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Benefiting from Insurance

An empirical analysis of directors' and officers' liability insurance on Canadian corporations' capital structure

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Abstract

In this thesis, we examine the role of Directors' and Officers' Liability Insurance, as a proxy of comprehensive corporate insurance, in strategic risk management within corporations and its impact on various aspects of a firm's capital structure. Our empirical study is grounded in a dataset containing Canadian corporations listed on the S&P/TSX Index, examining insurance and financial data to understand how alternations in insurance premium levels affect a firm's capital structure, valuation, and risk profile.

Our findings indicate that insurance reduces the asset volatility, lowers cost of debt and positively influence its leverage. Furthermore, enhanced insurance appears to beneficially affect the enterprise value, likely due to increased tax benefits from increased leverage and an improved risk profile.

The application of the Leland model in this research allows us for the validation of our findings by examining the connection between insurance and asset volatility, as determined through the Merton model. Our analysis implies that insurance will reduce the asset volatility thus enhancing its risk profile. Leland's theory further supports our findings, asserting that a reduction in asset volatility will yield similar changes in its capital structure.

Overall, our findings suggest that insurance is advantageous for companies, leading to reduced volatility and cost of debt, and positively impacting the firm's leverage and enterprise value.

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1 Introduction

Insurance has its roots in ancient mutual aid and has evolved significantly over the centuries. Initially, non-monetary economies relied on mutual support, exemplified by ancient practices in Babylon, Greece, and China (Ivry, 1961). These societies employed methods to distribute risk, a fundamental part of insurance. Furthermore, the medieval period marked the advent of marine insurance, a cornerstone for the burgeoning international trade. The establishment of Portugal's commercial fund Bolsa de Comércio in 1293 highlights this development, representing the documented origins of marine insurance in Europe (Diffie & Winius, 1977). The 17th century's flourishing trade in London catalyzed the development of business insurance, particularly marine insurance (Lloyd's, 2023). Today's era has further witnessed the emergence of specialized insurance types, reflecting the increasing complexity of economic activities and the need for more sophisticated risk management solutions.

Firm insurance, now encompassing 40-50% of all insurance premiums, has evolved to meet these complexed business risks (McKinsey, 2021). It includes various types such as property, liability, and workers' compensation, addressing risks from property damage to employee injuries. The purpose of firm insurance is to pool risks, providing stability, enabling investment and innovation, and fostering economic growth by reducing the impact of losses on firms. Yet, the justification for firms' insurance purchasing decisions is subject to debate. Diversification of risk can often be managed internally, and purchasing insurance incurs explicit costs and can potentially give rise to principal-agent problems. The awareness and understanding of firm insurance vary, raising questions about its perceived value. Furthermore, acquiring comprehensive data on corporate insurance poses a challenge, as firms exhibit averseness in disclosing information that could expose their strategic risk management approaches. This secrecy underscores the complexities in assessing the true impact and value of insurance in corporate settings.

Despite these challenges, insights can be derived from available data in specific cases, such as with Directors' and Officers' Liability Insurance (D&O insurance). Examining D&O insurance premiums can offer insights into why firms choose to buy insurance. D&O insurance is purchased by the company and designed to protect executives from personal

losses if they are sued for alleged wrongful acts while managing a company, as it covers legal fees, settlements, and other costs. Around 70-90% of public listed companies in developed countries have this insurance, where the purpose of D&O insurance is to enable risk-taking and decision-making without personal financial risk, thus fostering innovation an growth (Yuan et al., 2016). Essentially, D&O insurance, like other firm insurance, can be viewed a strategic tool for risk management.

This research explores the rationale behind corporate insurance purchases, using D&O insurance as a proxy due to the limited availability of broader firm insurance data. The study probes into how insurance, implying reduced risk, influences corporate capital structure and enhancing a company's value. Thus, the research question is as following:

> "Can insurance increase enterprise value by affecting capital structure?"

The research methodology entails compiling a dataset of corporations listed on the S&P/TSX Composite Index as of September 4th, 2023, where the collected data encompasses D&O insurance, accounting, and market data of these companies. Canadian corporations are specifically selected for this study due to statutory obligations that ensure the disclosure of D&O insurance coverage (Boyer & Delvaux-Derome, 2002).

This thesis is organized into eight chapters. Chapter 2 sets the stage with a discussion of the relevant theoretical framework, encompassing general insurance principles, D&O insurance specifics, and an overview of the Merton Model and Leland Model. Chapter 3 presents four hypotheses based on the framework and previous research. The process of data collection and the variables employed are detailed in Chapter 4. The methodology underpinning the research is outlined in Chapter 5, followed by an analysis and presentation of findings in Chapter 6. Chapter 7 is dedicated to discussing these findings. Finally, Chapter 8 concludes the thesis by summarizing key insights and offering concluding remarks.

1.1 Existing Research

In recent decades, the focus on D&O insurance has intensified, reflecting the changing corporate governance landscape and the growing responsibilities shouldered by company executives. Several studies have been undertaken internationally on D&O insurance, with the bulk of prior research centering on the U.S. and Canadian markets. This section aims

to present a summary of the most significant research that has informed the choice of methodologies and deepened the understanding of the demand for D&O insurance.

Research has shown that larger companies are more likely to get D&O insurance. Boyer and Delvaux-Derome (2002) delved into this association by examining Canadian corporations from 1993 to 1999. The findings affirmed that larger corporations exhibit a higher likelihood of purchasing D&O insurance. This tendency is rationalized by the complex organizational structures and the extensive personnel involved in larger firms, necessitating robust insurance coverage to mitigate legal risks.

Furthermore, Boyer unveiled additional determinants influencing the decision to obtain D&O insurance. The study indicated that financially robust firms tend to show less interest in acquiring D&O insurance. Also, a diminished likelihood of obtaining D&O insurance was observed in firms with a substantial number of outsiders on the board of directors and when board members held a significant financial stake in the corporation. In essence, the composition of the board, the financial health of the company, and its size surfaced as pivotal factors in the decision to procure D&O insurance. Core (1997) studied Canadian firms from 1993 to 1994 and found those at greater litigation risk are more prone to acquire D&O insurance with higher limits, in addition to firms that possess greater growth opportunities are more likely to buy D&O insurance.

O'Sullivan (2002) studied UK companies and came to similar conclusions as Boyer and Core, saying that larger companies and businesses with growth opportunities are the main buyers of D&O insurance. By comparing companies with and without insurance, O'Sullivan found that insured companies have more fluctuation in their share prices and a bigger presence in the US. These differences make it more likely for companies to face legal issues, highlighting the need for D&O insurance among larger firms.

According to Yi et al. (2013), while the majority of Western firms typically maintain D&O insurance, only 52% of companies in Taiwan follow suit. This scenario enabled Yi et al. to examine the financial implications between insured and uninsured entities over a period from 2008 to 2010. They discovered that firms with D&O insurance operated with a cost of debt that was approximately 10% higher than their uninsured counterparts. When controlling for risk specific variables, the insured entities experienced a 1.85% rise in debt cost. Elements such as institutional ownership, board dynamics, and prospective

growth were found to offset these costs.

Lin et al. (2013) examined the relationship between D&O insurance and loan spreads by using D&O insurance data for a sample of Toronto Stock Exchange 300 Index constituent stocks and bank loan data from 1996 to 2008. Their findings revealed that companies with enhanced D&O insurance coverage faced steeper loan spreads, a phenomenon moderated by the nature of the loan and surveillance mechanisms. Diving deeper, the research identified a connection between substantial D&O insurance and an increase in organizational risk-taking, alongside a heightened likelihood of financial restatements stemming from aggressive reporting. However, when deployed effectively and in conjunction with robust governance structures, D&O insurance could augment the value derived from significant capital expenditure. In essence, while D&O insurance may elevate debt costs, its strategic application within well-governed firms can lead to enhanced capital value.

Building on the intricate relationship between D&O insurance and a firm's financial landscape, Chen et al. (2016) embarked on a comprehensive exploration of how D&O insurance intersects with a company's cost of equity analyzing Canadian firms from 1996-2008. Their research unearthed a direct positive relationship between D&O insurance coverage and elevated equity costs. Two principal conduits surfaced for this relationship: the quality of information available and the propensity for risk-taking by firms. Contrary to what might be expected, this positive association does not stem from optimal risk-taking behavior. In fact, evidence suggests market pessimism towards augmentations in D&O insurance coverage, combined with stagnant cash flow improvements and diminished valuations for highly insured entities. This raises concerns that D&O insurance might inadvertently dilute the stringent oversight of shareholder litigation, consequentially pushing up the cost of equity.

On the contrary, Hwang and Kim (2018) studied the impact of D&O insurance on firm value, analyzing Korean companies from 2002-2008 and comparing insured and non-insured companies. Their findings showed firms with D&O insurance typically possess higher market values, especially those with strong growth prospects. The benefits of D&O insurance encompass good governance monitoring, specialized settlement services, and a reduced risk of bankruptcy. Holderness (1990) support these findings and states that D&O insurance can effectively be used in the supervising of board activities and can be

an effective metric for assessing management quality. However, there are concerns about managerial opportunism and the protection of dominant shareholders from litigation risks. Despite some studies provided earlier indicating potential negative firm related benefits of having D&O insurance, Hwang and Kim (2018)'s research underscores D&O insurance's role in supporting growth-centric firms.

Egger et al. (2015) explores D&O insurance within volatile markets through a study of 232 Canadian firms from 1996-2008, revealing its strategic use by initial shareholders to exploit belief differences between company insiders and external investors. They find that new shareholders and market volatility are associated with increased insurance coverage and premiums, suggesting that D&O insurance is not merely a governance failure but a tactical response to market conditions.

Many researchers have looked at the connection between D&O insurance and the decisions managers make. According to Baker and Griffith (2011), D&O insurance plays a role in the company's risk management, and that people are unwilling to serve on public boards without being insured. Furthermore, Lin et al. (2011) examined the effect of D&O insurance on the outcome of M&A decisions using data from a sample of Canadian firms for the period 2002-2008. Their findings indicate that D&O insurance could reduce the incentive of managers to act in the best interest of stakeholders and induce unintended moral hazard. Thus, they suggest that companies with substantial D&O coverage are more likely to make poor M&A decisions as a result of managerial opportunism from the policy shielding directors and officers from the discipline of shareholder litigation.

Chalmers et al. (2002) supports this evidence on managerial opportunism from another perspective. Analyzing 72 IPO firms from 1992 to 1996, the researchers hypothesized that if managers used inside information, their chosen insurance coverage would align with post-IPO stock performance. The results revealed a notable negative connection between insurance coverage at IPO and three-year post-IPO stock prices, hinting at possible managerial opportunism in D&O insurance decisions.

Boyer and Tennyson (2015) researched how D&O insurance relates to company size, governance features, and business threats, analyzing 328 Canadian firms from 1996 to 2005. Their findings highlighted the factors and impacts of D&O insurance, suggesting that increased D&O insurance tends to result in more risk taking and aggressive earnings

management. They further argue that having insurance can give rise to moral hazard. In a similar vein to Boyer and Tennyson's exploration, Weterings (2015) delves into the implications of D&O insurance, pointing out the inherent moral hazard. The protective characteristics of the insurance might inadvertently reduce the urge for directors and officers to act with prudence. Weterings' study from the Netherlands shows that D&O insurers may not be adequately addressing this issue. Baker and Griffith (2011) investigated how corporations use D&O insurance to evade consequences for corporate misconduct, thereby weakening securities laws. Given their insights, Weterings suggested that similar practices might be observed among D&O insurers in other European nations and the United States.

These findings are contrary to those of Bhagat et al. (1987), who suggest that D&O insurance could be beneficial for companies in attracting and retaining competent individuals, particularly those who are risk-averse, to serve in directorial and executive roles. Such insurance can encourage the management to avoid overly conservative investment decisions that might not align with shareholder interests, thereby potentially enhancing shareholder wealth. According to research from Bradley and Chen (2011), directors with limited liability and indemnification might steer away from risks to safeguard their positions and enjoy a stable career. This cautious attitude is likely magnified when managers have significant personal and financial investments in the firms they oversee.

2 Theoretical Framework

In this section, the theoretical aspects of insurance in the realm of corporate risk management are reviewed. Drawing on the insights of leading researchers, the principles of insurance and its strategic applications within businesses are investigated, focusing on how it aids in mitigating various risks. Special attention is given to the complexities of insurance markets and the specific role of D&O insurance in corporate governance. Additionally, this segment briefly introduces the Merton model's approach to risk evaluation and the Leland model's insights into optimal capital structure. This segment aims to provide a foundational understanding of the multifaceted impact of insurance on corporate strategies and risk management, serving as a primer for the detailed discussions that follow.

2.1 Insurance

The theoretical framework surrounding insurance is complex and multi-faceted, encompassing various forms and purposes. As defined by Eeckhoudt et al. (2005, p. 45), "insurance occurs when one party agrees to pay an indemnity to another party in case of the occurrence of a prespecified random event generating a loss for the initial risk-bearer". This fundamental principle highlights insurance as a pivotal risk management tool.

Complementing this view, Gupta (2008) expands the understanding through his dual perspective of insurance. From a financial perspective, it represents a collective strategy to mitigate the impact of losses, pooling resources through premium payments. Legally, it binds parties to a promise of restitution, ensuring a safeguard against predetermined risks. Together, these perspectives converge to define insurance as a societal instrument, designed to manage uncertainty and provide stability against the vicissitudes of risk.

Borch (1990) emphasizes the difficulty in encapsulating the concept of insurance into a concise definition, given its diverse forms and applications. He identifies two key components of an insurance contract: the premium paid by the insured at the inception of the contract, and the compensation paid to the insured upon the occurrence of specified events. The connection between these components, particularly how premiums are calculated based on the probability of the insured event, forms the core of insurance theory. This relationship highlights the inherently probabilistic nature of insurance, revolving

around the assessment and management of risk.

Focusing on corporate insurance, it is evident that businesses utilize various insurance types to mitigate different risks. Berk and DeMarzo (2020) point out that companies often procure property insurance to protect their assets against damage or loss due to hazards such as fires or natural disasters. Additionally, personnel insurance is crucial for covering losses related to the absence of key employees, and business interruption insurance safeguards against loss of income resulting from operational disruptions. These types of insurance exemplify the broader role of insurance in corporate risk management, transferring the risk from the business to the insurer.

The function of insurance in a corporate context extends beyond mere risk transfer; it also plays a vital role in enabling businesses to undertake activities that might be too risky without such protection. The assurance of compensation for potential losses makes it feasible for firms to explore new ventures, invest in innovation, and expand operations, contributing to overall economic growth and stability (Thoyts, 2010). Furthermore, the insurance sector itself is a significant contributor to the economy. Insurers invest the premiums collected into various financial markets, thereby providing a substantial source of capital. This investment activity not only benefits the insurers in terms of potential returns but also supports economic development by channeling funds into productive enterprises.

2.1.1 Elements of Insurance

Insurance policies are commonly characterized by the three elements: premiums, deductibles, and coverage limits. These elements detail the cost of insurance, the portion of loss shouldered by the insured, and the maximum reimbursement by the insurer in the event of a loss.

To acquire insurance, a company must make an upfront payment, known as the premium, to the insurance company. The premium is meant to reflect the cost of the risk that the insurer takes on. In the event of an unexpected adverse event, the insured company receives a payout from the insurer. In a perfect market, the premium is actuarially fair and structured such that it yields a Net Present Value (NPV) of zero for both the insurer and the insured (Berk & DeMarzo, 2020).

The fair premium can then be calculated as

$$\text{Insurance Premium} = \frac{\Pr(X) \cdot E[X]}{1 + r_L}, \tag{2.1}$$

where $\Pr(X)$ is the probability that a loss will occur, $E[X]$ is the expected payment conditional on a loss occurring, and r_L represents the appropriate cost of capital given the risk of the loss.

Insurance companies can create low-risk portfolios by pooling together the risks from many statistically independent policies. This strategy will then yield more predictable yearly claims. Consequently, the cost of capital aligns itself with the risk-free interest rate. However, some risks are more difficult to diversify completely, such as hurricanes and earthquakes, which can create enormous losses. When the risk cannot be fully diversified, the cost of capital will include a risk premium. The risk-adjusted r_L for losses is less than the risk-free rate, leading to a higher insurance premium as shown in Equation (1).

A different formulation often used in insurance theory can be written as

$$\text{Insurance Premium} = \frac{\Pr(X) \cdot E[X]}{(1 + r)} \cdot (1 + \lambda), \tag{2.2}$$

where r is the risk-free rate and λ is a loading term which should cover the insurer's costs as well as provide a profit margin. In the context of D&O insurance, the insurer will set a premium equal to its assessment of the company's litigation risk plus a mark-up for its overhead and profit (Core, 2000).

Furthermore, the insurance company will usually set a predefined sum, known as a limit, which defines the maximum amount of money the insurer will pay towards a covered claim. If the company opts for a higher coverage limit, this typically corresponds to higher premium payments. In addition, the insurer may require the claimant to pay an insurance deductible. Once this amount is paid, the insurer will contribute to cover the remaining costs of the claim, up to the determined coverage limit.

2.1.2 Information Asymmetry in the Insurance market

The Modigliani-Miller (MM) theorem posits that in perfect capital markets, a firm's valuation is independent of its capital structure (Modigliani & Miller, 1958). According to MM, in an ideal market without taxes, bankruptcy costs, or informational asymmetry, the way a company finances itself through debt or equity has no impact on its total value. Translating these principles to the insurance industry, MM would imply that in such a market, insurance companies would price premiums directly in proportion to the risk they cover. This would mean that with full information symmetry and no market frictions, insurance premiums would perfectly mirror the actual risk involved, ensuring that each policyholder pays a fair price corresponding to the potential for loss.

In contrast to the strict assumptions of perfect capital markets, George Akerlof's (1970) seminal study provided insights into how information asymmetry disrupted markets, such as those for used cars. He demonstrated that when sellers were aware of defects in the cars they sold, and buyers could not see these defects, the resulting information imbalance caused lower overall prices for high-quality used cars. Buyers, factoring in the chance of buying a "lemon", or a defective car, offered lower prices across the board. This behavior resulted in an inefficient market where "good" cars couldn't fetch their true value.

Rothschild and Stiglitz (1976) study revealed that in insurance markets, information asymmetry can preclude pooling contracts, potentially leading to non-existent equilibriums, where insurers are unable to distinguish between varying risk levels among clients. Such scenario diverges from Akerlof's observations of persistent, albeit inefficient, equilibriums.

In light of these findings, Berk and DeMarzo (2020) emphasize the critical need for transparency. They argue that clear and accessible information is vital to the efficiency and functionality of financial markets, including the insurance sector. Such transparency is essential for informed decision-making, leading to fair premiums that are truly indicative of the insured risks.

Moving beyond the prevalence of asymmetric information, the attention turns to examine its critical implications: adverse selection and moral hazard. These concepts are pivotal in understanding the complexities of the principal-agent relationship.

2.1.2.1 Adverse Selection

Adverse selection occurs when the agent to a transaction possesses more information than the principal, where this informational imbalance leads to decisions where the agent benefits at the principal's expense due to the principal's lack of access to the same information (Darrough & Stoughton, 1986).

Specifically for the insurance industry, this discrepancy occurs because individuals inherently possess more intimate knowledge of their own health, activities, and other risk factors than insurers can feasibly obtain or discern. As previously stated by Rothschild and Stiglitz (1976), higher-risk individuals tend to select insurance coverage more frequently than lower-risk ones, which can distort the risk assessment and pricing structures of insurers.

Furthermore,the investigation by Puelz and Snow (1994) into the automobile insurance market underscored the complex risk assessment challenges insurers face due to information asymmetry, often resulting in premiums that overshoot actual risk to mitigate potential losses. Puelz and Snow's observed market behaviors provide empirical support to Rothschild and Stiglitz's theoretical assertion that information asymmetry can destabilize market equilibrium, validating the phenomenon of adverse selection that complicates the insurance industry's pricing strategies.

Consequently, the insurance market may confront a kind of "lemons" problem, as described by Akerlof (1970), leading to potential market failure if insurers cannot adequately distinguish between high and low risks. When the market cannot correctly price the risk due to lack of information, it can lead to a situation where only those at high risk of loss are insured, which is not sustainable. Higher premiums, while compensating for risk, can push away those least likely to file claims, further unbalancing the insured demographic (Berk & DeMarzo, 2020).

A challenge for insurers is thus to design premiums that mitigate the risk without deterring low-risk individuals from maintaining coverage. To combat this, the industry employs strategies such as risk-based pricing and underwriting scrutiny to ensure fair pricing and manage the risk pool effectively. Regulations also play a role in curbing adverse selection's effects. By standardizing practices around pre-existing conditions and coverage eligibility,

regulatory measures seek to create a more equitable insurance landscape that protects insurers and customers alike (HIPAA, 2022).

Berk and DeMarzo (2020) warn that such market inefficiencies can distort resource allocation and adversely affect the economy. In the realm of insurance, unfair premiums can lead to misinformed financial decisions by consumers, which is a stark deviation from the efficient market hypothesis favored by economists.

2.1.2.2 Moral Hazard

Contrary to adverse selection, moral hazard occurs after the purchase of insurance. Kenneth J. Arrow called this agency problem for "hidden actions"[1], where moral hazard arises when the agent's behavior remains concealed from the principal, and this behavior holds a different value for the agent than it does for the principal (Arrow, 1963, 1984). According to Bengt Holmström, the root cause of moral hazard lies in an information asymmetry among individuals, stemming from the inability to observe and contract upon individual actions (Holmström, 1979).

Emphasizing how insurance coverage can change an individual's risk-taking behavior due to a disconnection from the consequences, Arrow posited that this disconnect could lead to market inefficiencies. Arrow's study on health insurance showcased that the promise of coverage could lead to the overuse of medical services, suggesting at broader implications for market practices (Arrow, 1963).

Arnott and Stiglitz (1990) supports Arrow's findings regarding moral hazard altering the nature of market equilibrium. Since insurers are frequently unable to thoroughly evaluate the risk habits of the insured, who possess exclusive information about their own risk-related behaviors, this mismatch leads insurers to craft safeguards such as deductibles and copayments to align incentives and protect against unwarranted claims. Moreover, Chiappori and Salanié (2000) finds that purchasing insurance can reduce a company's motivation to implement preventive measures since it does not fully absorb the cost of risks. This may result in a direct relationship between selecting insurance policies with lower deductibles and increased actual risk post-contract. Discrepancies in a company's risk profile pre- and post-insurance can lead to challenges for insurers when devising

[1] Arrow used the term "hidden information" to describe adverse selection.

optimal policy contracts.

Chiappori and Salanié's findings laid the groundwork for distinguishing between moral hazard and adverse selection in insurance data, a distinction that was further explored by Abbring et al. (2003). This latter study challenged the traditional view of moral hazard within experience-rated insurance contracts. Using French car insurance data, Abbring et al. found no clear evidence of the expected increase in claim frequencies typically associated with moral hazard, instead suggesting a more intricate interplay with adverse selection. The results indicate that the connection between past and future claims is less direct than expected, underscoring the complexity of isolating moral hazard from adverse selection in empirical data.

To address potential information asymmetry and moral hazard, insurance markets integrate practices to incentivize risk-averse behavior among policyholders. These practices include differentiating premiums based on risk, offering discounts for safety measures, and conducting thorough evaluations of insurance claims. The goal is to align the incentives of insured individuals with the interests of insurers, ensuring that insurance protection does not lead to disproportionate risk-taking but instead maintains market efficiency. However, as discussed in this section and in Section 1.1, there is some disagreement regarding the extent of moral hazard in insurance. This highlights an ongoing challenge for insurers to devise sophisticated methods for accurately assessing risks and promoting optimal behavior among policyholders.

2.1.3 Why Do Firms Buy Insurance?

Mayers and Smith's (1982) seminal study provides a comprehensive examination of the motivations behind corporate decisions to purchase insurance, challenging traditional notions of risk aversion. They argue that corporations, in contrast to individuals, do not primarily purchase insurance solely due to risk avoidance; companies with widespread ownership can reduce the reliance on insurance for risk aversion purposes due to shareholders' ability to spread risk through capital markets.

Mayers and Smith argue that insurance serves to protect the firm's fiscal health and operational continuity, both of which are crucial for preserving shareholder value. Insurance also plays a role in mitigating the potential costs associated with bankruptcy, which,

although infrequent, can have disproportionately adverse effects. Additionally, it ensures a more equitable risk distribution within the company's structure, protecting key assets and preventing any single stakeholder from bearing excessive financial burden during challenging times.

Furthermore, the financial and regulatory frameworks within which corporations operate are pivotal in shaping their insurance procurement decisions. Mayers and Smith emphasize that tax considerations may influence corporate behavior toward insurance due to its potential to minimize expected tax liabilities, especially by exploiting tax deductions available for loss recovery. In sectors subject to stringent regulation, insurance becomes virtually indispensable. Entities within these sectors might find it more cost-effective to entrust risk assessment to insurance professionals rather than to manage it internally. Additionally, the necessity to comply with mandatory insurance legislation introduces another dimension of complexity, reinforcing the perception of insurance as an integral component of corporate financial strategy.

However, Mayers and Smith also underscore that the decision to purchase insurance often goes beyond the straightforward application of risk management principles. They suggest that while corporations may make appropriate insurance decisions, they may do so for reasons that do not always align with the primary goal of maximizing shareholder value. For instance, the trend toward self-insurance and higher deductibles indicates a shift towards more complex internal risk management rather than traditional insurance. This shift reflects a broader trend of sophisticated risk management strategies that include managing potential conflicts of interest within the firm's internal and external stakeholder relationships.

Subsequent research has expanded upon Mayers' and Smith's foundational framework. Zou and Adams (2008) explore the impact of insurance on firms' debt capacity by comparing Chinese insured and uninsured firms, publicly listed, from 1997 to 2003. They discover a relationship between insurance coverage and a reduced cost of capital, suggesting that insured firms are perceived as lower risk by insurers and creditors alike, potentially leading to favorable borrowing terms. Furthermore, Zou and Adams note that larger firms exhibit a higher tendency to secure insurance coverage.

Nordahl (2015) advances this discourse by introducing a model that challenges the

assumptions of Modigliani and Miller regarding perfect capital markets through scenarios that account for market imperfections. His model, which factors in double taxation and bankruptcy costs, posits that smaller companies with considerable debt and operational risks are more inclined to actively engage in insurance strategies. Nordahl's research also indicates that agency dilemmas and divergent incentives may influence the decision to purchase insurance, with the outsourcing of risk management being a significant motivator.

In today's era of rapid digitalization and globalization, the imperative for corporate insurance is increasingly linked to managing the risks associated with new digital business modalities and stringent privacy regulations. Regulatory agencies are intensifying scrutiny over how companies manage and safeguard customer data. Legislative frameworks such as the GDPR[2] in Europe and the CCPA[3] in the United States necessitate robust risk management strategies. Insurance emerges as a critical tool that enables companies to navigate these legislative requirements, offering a safety net against potential data breaches and other associated digital risks (Deloitte, 2023).

The decision-making process for firms to procure insurance is thus a multifaceted one, encompassing elements of risk management, financial strategy, and regulatory compliance. Empirical research underscores the complex interplay of these factors, reaffirming the essential role of insurance in corporate strategy.

2.2 Directors' and Officers' Liability Insurance

The executive committee, comprising the board of directors and officers, plays a pivotal role in jointly overseeing the operational activities of a corporation, thereby facilitating the achievement of its strategic objectives. However, the extent of their authority and responsibilities is limited by the company's regulatory framework, imposing certain limitations on their decision-making capabilities. Stakeholders, encompassing employees, shareholders, creditors, governmental entities, and other parties with aligned interests in the company, anticipate that the board acts in the best interest of the corporation. In instances where stakeholders perceive a deviation from this expectation, they reserve the right to initiate legal actions against the board or individual members, seeking

[2]General Data Protection Regulation
[3]California Consumer Privacy Act

reimbursement for alleged misbehavior (Core, 1997).

This scenario exposes directors and officers to litigation risks, where stakeholders may pursue legal recourse if they believe that the board's decisions were not optimally aligned with the company's interests. In such cases, individual board members may be held personally accountable for their actions. This risk of personal liability can potentially prevent individuals from assuming board positions (Daniels & Hutton, 1993). To mitigate this, corporations often acquire D&O insurance, which serves to shield board members from direct legal consequences, thereby reducing their exposure to litigation risks.

D&O insurance, obtained and maintained by the corporation, is designed to safeguard directors and officers against legal claims, provided their actions were executed in good faith and with integrity. The insurance typically encompasses two primary coverage categories: corporate and personal. Corporate coverage reimburses the firm for expenses incurred in defending its directors or officers in legal proceedings, whereas personal coverage directly compensates the individual when the firm is unable to provide financial support due to regulatory constraints or financial distress (Core, 1997). This insurance plays a crucial role in diminishing the litigation risks faced by directors and officers, thereby enhancing the appeal of board membership by lessening personal liability concerns (Daniels & Hutton, 1993).

Furthermore, studies such as Holderness (1990) suggest that D&O insurance can function as a monitoring mechanism for the board's performance. Holderness' research clarifies that the structuring of insurance policies, which are inherently dependent upon the historical performance metrics of directors and officers, can also necessitate the implementation of specific governance guidelines. This requirement is aimed at ensuring that the practices and standards of corporate governance align with the prerequisites delineated by the insurance policy. Further on, Holderness came up with empirical evidence posits that D&O insurance is a noteworthy factor in supervising board activities and can be an effective metric for assessing management quality. Research by Cao and Narayanamoorthy (2014) underscores that D&O insurance not only offers financial protection against litigation but also serves as a mechanism for monitoring the quality of corporate governance.

2.2.1 Understanding the Rationale Behind D&O Insurance

Prior to the 1930s, the occurrence of D&O insurance was minimal, primarily due to the absence of stringent regulations governing securities transactions and the lack of responsibility assigned to directors and officers. However, after the end of the Great Depression in the late 1930s, there was an increased public demand for the implementation of strong financial regulations. This call was driven by the desire to prevent future economic recessions and to increase corporate responsibility. The increment in regulatory measures subsequently heightened the litigation risk faced by directors and officers. Consequently, D&O insurance emerged as a mechanism to safeguard the interests of these corporate executives (LaCroix, 2016). The relevance of D&O insurance in the insurance market has notably increased in recent years, especially following the Enron[4] scandal, which caused a surge in lawsuits targeting company managers, thereby amplifying the appeal of D&O insurance (Bailey, 2005). Boyer and Delvaux-Derome (2002) emphasize that litigation risks predominantly originate from shareholders who are dissatisfied with corporate management, a likelihood that intensifies particularly when a company underperforms. Given this setting of litigation risks, D&O insurance emerges as a vital tool for mitigating such risk exposure, underscoring one of the primary reasons why firms procure D&O insurance.

Given that corporate management can be personally accountable for wrongdoing committed in their official capacities, they are vulnerable to substantial financial losses. This heightened risk exposure could potentially discourage individuals from pursuing managerial roles. Daniels and Hutton (1993) posit that this personal risk can be lessened through D&O insurance, thereby enhancing the attraction of director and officer positions. Thus, corporations are incentivized to obtain D&O insurance to attract and retain skilled human capital.

Another driving factor for firms to invest in D&O insurance is to prevent a too cautious approach by directors and officers who are accountable for their actions. O'Sullivan (1997) observed that in the absence of insurance, management might be inclined towards conservative decision-making to avoid personal liability, consequently hindering potentially

[4]An accounting scandal where Enron Corporation went bankrupt in 2001 following the exposure of internal fraudulent activities (Benston & Hartgraves, 2002)

beneficial risk-taking. Such conservatism could contradict shareholder interests. However, O'Sullivan further contends that D&O insurance can serve as an incentive tool for managers to act in the best interest of shareholders by mitigating litigation risks, thereby diminishing the tendency for conservative choices.

2.3 Merton Model

Merton (1974) introduced an innovative framework for the evaluation of a firm's credit risk, which contributed significantly for the application of a systematic and quantitative analysis in the domain of financial risk assessment. This model is based upon the option pricing theory developed by Black and Scholes (1973). Merton's critical insight was to conceptualize a firm's equity as equivalent to a call option on its assets. This comparison is supported in the notion that equity holders possess a contingent claim; specifically, they retain the right to fulfill the firm's liabilities or, alternatively, to transfer ownership of the company's assets to the creditors in scenarios where the liabilities exceed asset values.

Utilizing the Black-Scholes option pricing framework, Merton advanced a methodology to determine the market value of equity and to define the risk profile associated with the firm's debt. Central to this model is the derivation of explicit solutions based on option pricing formulas, which permit a quantitative assessment of these financial variables. Furthermore, Merton's model lays the theoretical groundwork for quantifying credit spreads. These spreads represent the incremental yield that must be provided by debt instruments bearing higher risk relative to the risk-free rate. Such spreads are calculated with reference to the asset volatility of the firm in question and the leverage ratio that it maintains.

In order to facilitate the use of his model, Merton posited several assumptions that align closely with the assumptions inherent in the Black-Scholes model. The model is predicated on the following assumptions (Merton, 1974, p. 450):

Table 2.1: Assumptions of the Merton Model

No.	Assumptions
1	No transaction costs, taxes, or problems with indivisibilities of assets
2	There are a sufficient number of investors with comparable wealth levels so that each investor believes that he can buy and sell as much of an asset as he wants at the market price
3	There exists an exchange market for borrowing and lending at the same rate of interest
4	Short-sales of all assets, with full use of the proceeds, are allowed
5	Trading in assets takes place continuously in time
6	The Modigliani-Miller theorem that the value of the firm is invariant to its capital structure obtains
7	The Term-Structure is "flat" and known with certainty. I.e., the price of a riskless discount bond which promises a payment of one dollar at time τ in the future is $P(\tau) = \exp(-r\tau)$ where r is the riskless rate of interest
8	The dynamics process of the firm value is a geometric Brownian motion, indicating that the asset price is log-normally distributed and evolve randomly over time

Building upon the mentioned assumptions and employing the Black-Scholes option pricing framework, Merton derived a formula that facilitates the valuation of a firm's equity E. This equation evaluates the firm's equity by incorporating the total value of the assets A and adjusting this valuation to account for the face value of the debt D. Additionally, the formula integrates the risk-free interest rate r, the asset volatility σ_A, the time to maturity T, and the cumulative standard normal distribution $N(\cdot)$ to estimate the equity's value. The equity valuation formula posited by Merton is expressed mathematically as

$$E = A \cdot N(d_1) - e^{-rT} \cdot D \cdot N(d_2), \tag{2.3}$$

where

$$d_1 = \frac{\ln(A/D) + (r + 0.5\sigma_A^2)T}{\sigma_A \cdot \sqrt{T}}, \tag{2.4}$$

and

$$d_2 = d_1 - \sigma_A \cdot \sqrt{T}. \tag{2.5}$$

With the application of Equation 2.3, the value of a firm's equity can be represented as contingent upon the firm's asset value. The Merton model extends beyond this to evaluate the relationship between the volatility of the firm's assets and that of its equity, captured in the following expression

$$\sigma_E = \left(\frac{A}{E}\right) \cdot N(d_1) \cdot \sigma_A. \tag{2.6}$$

Here, Equation 2.6 calculates the equity's volatility σ_E by considering the values of assets and equity, as well as the assets' inherent volatility. Nonetheless, the model acknowledges the unobservable nature of both the asset value and its volatility. However, within the framework's assumptions, it is feasible to estimate these unobservable variables using observable data such as the equity's current market value and its volatility, in addition to other observable parameters (Shumway & Bharath, 2008). The asset value and volatility are deduced by resolving a minimization problem in which Equations 2.3 and 2.6 are implemented (Formo & Haugan, 2021). The minimization problem involves determining the asset values and volatility that correspond to the minimal difference between estimated and observed values of E and σ_E. Solving this minimization problem enables the estimation of both the firm's asset value and its associated volatility. Further explanation and estimation are presented in Section 5.3 Estimating Asset Volatility.

2.4 Leland Model

Leland (1994) presents a theoretical framework for examining the optimal capital structure and its impact on firm valuation. This model evaluated the roles and proportions of leverage components necessary to get the optimal capital structure that maximizes the firm value. His study, as described in the article, builds upon previously theoretical developments in corporate finance, explicitly acknowledging the foundational works of Modigliani and Miller (1958), Merton (1974), and Brennan and Schwartz (1978). The model proceeds on the assumption that the operations of an enterprise are invariant with respect to financing choices and that once established, the capital structure is irreversible.

In the progression of his argument, Leland emphasizes the analytic advantage of time-independent variables to facilitate the extraction of an analytic solution for the valuation of

risky debt within a given capital structure. He initially implies debt as a time-dependent parameter due to predetermined maturity dates; nonetheless, he justifies a shift to consider debt as time-independent. His justification rests on two pillars: the typically long maturity of corporate debt, which removes the relevance of the maturity date to the return on principal, and the frequent renewal of corporate debt obligations that simulate perpetual maturity, prohibiting default. These arguments allow Leland to treat debt as a time-independent variable for analytical purposes, aligning with Modigliani and Miller's assumption, and enabling the expansion of earlier models by Merton (1974) and Black and Cox (1976) to include considerations such as tax impacts, bankruptcy costs, and potential protective covenants.

Leland further explains his model through diverse debt policy simulations. A particular focus is placed on the scenario with unprotected debt, wherein bankruptcy is contingent upon a firm's inability to cover its interest expenses. In this context, Leland introduce formulas to determine the optimal level of different leverage components that maximize the firm's value relative to its assets. One such formula, which aims to determine the optimal interest expenses for maximizing firm value, is presented as

$$C^*(V) = V[(1+X)h]^{-\frac{1}{X}}. \tag{2.7}$$

This equation is designed to identify the optimal level of interest expenses (C^*) that would optimize the value of the firm, based on its asset value (V). The variable X is defined as $\frac{2r}{\sigma^2}$, where r represents the risk-free interest rate and σ^2 denotes the volatility of the asset return. The term h signifies a combined factor that reflects the firm's financial and tax status. This factor is influenced by the variable X, and encompasses elements such as the cost of bankruptcy (α) and the tax rate (τ), presented as

$$h = \left[1 + X + \alpha\left(\frac{1-\tau}{\tau}\right)X\right]m, \tag{2.8}$$

where

$$m = \left[\frac{(1-\tau)X}{r(1+X)}\right]^{\frac{X}{1+X}}. \tag{2.9}$$

A further analysis of variable X within this model reveals that incremental asset volatility modulates the optimal interest expense in a manner depending upon baseline volatility levels[5]. The model suggests here that an increase in the asset's volatility induces a reduction in the optimal interest expense, provided that the prior level of volatility is lower than the baseline. Conversely, should the existing volatility be higher than the baseline, a further rise in volatility would result in an increase in the optimal interest expense.

Additionally, Leland calculated an equation to determine the optimal debt value (D^*) within his model as a function of the asset value

$$D^*(V) = \frac{V\left[(1+X)h\right]^{-\frac{1}{X}}\left\{1-k\left[(1+X)h\right]^{-1}\right\}}{r}, \tag{2.10}$$

where the term k is a derived variable that incorporates the impact of tax rate and bankruptcy costs

$$k = \left[1 + X - (1-\alpha)(1-\tau)X\right] m. \tag{2.11}$$

Moreover, by examining the variable X, the model suggests that an increase in volatility leads to a decrease in the optimal debt value, highlighting an inverse correlation between volatility and optimal debt levels.

These insights enable the application of the model to assess the influence of a firm's volatility on various components of its capital structure. This application will subsequently facilitate the empirical validation of this study's outcomes by investigating the effect of insurance on the firm's volatility, which in turn impacts the optimal capital structure as delineated by Leland's model.

[5]According to Leland this baseline lies at 15-20%

3 Hypothesis Development

The research aims to delve into the reasons behind corporate insurance purchasing decisions, particularly focusing on whether how strategic use of insurance enhance enterprise value by leverage incentives. This is approached by interpreting insurance coverage as a tool for reducing company volatility. The objective in this thesis is to shed light on novel aspects of firm insurance that may challenge conventional financial theory.

Hypothesis 1 [H1]: *Insurance Decreases Asset Volatility*

It is hypothesized that insurance acts as a volatility dampening mechanism for a firm's assets. This is predicated on the belief that insurance can absorb some of the financial shocks through risk mitigation that would otherwise affect a firm's operations, leading to a more stable asset performance over time.

Hypothesis 2 [H2]: *Insurance Lowers Cost of Debt*

Propose that the perceived reduction in risk associated with insurance results in a lower cost of debt. Creditors are likely to offer more favorable borrowing terms if they view the firm as less risky due to its insurance coverage.

Hypothesis 3 [H3]: *Insurance Increases Leverage*

With lower debt costs, firms may be incentivized to increase leverage, taking advantage of the tax benefits of debt financing. Further, it is hypothesized that the security provided by insurance encourages firms to leverage more, optimizing their capital structure.

Hypothesis 4 [H4]: *Insurance Increases Enterprise Value*

It is hypothesized that the culmination of these effects – reduced asset volatility, decreased cost of debt and increased leverage – contributes to a higher enterprise value. The tax shield benefits of higher leverage, combined with the stability brought by insurance, are expected to reflect positively on the enterprise value.

4 Data

The scope of this research has been somewhat limited due to a general lack of available insurance-related data across multiple countries. Currently, only a few legislative mandates require organizations to disclose details about their insurance policies. Additionally, many corporations may choose to withhold such information, possibly to keep their risk management strategies confidential. Notably, Canadian firms have since 1993 been obligated to disclose information concerning their D&O insurance policies (Boyer & Delvaux-Derome, 2002). Consequently, this study has selected corporations listed on the S&P/TSX index as of September 4th, 2023. This index reflects the performance of the top 250 companies traded on the Toronto Stock Exchange (TSX).

In pursuit of a more homogenous sample, the study excludes all financial institutions. The rationale behind this exclusion lies in the fact that the primary sources of revenue and expenses for these entities are financial in nature, rendering them incongruent with the aims of this research. Additionally, any corporation lacking either proxy circular reports or specific disclosures about their D&O insurance is also omitted from the sample. Following these criteria, the initial sample size is reduced to 113 companies.

Subsequently, firms are divided based on the sector in which they operate. Figure 4.1 provides a comprehensive breakdown of the 9 sectors represented in the dataset and their respective distributions among the companies. It is evident from the chart that the Basic Materials sector forms the largest category in the dataset, accounting for approximately 17.4% of the total observations, primarily including companies in mining and metals. Notably, the Industrials and Real Estate sectors are closely aligned in representation, accounting for 16.1% and 16.0% of the dataset, respectively. Furthermore, the Energy sector also represents a considerable fraction, contributing 13.8% to the overall sample.

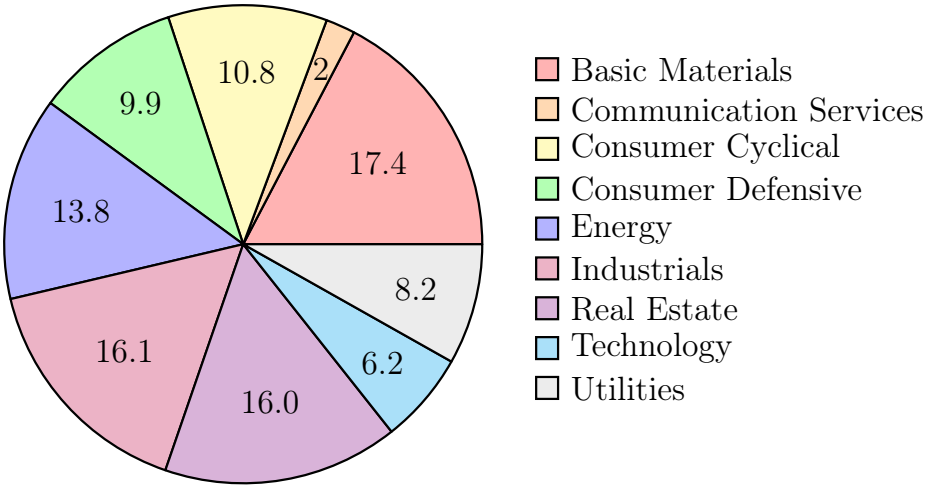

Figure 4.1: Sector Distribution in the Sample (%) from SEDAR+ (2023)

4.1 Insurance Data

The compilation of D&O insurance data involved manual collection from the proxy circular reports of various companies, extracted from the SEDAR+[6] system, covering a period from 2010 to 2022. These circular reports provide detailed insights into each company's D&O insurance, encompassing variables such as coverage limits, premiums, deductibles, and the currency in which these values were presented. Most of the data was reported in Canadian dollars, although a number of firms reported in United States dollars.

A primary obstacle encountered during this data collection was the inconsistency in the level of detail provided in the reports. Specifically, corporations that did not provide adequate disclosures regarding their D&O insurance were excluded from the sample. This was particularly the case for companies whose proxy circulars confirmed the existence of D&O insurance but lacked crucial details of premium payments. After an extensive review of the available proxy reports and validation for completeness and relevance, the final dataset comprised 998 observations across 113 companies, deemed sufficient for the objectives of this research.

[6]The System For Electronic Document Analysis and Retrieval (SEDAR+, 2023)

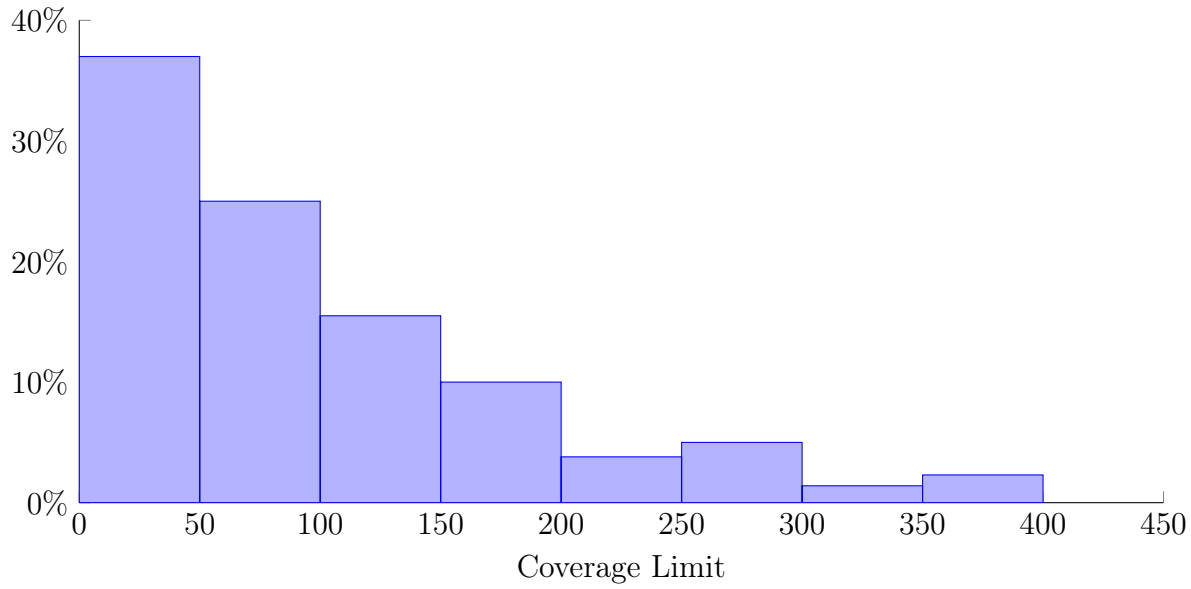

Figure 4.2: Distribution of Coverage Limits in Millions of Canadian Dollars (CAD) from SEDAR+ (2023)

Based on an analysis of the data points, it is observed that the magnitude of D&O insurance coverage exhibits variability, ranging from CAD 5 million to CAD 400 million. Figure 4.2 delineates the distribution of coverage limits across the dataset, providing a visual representation of the scope of insurance coverages within the examined sample. The distribution, as depicted in the figure, demonstrates variability in insurance sizes, with the most typical insurance coverage capping at CAD 50 million, constituting approximately 37% of the dataset. The data further indicates an inverse relationship between the magnitude of the coverage limit and its frequency in the sample; higher coverage values are less common. Specifically, coverage ranging between CAD 350 million and CAD 400 million represents a mere 2.3% of the dataset, underscoring its rarity.

4.2 Accounting Data

To enhance the analysis of D&O insurance, a compilation of accounting data for each corresponding company has been collected, spanning a time frame similar to the insurance data. This dataset includes balance sheet figures, encompassing elements such as the total assets and liabilities of the companies. In addition, information from the income statement related to the companies' earnings and expenses have been gathered. Notably, all accounting data are quantified based on their book values.

Furthermore, this accounting dataset is essential to deriving key financial indicators, crucial for the depth and consistency of the following analysis. The accounting data collection is conducted on an annual cycle, aligning with the fiscal years of the respective companies. Bloomberg has been utilized as the primary resource of data gathering.

4.3 Market Data

It is crucial to gather market-related data considering the examination of the hypotheses. As the corporations in the sample are all listed on the S&P/TSX index, the Bloomberg database is utilized for gathering the required data. The assembling includes a compilation of data of companies' market values and credit ratings, annual average exchange rates, in addition to one year Treasury bills for the necessary calculation presented in Section 5.3. The data is collected for each fiscal year, aligning with the period of other data collections. Furthermore, Bloomberg is also employed to collect data on the yearly average variation in stock prices, providing insights into stock volatility and its relation to the insurance parameters of the studied companies.

5 Methodology

This section will present the methodology used in Chapter 6, where the analysis and regression results are presented. It delves into the preparation of the dataset, emphasizing the importance of accurate and consistent data handling for reliable analysis. This groundwork is essential to ensure that the subsequent findings and interpretations are valid and reflective of real-world scenarios. The methodology encompasses a comprehensive approach, from the initial data collection to the detailed presentation of variables and econometric techniques employed. It includes a critical assessment of insurance data, accounting, and market information, underpinning the analysis with a robust empirical framework.

In undertaking this analysis, specific assumptions have been made to simplify and guide the research process. These include the assumption that insurance premiums are fairly priced, encompassing all types of coverage. Further, it is assumed that policies are paid annually on January 1st and have a one-year duration. Finally, it is assumed that the management always seeks to maximize the enterprise value. These assumptions are integral to the analysis, providing a consistent basis for examining the relationship between insurance variables, financial accounting, and market dynamics. Their inclusion is crucial for the consistency and relevance of the study, allowing for focused and meaningful interpretations of the data.

5.1 Preparation of the Dataset

5.1.1 Insurance Data

It is observed that numerous firms disclosed two distinct figures in their proxy reports: a standard limit and an additional coverage limit for other claims under their insurance policies. Due to the absence of detailed explanations regarding the coverage limits and the precise scope of the insurance premiums, it is assumed that the premium encompasses the supplementary coverage limit as well.

The proxy reports provided data which only referenced either the current or previous year's insurance coverage, often without clarifying the exact year to which the insurance

applied. When faced with such uncertainty, it was conjectured that the reported insurance information corresponded to the year in which the proxy statement was issued.

Given the lack of information on insurance policy dates, assumptions about the information available to insurers at the time of underwriting are made. It is assumed that insurers rely on the most updated financial data, up to December 31st, prior to policy renewal. This assumption is premised on the annual policy renewal and payment date of January 1st. Consequently, even though proxy circulars are typically issued in March, it is assumed that insurers have access to preliminary year-end financials, which provide a timely and accurate financial snapshot for policy pricing. Insurers typically have access to provisional financial statements or can request current financial information directly from the firm, allowing them to make informed decisions about the risk profile of the company at the time of policy inception (McKinsey, 2021).

Moreover, a portion of the insurance data compiled was denominated in United States dollars rather than Canadian dollars. To maintain uniformity and facilitate comparability, all data originally presented in USD is converted to CAD using the mean exchange rate of the corresponding year.

5.1.2 Accounting and Market Data

Accounting and market data has been methodically gathered to reflect values as of the end of each company's fiscal year. Typically, the fiscal year data considered converges at the calendar year's close on December 31st. Variability, however, surfaces when the fiscal year-end does not coincide across different companies or varies within the same company over time. Such variances may be attributable to non-standardized fiscal calendar practices or shifts in the reporting cycles. Upon thorough examination, these variances were considered to be of negligible consequence to the study at hand. Whenever alterations in the fiscal year-end were noted, a corresponding adjustment in the timing of proxy report issuance was also observed, occurring after the release of financial statements. Consequently, it has been assessed that these adjustments have a negligible effect on the results. Nonetheless, to ensure the highest degree of accuracy and to minimize potential biases, the few instances where a company's fiscal year underwent changes were subsequently omitted from the dataset.

5.2 Presentation of Variables

Table 5.1 delineates the variables employed in this thesis, their computational methodologies, and their indicative metrics. They are segmented into three classifications: D&O insurance variables, financial accounting variables, and market variables. Table 5.2 displays the summary statistics. A thorough discussion of these variables is provided in Section 5.4 Control Variables.

Table 5.1: Variable Definitions

Variable	**Definition**
D&O Insurance	
PremEBIT	Ratio of annual premium payment for insurance to EBIT
Premium	Annual premium payment
Accounting	
EBIT	Earnings before interest and taxes
Ln Total Assets	The logarithm of total assets of a firm, measured as market value equity and book value debt
Cost of Debt	Ratio of cost of debt pretax, measured as interest expense to total debt
Leverage	Ratio of total debt to total assets
Tangibility	Ratio of net property, plant, and equipment to total assets
Current Ratio	Ratio of current assets to current liabilities
Market	
Enterprise Value	The enterprise value
Tobin's Q	Simplified Q-Ratio of market value equity and book value debt to book value total assets
Equity Volatility	The degree of variation of the company's equity stated in %
Altman Z-score	A statistical measure that quantifies the likelihood of a company entering bankruptcy

Table 5.2: Summary Statistics of Data from SEDAR+ (2023) and Bloomberg L.P. (2023)

Variable	mean	sd	min	p25.	median	p75.	max	n
PremEBIT	0.001	0.011	-0.107	0.000	0.001	0.002	0.126	998
Premium	0.737	0.949	0.033	0.150	0.338	0.947	8.400	998
EBIT	634	1413	-9085	91	248	820	14196	998
Ln Total Assets	8.600	1.389	4.635	7.570	8.591	9.681	11.996	998
Cost of Debt	0.025	0.016	0.000	0.016	0.025	0.033	0.238	940
Leverage	0.520	0.196	0.006	0.424	0.542	0.639	1.416	998
Tangibility	0.905	4.818	0.001	0.258	0.516	0.801	86.835	998
CurrentRatio	2.159	2.806	0.130	0.993	1.479	2.177	32.209	940
Enterprise Value	12998	1.349	63	2207	5678	15796	167049	964
Tobin's Q	1.500	0.817	0.378	1.057	1.274	1.660	7.555	998
Equity Volatility	32.157	15.870	10.928	20.689	27.875	38.789	129.54	930
Altman Z-score	4.241	12.273	-16.349	1.274	2.576	4.242	252.22	940

5.3 Estimating Volatility of Asset

Estimating the asset volatility is critical for the purpose of this study. Asset volatility reflects the level of uncertainty in a company's asset values, commonly referred to as business risk. The Merton (1974) model presented in Section 2.3, rooted in the Black-Scholes option pricing theory, provides an analytical framework for this purpose. It equates the equity of a corporation to an option on the company's assets, offering a novel perspective for assessing risk.

Within this framework, the aggregate market value of a company's assets (A) is initially approximated. This value is determined by combining the market value of the firm's equity (E) with the book value of its liabilities (D), laying the groundwork for the iterative estimation of asset volatility (σ_A) used as a dependent variable in analysis of Hypothesis $H1$.

Equation 2.3 from Section 2.3 connects the equity value with the underlying asset value, drawing a parallel to the payoff profile of a call option

$$E = A \cdot N(d_1) - D \cdot e^{-rT} \cdot N(d_2). \tag{5.1}$$

Equation 5.1 calculates equity value using the market value of asset and the present value of liabilities discounted at the risk-free rate r over the period T. For this study, the yield on 1-year Canadian Treasury bills has been adopted as proxy for risk free rate, which implies an assumption of debt maturity of 1 year. The variables $N(d_1)$ and $N(d_2)$ symbolize the probabilities of finishing in-the-money, in option pricing terms, reflecting the probabilistic nature of equity as a derivative.

As equity can be viewed as a call option with limited downside and unlimited upside, its volatility is inherently sensitive to the volatility of the firm's assets. Equation 2.6 from Section 2.3 derives asset volatility from the observed equity volatility, employing the delta of the option, represented by $N(d_1)$, as a scaling factor

$$\sigma_E = \sigma_A \cdot (E/A) \cdot N(d_1). \tag{5.2}$$

The two Equations 5.1 and 5.2 forms the basis for an optimization aimed at aligning model predictions with market data by determining the two unknown variables Asset Value (A) and Asset Volatility (σ_A)

$$\min_{A,\sigma_A} \left[(E_{\text{market}} - E_{\text{model}}(A, \sigma_A))^2 + (\sigma_{E_{\text{market}}} - \sigma_{E_{\text{model}}}(A, \sigma_A))^2 \right]. \tag{5.3}$$

The optimization framework seeks to adjust A and σ_A such that the model's implied equity value E_{model} and volatility $\sigma_{E_{\text{model}}}$ most closely align with the market-observed data E_{market} and $\sigma_{E_{\text{market}}}$. By iterating through potential values, the optimization refines estimates for asset value and volatility, converging on a solution that minimizes the objective function.

The results from the estimation shows an Asset Volatility with a median of 21.724% and standard deviation of 11.643%. The 930 observations from this estimation have been reviewed to ensure that the optimization has been properly conducted. The results are

further considered to be within a reasonable range, consistent with the comprehensive study from 2017 of US companies from Correia et al. (2017). Additional summary statistics of Asset Volatility (expressed in percentage) can be found in Appendix A.1.

5.4 Control Variables

In empirical research, control variables serve a critical function in mitigating omitted variable bias – a situation where the exclusion of a relevant variable leads to biased estimates. Stock and Watson (2020) emphasize that by including control variables that account for other factors influencing the dependent variable, which can provide clearer insights into the causal relationships of interest.

Controlling for sectors is particularly relevant in the analysis as it accounts for industry-specific risks and regulatory environments that can significantly influence firm-specific dependent variables like asset volatility, cost of debt, leverage, and enterprise value. Different sectors respond uniquely to economic conditions and possess inherent risk levels, which can affect insurance premium structures and the financial metrics of firms. By including sector dummies, this ensures that the analysis of the varied firms in the S&P/TSX index is not confounded by these industry-specific factors, allowing for a more accurate assessment of the hypotheses concerning the impact of insurance on firm-specific outcomes.

Total assets of a firm serve as a proxy for its size, which is a fundamental characteristic influencing the decision to purchase D&O insurance. Prior research consistently indicates that larger firms are more likely to procure D&O insurance. In all of the analyses, the natural logarithm of total assets, *Ln Total Assets*, is used to capture the non-linear effects of firm size on the dependent variables. This transformation contributes to stabilize the variance, reduce skewness, and allow for a more normal distribution of the variable, leading to more robust regression results. Lin et al. (2013) suggest that larger firm size can mitigate information asymmetry in credit markets, which further justifies its inclusion as a control variable in the analysis.

Incorporating *Tobin's Q*[7] into the regression model serves as a proxy for assessing growth and profitability opportunities (Core, 1997; Egger et al., 2015). An increased *Tobin's Q* is believed to relate to increased asset volatility. Firms pursuing growth are likely

[7]A common financial ratio named after the economist James Tobin

to undertake riskier investments, potentially leading to greater fluctuations in asset values [$H1$]. Relevant for the study, Yi et al. (2013) utilized this proxy to explore the dynamics between D&O insurance and the cost of debt. *Tobin's Q* allows to control for the market's perception of a firm's future earnings potential, thereby providing a more nuanced understanding of how growth expectations influence borrowing costs [$H2$]. A higher *Tobin's Q* may also indicate that a firm has greater growth opportunities, which could lead to higher leverage as firms capitalize on favorable borrowing conditions to invest in growth [$H3$]. Further, *Tobin's Q* can provide insights into how market valuations, influenced by both growth prospects and profitability, relates to the enterprise value [$H4$]. Based on corporate finance theory, it is believed that an increase in Tobin's Q increases enterprise value (Berk & DeMarzo, 2020).

Tangibility is included as a control variable for both the asset volatility [$H1$] and cost of debt [$H2$]. In terms of asset volatility [$H1$], a higher *Tangibility* may signal a stable asset base and potentially reduced volatility, as tangible assets usually do not fluctuate in value as rapidly as intangible assets. Conversely, a lower *Tangibility* may signal a less stable, more volatile asset base, reflecting a greater proportion of intangible assets or a structure where the debt may not be predominantly long-term financed. For the cost of debt, firms with a higher proportion of tangible assets often have better collateral to offer lenders, which can lead to reduced loan spread due to increased recovery rates in cases of default (Lin et al., 2013). Consequently, such firms might benefit from lower borrowing costs.

CurrentRatio is employed as a control variable for hypotheses $H1$ and $H3$. In the context of asset volatility [$H1$], a higher *CurrentRatio* may suggest a cushion against short-term market fluctuations, possibly leading to reduced volatility in the firm's asset values. Conversely, a lower *CurrentRatio* could indicate higher short-term financial risk, which may be associated with greater asset volatility. For leverage [$H3$], the *CurrentRatio* reflects the firm's short-term liquidity, with a higher ratio indicating more liquid assets relative to short-term obligations. This liquidity could potentially allow firms to manage or increase their leverage more confidently.

Altman Z-score[8] serves as a proxy for a firm's credit and bankruptcy risk. The firms are categorized into three dummies based on their risk profiles: *Z safe* for scores above

[8] Altman (1968)

2.99 indicating low risk, *Z grey* for scores between 1.81 and 2.99 indicating moderate risk, and *Z distressed* for scores below 1.81, the reference category, indicating high bankruptcy risk. Including these dummies contributes to control for the financial health of the firms, providing a clearer analysis of how D&O insurance influences cost of debt [$H2$] and leverage [$H3$].

EBIT is included in the first regression $H1$. *EBIT* alone is a measure for profitability, and it is hypothesized that an increase in *EBIT* would lower asset volatility since the financial distress is reduced (Lin et al., 2013).

5.5 Fixed Effects Regression

Fixed effects (FE) regression is a method used when analyzing panel data, which involves multiple observations over time for the same firms or entities (Stock & Watson, 2020). The FE model is particularly useful when the goal is to control for omitted variables that vary across entities but do not change over time, effectively isolating the impact of variables that change over time within entities. In the FE model, each entity has n unique intercept, capturing the omitted variables that are unique to each entity and constant over time. These entity-specific constants are represented through a series of binary indicator variables, which serves to absorb all variation between entities that does not vary over time.

In the study, FE regression is employed to control for individual company characteristics that could influence the dependent variable, such as management quality or corporate culture, which are not captured by the observed variables. This is essential in this context since these unobserved factors could correlate with both the decision to purchase insurance and the financial outcomes that are analyzed, potentially leading to biased estimates if not properly controlled for.

The general equation for a FE regression model is

$$Y_{it} = \beta_1 X_{1,it} + \cdots + \beta_k X_{k,it} + \alpha_i + u_{it}, \tag{5.4}$$

where $i = 1, \ldots, n$ and $t = 1, \ldots, T$. $X_{1,it}$ represents the value of the first regressor for

entity i in time t and so forth, while $\alpha_1, \ldots, \alpha_n$ are entity-specific intercepts.

In addition to controlling for individual company characteristics through fixed effects, the regression model incorporates time fixed effects to account for common external shocks or trends that could influence all firms within the sample simultaneously. Time fixed effects captures year-specific events, such as economic downturns, regulatory changes, or technological advancements, that could systematically affect the dependent variable. By including dummy variables for each time period, these common influences are isolated, ensuring that the estimated coefficients on the key independent variables reflect only within-firm variations over time, rather than changes that affect the entire market or economy. This is crucial for obtaining unbiased estimates of the effects of the independent variables on the dependent variable. The FE regression model with both entity and time fixed effects can be expressed as

$$Y_{it} = \beta_1 X_{1,it} + \cdots + \beta_k X_{k,it} + \alpha_i + \lambda_t + u_{it}, \tag{5.5}$$

where λ_t is the time fixed effect.

Heteroskedastic-robust standard errors are employed in this analysis to address the anticipated issue of non-constant error variance across observations, often a case with real-world data. Heteroskedasticity, which occurs when error variances differ across observations, can lead to biased standard errors, which in turn affect the reliability of hypothesis tests. Heteroskedastic-robust standard errors are a remedy to this problem, providing consistent estimates of the standard errors even when the assumption of homoscedasticity, which posits that error variances are uniform across observations, is violated.

In the FE regression it is critical to account for the possibility that errors may not be independently distributed across all observations, often called autocorrelation. Autocorrelation in regression errors can lead to underestimation of standard errors, which may result in inflated test statistics and the potential for falsely significant results. A solution for this issue is to employ clustered standard errors, which account for correlations within groups and acknowledging that observations from the same entity, such as a firm across different time periods, might be interrelated.

Clustered standard errors are used in the analysis to correct for the potential that the

error terms are correlated within the same firm across different time periods. This could happen due to unobserved firm-specific attributes that persist over time. By clustering at the firm level, we acknowledge that the panel data observations are not independent across time, and thus provide more accurate standard error estimates. This approach strengthens the validity of the statistical inference by reducing the risk of Type I[9] errors.

5.5.1 Outliers and Influential Observations

Outliers can exert disproportionate influence on statistical analyses, particularly in regression models, potentially leading to biased estimates and misinterpretations of the data (Stock & Watson, 2020). Outliers may arise from data entry errors, sampling errors, or unusual conditions not representative of the population. In the study, winsorization technique was employed in the effort to mitigate the potential bias introduced by outliers.

According to Adams et al. (2019), winsorization is the most common method used in empirical finance research. Winsorization is a method that adjusts extreme values to the boundaries determined by a specified percentile, thus reducing the influence of outliers without removing data points from the dataset. For the dataset, where observations in variables ranges from roughly 900 to 1000, setting the lower and upper bounds to the 1st and 99th percentiles respectively, was deemed optimal. This decision was based on the balance between maintaining the dataset's integrity and reducing the impact of extreme values. Using these percentiles are effectively minimizing the influence of the most extreme observations without compromising the underlying structure of the data. This threshold ensures that the dataset remains representative of the broader population while minimizing the impact of potential outliers.

This technique is applied based on the observation that a small number of outliers were present in the insurance, accounting, and market data. Specifically, several outliers in the insurance data raised suspicions of potential typos in the proxy circular. These, along with instances where ratios were distorted due to denominators approaching zero, contributing to non-representative high values, were effectively moderated through the application of winsorization. It is important to acknowledge that winsorization has the potential to alter the underlying distribution of the data. However, given the size of the dataset and the

[9]Occurs when a correct null hypothesis is incorrectly rejected

nature of the observed outliers, winsorization provides a balanced approach to preserving as much original data as possible while still maintaining a high level of statistical integrity.

5.5.2 Testing for Multicollinearity

Multicollinearity poses a substantial challenge in regression analysis, particularly when seeking to uncover the true influence of independent variables on a dependent variable. This issue is characterized by a highly correlation between two or more variables, which can lead to inflated standard errors and, consequently, unreliable statistical inferences regarding the independent variables (Stock & Watson, 2020).

One effective approach to detect and quantify multicollinearity in regression models is the use of the Variance Inflation Factor (VIF). This method contributes to assess how much the variance of an estimated regression coefficient is inflated due to multicollinearity. A common guideline suggests that a VIF-value above 5 warrants further investigation for potential multicollinearity, while values above 10 indicate severe multicollinearity that typically requires corrective measures (Mason & Perreault, 1991). In this study, VIF-values are reported and discussed for each model.

5.6 Normalization of Premium

In this econometric analysis, the normalization of D&O insurance premiums with EBIT was employed, drawing upon the framework established by Goldstein et al. (2001). They advocate for using EBIT as a state variable in financial modeling due to its direct connection to operational profitability, which remains consistent regardless of changes in capital structure or tax liabilities. This consistency makes EBIT an ideal denominator for comparing insurance costs across firms, as it reflects a firm's ability to generate earnings before the influence of interest and taxes.

Normalizing premiums with EBIT provide insight into how much of these earnings are allocated towards managing risk. The use of *PremEBIT* aligns with the Goldstein, Ju, and Leland model, which suggests that operational earnings are integral to firm valuation, responding to risk management strategies such as insurance. By employing *PremEBIT*, the study adheres to a robust methodological approach that underlines the importance of operational profitability in the strategic decisions firms make regarding risk management,

in line with established financial theory and practices. *PremEBIT* is employed in the examination of the hypotheses $H1$, $H2$ and $H3$ because the respective dependent variables *Asset Volatility*, *Cost of Debt* and *Leverage* are normalized measures. This is contrary to *Enterprise Value* from $H4$, a dependent variable in absolute and not relative terms, where *Premium* is employed.

5.7 D&O Insurance as a Proxy

Section 2.1 Insurance and 2.2 Directors' and Officers' Liability Insurance contribute to highlight how D&O insurance can serve as a proxy for the broader scope of corporate insurance. Both D&O and corporate insurance fundamentally aim at risk mitigation, reflecting their shared objective in the corporate risk management landscape. This common goal is rooted in the transfer of risk, a core function in the insurance industry (Eeckhoudt et al., 2005).

Additionally, one of the key similarities between these insurance types is their role in fostering a risk-tolerant environment within corporations. Corporate insurance allows companies to undertake operations that might be too risky without such protection, thus encouraging business expansion and innovation (Thoyts, 2010). Similarly, D&O insurance provides a safety net against personal financial liabilities for corporate leaders, promoting bolder decision-making without the fear of personal consequences (O'Sullivan, 1997). This parallel in fostering a conducive environment for risk-taking decisions underpins the notion of D&O insurance as a proxy for the broader corporate insurance.

Furthermore, both types of insurance are influenced by similar market dynamics, such as information asymmetry, adverse selection and moral hazard. These factors play a significant role in shaping the insurance landscape, affecting pricing and provision, and underscoring the complexities involved in the insurance market. The pricing mechanisms, though distinct in their specifics, are similar, where the premium increases in proportion to the cost of the risk assumed by the insurer. This approach to risk evaluation further aligns D&O insurance with the general character of corporate insurance.

While D&O insurance mirrors certain aspects of the broader corporate insurance, it is important to recognize some limitations in using it as a complete proxy. D&O insurance is more narrowly focused on the legal responsibilities and potential liabilities of corporate

leadership, differing significantly in approach and focus from the broad operational risk coverage provided by corporate insurance. This distinction highlights that while D&O insurance can reflect some aspects of corporate insurance, it cannot fully substitute the comprehensive coverage offered by the latter. It's crucial to understand these distinctions to appreciate the unique and complementary roles each insurance type plays in corporate risk management. However, despite of these limitations, it seems reasonable in this setting to use D&O insurance as a proxy for the broader corporate insurance. Hereafter, D&O insurance will simply be referred to as insurance.

6 Analysis

6.1 Insurance on Asset Volatility

The following regression table details the analysis of how insurance can affect the asset volatility of the firm, corresponding to hypothesis $H1$.

Table 6.1: Regression results $H1$

	Dependent variable:
	Asset Volatility Fixed Effects [H1]
PremEBIT	−38.575∗
	(21.554)
EBIT	−0.001 ∗ ∗∗
	(0.0003)
Tobin's Q	4.671 ∗ ∗∗
	(1.313)
Ln Total Assets	−5.080 ∗ ∗∗
	(1.391)
Tangibility	−0.077
	(0.057)
CurrentRatio	0.142
	(0.173)
Sector Dummy	YES
Year Dummies	YES
Observations	878
R^2	0.162
Adjusted R^2	0.140
Note:	∗p<0.1; ∗∗p<0.05; ∗∗∗p<0.01

The negative coefficient of -38.575 for *PremEBIT* indicates a significant relationship at the 10% level, suggesting that higher insurance spending relative to their profitability is associated with reduced asset volatility, supporting the hypothesis. Furthermore, *EBIT*'s negative coefficient, which is significant on all conventional levels, suggests that firms with

higher earnings experience less volatility, likely due to stable operational performance. This is consistent with the hypothesis.

The *Tobin's Q*, with a positive coefficient of 4.671, and significant at all conventional levels, could indicate that firms with a higher growth potential engage in activities and investments that enhances the asset volatility. The negative and strong significant coefficient for *Ln Total Assets* at -5.696 suggests that larger firms, which typically have more diversified operations, also experience less volatility in their asset valuations. These findings are consistent with the hypothesis.

Tangibility and *CurrentRatio* appear to lack statistical significance, suggesting that stable asset presence and liquidity may not be key determinants of asset volatility. This insignificance could be attributed to other variables in the model capturing the effects typically associated with tangibility and liquidity. The model's R-squared value of 0.162 suggests low explanatory power, implying that there are other factors not included that affects asset volatility.

Analyzing the results of the VIF-values for $H1$ in Appendix A.2 reveals that all variables have values below 5. These low values indicate that the variables do not interfere with each other, suggesting the reliability and validity of model $H1$.

This analysis lends quantitative support to hypothesis $H1$.

6.2 Insurance on Cost of Debt and Leverage

The following regression table details the analysis of how insurance impacts the cost of debt and leverage, corresponding to hypotheses $H2$ and $H3$, respectively.

Table 6.2: Regression results $H2$ and $H3$

	Dependent variable:	
	Cost of Debt Fixed Effects Model [H2]	Leverage Fixed Effects Model [H3]
	(1)	(2)
PremEBIT	−0.226∗	0.258∗
	(0.135)	(0.138)
Ln Total Assets	−0.003 ∗ ∗	0.046 ∗ ∗∗
	(0.001)	(0.010)
Tobin's Q	−0.002∗	0.021∗
	(0.001)	(0.012)
Tangibility	−0.003	
	(0.004)	
CurrentRatio		−0.012 ∗ ∗∗
		(0.003)
Z safe	−0.007 ∗ ∗∗	−0.162 ∗ ∗∗
	(0.003)	(0.023)
Z grey	0.003	−0.087 ∗ ∗∗
	(0.002)	(0.020)
Sector Dummy	YES	YES
Year Dummies	YES	YES
Observations	850	850
R^2	0.208	0.569
Adjusted R^2	0.189	0.484
Note:		*p<0.1; **p<0.05; ***p<0.01

In Model $H2$, the coefficient for *PremEBIT* is negative and significant at the 10% level, suggesting that more insurance could lead to a lower cost of debt. This implies that firms

investing more in insurance relative to their profitability may be rewarded with lower borrowing costs, possibly due to the perception of reduced financial risk by lenders.

As expected, *Ln Total Assets* exhibits a negative association with the cost of debt, significant at the 5% level, indicating that larger firms generally benefit from lower relative costs of debt. The coefficient of *Tobin's Q* also shows an association with the cost of debt, significant at a 10% level, implying that within this model, growth may be a determinant of the cost of debt. *Tangibility*, reflecting the proportion of tangible assets to total assets, has notably a negative but not statistically significant effect on the cost of debt. This suggests that while firms with more tangible assets might offer better collateral, potentially lowering borrowing costs, this analysis does not quantitatively support this.

The Z-score variables show that firms classified as "safe" have a significantly lower cost of debt, while the "grey" area firms do not exhibit a significant change. The results are consistent with the expectations. The negative coefficient of *Z safe* underscores the importance of creditworthiness in securing favorable debt terms. The model's R-squared value suggests moderate explanatory power, implying that there are other factors not included that affects *Cost of Debt*.

In Model $H3$, the regression analysis provides a compelling narrative on why firms acquire insurance. The positive coefficient of *PremEBIT*, significant at a 10% level, implies that insurance incentives firms to leverage more, aligning with the hypothesis regarding the strategic choice to utilize the risk mitigation offered by insurance to support additional borrowing.

The coefficient for *Ln Total Assets* is both positive and highly significant, indicating that firm size positively correlates with leverage. The *Tobin's Q* positive and weak significant coefficient suggests that firms with higher growth potential tend to have higher leverage, which is as expected. Conversely, the negative coefficient for *CurrentRatio*, significant at the 1% level, indicates that firms with higher liquidity maintain lower levels of debt.

The negative and significant coefficients for *Z safe* and *Z grey* suggest that firms with better credit ratings or only moderate credit risk are less leveraged. The R-squared value of 0.569 is substantial, indicating the model accounts for over half of the variability in leverage among the firms studied.

Analyzing the results of the VIF-values for $H2$ and $H3$ in Appendix A.2 reveals that all variables have values below 5. These low values indicate that the variables do not interfere with each other, suggesting the reliability and validity of model $H2$ and $H3$.

This analysis lends quantitative support to hypothesis $H2$ and $H3$.

6.3 Insurance on Enterprise Value

The following regression table details the analysis of how insurance impacts enterprise value, corresponding to hypothesis $H4$.

Table 6.3: Regression results $H4$

	Dependent variable:
	Enterprise Value Fixed Effects [H4]
Premium	2044.4∗ (1173.1)
Tobin's Q	6078.3 ∗ ∗∗ (1157.8)
Ln Total Assets	7094.6 ∗ ∗∗ (2016.1)
Sector Dummy	YES
Year Dummies	YES
Observations	878
R^2	0.465
Adjusted R^2	0.397
Note:	*p<0.1; **p<0.05; ***p<0.01

The *Premium* variable, significant at 10% with a positive coefficient of 2044.4, suggests that an increase in insurance is associated with higher enterprise values. The results are consistent with the hypothesis. This implies that increased insurance may cause an increased enterprise value through the benefits of tax deductibles from increased leverage. Potentially, positive market reception on the firm's risk management strategy could further enhance the enterprise value.

Tobin's Q carries a coefficient of 6078.3 and is significant at all conventional levels,

suggesting a positive relationship with enterprise value. This can indicate that firms with larger growth opportunities often have more to gain from leverage. The ability to invest in high-return projects can significantly enhance their value, and strategic use of insurance can facilitate access to the necessary capital by improving their risk profile for lenders.

The *Ln Total Assets* coefficient at 7094.6 is significant at all conventional levels, underscores that larger firms are typically valued higher in the market. This can be due to their ability to exploit economies of scale and optimize tax strategies more effectively than smaller firms. The high R-squared value indicates that the included variables account for a considerable proportion of the variance in enterprise value, denoting a strong association.

These results, combined with the analysis from Section 6.1 Insurance on Asset Volatility and 6.2 Insurance on Cost of Debt and Leverage, indicates that the reduced risk from insurance may cause firms to strategically use insurance to manage their capital structure and maximize enterprise value, supporting the hypotheses $H2$, $H3$ and $H4$. It appears that the stakeholders recognize and values the complex interplay between a firm's risk management practices, its capital structure decisions, and its overall financial health.

Analyzing the results of the VIF-values for $H4$ in Appendix A.2 reveals that all variables have values below 5. These low values indicate that the variables do not interfere with each other, suggesting the reliability and validity of model $H4$.

This analysis lends quantitative support to hypothesis $H4$. Consequently, the collective insights from all analyses reinforce the research question, supporting quantitatively that insurance increases enterprise value by affecting capital structure.

7 Discussion

In this section, the analysis results from Chapter 6 will be discussed. This discussion delves into how insurance impacts the asset volatility, cost of debt, leverage and enterprise value, linking empirical findings with theoretical frameworks and contrasting them with previous studies. It critically examines the role of insurance in corporate finance, considering its influence on enterprise value, risk management strategies, and capital structure decisions. By exploring these dynamics, this discussion aims to provide a comprehensive overview of insurance's multifaceted role in corporate governance and financial stability.

7.1 Insurance on Asset Volatility

This segment aims to clarify whether insurance reduce asset volatility, as hypothesized in $H1$. The effects of insurance on asset volatility are further examined through the lens of Leland's theoretical framework, offering insights into its impact on the firm's capital structure. This exploration includes a comparative assessment of previous findings and Leland's theory regarding the influence of insurance on capital structure through volatility variation.

Initially, as analyzed in Section 6.1 Insurance on Asset Volatility, the quantitative results suggest a connection between insurance and asset volatility. Integrating these results with Leland's model provides a deeper validation of the preceding analysis. Leland (1994) posited that asset volatility fluctuations influence optimal interest expenses, contingent on the baseline volatility level. Given that most observations exceed the volatility threshold, Leland's model suggests that insurance-induced volatility reduction would decrease interest expenses. This hypothesis aligns with results from Section 6.2, suggesting that increased insurance reduces cost of debt. Additionally, Leland's model implies an inverse relationship between volatility and optimal debt value, suggesting that insurance-induced volatility reduction increases the debt value. This further aligns with the results from Section 6.2, suggesting that an increase in insurance increases leverage.

The application of this methodology mainly serves as a validation of the empirical findings of this study. It clarifies how insurance influences distinct aspects of a firm's capital structure through asset volatility. Corresponding to Leland's theoretical framework, these

effects are consistent with the results described in the preceding analysis. Consequently, the prior analysis receives confirmation through the application of Leland's model, reinforcing their validity. While the model's assumptions, particularly regarding unprotected debt, might seem bold and not always reflective of real-world scenarios, Leland's alternative versions of the model, including those accepting protected debt, yield similar conclusions.

However, while the model's applicability in real-world scenarios carries inherent uncertainty, it is critical to note Leland's assumption of perpetual debt, which abstracts away from actual debt maturity and results in time-invariant calculations. This study's reliance on Merton's model for estimating asset volatility, which assumes finite debt, and in this case a maturity of one year, introduces a potential discrepancy when evaluating asset volatility. Thus, the implementation of Merton into Leland could potentially bias the estimates and affect the interpretation of $H4$ to some extent.

7.2 Insurance on Cost of Debt and Leverage

Utilizing the data presented in Table 6.2, this discussion aims to ascertain the validity of the hypotheses $H2$ and $H3$ proposed in Section 3 Hypotheses Development. These hypotheses posit that insurance reduces the cost of debt predominantly by mitigating risk which in turn increases the incentive to increase leverage. It is preceded on the notion that creditors are likely to offer more favorable borrowing terms as a reward for firms that mitigate their risk through acquiring insurance.

Model $H2$ in Table 6.2 suggests that an increase in insurance reduces cost of debt. The results from $H3$ further suggests that increasing insurance causes increased leverage. The findings, given the choice of methodology, align with corporate finance theory where firms pursue to maximize their enterprise value through optimal capital structure, and would take on more debt when it becomes cheaper (Leland, 1994). However, to assess validity into the findings, prior research and potential violations and biases must be discussed.

Contrary to the findings from Table 6.2, Yi et al. (2013) and Lin et al. (2013) observed that firms with D&O insurance often incurred higher debt costs, triggered by increased organizational risk-taking due to insurance coverage against litigation risk. Considering corporate finance theory, this would further imply that firms are less likely to take on more debt. In considering these studies, it is important to note that their results could

be influenced by different research periods. Lin et al. focused on the period from 1996 to 2008. In contrast, Yi et al. concentrated on the 2008-2010 period, which was marked by heightened global market instability triggered by the 2007-2008 financial crisis. The financial crisis period was marked by atypical volatility within the insurance industry, and major regulations within the industry has been done in the aftermath (Bouzouita & Craioveanu, 2019; Zaidi et al., 2018). Consequently, their analyses may reflect biases introduced by the turbulent economic conditions of the time. In addition, Yi et al. used data from Taiwanese firms, where several factors, both observable and unobservable, may differ compared to Canadian firms, raising a question regarding external validity. In contrast to both Yi et al. and Lin et al., the study spans from 2010 to 2022, possibly reflecting a different approach to insurance in corporate governance.

Further, research by Hwang and Kim (2018) and Holderness (1990) suggests that D&O insurance can serve as an effective governance monitoring tool, potentially reducing bankruptcy risks and influencing management quality. Employing insurance as a monitoring tool can then increase corporate predictability and insight, thereby reducing a firm's risk. This risk reduction can subsequently lead to a decrease in the firm's cost of debt, aligning risk management with enhanced financial stability. This claim is supported by Zou and Adams (2008), which found correlation between insurance coverage and a reduced capital cost, as insured firms are perceived as lower-risk entities by both insurers and creditors, leading to more favorable borrowing terms. These findings align with those in Table 6.2.

Whereas the literature gives some potential evidence that the findings are valid, there are still some concerns regarding the methodology of this study. Determinants of *Cost of Debt* that potentially influence the significance and coefficient of *PremEBIT* may be omitted from the models, especially when considering the low R-square from $H1$. This potential bias makes it further difficult to assess whether insurance increases *Leverage* as a result of insurance lowering the cost of debt or not.

The regression results from $H3$ indicating a positive relationship between *PremEBIT* and *Leverage* must also be interpreted with caution. While they suggest that insurance could be a determinant in leveraging decisions, the potential for reverse causality or omitted variable bias cannot be overlooked. This raises the question of whether firms with higher

leverage also seek more insurance as a hedge against the greater risk of financial distress (Core, 1997; Zou & Adams, 2008). Yet, such a risk management approach may suggest involvement in activities that erode value, contradicting this study's assumption that firms aim to maximize enterprise value. The research from Chen et al. (2016) did neither find a statistically significant *Leverage* in their examination of D&O insurance as a dependent variable, underscoring the uncertainty of what the true effect of insurance on debt actually is. Additionally, Chen et al.'s suggestion of increase cost of equity with D&O insurance is somehow contrary to this study's findings, whereas the increased risk would likely increase the cost of debt, thereby diminish incentives to leverage.

From $H3$, the discussion is further complicated by the challenges in addressing how debt is distributed within the firm. The model does not explicitly delineate between short-term and long-term debt or their respective maturities, which are critical in understanding the full scope of firms' capital structure and their implications when debt becomes cheaper. Potentially, more refined models, incorporating detailed information on the firm's debt structure, could potentially yield more accurate estimates and reduce bias in understanding the true effect of insurance on debt costs. Nonetheless, the current model serves as a preliminary indicator of this effect, supported by prior research.

7.3 Insurance on Enterprise Value

This discussion will revolve around the impact of insurance on enterprise value, drawing on the results presented in Table 6.3. Moreover, this examination seeks to ascertain whether the postulated hypothesis regarding the influence of insurance on enterprise value, as delineated in Section 3 Hypotheses Development, holds empirical validity.

Within Table 6.3, insurance demonstrates a positive relationship with enterprise value, which holds statistical significance at the 10% level. This implies that greater emphasis on insurance may result in enhanced enterprise value. This relationship may be rational through insurance's impact on firm leverage. As the firm's tax shield value is contingent on its leverage, increased insurance coverage, leading to enhanced leverage, could feasibly result in an increased enterprise value. This reasoning is consistent with traditional corporate finance theory, where tax deductibles play a crucial role in firm valuation (Berk & DeMarzo, 2020; Leland, 1994; Modigliani & Miller, 1958).

Further on, the relationship can also be explained by other reasons, particularly the role of insurance as an instrument for improving the firm's risk profile. A decrease in risk will, ceteris paribus, lead to a lower discount rate when calculating the present value of future cash flows, effectively increasing the enterprise value. In essence, as risk perception decreases, the required return diminishes, which increases the present value of the firm's projected earnings.

Contrasting with these findings are the insights from previous research, such as Chen et al. (2016), which investigated the effect of D&O insurance on a company's equity cost. Chen et al. identified a positive relationship between D&O insurance coverage and increased equity cost, attributing this to market skepticism towards D&O insurance. The rationale was that insurance could contribute to increased risk-taking by management due to weakened litigation risk, leading to higher equity costs and negatively impacting firm valuation. This perspective suggests a form of moral hazard induced by insurance coverage, potentially leading to decision-making inconsistent with stakeholder's interests. Other studies also confirm this statement, noting that D&O insurance could unintentionally encourage less prudent M&A decisions and more aggressive earnings management (Boyer & Tennyson, 2015; Lin et al., 2011). Furthermore, if moral hazard is present in the sample of this study, the assumption that firms seek to maximize their value, which implies that directors and officers act rationale, would simply break.

In contrast, there is a body of research that presents opposing viewpoints. For instance, Zou and Adams (2008) found that insurance can lead to a reduction in the cost of capital. They argued that insurance could be seen as a risk-reduction mechanism, lowering capital costs. Hwang and Kim (2018) also noted higher market values in firms with D&O insurance, especially those with strong growth prospects. This could be due to insurance's impact on governance monitoring and reduction of bankruptcy risk. Thoyts (2010) supported this by highlighting insurance's role in risk transfer, promoting innovation and growth within the company that could contribute to enhanced valuation.

Moreover, the market tends to favor firms with effective management, potentially leading to higher valuations. The absence of D&O insurance may discourage qualified individuals from serving on public boards due to the lack of protection against litigation risk, as shown by studies (Baker & Griffith, 2011; Bhagat et al., 1987; Core, 1997). Thus, insurance can

attract skilled management, allowing the market to recognize and reward companies with competent directors and officers.

Furthermore, Bradley and Chen (2011) challenge the notion that insurance increases moral hazard. They argue that despite insurance coverage against litigation risk, managers may still act cautiously to protect their positions within the company. This underscores the importance of directors and officers continuing to act in the company's best interests. The fact that management often has personal financial stakes in the company, motivating them to act in the firm's best interest, strengthens the contradict notion that insurance leads to moral hazard and support the idea that insurance can enhance value.

In this context, Table 6.3's results are consistent with prior research indicating a positive relationship between insurance coverage and reduced capital costs, leading to higher firm valuations. Moreover, there is evidence indicating that insurance can stimulate innovation and growth within firms, and studies suggest that it doesn't necessarily lead to moral hazard, as managers often act in the company's best interests to maintain their careers and personal stakes. Additionally, concerning the potential issues of moral hazard and earnings management addressed earlier, the findings presented in Table 6.3 would likely be contradictory and not corroborate Hypothesis $H4$, considering the chosen methodology of this study. In other words, employing a Fixed Effects regression across a 13-year span is considered sufficient, given that earnings management, if present, would likely manifest within a shorter timeframe and result in a reduced firm value. However, it is important to acknowledge potential biases in $H4$ as presented in Table 6.3. While the low VIF-values discussed in Section 6.3 suggest minimal concerns regarding multicollinearity, the control variables used may not completely isolate the true effect of insurance. Consequently, there remains a possibility of omitted variable bias influencing the results.

8 Conclusion

This thesis delves into the impact of directors' and officers' insurance on various elements of a company's capital structure, drawing on data from Canadian firms between 2010 and 2022. While previous studies have investigated how D&O insurance affects debt costs, equity costs, firm valuation, and corporate governance dynamics, there remains a lack of consensus on its definitive impact on capital structure, with mixed evidence on its benefits or disadvantages. To our knowledge, there has been no prior research using D&O as a proxy for broader firm insurance. This novel approach enriches the discourse and offers insights that are unique and may be of significant value. Our primary objective of this study is to shed light on why firms buy insurance by looking at its influence on capital structure and evaluating its potential to enhance enterprise value as a risk managing tool.

"Can insurance increase enterprise value by affecting capital structure?"

Based on our analysis and discussion we suggest that insurance reduces asset volatility which in turn reduces the cost of debt. We further suggest that the positive relationship between insurance and leverage is to be due to the lower costs of acquiring leverage, a result of decreased debt expenses obtained by insurance. We argue that insurance increases firm value, due to the reduced risk profiles and enhanced tax benefits linked with increased leverage. Consequently, yet only partly supported by empirical evidence, we supporting the four hypotheses by concluding that insurance reduces asset volatility, decreases costs of debt and in turn increases leverage and enterprise value.

Our results are further strengthened by Leland's model, which highlights the role of different factors in determining a firm's optimal capital structure for maximum valuation. We particularly focus on the effects of changes in asset volatility, a key element in Leland's theory, on capital structure components. Here we have uncovered a negative relationship between insurance coverage and firm volatility, validating that increased insurance lowers volatility. Moreover, according to Leland, this decrease in volatility could lead to reduced debt costs and higher optimal leverage. Combined with these insights, prior research presented in Section 2. Theoretical Framework within firm insurance (Mayers & Smith, 1982; Nordahl, 2015; Zou & Adams, 2008) and traditional corporate finance theory (Berk & DeMarzo, 2020; Modigliani & Miller, 1958) further underscores many fundamentals

aspects of our conclusions.

The study's internal validity is strengthened through the justification of methodology in Section 5. While there is a potential risk of endogeneity and omitted variable bias in our regression analysis, we have taken measures to minimize this through the application of time and entity fixed effects regressions with clustered standard errors, controlling for sector specific characteristics, and the winsorization technique. The internal validity is further strengthened by our comprehensive dataset, as we investigate 113 listed Canadian firms through the period from 2010-2022.

However, by only examining Canadian firms restricts the generalizability of the findings, as the prevalence and effects of insurance varies internationally. We also find it challenging to ensure the external validity of our study for companies that do not have insurance. This implies that our conclusions are mainly applicable to companies that are already insured. Having studied D&O insurance, firm insurance, and finance theory during our thesis work, we have determined that access to publicly available information about insurance policies in other countries is essential for a more comprehensive understanding. As initially mentioned, the existing literature's arguments on insurance's purpose are divided and only based on a handful of different economies. Therefore, data from a wider range of economies is crucial to evaluate any external validity.

While this study contributes to understanding the impact of insurance on a firm's value and capital structure, it also highlights the need for further research in this domain. During our investigation of D&O insurance, we observed that the policies often included deductibles. With a more enhanced dataset, important questions regarding information asymmetry in insurance could be addressed more thoroughly. The study also opens the question of whether D&O insurance can serve as a proxy for the broader corporate insurance, given their similarities. Nonetheless, our findings contribute to a preliminary understanding of how the broader corporate insurance might affect a firm's value and capital structure. Thus, while our study offers preliminary indications, it also opens opportunities for more comprehensive future research in this field.

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Appendices

A Appendix

A.1 Tables

Summary statistics including asset volatility

Table A.1: Summary Statistics of Data Retrieved from SEDAR+ and Bloomberg including Asset Volatility

Variable	mean	sd	min	p25.	median	p75.	max	n
PremEBIT	0.001	0.011	-0.107	0.000	0.001	0.002	0.126	998
Premium	0.737	0.949	0.033	0.150	0.338	0.947	8.400	998
EBIT	634	1413	-9085	91	248	820	14196	998
Ln Total Assets	8.600	1.389	4.635	7.570	8.591	9.681	11.996	998
IntexDebt	0.025	0.016	0.000	0.016	0.025	0.033	0.238	940
Leverage	0.520	0.196	0.006	0.424	0.542	0.639	1.416	998
Tangibility	0.905	4.818	0.001	0.258	0.516	0.801	86.835	998
CurrentRatio	2.159	2.806	0.130	0.993	1.479	2.177	32.209	940
Enterprise Value	12998	1.349	63	2207	5678	15796	167049	964
Tobin's Q	1.500	0.817	0.378	1.057	1.274	1.660	7.555	998
Equity Volatility	32.157	15.870	10.928	20.689	27.875	38.789	129.54	930
Altman Z-score	4.241	12.273	-16.349	1.274	2.576	4.242	252.22	940
Asset Volatility	23.134	11.643	5.283	17.832	21.724	28.519	74.382	930

A.2 VIF

VIF-values for the four models

Table A.2: Variance Inflation Factor (VIF) values for the four models.

GVIF-values are shown with $GVIF^{1/(2\times Df)}$ in parentheses.

Variable	VIF Values			
	Model H2	Model H3	Model H4	Model H1
PremEBIT	1.029 (1.015)	1.030 (1.015)	-	1.029 (1.014)
ln Total Assets	1.274 (1.129)	1.247 (1.117)	1.179 (1.086)	2.113 (1.454)
Tobin's Q	1.747 (1.322)	1.754 (1.324)	1.477 (1.215)	1.559 (1.249)
Tangibility	1.104 (1.051)	-	-	1.108 (1.053)
Z safe	2.900 (1.703)	3.063 (1.750)	-	-
Z grey	1.875 (1.369)	1.873 (1.368)	-	-
Sector Dummy	2.969 (1.062)	3.814 (1.077)	1.564 (1.025)	2.341 (1.048)
Year Dummy	1.220 (1.008)	1.222 (1.008)	1.134 (1.005)	1.258 (1.010)
Premium	-	-	1.473 (1.214)	-
EBIT	-	-	-	1.448 (1.203)
CurrentRatio	-	1.444 (1.202)	-	1.362 (1.167)