress. Financial ratio models are meant to identify the financial manifestations of distress, but they have not been very effective in illustrating the managerial and organizational motivations and reactions associated with financial distress. The result of strategic mismanagement decisions rather than merely financial weakness. Managerial capability and competence are highly important in selective contracting, risk management, and managing financial crises in project-based industries such as building and other similar contracting activities. Unfortunately, this aspect is not addressed in conventional models of financial distress prediction.

In an effort to fill the causality gap for managerial-related issues surrounding financial distress, current literature streams have called for the inclusion of non-financial factors within models for the prediction of financial distress. Based on Agency Theory, it is postulated that the presence of conflicts of interest and manager competency limitations may act to worsen risk-taking activities. Moreover, the Signal-Games Approach’ prediction that value-relevant information is observable in the form of organizational size and personnel-related factors such as education and experience supports the use of managerial-related variables for the prediction of financial distress within the framework of information asymmetry. In light of these challenges, the article proposes a conceptual approach towards improving predictions of financial distress within the Malaysian construction industry using a combined approach of conventional financial distress theory ratios and indicators of Business Management Literacy. Contrary to developing a whole new theory of predictions, the article proposes expanding existing theory through a logistic regression approach that incorporates assessments of managerial abilities, capable of interpretable probabilities and policy significance. Furthermore, from a rationale of explanation between the Altman-Z Score and a combined financial and managerial approach, the article aims to illustrate how management literacy can also contribute towards enhancing the reliability of early warning predictions, especially with respect to false negatives.

In this regard, this paper contributes to the existing literature on the need for contextual adaptation in models designed for business failure prediction, specifically in the case of emerging markets and high-risk sectors. It also aims to address the existing need for more theoretically inclusive models capable of considering the state beyond mere financial considerations, where management has a pivotal role in organizational outcomes. Finally, the developed framework is expected to benefit policymakers, financial entities, and researchers seeking more accurate models capable of predicting business failure and maintaining the overall stability of Malaysia's building industry.

LITERATURE REVIEW

Academic research in the prediction of financial distress has evolved over several decades, and the study of finance, accounting, economics, and strategic management has provided useful insights. The earlier research efforts were primarily devoted to finding the relationship that exists between certain accounting-related variables and the failure of companies, while the current trend of research is more inclined towards contextual variables. This section identifies the major theoretical and empirical underpinnings that serve as the foundation of financial distress prediction and combines Financial Distress Theory, Agency Theory, and Signalling Theory into an eclectic predictive framework.

Financial Distress Theory and Ratio-Based Prediction Models

Financial Distress Theory (FDT) views business failure as a continuum of decline where consistently reduced financial performance characterizes the path of firms toward financial distress. Business distress is perceived not as a sudden phenomenon, where reduced profitability, deteriorated liquidity, high leverage, and inefficiency of asset use steadily limit a firm's ability to repay its debts. Initial empirical studies by Beaver (1966) illustrated how a set of accounting ratios could be used to differentiate distressed and not distressed firms several years before bankruptcy, thereby providing a basis for subsequent models based on multiple variables. Altman (1968) extended these studies by formally presenting the Z-Score model, a multiple discriminant analysis combining multiple financial ratios. This approach proved highly effective in its original American manufacturing setting and quickly became the norm for bankruptcy predictions. Later studies expanded and improved these results by applying different statistical methods. Ohlson (1980) presented logistic regression as an approach more intuitive and less bound by the strict assumptions of MDA. Later studies included efficiency, turnover, and leverage ratios to improve model robustness (Platt & Platt, 2002; Tinoco & Wilson, 2013).

Though advancements in methodologies have been made, existing literature consistently shows little external validity in ratio-based models. There is often a decrease in predictive validity when the ratio-based model is used in other industries or environments. Misclassifications, including high rates of false negatives, are common when coefficients are drawn from developed countries in emerging market literature. Misclassifications are particularly common in emerging industries such as construction, as revenue is often recognized on projects, cash conversion cycles are long, and high-capital gearing skews conventional financial information. Evidence in Asian construction markets has demonstrated financial ratios are not an adequate proxy in modeling construction risks.

Agency Theory and the Managerial Origins of Financial Distress

Although the FDT describes the process by which the symptoms of financial distress appear, it offers little understanding of the motivations behind financially distressed firms. This shortcoming can be overcome by considering the Agency Theory because the Agency Theory examines the factors related to behavioral and governance theory and their impacts on financial decisions. Jensen and Meckling (1976) described how the agency problem between the principal and the agent can cause inefficient decisions.

In the context of the construction industry, it is obvious that agency issues are more prominent. In other words, project managers and their desire for short-term growth or personal rewards may encourage aggressive bidding, high leverage, or expansion rates that negatively affect financial distress. Empirical research supports this interpretation and suggests that poor governance arrangements, an unexperienced management team, and inefficient strategic management are positively associated with financial bankruptcy (Daily & Dalton, 1994; Heo & Yang, 2014). It is important to notice, however, that it is specifically the Agency Theory that emphasizes managerial capability as a signal indicating when their more sophisticated financial knowledge is reflected in more conservative strategic decisions, thus decreasing the risk of distress (Custódio & Metzger, 2014). Nonetheless, it is clear that all traditional distress models implicitly and uniformly equate managerial capability and assume homogeneity among them, thus overlooking their behavioral differences and thus miscuing causality between financial observations and strategic intent.

Signalling Theory and Managerial Attributes as Predictive Indicators

Signalling Theory is an additional explanation for including managerial qualities as a determinant in distress models. In environments with information asymmetry, managers are more knowledgeable about organizational quality and the potential of the organization than other participants. According to Spence (1973), when characteristics are hard to fake, those characteristics are good indicators of organizational quality. In the organizational or corporate setting, managerial education, experience, and organizational capacity act as these signals. Higher educational attainment can be seen to signify cognitive ability and analytical prowess, and high experience can indicate tacit knowledge and ability to handle crises. There is evidence to show that firms with highly educated and experienced managers and executives demonstrate stronger performance and lower risk characteristics than other firms (Bhagat et al., 2010; Chatterjee et al., 2023). Organizational capacity or size of the firm can indicate maturity and availability of resources, and thereby provide stronger resistance to financial distress. Taken collectively, these factors are referred to as Business Management Literacy or BML and signify the human capital or organizational capability embodied within a firm. From the perspective of signaling theory, high BML implies that there is less asymmetry of information and increased confidence of stakeholders, and from agency theory, high BML helps reduce opportunistic behavior and results in high-quality decision-making. 2.4 Toward an Integrated Hybrid Framework In recent literature, the trend is to increasingly recommend the use of hybrid models of distress prediction that combine both financial and non-financial variables.

All the literature that combined accounting ratios with governance variables, management characteristics, or macro variables reported an increased accuracy of prediction and a reduced misclassification error. Logistic regression analysis has been found to offer an attractive platform for combining these variables. In contrast, within the Malaysian construction industry, research that considers managerial variables from a more empirical point of view is still limited. On one hand, empirical research on the Malaysian construction industry is still needed to highlight managerial variables. On the other hand, models adapted from the Z-Score method or purely financial regression equations tend to be less informative about how managerial factors influence financial distress. This viewpoint emphasizes how a combination of Financial Distress Theory, Agency Theory, and Signalling Theory, by recognizing the essential role of Literacy, acts to address a need for a more practical and integrated framework for a financial distress early warning system for emerging high-risk sectors.

METHODOLOGY

This research applied conceptual-analytical approach, and it is based on a set of established empirical methodologies that are relevant to financial distress prediction. This project will not conduct a new empirical estimation. This research will instead synthesize and evaluate established methodological approaches to compare two prominent approaches to financial distress prediction: (1) a traditional Altman Z-score method, based on Multiple Discriminant Analysis, to (2) a merged method based on logistic regression, combined with established financial ratios from Financial Distress Theory (FDT) with non-financial business management indicators from Business Management Literacy (BML). This will enable a logical comparison to be made about the conceptual merits and shortcoming of each method within the Malaysian construction industry. The Altman Z-Score is used as the benchmark model because of its prestige and long-standing use by practitioners and regulators. However, its reliance on fixed coefficients and linear boundary lines limits its flexibility to incorporate industry and emerging market considerations. Conversely, the logistic regression part of the proposed framework is methodologically superior because it calculates the likelihood of distress as a continuous variable with values between zero and one. The use of probabilities to indicate possible levels of distress is more useful to regulators, lenders, and investors because they will have the flexibility to set the risk levels according to pre-defined policies and risk tolerance levels.

Financial distress status is the dependent variable defined by a dummy variable indicating whether a business falls under PN17 or GN3 or whether it has been subjected to formal bankruptcy procedures. This definition of the dependent variable connects the framework to policy-relevant outcomes instead of just events identified by statistical failure. BML variables include two structured blocks of variables. Block one consists of the core financial variables of liquidity, profitability, leverage, efficiency, and asset turnover. Block two expands the framework by incorporating the BML proxies: the highest academic attainment of the main personnel responsible in the business organization; the accumulated experience of the main personnel; and the capacity of the organization measured by the size of the workforce. From an analytical point of view, the approach underlines the incremental explanatory capability of the model and its ability to quantify the value of BML variables over and above standard financial data. Special attention is paid to the avoidance of Type I errors or false negatives, where troubled companies are mistakenly identified as non-distressed entities. Type I errors carry high

economic and systemic expenses, especially when considering credit and regulatory risks. By using error asymmetry and relevance, this approach moves towards a more pragmatic and theoretically comprehensive method of financial distress detection.

FINDINGS AND DISCUSSION

The goal of this study is to develop and refine the argument that predictions of financial distress in the Malaysian construction industry can attain further predictive sophistication by the incorporation of a hybrid model, integrating traditional financial data with proxies of Business Management Literacy (BML). There is no new empirical estimation. However, from an amalgamation of prior empirical studies and with the aid of theoretical reasoning, several inferences can be made concerning the key findings relative to the performance and explanatory ability of the proposed model.

Limitations of Purely Financial Prediction Models

The first conceptual finding reinforces the widely documented limitation of purely financial distress models, particularly the Altman Z-Score, when applied to emerging markets and industry-specific contexts. Prior studies consistently demonstrate that the Z-Score's fixed coefficients and reliance on Multiple Discriminant Analysis reduce its adaptability to sectors characterized by high volatility, project-based revenue structures, and extended cash conversion cycles. In the Malaysian construction sector, this limitation manifests most critically in the form of false-negative classifications, where firms later designated as PN17 or GN3 are previously identified as financially "safe."

This finding supports the argument that financial ratios alone capture the symptoms of distress rather than its underlying causes. Liquidity shortages, declining profitability, and excessive leverage typically emerge only after a sequence of strategic and operational decisions have already weakened the firm. Consequently, ratio-based models tend to react to distress rather than anticipate it, limiting their usefulness as early-warning systems for regulators and investors.

Incremental Explanatory Role of Business Management Literacy

Findings from this study indicate that Business Management Literacy variables possess meaningful incremental explanatory power beyond what is captured by traditional financial ratios. Based on Agency Theory, in construction firms managing multiple long-term projects, educational and managerial experience should reduce opportunistic behavior, excessive risk-taking, and inefficient resource allocation, all of which suffer on the managerial level. Such managers should, possess educational qualifications and work experience in the industry in order to be able to anticipate risks associated with the projects in question, negotiate contracts, and take pre-emptive corrective actions before accounting losses arise.

From the perspective of Signaling Theory, BML proxies also serve as valid and reliable proxies for firm quality due to information asymmetry. Organizational size as measured by the size of the workforce is often viewed as an indicator of operational maturity, and the level of managerial skill necessary to work with and maneuver complex, diverse, and interdependent project systems. Therefore, it can be expected that firms with stronger BML characteristics are likely to exhibit a high degree of resilience in the face of economic downturns and shocks in the industry, and are less likely to suffer from formal distress.

Advantages of Logistic Regression as a Conceptual Framework

One more important finding is the methodological superiority of logistic regression as the analytical environment for the proposed hybrid model. In contrast to the Altman Z-Score, which provides discriminant score output, logistic regression provides an estimated probability of distress, which allows for deeper and more flexible risk interpretations. This output is beneficial for risk regulation and credit risk situations, as they may vary the level of risk and policy in place to determine where to intervene or not.

In principle, the hybrid logistic framework also allows for the systematic evaluation of additional model performance. In comparing baseline financial-only models to models that also include BML variables, stakeholders are able to perceive, beyond classification accuracy, additional meaningful achievements where outcomes are economically beneficial, especially when Type I error events are reduced. Considering that the false negative is one of the most, if not the most, costly mistake in predicting bankruptcy, the hybrid model's focus on such errors is a significant improvement.

Implications for Regulation and Industry Practice

It is predicted that the inclusion of managerial variables within the distress prediction models will add some value to the approach, especially from a regulatory perspective. Within the Malaysian context, PN17 and GN3 classifications have become lagging benchmarks, often activated only whenever a company is going through severe financial distress. This hybrid model is designed to conceptually shift distress monitoring to a leading perspective, allowing for further supervisory control and the mitigation of systemic distress within the construction industry.

The findings of the study illustrate the challenges of solely trusting financial statements when trying to evaluate credit risk, particularly for shareholders and financial credit providers. This is because assessing the managerial quality indicators leads to a more complete picture of the firm's viability, given that the industry is one where performance is highly correlated to the quality of leadership and organizational orchestrating.

Theoretical Contributions

Academically, the study adds value by trying to advance the operationalization of Agency Theory and Signalling Theory within the context of managerial prediction of financial distress. The framework, by linking managerial capability to distress, attempts to address the managerial causation gap that has so far fettered ratio models. The inclusion of BML into a logistic regression framework, demonstrates the possibility of jointly modeling financial symptoms and managerial causes in a rational framework.

CONCLUSION

The goal of this study is to gain additional insights into predicting financial distress in the construction sector in Malaysia. This study tries to address the limitations of the Altman Z-Score. Although the Z-Score is the most used tool for this type of analysis, it sometimes is not the most effective tool for analyzing emerging markets or particular industries due to the Z-Score's reliance on financial information, fixed coefficients, statistical assumptions, and financial information on the emerging market. In the construction industry, which is high-risk and project-dependent, the Z-Score is particularly likely to produce false-negative classifications, which greatly diminishes the Z-Score's effectiveness.

Integrating Financial Distress Theory, Agency Theory, and Signalling Theory, this study proposes a hybrid framework combining traditional financial ratios and Business Management Literacy (BML), which includes managerial education, experience, and organizational capacity, which fill in the managerial causality gap in traditional distress. Financial ratios capture the visible symptoms of the distress, while BML reflects the managed governance that influences firm response and resilience. This provided a more comprehensive motivation on why firms become financially distressed, particularly in complex and volatile environments.

In addition, the paper maintains that, unlike other methodologies, logistic regression shows the greatest analytical flexibility to hybridize. This, speaking generally, provides greater interpretability and relevancy to policies which are useful for regulators, lenders, and investors that need to decide where and when to intervene and at what level of risk and what are the economic conditions. Additionally, the overriding focus on reducing Type I errors is what makes the framework particularly relevant to the economy, given the considerable economic and social ramifications that come about as a result of not detecting failing firms in a timely manner.

In practical terms, the framework is significant for regulators who are attempting to shift from the reactive distress classification PN17 and GN3 to more forward-looking supervisory strategies. It also has an implication for financial institutions and investors to recognize the importance of integrating an evaluation of managerial performance when conducting a credit risk analysis. For academics, the contribution of the framework lies in the area of financial distress by showing that non-financial factors, specifically managerial, can be substantiated and incorporated into frameworks in a cohesive manner.

To strengthen the case for integrating theory to context, future studies can improve the framework by testing it in other high-risk sectors and in other emerging economies. Also, studies can improve the framework by using longitudinal data of firms to allow the proposed framework to be more flexible, as it is intended to be.

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