Lisbon School of Economics & Management
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MASTERS IN
FINANCE

MASTER'S FINAL WORK
DISSERTATION

CORPORATE GOVERNANCE AND FINANCIAL HEALTH: EVIDENCE FROM CANADA

MELISSA LOPES SILVA

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SUPERVISION:

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Abstract

This study aims to assess the relationship between corporate governance and financial health of Canadian publicly listed companies. The final sample is composed of 455 firm-year observations of 30 unique listed companies from 2002 to 2022, these are listed in several stock exchanges based in Canada. The study utilizes a revised version of the Altman Z-Score as a metric to assess financial distress, considering its widely recognized predictive power. Results suggest that corporate governance may play a role in shaping the financial health and performance of companies. Specifically, board size and independence of the board, as well as the association between the two independent variables. Findings of this study have important implications for Canadian regulators, policymakers, and practitioners in enhancing corporate governance practices and mitigating the risks associated with financial distress.

JEL: C13, F30, G00, G01, G30, G33

Keywords: Financial distress, Probability of Default, Canada, Board of Directors, Cash Flow ratio, Z-Score

Resumo

Esta tese tem como objetivo avaliar a relação entre governação corporativa e a saúde financeira das empresas listadas publicamente no Canadá. A amostra final é composta por 455 observações de 30 empresas listadas em várias bolsas de valores baseadas no Canadá, abrangendo o período de 2002 a 2022. O estudo utiliza uma versão revista do Altman Z-Score como métrica para avaliar a dificuldade financeira, considerando o seu amplamente reconhecido poder preditivo. Os resultados sugerem que a governação corporativa pode desempenhar um papel na formação da saúde financeira e desempenho das empresas, especificamente, o tamanho do conselho e a independência do conselho, bem como a associação entre as duas variáveis independentes. As descobertas deste estudo têm importantes implicações para reguladores, formuladores de políticas e profissionais no Canadá, no sentido de aprimorar as práticas de governança corporativa e mitigar os riscos associados à angústia financeira

JEL: C13, F30, G00, G01, G30, G33

Palavras-chave: Pressão financeira, Probabilidade de Falência, Canada, Conselho de Administração, Fluxo de caixa, Z-Score

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Abbreviations

ANN	Artificial Neural Network
CEO	Chief Executive Officer
CFO	Cash Flow from Operations
CG	Corporate Governance
EBIT	Earnings before Interest and Tax
FANN	Forecasted Artificial Neural Network
FCF	Free Cahs Flow
GDP	Gross Domestic Product
LSE	London Stock Exchange
MDA	Multiple Discriminant Analysis
NF	Non-Failed Firms or Non-Bankrupt Firms or Healthy firms
NWC	Net Working Capital
NYSE	New York Stock Exchange
OECD	Organisation for Economic Co-operation and Development
OSB	Office of the Superintendent of Bankruptcy
PD	Probability of Default
ROA	Return on Assets
TSE	Toronto Stock Exchange
U.K.	United Kingdom
U.S.	United States

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1 Introduction

This study aims to assess the relationship between corporate governance features and financial health in a large time span. In particular, this research aims to expand the Vo and Nguyen (2014) work to the Canadian market, as the country specific features may well yield diverse findings.

Different outcomes of financial crises that occurred throughout the world and had an impact on the economies of developed and developing nations on a short-term and long-term basis have demonstrated that weak investment and financial tool dispositions in financial and investment institutions cause inconsistent growth and continuity of the financial sector on the one hand and a lack of consistency in achieving a balance of liquidity, profitability, and safety on the other. Bankruptcy is likely if financial hardship is not identified in time and turnaround actions are not adopted. All parties involved in the company are impacted by the significant costs of bankruptcy (Altman, 1984; Andrade & Kaplan, 1998; Altman & Hotchkiss, 2006; Natalia, 2007; Opler & Titman, 1994).

In today's dynamic business environment, financial distress and its subsequent impact on companies' survival and performance have garnered significant attention from scholars, regulators, and practitioners alike. Financial distress refers to a state in which a company's financial condition deteriorates to the extent that it faces difficulties in meeting its obligations, such as paying off debts or operating costs. Such distress can lead to severe consequences, including bankruptcy, liquidation, and substantial losses for stakeholders. Therefore, understanding the factors that contribute to financial distress and its management is crucial for ensuring the stability and sustainability of companies.

A relevant control mechanism in mitigating financial distress and improve firms' financial health relates to the corporate governance system of organizations. According to OECD (2015), '*Good corporate governance helps to build an environment of trust, transparency and accountability necessary for fostering long-term investment, financial stability and business integrity, thereby supporting stronger growth and more inclusive societies.*'

The corporate governance has gained considerable prominence in recent years. Corporate governance encompasses a set of mechanisms and practices that guide and control the actions of corporate actors, including boards of directors, management, and shareholders,

to align their interests with those of the company and its stakeholders, Khan, H. (2011). Good corporate governance practices are widely recognized as vital for maintaining the integrity of firms and fostering long-term value creation, OECD (2015). However, the extent to which corporate governance can influence financially distressed companies' turnover, Mariano, S.S.G., Izadi, J. and Pratt, M. (2021), remains an area that warrants investigation.

Every company follows a system that regulates the way the company is directed and controlled. Corporate governance is known worldwide as a vehicle between business and finance, is the system of rules, practices and processes that control a firm. The term corporate governance has different interpretations due to its multiple related subsets. Usually, we find surveys studying corporate governance in varied approaches, this is possible because of the diversity of the term.

A relevant question in corporate governance literature persist year after year, whether and how good corporate governance increases firm value? Recent studies determine that corporate finance practices have become more aligned with finance theory over time. However, they came to different results on correlations between good corporate governance and firm performance. A positive correlation is suggested by Prevost, et al. (2002); Chung, Wright & Kedial (2003); Gompers et al. (2003); Callahan, Millar & Schulman (2003); Mak & Kusnadi (2005); Black, Love and Rachinsky (2006); Krivogorsky (2006); Brown and Caylor (2006); Nicholson and Kiel (2007); Larcker et al. (2007); Bhagat and Bolton (2007); Sunday (2008); Daines et al. (2008); Carline et al. (2009); Chhaochharia and Laeven (2009); Renders, Gaeremynck & Sercu (2010).

On the contrary, Hutchinson (2002); Bauer et al. (2004); Giroud and Mueller (2010) stand with a negative correlation. Many others report mixed results, Brown and Caylor (2006); Bebchuk, et al. (2009); Aggarwal et al. (2010); Chi and Lee (2010). These divergent findings are mostly a consequence of different time periods being analyzed and the context under analysis.

The growing formalization through country specific codification became a difficult when judging results concerning the effect of corporate governance on firm performance. One-country approaches are now preferred. That is why Conheady et al. (2015) examines only Canadian listed companies, finding that ‘board structure and stock ownership are consistently positively associated with firm performance. Independence, structure, and

systems have no association with either the contemporaneous or the one year ahead market measure of performance'.

Yet, only a few studies examined performance effects in-depth were published in the last years. Besides, there are multiple studies of corporate governance practices that focus on U.S. and U.K. companies but only few explore the Canadian market.

After several research papers showing that improving corporate governance seems to be the right path to pursue better results on firm performance, Yang (2011) question 'Doesn't corporate governance matter in Canada?'. For the author, it is mystifying that almost no Canadian studies detect any relationship between corporate governance and firm value.

While prior research has extensively explored the impact of corporate governance on firm performance and financial outcomes, the specific influence of corporate governance on financially distressed companies' turnover is relatively understudied. The turnover of financially distressed firms refers to the process through which these companies are restructured, reorganized, or acquired to mitigate financial distress and maximize value for stakeholders. It is important to understand how corporate governance mechanisms can shape this turnover process and potentially enhance the prospects of financially distressed companies.

Contrasting the U.S., Canada follows a principles-based methodology in corporate governance control and Canadian firms are required to divulge whether they comply with corporate governance guidelines set up by authorities or explain any deviation from the recommended guidelines.

Yang (2011) observed that some time-varying, unobservable firm characteristics that prompted companies to implement high-standard corporate governance also increased firm value, however, better corporate governance practices appeared to decrease firm value. So, Yang (2011) propose that firms may use corporate governance to signal to the market some desirable characteristics yet, adopting good corporate governance by itself may reduce their firm value.

As per Gompers, Ishii, Metrick 2003, data for the U.S. strongly indicates that 'at firm's level, better governance leads not only to improved rates of return on equity and higher valuation but also to higher profits and sales growth'.

Corporate governance codes were adopted after 2002 as a kind of smooth regulation in several countries. The post-Sarbanes-Oxley period is described by a cross-country homogenization of corporate governance codes and practices (Bainbridge (2016)). Dalton et al. 1998 confirmed in a meta-analysis of empirical studies that both the supervisory board composition as well as leadership structure don't have any influence on financial performance.

Malik & Makhdoom (2016) achieved a powerful positive correlation among corporate governance and firm performance. As per their conclusions 'Smaller board sizes are found to generate better firm performance in Fortune Global 500 Companies. Frequency of board meetings have also been found to have inverse relationship with firm performance. The study supports board independence to improve transparency in board decision-making process. CEO compensation has been found to have inverse relationship with firm performance.'

Per Chow et al. (2011), a firm is financially distressed when the operating cash flow is not sufficient for meeting the current obligations of the firm. It also involves a situation where the firm constantly experiences loss, breach loan contract, and find it difficult in honouring organisational commitment.

There are internal and external determinants of financial distress. Internally there are financial and non-financial factors. When current assets are insufficient to cover current liabilities the liquidity ratio of a firm gets low which can lead to financial distress. A high ratio of leverage reduces the ability of a firm to survive when experiences negative shock in its cash flow. Low profitability level may lead to low level of liquidity. Small firms (size reflects assets) undergo financial distress. The share price inverse link with financial distress. Lastly, low revenue growth usually leads to difficulties meeting creditor's repayment period. As non-financial factors there are customer, experience, sales, and disaster causes. The external determinants are known as macro economic factors as inflation, exchange rates, political interest, instability in government policy.

The top 10 signs that may indicate financial distress are: cash flow problems; defaulting on bills; extended terms; high interest payments; falling margins; increasing overhead costs; sales are decreasing; customers are not coming back; high levels of outstanding receivables; high turnover and decreased morale.

Due to Canada's uniqueness, lack of research compared to other European and American nations, and low bankruptcy probability compared to other nations worldwide, it was chosen as the subject of this study. The COVID period will also be studied in this research, having data of before, during and after the pandemic period. By using board characteristics such as board size and independent board, this study aims to find the impact of these independent variables on the probability of default. We aim to find if the board characteristics add any results on the Altman's Z-Score model.

This study's primary goal is to give a thorough analysis of the popular Z-score model from the standpoint of Canadian publicly traded corporations. Second, to expand the original model by including board characteristics as dependent variables, as well as using CFO as the sixth variable on Altman's model. This is a revised model proposed by Vo, D. H. and Nguyen T.M. (2014). Third, to ascertain whether the new model has a higher predictability of bankruptcy than the original.

As per the Government of Canada statistics, in 2021 there were a total of 92,572 insolvencies filed with the Office of the Superintendent of Bankruptcy (OSB), representing a 6.7% decrease from 2020 and the lowest volume of insolvencies since 1995. The decrease continues the decline in insolvencies witnessed since the onset of the Covid-19 pandemic. When it comes to business insolvencies, these decreased from 3,680 filings in 2019 to 2,786 filings in 2020 and 2,480 in 2021.

We must take into consideration that the Canadian economy began to recover from the Covid-19 pandemic in 2021. The Canadian real Gross Domestic Product (GDP) increased by 4.0% in 2021, up from a decrease of 5.2% in 2020.

The total number of business insolvencies in 2021 decreased by 11.0% from 2020.The three sectors that registered the largest decreases in the number of insolvencies were: Retail Trade: 122 fewer filings (−32.4%), Accommodation and Food Services: 74 fewer filings (−16.8%), and Arts, Entertainment and Recreation: 49 fewer filings (−41.9%).

The following research questions will guide the investigation: To what extent does corporate governance affect the turnover of companies in Canada? What specific corporate governance mechanisms influence the turnover process of firms? How does the Altman Z-Score, as a widely recognized metric for financial distress, relate to the turnover outcomes of the Canadian listed companies?

The risk metric used is Altman's Z-Score. This will be helpful to determine the financial condition of the company and probability for bankruptcy. The formula helps the investors to evaluate the business´ financial strength. The total sample consists of 30 stock listed companies in the period 2002 to 2022.

The study has successfully achieved its goal of elucidating the connection between board structure and company well-being. It has been confirmed that both board size and board independence influence the likelihood of default in the Canadian market.

The remainder of this thesis is organized as follows: Section 2 presents a comprehensive review of the relevant literature on corporate governance, financial distress, Altman Z-Score, and their interplay. Section 3 outlines the research methodology, including the data collection process, sample selection, variables, and statistical techniques employed. Section 4 presents the data analysis along with the descriptive statistics and correlations matrix. Section 5 provides the regression analyses and results. Finally, Section 6 discusses the findings, interprets the results, and provides implications for theory, practice, and future research.

2 Literature Review

Taking OECD (2015), "*Corporate governance involves a set of relationships between a company's management, its board, its shareholders and other stakeholders. Corporate governance also provides the structure through which the objectives of the company are set, and the means of attaining those objectives and monitoring performance are determined.*"

Several theoretical perspectives have contributed to the understanding of corporate governance. Agency theory posits that conflicts of interest between shareholders (principals) and managers (agents) can arise due to divergent goals and information asymmetry. Corporate governance mechanisms act as control mechanisms to mitigate these conflicts and align the interests of managers with those of shareholders. The stewardship theory emphasizes the importance of trust, cooperation, and shared goals between managers and shareholders, suggesting that effective governance can foster a sense of stewardship and responsible behavior among corporate actors.

Various governance mechanisms exist to ensure the effectiveness of corporate governance. These include board characteristics, ownership structure, executive compensation, and shareholder activism. Board characteristics, such as independence, diversity, and expertise, can enhance board effectiveness and oversight. Ownership structure, encompassing the concentration and types of shareholders, can influence managerial behavior and accountability. Executive compensation mechanisms, including the alignment of pay with performance, can incentivize executives to act in the best interests of the company. Shareholder activism allows shareholders to voice their concerns and influence corporate decisions, thus enhancing governance effectiveness.

Financial distress refers to a state in which a company experiences significant financial difficulties and is at risk of insolvency. It is a critical period for firms, as the actions taken during this phase can significantly impact their survival and recovery prospects. Turnover, in the context of financially distressed companies, refers to the exit of top management and members of the board of directors. The turnover of key decision-makers can either contribute to the company's revitalization or exacerbate its financial woes.

Research on financial distress has identified various factors that contribute to its occurrence and progression. These factors include poor financial performance, excessive

debt levels, inadequate liquidity, ineffective strategic decision-making, and adverse market conditions. The decision to replace top management and board members during financial distress is often driven by the need to introduce fresh perspectives, expertise, and leadership to improve the company's financial position and restore stakeholders' confidence. Financial distress can have severe consequences for firms, including increased bankruptcy risk, loss of stakeholders' trust, and value erosion.

The first multivariate bankruptcy prediction model was developed by Altman in the late 1960s. Following the publication of this groundbreaking paper, scholars in the fields of finance, banking, and credit risk adopted the multivariate method to failure prediction. To choose the best companies for their portfolios, asset managers and investors require trustworthy tools. Investor returns are negatively impacted by financial turmoil, although risk might present potential for significant gains on short-sale methods. Rating agencies need a method to predict default because they evaluate the risk of the companies and of securities issuance. The Z-Score model can be used by the management of troubled enterprises, according to Altman's (1983) recommendation.

The Altman Z-Score, Altman, E. (1968), is a widely recognized metric for assessing financial distress and predicting the probability of bankruptcy. The Z-Score combines multiple financial ratios to produce a single score, providing an indication of a company's financial health.

The Z-Score considers factors such as profitability, liquidity, leverage, solvency, and market valuation. By evaluating these financial indicators, the Z-Score attempts to provide a comprehensive view of a company's financial condition and the potential risks it faces. It has been extensively used in empirical studies to measure financial distress and bankruptcy risk.

As mentioned above, U.S. large companies are often the subject of studies about corporate finance practices. It is interesting to examinate the Canadian case as Canada’s Corporate governance’s system originates from the British common law model and is deeply shaped by improvements in the United States as Macdougall and Valley (2019) point out. As Baker et al. (2009) notice the differences between the Canadian, U.S., and U.K. context tend to discrepancies in corporate finance practices that eventually affect firm performance divergences on the three countries. One example, while a U.S. firm usually have a single person as CEO and chair, Canadian corporations are most likely to have two

people for the two positions. On the other hand, U.K. have a lot more executives on the board that Canadian companies.

One of the most famous investigators on Canadian market were Jog and Srivastava (1995) yet, they used only large companies and the study covered few capital budgeting, risk assessment, and cost of capital techniques.

Macdougall and Valley (2019) refer that corporate governance practices in Canada are influenced by legislation and best practices driven by institutional shareholder groups, the media and professional director associations. Canadian corporate governance is also affected by the high proportion of Canadian public companies that have major or controlling shareholders, either through share ownership or with multiple voting rights.

Canadian institutional investors have a massive authority on Canadian corporate governance practices. The Canadian Coalition for Good Governance is a national institutional investor organization that encourage good governance practices in firms whose shares its participants own. Corporate Governance contains around 50 members, including many of Canada's largest institutional investors, collectively managing almost C$4 trillion in assets.

Both Canada and U.S. rank highly in the La Porta et al. (1998) metric for investor protection. Canadian and U.S. firms are widely held, positioned well above the median of countries in the high investor protection grouping in La Porta et al. (1999). Though, the regulatory environment might be deemed less stringent in Canada relative to the U.S., which could give rise to less optimal deployment of governance mechanisms. Since 1995, the Toronto Stock Exchange (TSX) has maintained a code of 14 'Best Practices' that firms can voluntarily choose to adhere to, which include recommendations for a majority of independent board members, for separation of the roles of chairman and CEO, and for reduction of board sizes to facilitate more efficient decision-making.

Another distinction is that Canada does not follow a uniform legal code across provinces. In particular, firms headquartered in Quebec, as opposed to the other provinces, are subject to the French civil law tradition. According to La Porta et al. (2000, p.9), 'French legal origin countries have the worst quality of law enforcement of the four legal traditions, even controlling for per capita income. La Porta et al. (2002) provide data to show that this tradition is inimical to corporate valuation. If that is true, then one might

argue that Quebec-based firms should demonstrate worse performance than firms headquartered in other provinces.

Klein et al. (2003) use the Globe and Mail's Governance ranking data to demonstrate that some corporate governance mechanisms appear to have value for shareholders in Canada, although traditional measures such as board composition and independence are not correlated with performance. Allaire and Firsirotu (2005) use the same rankings for large-cap Canadian firms and conclude that governance mechanisms have virtually no impact on the performance of large-cap corporations in Canada. These studies do not address the problem of the interdependence of the various mechanisms for controlling agency problems and the potential simultaneity between these mechanisms and the various measures of firm performance.

Lorne N. Switzer & Catherine Kelly (2006) studied corporate governance mechanisms and the performance of small-cap firms in Canada, and the results confirm simultaneity between several governance mechanisms and Canadian small-cap firm performance. CEO ownership and shareholder rights are shown to determine board independence. CEO ownership in turn is shown to depend on the extent of shareholder rights and whether the CEO is also Chairperson of the board. They found that Canadian small-cap firms appear to overutilize debt as a control mechanism. The market for corporate control, measured as the extent of takeover activity in the firm's industry, is found to have a positive effect on performance. Also, the research find a significant premium for firms who cross-list on U.S. exchanges.

Best practices of audit committee characteristics are an important determinant of good corporate governance. An effective audit committee has a significant bearing on the financial performance and future direction of a firm. Essentially, an audit committee that practises good corporate governance greatly enhances the firm's performance. Norziaton, I. K., & Hafizah, S. (2019) focus their study investigating the relationship between the determinants of audit committee characteristics and financially distressed Malaysia firms. Their findings indicate that financially distressed firms are significantly associated with audit committee expertise, as the audit committees of the financially distressed firms are not financially literate. The study also demonstrates that audit committees with fewer independent members are more susceptible to management manipulation, endangering the company's survival. The study's findings are consistent with the notion that many directorships held by audit committee members and financially troubled companies have

a substantial unfavorable association. As a result of having to serve on many boards concurrently due to multiple directorships, audit committee members get disorganized and miss critical issues that demand their immediate attention. Disputes, however, the notion that financial difficulty and audit committee size are negatively correlated.

Boodoo, Muhammad Umar (2018) aimed to investigate the connection between Canadian government, unionization, and the different parts of CEO compensation. This paper indicates that CEO compensation is only slightly influenced by governance methods after controlling for size, performance, industry, and firm random effects. Stronger governance is linked to higher CEO salary, supporting the idea that CEOs are often compensated for the increased scrutiny they currently endure.

The relationship between corporate governance and financial distress is complex and multifaceted. Effective corporate governance mechanisms can help prevent or mitigate financial distress by improving transparency, risk management, and decision-making processes. A well-functioning board of directors, independent from management, can provide oversight and guidance to prevent excessive risk-taking and ensure the adoption of prudent strategies. Ownership structure can influence the level of monitoring and alignment of interests, affecting risk management and financial stability. Executive compensation mechanisms can incentivize managers to act in the long-term interests of the company and discourage excessive risk-taking.

In summary, the literature on the relationship between corporate governance and turnover in financially distressed companies highlights the complex nature of this relationship. While some studies suggest a positive association between strong governance and higher turnover rates, others indicate a negative association. These divergent findings may be attributed to variations in sample characteristics, methodologies employed, and contextual factors.

Empirical studies exploring the link between corporate governance and financial distress have yielded mixed results. Some studies have found a significant relationship between specific governance mechanisms and financial distress outcomes. For example, board independence, board size, and ownership concentration have been found to influence the likelihood and severity of financial distress. Other studies have shown inconclusive or insignificant relationships, highlighting the contextual nature of the relationship and the need for further investigation.

Furthermore, there is limited research specifically examining the impact of corporate governance on the turnover process of financially distressed companies. Understanding how corporate governance mechanisms affect the outcomes of financially distressed firms in terms of restructuring, reorganization, or acquisition is crucial for enhancing the effectiveness of governance practices in distressed situations.

Despite the existing body of literature, there is a research gap in understanding the specific mechanisms through which corporate governance influences turnover in financially distressed companies, particularly in the Canadian context. This thesis aims to address this gap by providing empirical evidence on the impact of corporate governance on turnover in financially distressed firms in Canada. By employing the Altman Z-Score as a metric to assess financial distress, this study aims to contribute to the existing literature by providing empirical evidence on the relationship between corporate governance and turnover outcomes the Canadian context.

Three components make up the Altman Model, which can be seen as a whole. The variables themselves make up the first portion; the coefficients associated with each variable make up the second part; and the cut-off ranges, which guide the evaluation of the resulting Z-scores, make up the third component. The first two components mentioned above have been the same since 1968. The third part's cut-off values, which Altman originally listed as 1.1-2.6 (Altman E. I., Z-Score History & Credit Market Outlook, 2017), have similarly remained constant over time.

The fact that the model consistently produces outstanding results in testing, both for various businesses and for various geographies, is one reason for this lack of change. These findings have greatly increased researchers' confidence in the concept. In Tuxtepec, Mexico, one study employed the Z-score as a "fact" to determine the health of small and medium-sized businesses, identifying 75% of them as healthy and the remaining 25% as either in the grey area or on the verge of bankruptcy (Hernandez, 2018). The reliability of the Altman's model was demonstrated by similar studies done for the NIFTY 50 index (Sanesh, 2016), industrial listed companies in Italy (Celli, 2015), insurance companies listed on the Amman Stock Exchange (Al-Manaseer & Al-Oshaibat, 2018), and the Indonesian listed Banking Industry (Muammar Khaddafi, 2017).

This does not imply, however, that the paradigm has not faced opposition. In reality, past study has consistently shown that one or more of the three components may be improved.

For instance, Muminovic came to the conclusion in his paper that, despite the Z-score model's popularity in the Serbian capital market, maintaining the model's coefficients and variables while making minor cosmetic accounting changes led to inaccurate results, indicating the need for a revised model that takes both the coefficients and the cut-off ranges into account (Muminovic, 2013). The cut-off scores were altered, though, and four ranges were utilized in place of the original three (Thai, Goh, Teh, Wong, & Ong, 2014).

The model's MDA methodologies have also been put to the test. In fact, one of the few recent Canadian studies on the Altman Z model was carried out in 2017, and the author (Mohammad Mahbobi, 2017) aimed to develop a hybrid Forecasted Artificial Neural Network (FANN) model that would outperform the Altman model. The study was successful in its conclusion, but it also revealed that LOGIT and artificial neural network (ANN) models do not behave any better than the Z model.

Following Ahmed, M. A. R., & Govind, D. (2018) logic this study will be performing a revised model that takes CFO ratio as part of Altman's Z-Score model.

The results of Vo and Nguyen's (2014) study diverge from earlier research, such as the study conducted by Eisenberg, Sundgren, and Wells (1997), which established a negative correlation between board size and firm performance. On Figure 1 below, there is present the analytical framework used by Vo and Nguyen's (2014) when putting together the final model used. Similarly, Muth and Donaldson (1998) emphasized the board's significance in mirroring both internal and external business environments, suggesting the presence of an optimal board size tailored to individual company circumstances, fostering a harmonious blend of inside and outside directors. In contrast, Vo and Nguyen's (2014) findings align with Bhagat and Black's (1999) conclusion that there is insufficient evidence to support the notion that an increase in board size leads to improved firm performance. This suggests that, in the context of Vietnam, the size of the board may not necessarily reflect its effectiveness in managing companies, as it appears to have little to no impact on firm performance.

Vo, D. H., & Nguyen, T. M. (2014) found a positive significant correlation between Z-Score and board independence, similar to Klein (1998). Several papers are conducting analysis with board independence and board size, this study purpose is to use the present literature to test the Canadian market.

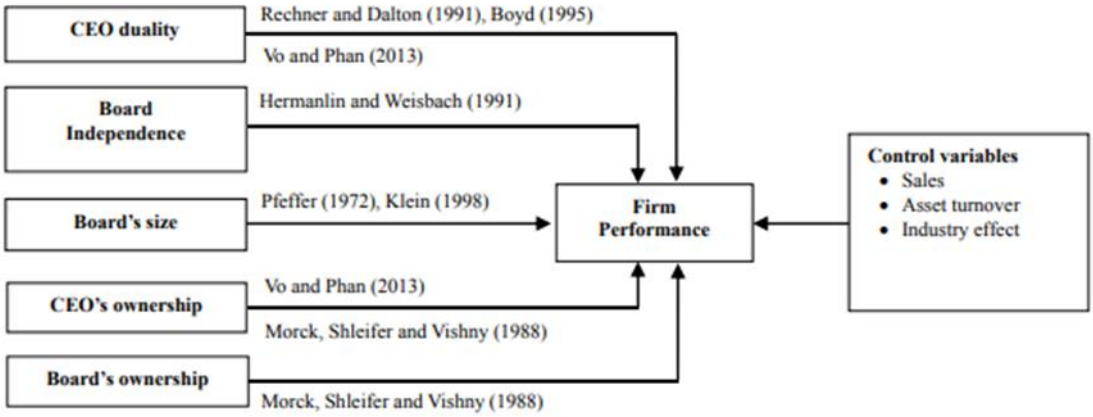

Figure 1 – Analytical Framework used by Vo, D. H., & Nguyen, T. M. (2004)

Based on the findings from existing literature and the focus on the Canadian market, we propose the following research hypotheses:

- H_1: Board size has significant effect on predicting probability of default in the Canadian market.
- H_2: Independence of the board has significant effect on predicting probability of default in the Canadian market.
- H_3: The revised Altman Z-Score has a higher predictability of bankruptcy than the original

3 Research Methodology

The fundamental work by Edward I. Altman, published in 1968, which introduced the then-revolutionary bankruptcy prediction model now commonly known as the Altman's Z-Score, will be 55 years old in 2023 (Altman E. I., 1968). He was the first to create a bankruptcy prediction model using the Multiple Discriminant Analysis (MDA) technique and five financial ratios in his study.

Prior to the publication of his research, bankruptcies were typically modeled using univariate ratio analysis models, such as the classic study by Beaver (Beaver, 1966), which provided the foundation for additional multivariate models. Since then, numerous improvements to the multivariate Altman Z-Score model have been made, and Multiple Discriminant Analysis (MDA) has seen widespread use. The best-known of these technologies, the Ohlson's O-Score (Ohlson, 1980), was created in following years, along with others like logistic regression (Logit) models. A range of AI techniques, including neural networks, genetic algorithms, case-based reasoning, and recursive partitioning, have been developed more recently because of rising processing power (Richard H.G. Jackson, 2013). Regardless of the approach of such more up to date methods, the utilization of Altman's Z-score has not retreated in fame. As a matter of fact, prestigious examination, and speculation the executives' firms like the Morningstar, right up until now, do not avoid contrasting their much-desired underlying Distance with Default model to the Z-score to flaunt their viability (Morningstar, Inc., 2009).

Curiously, even though Altman's Z-score depended on US firms and ensuing examinations have traversed over every one of the landmasses from Africa to Asia, Australia and Europe, it is clear that inside and out investigations to the Canadian Market is relatively deficient. As of late, an examination was embraced which integrated Beaver's paper and added the utilization of the CFO to the first model and tried its viability for English openly recorded organizations Almamy, J. (2016). The paper reasoned that the sixth variable in their "J-UK" model for sure was a further developing element on the Z-score and the organizations examined were the ones recorded in the English securities exchanges. Such examinations have likewise been led for the US market without a doubt by Altman himself in 1968, when he tried the viability of this 6th variable in 1968, however no such review was as of late embraced for the Canadian securities exchange, despite the TSE being practically identical to the NYSE or the LSE.

3.1 Data Collection and Sample Selection

The primary source of data for this study will be financial and governance data obtained from Refinitiv Eikon.

Sample selection initiated with data from all listed firms on the principal stock indexes of Canada, being Toronto Stock Exchange (TSE), Toronto Venture Exchange (TSE-V), Canadian Securities Exchange (CSE), TSE-V NEX, and Neo Stock Exchange. The initial sample was narrowed down after the exclusion of firms with insufficient data to perform the analysis. The final sample comprises 30 listed companies all part of the Toronto Stock Exchange from 6 different sectors, Energy, Basic Materials, Technology, Industrials, Utilities, and Consumer Cyclicals, from the period of 2002 to 2022, comprising 455 firm-year observations.

3.2 Research Design

Altman, E. (1968), developed the Altman Z-Score model as a financial tool designed to forecast the probability of a company facing bankruptcy. This model's origins can be traced back to the era of the Great Depression when Altman initiated his research due to a significant increase in default occurrences.

The Z Score Model serves the objective of evaluating a company's financial well-being and its ability to potentially face financial distress within a two-year timeframe. Its track record demonstrates remarkable accuracy in anticipating bankruptcy across diverse industries and market conditions. Research findings indicate that the model boasts a reliability rate ranging from 72% to 80% in bankruptcy prediction. Nevertheless, it is important to note that the applicability of the Z-Score hinges on the availability of relevant benchmark data for comparison; without this context, its forecasting capabilities cannot be effectively harnessed.

The analytical model used in the study is a revised model to the Altman Z-score model (1968). Almamy, Jeehan & Aston, John & Ngwa, Leonard N. (2016) introduced the CFO to Total Debt ratio as an additional variable in Z-Score model. This enhanced model was then tested on British publicly listed companies, the study's findings affirmed that the inclusion of the 6th variable in their 'J-UK' model positively influenced the Z-score, and the study's sample consisted of companies listed on the British stock markets. Similar to this, Ahmed, & Govind, (2018) used the 6^{th} variable model in Canadian listed companies

and found that adding a sixth variable produces improvements. The model used is then, a linear equation based on the research mentioned, the original Altman Z-Score:

$$\zeta = 1.2X_1 + 1.4X_2 + 3.3X_3 + 0.6X_4 + 1.0X_5 + 0.2X_6$$

where the Zeta (ζ) dependent variable denotes the Altman's Z-score, X1 is the Working Capital/Total Assets ratio, X2 is the Retained Earnings/Total Assets ratio, X3 is the Earnings Before Interest and Tax/Total Assets ratio, X4 is the Market Value of Equity/Total Liabilities ratio, X5 is the Total Sales/Total Assets ratio, and X6 is Cash Flow of Operations/Total assets ratio.

Typically, a company's likelihood of bankruptcy can be inferred from its Z-score, with lower Z-scores signaling higher bankruptcy risk. When a company's Z-score falls below 1.1, it indicates significant financial distress and a substantial probability of bankruptcy. Conversely, a Z-score of 2.6 or higher suggests the company is in a secure financial position and is unlikely to experience bankruptcy. For Z-scores falling between 1.1 and 2.6, the situation is less clear, representing a gray area with a moderate chance of bankruptcy.

Investors leverage Altman's Z-score to inform their decisions regarding buying or selling a company's stock, based on their assessment of its financial strength. If a company's Z-score approaches 2.6, investors may consider purchasing its stock due to the minimal risk of bankruptcy in the next two years. Conversely, when a company's Z-score approaches 1.1, investors may contemplate selling its stock to safeguard their investments, as the score implies a high probability of impending bankruptcy.

In recent times, a Z-Score approaching zero has become a cause for concern, indicating potential financial distress within a company. In a lecture titled "50 Years of the Altman Score" delivered by Professor Altman in 2019, he underscored that contemporary data has revealed a shift in the threshold of concern. Rather than the previously noted 1.1, Professor Altman emphasized that a Z-Score nearing zero is the critical point where investors should start to worry about a company's financial stability.

In the year 2007, there was a notable discrepancy in the credit ratings assigned to specific asset-related securities—they were rated higher than what their actual risk profile warranted. At that time, the Altman Z-score analysis signaled a substantial increase in the risk levels of these companies, hinting at a looming possibility of bankruptcy.

Edward Altman's calculations led him to anticipate a forthcoming crisis, one rooted in the corporate sector, which could trigger a meltdown in the credit market. While he initially anticipated the crisis to emanate from corporate defaults, the actual financial turmoil that unfolded in 2008 had its origins in mortgage-backed securities (MBS). Nonetheless, by the subsequent year, 2009, corporations did experience a historically high rate of defaults, albeit after the initial shock of the financial crisis brought about by the MBS market meltdown.

3.2.1 The Five Financial Ratios in Z-Score

X_1 = Working Capital/Total assets ratio is a financial metric that assesses a company's short-term liquidity and its ability to cover its short-term obligations using its current assets. The Working Capital to Total Assets ratio provides insight into a company's liquidity and its ability to meet its short-term financial obligations. Its interpretation should consider industry norms and trends.

X_2 = Retained earning/Total assets ratio is a financial metric that measures the proportion of a company's total assets that are financed by its retained earnings. Retained earnings represent the cumulative profits earned by a company over time that have not been distributed to shareholders as dividends. A higher ratio indicates greater reliance on internal financing, while a lower ratio suggests a greater need for external funding. The interpretation should consider historical trends and industry benchmarks.

X_3 = EBIT/Total assets ratio measures how effectively a company utilizes its assets to generate operating profits. A higher ratio is generally favorable, indicating efficient asset utilization and strong profitability. However, the interpretation should consider historical trends and industry standards to provide a comprehensive assessment of a company's financial performance.

X_4 = Market Value of equity/Total Liabilities ratio assesses the balance between equity and debt financing in a company's capital structure. The market value, also known as market capitalization, is the value of a company’s equity. It is obtained by multiplying the number of outstanding shares by the current price of stocks. A higher ratio suggests lower financial risk, while a lower ratio implies higher financial leverage and risk. Interpretation should consider historical trends and industry norms to provide a comprehensive assessment of a company's financial position.

X_5 = Sales/Total assets ratio evaluates how efficiently a company uses its assets to generate sales revenue. A higher ratio suggests efficient asset utilization, while a lower ratio may indicate a need for improvement in asset management or sales strategies. Interpretation should consider historical trends and industry norms for a more comprehensive assessment.

The figure below represents the original Altman Z-Score model, with the break down of components and their weighting factor on the model.

Variable	Definition	Weighting factor
X_1	Working capital / Total assets	1.2
X_2	Retained earnings / Total assets	1.4
X_3	EBIT / Total assets	3.3
X_4	Market value of equity / Book value of total liabilities	0.6
X_5	Sales / Total assets	1.0

"EBIT" is earnings before interest and taxes.

Figure 2 -Edward I. Altman, 2018: Original Z-score model

3.2.2 Additional ratios to Z-Score model

In addition to the five ratios above, as mentioned, we will take into consideration CFO ratio.

X_6 = CFO/Total assets, is a financial ratio that helps assess how effectively a company generates cash from its core operating activities in relation to its total asset base. It's an important measure of a company's liquidity and financial health. This ratio is considered a crucial indicator for forecasting corporate insolvency.

Thus, we use both the original Altman Z-Score and a revised version by Ahmed & Govind (2018).

3.3 Z-Score cut-off scores

Z-Score cut-off scores represent the specific threshold values used to categorize or interpret Z-Scores in various applications. These cut-off scores help classify individuals, companies, or data points into different risk or performance categories based on their Z-

Scores. The choice of cut-off scores can vary depending on the context and the specific Z-Score model being used.

In the Altman Z-Score model used, which predicts bankruptcy risk for companies, the cut-off scores are:

- Z-Score > 2.6: Safe Zone – Indicates a low risk of bankruptcy.
- 1.1 < Z-Score < 2.6: Grey Zone – Suggests moderate risk of bankruptcy.
- Z-Score < 1.1: Distress Zone – Indicates a high risk of bankruptcy.

These cut-off scores are often established through statistical analysis, research, or industry standards to help make meaningful decisions or assessments based on Z-Scores. It's important to note that cut-off scores can vary depending on the specific context and the goals of the analysis.

4 Data Analysis and Results

4.1 Descriptive Statistics

The revised model was winsored at 1% to mitigate the impact of extreme values on the statistical analysis.

An overview of the dataset used in this study is presented in the below table. The descriptive statistics includes the number of observations, the mean, standard deviation, minimum and maximum value.

Variables	Obs	Mean	Std. Dev.	Min	Max	Skew.	Kurt.
Revised Z-Score	455	15.468	44.434	1.952	344.27	6.279	43.033
X_1	455	0.01	0.088	-0.453	0.362	0.768	6.01
X_2	455	0.049	0.063	-0.379	0.258	-1.517	14.506
X_3	455	0.085	0.06	-0.102	0.414	1.273	7.189
X_4	455	25.827	86.917	1.852	824.386	6.917	53.346
X_5	455	0.54	0.691	0.099	5.25	4.313	23.765
X_6	455	0.113	0.053	-0.086	0.367	0.719	4.719

Table 1 – Revised Z-Score variables' descriptive statistics

To embark on, the examined listed companies consistently exhibited a positive Revised Altman model over the twenty years spanning from 2002 to 2022. The maximum Z-Score value was 344.27 and the minimum 1.952 which means none of the 30 listed companies in study were with high risk of bankruptcy, and in fact, were only 13 observations where

the model assumed a value minor than 2.6, being in the grey zone with a moderate probability of default.

The dependent variable has a standard deviation of 44.434 which suggests a relatively wide spread of values. With a positive skewness of 6.279 indicates that the distribution is skewed to the right (tail on the right side), kurtosis value of 43 indicates heavier tails and leptokurtic.

The independent variable X_4 Market Value of equity/Total Liabilities ratio stands out with a mean of 25.827, maximum of 824.386 suggesting that there is a company with market value significantly greater than its total debt and other liabilities, however that is unusual and not commonly encountered in typical financial analysis, ant that is why there is such a discrepancy between the maximum and minimum value of this variable. X_2 variable stands up when it comes to skewness, being the only variable with a negative value, indicating a that the distribution is skewed to the left.

Table 2 displays the variables in use on the regression analysis performed below, along with their definitions.

Variables	Definition
Dependent variables	
Altman-Z	Discriminant model of Altman (1968)
Altman-Z, revised	Revised Z-Score ratio – adding CFO ratio as independent variable (Ahmed & Govind, 2018)
Independent variables	
Board Size	Total number of board of directors
Independent Board	Proportion of independent members over total members
Governance Score	Index to assess the quality and effectiveness of the governance practices
Control variables	
Size	Firm's size – Log of market capitalization
CF Operating %	Operating Cash Flow Margin – % of revenue converted into cash from firm's core operations
CF Investing %	Investing Cash Flow Margin – % of company's revenue reinvested in its operations and expansion
CF Financing %	Financing Cash Flow Margin – Insight into how the firm is funding its operations and growth
FCF %	Free Cash Flow %
NWC %	Net Working Capital %

Table 2 – Variables definition

On Table 3, the descriptive analysis of the three independent variables as well as the control variables can be seen. The independent board variable has a mean of nearly 80 meaning that in average 80% of the board is constituted by independent members, when

it comes to bard size in average there are 11 members in the board. Lastly, the governance score mean value is roughly 62, in a scale of 0 to 100, with a relatively high standard deviation, indicating significant variability in governance scores among the entities in the sample.

Size is a key financial metric used to evaluate the scale or magnitude of the entities in the sample, it is calculated by using the logarithm of market capitalization. On average, the companies in the dataset have a market capitalization of approximately 23.485 billion of dollars.

Interpreting "CF Operating %," "CF Investing %," and "CF Financing %" variables provides insights into the sources and uses of cash within the company. CFO% average is 0.312, with p25, median, and p75 positives, suggesting that the companies are effectively generating cash from its core operations, which is often seen as a sign of a healthy business. A negative value for CFI% indicates that the company is spending more on investments than it is receiving from those activities, this may be a sign that the company is making significant investments for growth, expansion, or other strategic reasons. However, it is important to assess the efficiency and returns of these investments to determine whether they are adding value to the company. Lastly, a positive average of CFF% 0.009 suggests that the company is using financing to support its operations or growth, yet a negative value, as seen at a percentile 25 and 50, may indicate debt repayment or other capital management activities.

The average free cash flow percentage is about 1.5%, with low standard deviation and the net working capital percentage has a mean of approximately 5.9%, indicating the relative proportion of net working capital to total revenue for the sample.

Table 3 – Descriptive Statistics

	N	Mean	Std. Dev.	p25	Median	p75
Altman-Z	455	15.445	44.433	3.940	5.988	11.445
Altman-Z, revised	455	15.468	44.434	3.961	6.009	11.476
Board Size	455	11.213	2.595	9.000	11.000	13.000
Independent Board	455	79.552	13.020	71.430	83.330	90.910
Governance Score	455	61.970	21.802	46.970	67.921	77.042
Size	455	23.485	0.974	22.818	23.605	24.259
CF Operating %	455	0.312	0.176	0.200	0.289	0.386
CF Investing %	455	-0.306	0.369	-0.412	-0.223	-0.133
CF Financing %	455	0.009	0.292	-0.116	-0.041	0.066
FCF %	455	0.015	0.151	-0.012	0.002	0.026
NWC %	455	0.059	0.365	-0.121	-0.034	0.081

4.2 Correlation Analysis

A correlation analysis was performed between the Revised Z-Score and its components. There are 4 independent variables with a lower level of significance ($p<0.1$) in relation to the Revised Z-Score model. X_1 (0.291*) and X_4 (0.989*) present a positive correlation to the dependent variable. However, there can be spot a negative correlation between the model and X_4 variable (-0.084*), as well as the board size (-0.164*).

Below table 4 presents the correlation matric between the dependent variable, independent variables, and control variables.

Board size has a negative correlation with Altman-Z and Altman-Z, revised (-0.164*). This indicates that as board size increases, Altman-Z scores tend to decrease. Independent board has a positive correlation with Governance Score (0.586*), indicating that a higher percentage of independent board members is associated with a higher governance score. Governance score has a negative correlation with Altman-Z, Altman-Z, revised, board size, and size. This suggests that a higher governance score is associated with lower Altman-Z scores and smaller board sizes. Size has positive correlations with board size (0.406*) and independent board (0.070). A larger company size is associated with a larger board size and a slightly higher percentage of independent board members.

CF Operating % has a positive correlation with board size (0.396*) and a negative correlation with governance score (-0.173*). CF Investing % has a negative correlation with board size (-0.324*) and a positive correlation with size (0.186*). CF Financing % has a negative correlation with size (-0.803*) and FCF % (0.338*). FCF % has a positive correlation with CF Operating % (0.100*) and CF Investing % (-0.475*).

NWC % has positive correlations with CF Operating % (0.449*), CF Investing % (0.449*), and FCF % (0.397*). It also has negative correlations with board size (-0.227*) and governance score (-0.232*)

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
(1) Altman-Z	1										
(2) Altman-Z, revised	1.000*	1									
(3) Board Size	-0.164*	-0.164*	1								
(4) Independent Board	0.070	0.070	0.014	1							
(5) Governance Score	-0.022	-0.022	-0.136*	0.586*	1						
(6) Size	-0.023	-0.023	0.406*	0.070	0.157*	1					
(7) CF Operating %	0.396*	0.396*	-0.173*	0.230*	0.031	-0.181*	1				
(8) CF Investing %	-0.324*	-0.324*	0.176*	-0.150*	-0.049	0.186*	-0.475*	1			
(9) CF Financing %	0.194*	0.194*	-0.146*	0.028	0.015	-0.158*	0.049	-0.803*	1		
(10) FCF %	0.043	0.043	-0.054	-0.046	-0.054	-0.060	0.100*	0.338*	0.030	1	
(11) NWC %	0.449*	0.449*	-0.227*	-0.029	-0.025	-0.232*	0.177*	-0.112*	0.240*	0.397*	1

**** p<0.01, ** p<0.05, * p<0.1*

Table 4 - Correlations

5 Regression Analysis

5.1 Diagnostic Tests

Two critical aspects of data analysis were addressed: heteroscedasticity and the normality of the data. The Breusch-Pagan Test for Heteroscedasticity assessed whether the assumption of constant variance across observations, known as homoscedasticity, held true. The null hypothesis assumed homoscedasticity, while the alternative hypothesis suggested the presence of heteroscedasticity. The test was applied to the fitted values of the Revised Z-Score model, and the low p-value (0.0060) indicated that the assumption of constant variance was likely violated.

Following the detection of heteroscedasticity, the application of robust standard errors was recommended. These robust standard errors account for and correct the issue of heteroscedasticity, ensuring that statistical estimates remain valid and reliable.

The Shapiro-Wilk W Test for Normality examined whether the data followed a normal distribution. The null hypothesis assumed normality, while the alternative suggested non-normality. The extremely low p-value (0.000) led to the rejection of the null hypothesis, indicating that the data was not normally distributed.

An omitted variable test known as the Ramsey RESET test was also conducted. The purpose of this test is to determine if the regression model contains omitted variables that could significantly affect the model's accuracy and predictions.

The calculated F-statistic is 2.29, and the associated p-value is 0.0773. The significance of the p-value is crucial for interpretation. If the p-value is greater than 0.1 (which is not in this case), you would fail to reject the null hypothesis. Therefore, based on this test, there is strong evidence to suggest that omitted variables significantly impact the model.

Lastly, The Wald test was performed to assess the collective significance of board size, independent board, and governance score within the regression model. The calculated F-statistic is 6.95, and the associated p-value is 0.0001, indicating that the subset of coefficients is jointly significant in explaining the variation in the dependent variable. The low p-value suggests that at least one of these coefficients is not equal to zero, demonstrating that these variables collectively have a significant impact on the dependent variable.

5.2 Regression Analysis

Table 5 presents the results of a regression model for various variables. The values in the table represent the coefficients estimated for each independent variable in predicting both "Altman-Z" and "Altman-Z, revised." These coefficients indicate the estimated impact of each independent variable on the dependent variables, all else being equal. Robust standard errors are used to correct for heteroskedasticity in the model. Year Fixed Effects are also included in the model, indicating that the analysis controls for time-related factors.

To note that each one of the four regressions have the same effect on both dependent variables.

Analysing the independent variable board size and its relationship with Altman Z-Score and Altman Z-Score revised, the variable has a negative impact in the model (-1.696) and it is highly statistically significant (*** p<.01). On the first model (1) and (2), the adjusted R-squared value (0.219) measures the goodness of fit of the regression model. It indicates how well the independent variables explain the variation in the dependent variables. In this case, the independent variables explain about 21.9% of the variation in Altman-Z and Altman-Z, revised. The F-statistic (2.773 and 2.774) tests the overall significance of the regression model, suggesting it is significant.

On the second model (3) and (4), the coefficient for independent board is 0.219, and it is highly statistically significant (*** p<.01). The independent variables collectively explain approximately 21.5% of the variation in both Altman Z and Altman Z, revised.

On the third model (5) and (6), the coefficient for governance score is -0.062, and it is statistically insignificant at the all levels. Size is 2.262, and it is statistically significant at the ** p<.05 level. The adjusted R-squared value 0.21, indicating that the independent variables collectively explain about 21% of the variation in both models.

Governance score is the independent variable with less significance when comparing with board size and board independence.

To conclude, a model with all three independent variables was performed. Both board size (-2.300) and governance score (-0.298) have a negative effect on the dependent variable, both are highly statistically significant (*** p<.01). Independent board has a positive implication on the dependent variable (0.506) and it is also highly statistically significant (*** p<.01). Size is highly statistically significant (*** p<.01) and positive

related with Altman Z, revised (5.435). The adjusted R-squared (Adj R2) value in this model is 0.232, indicating that the independent variables collectively explain approximately 23.2% of the variation in Altman-Z, revised. The F-statistic is 3.177.

	(1) Altman-Z	(2) Altman-Z, revised	(3) Altman-Z	(4) Altman-Z, revised	(5) Altman-Z	(6) Altman-Z, revised	(7) Altman-Z	(8) Altman-Z, revised
Board Size	-1.696***	-1.696***					-2.299***	-2.300***
	(0.507)	(0.507)					(0.555)	(0.555)
Independent Board			0.219***	0.219***			0.506***	0.506***
			(0.082)	(0.082)			(0.125)	(0.125)
Governance Score					-0.062	-0.062	-0.298***	-0.298***
					(0.041)	(0.041)	(0.070)	(0.070)
Size	3.980***	3.980***	1.992*	1.991*	2.262**	2.262**	5.434***	5.435***
	(1.387)	(1.387)	(1.134)	(1.134)	(1.112)	(1.112)	(1.508)	(1.508)
FCF %	-51.457	-51.450	-51.473	-51.468	-52.498	-52.493	-51.374	-51.368
	(37.993)	(37.994)	(38.198)	(38.200)	(38.501)	(38.502)	(37.560)	(37.561)
NWC %	63.486***	63.480***	65.264***	65.259***	65.463***	65.458***	63.204***	63.198***
	(11.558)	(11.558)	(11.893)	(11.893)	(11.950)	(11.950)	(11.604)	(11.604)
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	455	455	455	455	455	455	455	455
Adj R^2	0.219	0.219	0.215	0.215	0.212	0.211	0.232	0.232
F-stat	2.773	2.774	2.731	2.731	2.966	2.967	3.176	3.177

Robust standard errors are in parentheses
**** p<.01, ** p<.05, * p<.1*

Table 5 – Main Analyses

5.3 Additional analysis: robustness

Table 6 presents results from five different regression analysis that includes interaction terms and various independent variables for both Altman Z-Score and Altman Z-Score revised. Industry Fixed Effects and Year Fixed Effects are included in the model, indicating that the analysis controls for industry-related and time-related factors. Robust standard errors are being used to account for heteroscedasticity.

All models include size, FCF percentage and net working capital percentage as control variables. A brief description of each regression per column follows.

- Column 1 and 2 – the regression is examining the connexion between the dependent variables and independent variables, including the interaction of board size and independent board. The interaction term allows the regression to evaluate if the relationship between the dependent variable and board size depends on the presence of independent directors on the board, or vice versa.

- Column 3 and 4 – These models differ from the first ones in the way it accounts for the interaction between board size and independent board. It is accounting for both the main effects as well as their interaction.
- Column 5 and 6 – on these models are examining the relationship between the dependent variables and the interaction effect between governance score and independent board. It also accounts for each independent variable on its own.
- Column 7 and 8 – the last 2 models study the connexion among board size and governance score on top of the effect of each variable single.

Similar to the results of table 5, each one of the four regressions have the same effect on both dependent variables.

When combining the interaction between board size and independent board (0.020) and the main effect of board size (-3.816), both highly significant at 1% level, the adjusted R-squared is 0.245, indicating that the independent variables in the model explain a substantial portion of the variation in the Altman-Z, revised score. The F-statistic is 3.218, suggesting that the overall regression is statistically significant.

Model 4 highlights that having independent directors and larger board sizes have significant effects on the model. Board Size × Independent (-0.100**) have a negative impact in the model and it is significant at 5% level. Independent board coefficient is positive (1.381) and highly statistically significant (***p<0.01). The coefficient for board size (5.587) is positive and statistically significant at the 5% level (p<0.05). The independent variables in the model explain 22.6% of the variation in the Altman Z-Score, revised.

The coefficient for the interaction between governance score and independent board is positive but very small (0.003). It is statistically insignificant. This suggests that the interaction has a minor effect on the Altman-Z, revised. The coefficient for governance score is negative and statistically significant at the 10% level (p<0.1), suggesting that a higher governance score is associated with lower Altman-Z, revised scores. This implies that stronger corporate governance is related to weaker financial distress predictions.

To finish, Model 8 suggests that the presence of independent directors on the board and the governance score do not have a direct effect on the Altman-Z, revised score (-0.006). Larger board sizes (-1.580) are associated with lower Altman-Z, revised scores. The

coefficient for governance score is negative (-0.038), but not statistically significant at conventional levels (p>0.1).

	(1) Altman-Z	(2) Altman-Z, revised	(3) Altman-Z	(4) Altman-Z, revised	(5) Altman-Z	(6) Altman-Z, revised	(7) Altman-Z	(8) Altman-Z, revised
BS × IB	0.020***	0.020***	-0.100**	-0.100**				
	(0.007)	(0.007)	(0.041)	(0.041)				
IB			1.381***	1.381***	0.241	0.240		
			(0.525)	(0.525)	(0.174)	(0.174)		
BS	-3.816***	-3.816***	5.587**	5.587**			-1.580**	-1.580**
	(0.969)	(0.969)	(2.723)	(2.723)			(0.770)	(0.770)
GS					-0.466*	-0.466*	-0.038	-0.038
					(0.243)	(0.243)	(0.202)	(0.202)
GS × IB					0.003	0.003		
					(0.003)	(0.003)		
BS × GS							-0.006	-0.006
							(0.016)	(0.016)
Size	4.400***	4.401***	4.321***	4.321***	2.624**	2.624**	4.555***	4.556***
	(1.374)	(1.374)	(1.467)	(1.467)	(1.138)	(1.138)	(1.392)	(1.392)
FCF %	-43.959	-43.955	-50.338	-50.332	-52.177	-52.172	-51.826	-51.820
	(37.541)	(37.543)	(37.311)	(37.312)	(38.156)	(38.157)	(38.063)	(38.064)
NWC %	50.078***	50.073***	61.756***	61.750***	66.155***	66.150***	63.526***	63.520***
	(10.815)	(10.815)	(11.144)	(11.144)	(12.179)	(12.179)	(11.645)	(11.645)
Industry FE	Yes	No	No	No	No	No	No	No
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	455	455	455	455	455	455	455	455
Adj R^2	0.245	0.245	0.226	0.226	0.219	0.219	0.218	0.218
F-stat	3.215	3.218	2.708	2.709	2.937	2.938	2.957	2.959

Robust standard errors are in parentheses
*** p<.01, ** p<.05, * p<.1*
BS – Board Size; IB – Independent Board; GS – Governance Score

Table 6 – Additional analyses: robustness

Analysis supports H_1. It is constant that board size negatively affects the probability of default. Larger boards are linked to higher probability of default. However, model 2 shows a significant positive relationship between board size and Altman-Z scores.

Mixed results for H_2 can be seen. In Model 2, we observe a positive coefficient for the interaction between board size and independent board, suggesting that larger board sizes combined with independent boards positively affect financial stability. Independent board is also significant on model 4. However, in Model 6, the variable alone does not show significant impact on the Altman-Z, revised score. This suggests that the relationship between board independence and default prediction is influenced by other factors, making it less straightforward to draw a definitive conclusion.

Based on descript statistics, correlation matrix and regressions analysis, H_3 is unconclusive. The same results were generated when comparing the two scores using the same model what can mean that different variables may be used to get to a better decision.

6 Conclusions

6.1 Main Findings

The Z-score model serves as a highly pragmatic instrument for forecasting corporate insolvency and overseeing risk in businesses. With frequent instances of company liquidations, creditors often face losses. Altman's predictive models offer an effective means to address this challenge in the Canadian market. Additionally, investors can employ this tool to assess the financial health of private companies when contemplating investments.

For board composition, this study succeeds in providing evidence to support the relationship between board size and firms' financial health. The findings from this study are similar to those from previous studies including Eisenberg, et al. (1998) study which confirmed that there is a negative correlation between board size and firm performance, Badu & Appiah (2017), and Riaz, et al. (2017). However, it negates the view of Vo & Nguyen (2004). Despite of the positive correlation between board independence and the Altman Z-Score revised, the independent variable has mixed results, indicating that the impact on bankruptcy prediction may be influenced by other variables. That can be seen when combining this metric with board size or governance score. It usually has a positive significance alone but when combining can have a positive or negative significance depending on the model. The most intriguing discovery in this research is precisely that the influence of board independence, as gauged by the ratio of independent members, varies across different performance metrics in the Canadian market, as Vo & Nguyen (2004) also predicted.

The revised Altman Z-Score model that includes CFO as sixth variable presents different results when evaluating the sample. There were found 2 observations where the score was below 1.1, reflecting a high risk of bankruptcy. Nevertheless, when comparing the various models, the impact of the independent and control variables is the same for both the original Altman Z and Altman Z revised models.

In sum, Canadian listed companies presented a very low risk of bankruptcy. The importance of this study remains with the likelihood of analysing what are Canadian firms doing differently to prevent bankruptcy. This can be a starting point to further explore the Canadian firms' board composition.

This study significantly contributes to the existing literature on corporate governance and firm financial health. It underscores the multifaceted nature of corporate governance's impact on companies' financial stability, emphasizing the varying effects of board size and independence. The research expands our understanding of the intricate relationship between corporate governance practices and the likelihood of financial distress in the Canadian market. These insights provide valuable information for regulators, policymakers, and practitioners, as they highlight the importance of implementing effective corporate governance measures to safeguard companies against financial instability and enhance their long-term performance. Additionally, the study encourages further exploration of predictive models and the incorporation of multiple variables in assessing the financial health of firms, setting the stage for more comprehensive and context-specific risk management strategies.

The findings and conclusions drawn from this study carry substantial implications for practitioners in the Canadian business landscape. Firstly, the study highlights the vital role of corporate governance in influencing the financial health and performance of publicly listed companies. Practitioners, including board members, executives, and corporate advisors, should take heed of the varying impacts of board size and independence on the probability of financial distress. These insights offer actionable guidance for Canadian companies seeking to enhance their financial health and mitigate the risks associated with insolvency. For instance, they underline the importance of optimizing board size to strike a balance between diverse perspectives and effective decision-making while avoiding unnecessary bureaucracy. The study also emphasizes the significance of maintaining a healthy level of board independence to ensure prudent governance.

6.2 Limitations and future research

Altman's Z-score model might not be the sole approach to gauge financially troubled companies. The investigator suggests considering other models to identify financially distressed firms. This approach could potentially increase the count of distressed firms in the Canadian listed market.

Additional investigation into Altman's Z-score and alternative formulas is required to improve and enhance this potentially valuable tool. This will contribute to building a set of effective tools for forecasting financial difficulties.

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