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Capital Structure Implications for Corporate Governance

by

Nishanth Rajan

A dissertation submitted in partial satisfaction of the
requirements for the degree of
Doctor of Philosophy

in

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in the

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of the

University of California, Berkeley

Committee in charge:

Professor Hayne Leland, Chair
Professor Ulrike Malmendier
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Nishanth Rajan

Abstract

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Doctor of Philosophy in Business Administration

University of California, Berkeley

Professor Hayne Leland, Chair

This dissertation consists of two essays that look at the outcome of agency costs of debt on the firm's capital structure and governance decisions. The first essay considers how monitoring of management by a shareholder aligned board of directors may induce an asymmetric information problem between shareholders and creditors. To mitigate this problem, the board may be more lenient with the manager and may have an incentive to be inherently weaker. In the second essay, I consider how creditors and shareholders interact when both actively monitor the manager. I demonstrate that, ex-post to floating debt, active shareholders may unilaterally shirk their monitoring duties to shift the burden of costly monitoring to debt claimants.

To that unassuming spirit, who in three small steps covered the three
worlds and more,

and to my family.

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I am truly blessed to have the support of my family. My father's watchful presence and my mother's unconditional love have brought me quite far in life and imbued me with the strength and convictions needed to go much farther still. I am truly lucky to be married to my wife, who reminded me that it is better to aspire than to expect and whose steadfast encouragement has banished any possibility of inertia. I am also fortunate to have a large extended family whose support I have relied on often throughout the years.

Chapter 1

Introduction

This dissertation focuses on the composition of the firm's capital structure and its interaction with corporate governance structure. Much has been written and researched about the conflicting incentives of creditors and shareholders in the decision making process of the firm. Equally well researched is the role of contracts and monitoring to align management's incentives with the firm. Canonically, monitoring is often limited to equity claimants and their effort to check rogue managers who engage in value destroying activities by maximizing private benefits. When debt claimants monitor, they are often monitoring managers whose actions ex-post to debt issuance are assumed to be fully aligned with equity claimants.

I add to the literature by considering the joint interaction of creditors, shareholders and managers. I illustrate how the debt-equity agency cost is also an endogenous cost to corporate governance, how managers sometimes align with creditors and are more likely to maximize firm value than shareholders, and how leverage may distort monitoring incentives of all claimants. Then, I consider the differing roles of debt and equity claimants in monitoring management. I claim that equity and debt monitor actions along different dimensions and I analyze regimes where monitoring by claimants can be either substitutes or complements. Here, and everywhere else in this dissertation, I define the firm to be the sum of its debt and its equity. And I define corporate governance as actions taken mainly by shareholders, and by creditors where noted, to monitor the manager.

The issues surrounding corporate governance have steadily been increasing in prominence. Survey papers (Becht, Bolton, and Röell 2002) identify many reasons for the rise, including the wave of privatizations, deregulation, increased participation of pension funds/active shareholders and the major scandals and failures of the early 2000 period. When the firm is considered as a "nexus of contracting relationships" (Jensen and Meckling 1976), corporate governance is a "common agency" problem, where one agent, the manager, has to act in the best interest of multiple principals including shareholders, creditors and employees. Modern governance literature often looks at the allocation of control rights between management and the firm, i.e. both debt and equity, and balances shareholder power with management. The corporate scandals of 2001 and 2002 spawned the Sarbannes-Oxley Act and increased reporting requirements, strengthening board independence and biasing con-

trol towards shareholders and away from management. Governance after the fiscal crisis of 2008 is in a state of flux; activist shareholders continue to rally against perceived CEO over-compensation and risk taking and there is a prevalent notion that boards, though on a secular trend of being independent from the CEO, were somehow still unprepared for the job. However, there is also a trend towards stronger management. For example, trust in strong leaders persists in Wall Street where Jamie Dimon, the CEO of JP Morgan is also the chairman of its board. It is also true in growth industries like Facebook where customized dual class structures gives CEO Mark Zuckerberg upon IPO, fifty-seven per cent of the voting shares, though only eighteen per cent of the company's market capitalization. I claim that leverage plays an important role in this tension between boards and management. It is in this context that I analyze the interaction of the board of directors, who represent shareholder's fiduciary interests, and the manager, whose incentive contract may best solve the common agency problem between both creditors and equity claimants.

Why does capital structure play such an important role in a firm's interaction with management? First, debt financing is often a key component of an optimal contract that aligns managerial incentives. The fundamental assumption relies on the loss to the manager's utility from bankruptcy, be it a private reputational benefit, the present value of lost wages or a combination of the two. Next, creditors may monitor via direct intervention in manager or shareholder decision making, often exacting contractual penalties for certain types of investment or reorganization decisions. This often takes the form of covenant based monitoring with strict covenants and technical defaults acting like triggers for renegotiation and transitions to debt control. Literature on debt monitoring tends to focus on the role of debt structure in incentivizing monitoring by playing off the competing claims from junior and senior debt claimants, and from public and private debt. Young firms rely on private and bank finance. As firm's mature, financing is expanded to public debt and equity. As the role of equity monitoring has increased recently, the role of banks in monitoring seems to have decreased, possibly driven by the increases in secondary markets for loans. Collateralized Loan/Debt Obligations and Credit Default Swaps that have allowed banks to significantly mitigate the losses felt in bankruptcy and thus blunting an important component of the optimal contract for debt monitoring of management. The transition from debt based monitoring to equity based monitoring is a relatively unexplored topic as is the coexistence of the two types of monitoring. I contribute to this gap in the literature by analyzing the different dimensions in which creditors and shareholders may monitor the firm. In many cases, monitoring by both claimants may be substitutes as opposed to complements. Given that all monitoring is costly, this can lead to strategic interactions between debt and equity to shift the burden of monitoring and thus to another agency cost to debt.

What are the major duties of boards of directors? One duty of the board is to set compensation contracts for managers of the firm. These publicly observable contracts play a key role in aligning managerial incentives with the equity and debt claimants of the firm. Another important role of the board is to actively monitor the manager. Often this takes the form of evaluation; where the board is tasked with selecting the best manager for the firm and replacing her as necessary. Replacement may happen if there is evidence of managerial

misbehavior or new information about the match between the manager and the firm and the availability of superior replacements. However, the board only spends a small fraction of its time in the process of replacing management (Adams and Ferreira 2007). A significant portion of the board's time is spent on advisory roles and boards are often direct participants in major investment decisions. Furthermore, most boards consist of industry specialists and leaders or political insiders, who have the expertise required and are expected to provide strategic guidance to the firm's investments. As such, the board can circumvent or overrule management without necessarily replacing the manager or reworking her contract. Thus boards of directors, who are tasked with monitoring and advising the firm's management, have wide access to both the public and the private information of the firm's future direction. While this access to information is a key component of the firm's governance structure, boards of directors are mainly aligned with the firm's shareholders. Most boards of directors have fiduciary responsibilities to shareholders and may be sued by shareholders for not representing their interests. Furthermore, most boards are compensated with equity stakes. Given that boards of directors primarily serve shareholders, this fundamental asymmetry between shareholders and creditors interests induces an agency cost to debt from strong boards.

The key feature of the resolution to this nexus of conflicts between management, creditors and shareholders, is the role of public incentive contracts and private information on the firm's investments. Because incentive compensation between the manager and the firm is verifiable, vesting the manager with decision rights is a way for shareholders to credibly commit against risk shifting. However, active board participation can increase firm value; while simultaneously circumventing the decision rights of the manager. The firm's governance structure balances these trade-offs induced by the firm's leverage.

The outline of this dissertation is as follows. In the chapter 2, I analyze the decisions of an equity aligned board of directors and their interaction with a manager who has private benefits to solvency. The key insight of the chapter is the hypothesis that managerial contracts are more credible and transparent commitments than board decisions. Since board meetings may involve firm and industry specific strategies and trade secrets, board decisions are not generally fully public. Thus board members, who tend to be aligned with shareholders, may be more likely to engage in asset substitution than risk averse managers who have private reputational benefits to solvency. Thus debt holders may be wary of strong boards and prefer that managers be entrusted with control rights in the firm's investment decisions. In chapter 3, I explore the hypothesis that debt and equity claimants monitor managers in fundamentally different ways; with debt claimants specializing in monitoring risk based decisions of the manager and equity claimants serving as a check against managerial decisions that reduce firm value in all payoff states. I analyze the interaction between debt and equity monitoring, and establish that they may be both substitutes and complements. Because monitoring is costly, equity claimants may endogenously monitor less transferring the burden to debt claimants. While this may be ex-post beneficial for shareholders of the levered firm, it may come at a cost to the firm's creditors and lead to an ex-ante reduction of firm value. This suggests that staggered boards may be beneficial to firm value. The final

chapter concludes.

Contributions to the Literature

The individual strands of the literature on optimal capital structure and optimal composition of corporate governance are enormous. Less voluminous is the intersection between capital structure and corporate governance. In lieu of an exhaustive review, I list a few foundational concepts and the associated papers.

The co-existence of debt and equity claims and their roles in motivating management has been studied (Dewatripont and Tirole 1994). By assumption that the manager prefers shareholder monitoring over debt control, the paper establishes debt as an incentive structure for managers. Thus bad performance leads to debt control and good performance leads to equity control and a partial congruence between managers and shareholders. Capital structure and investor control is part of an incentive contract to managers. Contracting on monetary incentives based on firm profitability is not sufficient to induce the first best outcome. On the other hand, debt may also play a role in committing shareholders to an aggressive replacement policy (Berkovitch and Israel 1996). The key insight is that replacing a manager induces uncertainty in the firm's payoffs and increases risk. For a levered firm, this is in the interest of the shareholders and boards of directors of levered firms may be aggressive monitors of management, which is also a feature in this dissertation.

There may be an alignment of management's natural incentives with debt claimants over those of shareholders (Inderst and Müller 1999). The paper considers the role of a large blockholder in the spirit of monitoring consistent with the established canon (Burkart, Gromb, and Panunzi 1997). Similar to the features replicated in this dissertation, excessive monitoring by equity claimants may be detrimental to firm value and ceding control to management may be additive to the firm in certain states of the world. This dissertation goes further along those lines by specifying the various dimensions of shareholder monitoring and illustrating how the multiple roles of the board may be in internal conflict in the presence of leverage. However, manager incentives may be tailored to align with the value of the total firm, both equity and debt claimants (John and John 1993). When decision making is left in the realm of optimally compensated management, the agency cost of debt is mitigated. This dissertation is the first, to my knowledge, to marry the fundamental trade-offs illustrated in these papers and analyze the subsequent impact on board strength. I also suggest some illustrative results for board composition and for leverage.

Active shareholder governance may be modeled in many ways. In this dissertation, the manager's match with the firm is unknown and monitoring is costly (Hermalin and Weisbach 1998). Marginal benefits to monitoring are diminishing as further signals on the manager's quality, such as earnings releases, are received. Thus board strength is a result of the collective utility maximization of each of its directors. In Hermalin and Weisbach 1998, the individual director balances the gain in utility from a higher cash flow to the firm from replacing the current manager with a better one with the private cost to the director from the

distaste to monitoring the CEO. As with much of the rest of the literature, board strength is proxied by director independence from management, with independent directors feeling less distaste for monitoring. Into this framework, I introduce leverage and the ability of the board to also affect investment decisions. Board participation in investment is listed as one of its top five roles according to the Business Roundtable, an industry group on corporate governance and policy. Boards of directors may play a critical role as a sounding board for management decisions (Adams and Ferreira 2007). My assumption is stronger in that I claim that boards can actively shape the firm's investment policies on a level equal to that of management. Thus boards of directors and management bear equal responsibility in firm strategy, and the outcome of the firm's strategic initiatives is a result of a bargaining game between boards and management. Anecdotal evidence of strong directors who significantly shape firm policy motivates this assumption. Finally, since boards of directors have a fiduciary duty to shareholders, they also have the incentive to increase firm risk if this benefits the firm's equity. Debt-equity conflicts in board fiduciary duties have been shown to be economically significant (Becker, Strömberg, and School 2010). A recently analyzed natural experiment is a 1991 ruling in Delaware courts that makes boards of directors of distressed firms answerable to the firm's creditors even if formal bankruptcy has not been declared. Consistent with the hypothesis that the increase in the board's fiduciary duties to include creditors mitigates the board's motives for risk shifting, Becker et. al. 2010 notes that leverage for firms increase after the ruling. One interpretation of this rise in leverage is the amelioration of the agency costs to debt from the board's perfect alignment with shareholders. The results provide some justification for the assumption that most boards of directors may not fully consider creditors in their decision making process.

As expansive as is the literature on governance and monitoring by either shareholders or by debt holders individually, there are few papers that look at the co-existence of monitors from different ends of the capital structure. The question of co-existence of debt and equity monitors may be deconstructed into its major components: the co-existence of debt and equity and the role of monitoring in each. Optimal capital structure literature deals with the former. One main driver of this literature is trade-off theory, based on the tax benefits to debt. The other is the balance between agency costs of debt and debt financing's role in providing management discipline. However, neither channel has much to say about monitoring specifically. Yet, the structure of a firm's financing and its security design often consider their role in motivating one monitor; either debt or equity. Since the role of capital structure in the incentives of equity monitors has been discussed above, I mention a few papers that illustrate capital structure's role in motivating debt monitoring. The presence of junior debt claimants can motivate the senior private claimants to monitor aggressively (Park 2000). Generally, the coexistence of debt with outside equity is driven by agency concerns (Fluck 1998). However, the information sets of debt and equity claimants are asymmetric and need not fully overlap. A related insight is the idea that debt and equity claimants are valuation specialists, who play orthogonal and complementary roles by revealing information about the firm's opportunities to the entrepreneur (Habib and Johnsen 2000). This dissertation uses a similar assumption of natural complementarities of debt and equity

participation. Finally, the motivation of each monitor is affected by the common agency problem (Khalil, Martimort, and Parigi 2007). The paper considers the co-ordination game between multiple equity investors and determine that co-ordination may lead to free riding and less monitoring. I find a similar result but by considering how equity monitors may free ride by shifting the monitoring burden onto debt claimants. However, none of these papers considers the strategic interaction of the two claimants over costly monitoring. To my knowledge, this dissertation is the first paper to consider the coexistence of both debt and equity monitors and analyze the impacts.

Chapter 2

Capital Structure Implications for Corporate Governance

2.1 Main concept/Motivation

I consider how a firm's leverage may affect the board of directors' strictness of monitoring management. The conflict between creditors and shareholders of a firm can impact the firm's governance structure over its management in an important and meaningful way. The board has a fiduciary duty to work for the interests of the firm's shareholders and may do so at a cost to debt claimants (risk shifting). Given that any agency costs to debt are anticipated and internalized ex-ante by shareholders, boards try to pre-commit against risk shifting. One commitment device is to vest the manager with decision rights and contract with her to maximize total firm value ex-ante to issuing debt. However, the board must also evaluate the match between the manager and the firm. A better match between the manager's skill set and the firm's requirements leads to higher cash flows. Furthermore, the board assists the manager in determining the firm's strategic direction. These monitoring and advising mandates of the board do not allow perfect precommitment. Often, the board may have as equal a say as management in the firm's investment decisions. At the least, most boards have some degree of veto power over management investment proposals. Shareholder aligned boards have an ex-post incentive to implement riskier projects by overruling the manager, who by nature of her compensation contract is incentivized to take the optimal risk for the firm. Cognizant of this agency cost to debt, the board of a levered firm balances the negative externality of strict monitoring with its role in evaluating the match between the firm and the manager. Since a weaker board is less prompt to replace below average monitors, firms with risky debt on their balance sheets may be more lenient. Consistent with the predictions of the model, I document the negative correlation between industry adjusted leverage and board independence in the data. Finally, I explore the strategic channel by which managers may use debt financing to induce less strict monitoring by boards.

A crucial role of any board of directors is the charge to choose executives who are the

best fit for the firm and who will substantially increase firm value and cash flows. Boards of directors that are independent from the management they oversee are more successful in this task as they avoid any bias towards current management in changing economic climates. Another important role of the board is to ensure that the manager is compensated such that her motives match that of the firm, equity and debt. Because managerial compensation is public information, these contracts are always written to maximize total firm value ex-post to debt issuance. If not, contractual features of debt such as bond covenants may be easily specified to reflect the new risks to creditors. Thus, such managerial compensation contracts provide a credible commitment against risk shifting. However, the agency cost of risk shifting cannot be completely eliminated because the board also plays a key role in the firm's investment decisions. Since investment decisions necessarily involve proprietary information, debt covenants are not possible on the actions of equity aligned boards of directors, who may then overrule management decisions and induce an asset substitution problem. This incompleteness in the contract space provides an important link between a firm's capital structure and its corporate governance. In this chapter, I analyze the governance structure of such a firm, whose board of directors may engage in risk shifting. I also consider the strategic incentives of managers to exploit the conflict between debt and equity claimants.

This analysis makes an important contribution to the highly intertwined literatures of optimal capital structure and optimal governance. I analyze a novel channel through which mechanisms used to control the agency costs of governance exacerbate the agency costs to debt. In doing so, I highlight the relative incompleteness in the contracting spaces of the debt-equity and the manager-firm conflicts. In the absence of active shareholder participation such as board monitoring, both types of agency costs can be perfectly controlled to attain a 'first best' result (John and John 1993). In this model, the only claims to the firm are equity and risky debt. The manager's compensation includes both a pay for performance incentive component to induce some risk taking along with an induced benefit to solvency, lost wages or clawbacks to act as a check against excessive risk shifting. The optimal contract relies on vesting the manager with full decision rights when the firm is solvent, and fixing the parameters of her contract to align her incentives with total firm value. I build off this contracting framework by noting that, in reality, the firm's investors, especially equity claimants, retain the ability to intervene in manager decision making power. By considering this contracting incompleteness where investors cannot fully cede control to managers, I find that the possibility of asset substitution may constrain the strength of corporate boards and hamper their ability to evaluate the manager. Like John and John 1993, I do not consider directly the firm's optimal capital structure decision. Since I do not model any tax incentives or other such benefits to debt, the important role debt claimants have in monitoring management is also abstracted away.

Though common wisdom maintains that creditors prefer strong boards for their perceived ability to prevent value destroying decisions made by management, anecdotal evidence often shows that bondholders do not fully trust board decisions and may sometimes side with the CEO over the board. An example is that of Six Flags Theme Parks and the events surrounding its bankruptcy in June 2009. Investor Daniel Snyder gained control of the board of

Six Flags via a proxy fight in 2005. According to SEC filings, his letter to the firm's shareholders accused the board of mismanagement, poor performance and claimed that "With its lackluster returns and repeated, costly refinancings, the Company is essentially being operated for the benefit of debt holders, not the stockholders. We intend to remedy that." Mr. Snyder won his bid and handpicked a new CEO. Though he was only chairman of the board and not the direct manager of the firm, Mr. Snyder's direct influence on corporate strategy was evidenced when Six Flags' business practices began to mirror those of the Washington Redskins, a company that Mr. Snyder owns and directly controls. Post bankruptcy, the reorganization plan called for much of the chain's management to be retained, including the CEO. However Mr. Snyder was removed from his post as the chairman of the board, a decision that has been interpreted as an ouster led by bondholders.¹ Especially interesting is the retention of Mr. Snyder's choice at CEO, possibly suggesting that the problem lay not with reckless management of the firm but rather with excessive interference by the board of directors, or at least its chairman. In this example, bondholders do not seem to have been displeased with the board because it failed to check managerial excesses. Rather, the displeasure might reflect the belief that the board was pushing management to such excesses.

I present a model where a board may evaluate and install a manager and set her compensation, while retaining the ability to intervene in management decisions. The ability to intervene is dependent on the bargaining power of the manager, which is a function of the board strength or independence from management. I find that boards of levered firms that cannot commit against risk shifting may be more lenient in replacing their managers. Using a novel proxy for managerial turnover from the literature, I show that firms with more leverage than the industry adjusted mean leverage ratio are associated with higher probability of manager survival. Models of board monitoring suggest the negative correlation between managerial tenure and board independence (Hermalin and Weisbach 1998). I add to this result some suggestive evidence that levered boards become weaker faster than their less levered counterparts when managerial tenure increases. I document this negative correlation between board independence and leverage in a data sample over a time period from 1996 to 2006.

2.2 Literature Review

The principal agent literature in capital structure focuses either on the agency costs between the equity holder and the manager or on the agency costs between debt holders and equity holders. This paper seeks to link the two strands of literature by noting that actions taken to reduce managerial agency costs by equity holders (i.e. the fundamental role of corporate governance) may have the externality of exacerbating the conflict between equity and debt holders. Most papers in the literature do not necessarily account for the effect of governance externalities on the other principals. One prevalent cost of governance considered in the literature comes from governance reducing the incentives of the agent to exert effort. In this

¹Slate.com May 3rd, 2010. Washington Post May 1st, 2010.

paper, governance has an added detrimental effect by increasing the cost of debt financing. The exacerbation of the debt-equity conflict is a cost to the mitigation of manager-firm conflict.

Corporate governance seeks to resolve the classic problem of separation of ownership and control (Berle and Means 1932), where dispersed owners of the firm seek to control a manager who is entrusted to make decisions crucial to the success of the firm. The manager left unchecked may undertake actions to increase her private benefit to the detriment of other stakeholders in the firm. Various methods of mitigating this problem include monitoring by a board of directors, monitoring by a large shareholder, executive compensation, the external takeover market, debt financing and monitoring by private debt. My focus is on the role of the shareholders, since it has been shown that activist shareholders and blockholders help determine the level of anti takeover devices, the structure of voting rules and the composition of the board of directors (Gillan and Starks 2000). Some aspects of corporate governance may have adverse consequences on creditors (Cremers, Nair, and Wei 2007). Most such analysis uses the G-index ((Gompers, Ishii, and Metrick 2003)) and looks at the subsequent effect on debt claimants². Of these various modes of governance, I consider the impact of a subset; monitoring by a board or a blockholder, and executive compensation. I stipulate governance to be actions by concentrated equity holders, implemented via the board, that mitigate firm-manager agency costs. I consider the costs to debt (and equity) claimants from the distortions to the manager's compensation contract that can result from increased strength of the governance institutions (such as board independence or blockholder presence).

Incentive contracting controls manager-firm misalignment and accounts for the impact to both equity and debt claimants. Surveys of executive compensation (Murphy 1999) have identified four main features of managerial contracts; base salary, performance bonuses, option based compensation and long term incentives. In this paper, I consider the pay-for-performance aspect of a manager's contract using an established framework (John and John 1993). Base salary and long term incentives are implicitly considered but not directly modeled. For now, I ignore options that can increase the convexity of the contract. Research on top management compensation looks at contracting that aligns managers with equity holders. However, certain managerial traits can be beneficial to debt holders. Alignment between debt holders and managers arise when managers are more wary of bankruptcy than equity holders. Managers have private benefits of control and they may have much of their human capital tied up in the firm which would be lost in bankruptcy. Also, managers may prefer the "quiet life" and have no innate desire to over-invest ((Bertrand and Mullainathan 2003)). This makes management less subject to risk shifting and debt overhang problems. Yet increased equity compensation coupled with debt on the firm's balance sheet increases the managerial incentive to over-invest, and this is also in the interests of equity holders (Ortiz-Molina 2006). In an established framework of optimal managerial contracting designed to

²The G-index is an industry standard governance index, where the incidence or approximately 24 rules is tracked in various firms as a proxy for shareholder power. Examples of such rules include existence of poison pills, staggered or classified boards, secret ballots, etc.

balance these opposing forces and taking capital structure as exogenous (John and John 1993), I use incentive contracting to ensure that the manager undertakes the investment policy that will maximize total firm value. This value maximizing policy may be altered by the board ex-post, possibly inducing risk shifting.

Debt also plays a direct role in controlling the various agency costs in the firm (Jensen and Meckling 1976). Managerial perquisite consumption or discretion over free cash flow is reduced by leveraging up the firm and increasing payments to debt³. However, these levered firms bear increased asset substitution, underinvestment and bankruptcy costs. Trading off these costs and benefits return optimal levels of leverage. In this paper, I assume there is no direct role of debt in mitigating the agency costs of managerial misbehavior. I constrain the firm to have some form of debt financing to circumvent the optimal capital structure issue. Because I do not consider any benefits of leverage such as tax shields or enhanced participation of creditors in monitoring management, the level of debt is exogenous. Including the benefits of debt in an extension of the current model may jointly determine equilibrium levels of governance and capital structure.

That private benefits of management may also be beneficial to creditors, be it managerial optimism (Hackbarth 2010), or as an incentive to exert effort, (Berkovitch, Israel, and Spiegel 2000)). An optimistic manager might float debt early and reduce managerial agency costs by constraining herself unwittingly more than a “rational” manager might. In doing so she might also reduce shareholder-debtholder agency cost as well. Also, the presence of debt may motivate management to exert effort. Debt makes shareholders commit to an aggressive replacement policy. This is because by replacing a manager of known ability with a lower ability, they “gamble” that the replacement manager will prove better; a form of risk substitution. However, larger debt also implies that the free cash flow of the firm is diminished as it is used to service debt payments. Since less of this cash flow is left for the equity claimant, the manager captures a smaller fraction of the marginal benefit of his effort. Components of compensation, such as a golden parachute, may commit equity holders to a softer stance on firing to mitigate this cost to the manager.

This paper adds to the literature on the separation of ownership and control in the context of shareholder monitoring (Burkart, Gromb, and Panunzi 1997). In the canonical model, shareholders have control rights but delegate much of the decision making to the managers. Occasional intervention reduces the manager’s private benefits and weakens her incentive to exert effort and may be detrimental to the firm in instances in where the management is better informed than the shareholders. Unlike most other models in the literature where the cost to corporate governance may sap managerial incentives to exert effort, here we consider a cost where corporate governance may induce risk shifting and exacerbate the agency costs of debt. Inspired by the literature where managerial concern for reputation building induces safer investments and aligns the manager’s investment decisions with debt claimants (Hirshleifer and Thakor 1992), I assume that managers share creditors’ preferences

³Benefits to debt financing can also include tax benefits and reduced asymmetric information advantages to debt financing.

for safe investments. Finally, I consider the shareholders' monitoring of managers who may align (or may be induced to align) with debt claimants. The cost of the monitoring then comes from possible decreases in debt value from ex-post risk shifting by the equity monitors.

This paper is also related to the literature that considers the contracting incentives of shareholders and management. Risk shifting is notoriously hard to determine in the data because it requires disentangling ex-post and ex-ante decisions. However, recent work considers short term investors and looks at the correlation between compensation and equity prices before and after the financial crisis of 2008 (Cheng, Hong, and Scheinkman 2010). In this quant-bubble story, over-confident and optimistic investors incentivize otherwise long-run value maximizing managers to make investments and take risks in subprime derivatives built from financial engineering. I focus on the role this increased risk taking preferences of shareholders may have on its debt claimants; and how these increased costs may filter back into the governance decision. Further suggestive evidence of increased board risk taking around the crisis period is provided by a positive correlation between market measures of risk and financial expertise of the board in the run-up to the financial crisis (Minton, Taillard, and Williamson 2010).

The paper's theoretical framework draws insights from many bedrock papers of the literature. The labor match model between the manager and the firm and the board's determination of the match quality is similar to Hermalin and Weisbach 1998. The model illustrates that manager replacement increases the effective volatility of the firm if less is known about the replacement manager than the incumbent (Berkovitch and Israel 1996). I focus on the ex-ante role of this distortion and claim that the board may actually be more lenient with managers to balance this agency cost of debt. Finally, I use the optimal contract derived by John and John 1993 to illustrate the contractual mechanisms that allow shareholders to commit ex-ante to undertaking the optimal investments even in the presence of debt. This allows me to highlight the inability of shareholders to refrain from ex-post intervention and avoid the moral hazard problem of asset substitution.

Recent work has also considered the role of capital structure in an optimal managerial contract that induce managers to exert costly effort (DeMarzo and Fishman 2007). In such papers, asset substitution ceases to be a problem as the agent (manager) bears the cost of increased termination and does not have any incentive to increase the risk of the firm. In this paper, I consider the effect of the friction where the principal cannot commit to ceding full control to the agent and thus the board of directors may intervene in key managerial decisions. I then consider the effect of this friction on the agency problem between two "principals": equity and debt claimants. I show that moral hazard by the manager may be controlled by contracting. However, moral hazard by the board of directors is necessarily less transparent and contractible.

2.3 Model

The model considers the implications of the following fundamental frictions or assumptions. First, contracts between managers and firms are more transparent than interactions between boards and managers over investment. Here, by transparency we mean that security holders can observe the same information as that observed by the board and managers. Similarly, signals of managerial quality, such as corporate earnings announcements, are public information while signals on project profitability are private to the board and the manager, and not known to debt claimants. Next, the board of directors can evaluate the match between managers and firms better if it is “strong”. Note that the board’s evaluation of the match between manager and firm is defined not only by its role in interpreting the signal on manager quality but also its being strong or independent enough to replace the manager if warranted by the updated prior. However, it is also easier for a stronger board to overrule manager investment decisions. The board cannot separate the evaluation and intervention functions. Finally, the manager has a private, possibly reputational, benefit to solvency.

In the model, debt is exogenous and the firm’s motivation for issuing debt is not considered. Furthermore, debt is issued at par with an exogenously specified face value. The debt claim pays a floating rate coupon which is determined after public signals on manager quality are observed. It is worth noting that since there is an agency cost to debt but no corresponding benefit, the firm value is decreasing in leverage by assumption. Debt maturity is the same as project maturity. Debt claimants can verify signals on managerial quality unearthed by the board. Since most measures of managerial quality such as earning announcement or management track records are already public, this information revelation may be enforced via bond covenants that trigger when the manager is replaced or her contract is renegotiated. However, debt claimants do not observe the subsequent decision on investment, jointly made by the management and board. Board meetings are generally closed due to the discussion of proprietary information and strategies and ex-post verification of the signals received (or not received) when making the decision is significantly harder.

The board of directors is assumed to be perfectly aligned with the shareholders. The board evaluates the manager and sets her compensation. The manager and the board jointly determine the firm’s investment decision. In case of disagreement, the firm’s investment is dependent on the individual bargaining power of the manager and the board.

There are two types of uncertainties; uncertainty about the manager’s ability and uncertainty about the risky project’s outcome. While the uncertainty on the manager’s ability follows a Bayesian updating process, the uncertainty of the risky project is an exogenous feature. The two uncertainties are independent.

Manager’s ability.

There is no asymmetric information about the manager’s ability; i.e. the manager, the board and debt claimants all simultaneously update their priors about the manager’s ability over

manager's contract is updated to reflect the new information. Furthermore, since covenants may allow debt claimants to renegotiate terms based on new information, the floating coupon to debt will reflect the updated information about the manager.

The manager's compensation is linear and consists of an equity share (e) and a wage (w)⁷. The manager's private benefit of solvency (b) may reflect the loss of future earnings or reputation in bankruptcy. I further assume that the manager has no bargaining power via her compensation contract. Her compensation is constant in her ability (i.e. $R(\alpha) = R$)⁸. Thus she is not a strategic participant nor is her private benefit to solvency internalized by the equity claimants. I further assume that the manager receives her wage ex-ante to the investment decision. This assumption is made for tractability and avoids the need for a solution to a fixed point problem. Under these assumptions, it can be shown that there exists a compensation contract such that her wage is fully determined given e and R .

Firm's investment opportunities

The firm's investment opportunities consist of two projects, one risky and the other safe. $\Theta \in \{risky, safe\}$.

- $\Theta = Safe$: The safe project has sure payoff y_m .
- $\Theta = Risky$: The risky project pays y_h , with probability ϕ , and $y_l = 0$ otherwise. Note, $y_h > y_m$.

The manager observes the risk of the firm's investment opportunities, the random variable, ϕ , and chooses between risky and safe projects. The common prior on the probability ϕ is that it is distributed uniformly on the unit interval.

Definition 2.1. *I define a decision rule such that the investment decision is captured by a threshold probability ϕ_i such that agent $i \in \{Manager, Board\}$ will invest in the risky project iff $\phi \geq \phi_i$.*

Given the threshold probability ϕ_i , the ex-ante expected value of the project when agent i makes the investment decision is given by

$$E_{\phi_i}[\tilde{y}] = \frac{1 - \phi_i^2}{2} \times y_h + \phi_i \times y_m.$$

Note that the threshold probability that maximizes the expected value of the project is given by $\phi^* = \frac{y_m}{y_h}$.

hold if the signal on manager ability is more public than that on the project expected return. Here the signal is assumed to be public to make the assumption stark.

⁷While a linear contract is exogenously assumed here, other work (e.g. John et al. JF 1993) has established conditions under which the contract may be optimal. Under the chosen assumptions, the linear contract will be optimal in this framework as well.

⁸This may be justified by the assumption that the manager's skill set is firm specific. Thus her outside opportunities are unrelated to her company-specific skills.

Board strength

Assumption 2.1. *The strength of the board is defined as $g \in [0, 1]$, the probability of getting a signal on manager quality. The board's bargaining power with management over investment is given by $\Lambda(g)$; where Λ is an increasing and convex function in g .*

Assumption 2.1 highlights the relative contractual incompleteness in the space of board contracts. The board has no credible way to commit against ex-post risk shifting because the very source of the board's strength in evaluating the manager is also the source of its ability to risk shift. I also assume that the board's ability to risk shift is convex even though its ability to evaluate the manager is linear.

The key to this assumption is the relative convexity of the board's ability to receive a signal versus the effect on its ability to intervene. One way to justify this assumption is to recast it in terms of the board's ability to determine different types of information. Since neither the board nor the manager know the true match between the manager and the firm, determining this fully unknown variable is likely to be a challenging task. However, managers are hired specifically for their expertise in assessing risks of the firm's investment opportunities. Given that management is expected to run information by the board, whose directors often have similar expertise, determining what the manager knows about the firm's risk is likely an easier task.

Debt Pricing

Assumption 2.2. *The firm issues risky debt, priced at par.*

- a) *The face value of debt, F , is the default barrier which may only be triggered at the final period.*
- b) *The coupon, paid ex-post to the signal on manager ability, reflects the updated risk of the firm from the information about the manager.*
- c) *F is specified such that the safe project return ensures solvency, i.e $F < y_m$.*
- d) *Debt is risky because the face value of debt is greater than the manager's expected ability, $F > \alpha_1, \alpha_0$.*

I assume a fixed face value to debt or a default barrier, F . The value of debt incorporates all information available to creditors. This feature is formalized with the debt coupon; which substitutes for a more explicit model of covenants that are triggered to renegotiate the terms of debt. On the other hand, the coupon will reflect the persistent asymmetric information between debt and equity claimants on the project choice. I assume that the risk free rate is zero. Since the market value of debt is not exogenous, original equity holders and the board will ex-ante internalize this agency cost of debt via the increased coupon.

Much of the interesting results explored in this model require debt to be risky, but not too risky or distressed. When debt is risky, conflicts exist between managers, equity holders

and debt holders. Since there are no assets in place or collateral in this model, risky debt is defined as a default barrier level, F , such that the safe project will ensure the solvency of the firm. If debt levels are too high (solvency only if $\tilde{y} = y_h$), debt is distressed and the manager and equity holders are aligned and will gamble for salvation by consistently investing in the risky project.

Firm Payoffs

The payoffs to the firm are functions of the choice variables (g, e, w) and of the exogenous parameters $(\alpha, \phi, F, \text{etc.})$.

Assumption 2.3. *The payoffs are separable and additive in the manager's ability (α) and in the chances of the risky project's high return (ϕ) .*

The total payoff to the project is given by $\tilde{y}(\phi) + \tilde{x}(\alpha)$ where ϕ and α are independent.

By assumption, the manager's ability does not change the intrinsic risk of the firm's investment opportunities, which is determined by ϕ . Instead, the manager's ability will increase the firm's mean payoff. A manager of higher ability benefits the firm equally in solvency or in bankruptcy, and thus is always beneficial to both creditors and shareholders.

Also important is the assumption that the manager's reservation wage is constant in her ability ($R(\alpha) = R$). This assumption circumvents the interaction of an underinvestment problem with the risk shifting problem. Underinvestment in this context could occur if equity holders do not reap the full benefit of a higher ability manager but bear the costs of evaluating her. Here I choose to focus on risk shifting as it is a cost that could increase with board strength.

These assumptions allow for the existence of an optimal contract between the manager and the firm. By disentangling first and second moment effects in managerial actions, we will see that there exists a parsimonious framework to balance benefits of higher ability managers and increased mean payoffs with the costs associated with strong boards from increased investment risk.

Timeline summary

Time 0:

- The board's prior on manager quality is distributed according to a normal distribution with mean and precision given by $\sim \mathcal{N}(\alpha_1, \frac{1}{\tau_1})$.
- The board's prior on the pool of available replacement managers also follows a normal distribution. $\mathcal{N}(\alpha_0, \frac{1}{\tau_0})$.
- All managers have an exogenous private benefit to solvency given by b , which is common knowledge.

- The information set at time 0, $\mathcal{H}_0 = \{\alpha_1, \tau_1, \alpha_0, \tau_0, b\}$ + distributional parameters of the signals on manager ability and project profitability.
- *Decision* : The board chooses its “strength”, g , given floating rate debt of face value F , issued at par.

Time 1: Signal on Manager Ability.

- The board receives a signal on the manager’s ability ($\hat{\alpha} = \alpha + \epsilon$ and $\epsilon \sim \mathcal{N}(0, \frac{1}{\tau_\epsilon})$) with probability g .
- *Decision* : The board decides whether to replace or retain the manager given. The information set at time 1, $\mathcal{H}_1 = \mathcal{H}_0 \cup \{\hat{\alpha}, g, F\}$.
- *Decision* : The board, acting in the interests of the shareholders, determines the components of the manager’s contract: an equity compensation component (e) to be realized later and a fixed wage paid immediately. The expected compensation of all managers is fixed at R .⁹
- The firm’s investment opportunities, which consist of two projects, $\Theta \in \{risky, safe\}$, is common knowledge. The probability of the high return in the risky project (ϕ) is stochastic and distributed uniformly on the unit interval, .
- The firm pays a coupon to debt claimants such that the market value of debt is priced at par; i.e. $F = coupon + E[Debt|\mathcal{H}_1]$.¹⁰

Time 2: Signal on Project Profitability.

- The probability of the high return (ϕ) is observed by the board and the manager, *but not by creditors*.
- Both managers and boards make their investment decisions given the information set at time 2, $\mathcal{H}_2 = \mathcal{H}_1 \cup \{\phi, e, w\}$
- In the case of disagreement, the board may overrule the manager and implement their preferred project with probability $\Lambda(g)$.

Time 3: Project realizations.

- The return to the firm, composed of two components $\tilde{x}(\alpha)$ and $\tilde{y}(\phi)$, is realized.
 - $\tilde{x}(\alpha) = \alpha$. The payoff is linear in the true ability of the manager.

⁹This assumption can be relaxed to make the compensation a function of the beliefs about managerial ability, $R(\alpha)$. The core insights behind the results hold under further restrictive assumptions on the private benefit to solvency, b .

¹⁰Note that \mathcal{H}_1 includes information on the current manager, who may either be the incumbent with updated beliefs on her ability or the replacement. The beliefs are common across all claimants.

- Final period payoffs are as follows:
 - Debt: $\min\{\tilde{x}(\alpha) + \tilde{y}(\phi), F\}$
 - Equity: $(1 - e) \times \max\{\tilde{x}(\alpha) + \tilde{y}(\phi) - F, 0\}$
 - Manager: $e \times \max\{\tilde{x}(\alpha) + \tilde{y}(\phi) - F, 0\}$

2.4 Results

The model is solved via backward induction. Since the moves are sequential, all decisions incorporate the available information at the time and account for other participants' best responses.

Definition 2.2. *A Bayesian-Nash equilibrium in the model satisfies the following conditions:*

- *The board, which is aligned with shareholders, maximizes the equity value of the firm subject to contractual constraints.*
- *Debt claimants write covenants to ensure that the coupon reflects the updated information on managerial ability.¹¹*
- *The manager maximizes the value of her compensation contract plus her private benefits when choosing an investment project.*
- *The manager, the board and debt claimants update their beliefs based on Bayes' Rule.*
- *The shareholders choose board strength to maximize expected firm value such that the manager's participation constraint is satisfied.*

Investment Decision

After observing the probability of high return for the risky project (ϕ), the manager chooses between the safe and risky project ($\Theta \in \{risky, safe\}$) to maximize the following objective function.

$$\max_{\Theta} M(\tilde{y}|\mathcal{H}_2) = \underbrace{E[e(\tilde{y} + \tilde{x} - F)^+]}_{\text{Equity Compensation}} + \underbrace{b \mathbb{I}_{\text{Firm Solvent}}}_{\text{Private Benefit}}[\mathcal{H}_2] + \text{wage}, \quad (2.1)$$

where b is the manager's private benefit, received only when the firm stays solvent. The expected behavior of the manager is captured by her threshold ϕ_m (the marginal value of

¹¹Here I have assumed that the signal on manager's ability is verifiable by debt claimants. If it were not contractible, boards may replace manager's too aggressively as manager replacement increases the firm's risk. This exacerbates the agency cost of debt.

ϕ that makes the manager indifferent between the risky and the safe project); which solves the following condition when equality is obtained.

$$\phi_m : M(y_{risky}(\phi)|\mathcal{H}_2) \geq M(y_{safe}|\mathcal{H}_2). \quad (2.2)$$

Note that the manager's wage plays no role in her project choice and is paid ex-ante. Under risky debt, the manager's investment threshold is given by

$$\begin{aligned} \phi \times (e \times (y_h + E[\tilde{x}|\mathcal{H}_2] - F) + b) &+ (1 - \phi) \times E[e \times (\tilde{x} - F)^+ + b\mathbb{I}_{\tilde{x} \geq F}|\mathcal{H}_2] + wage \\ &\geq e \times (y_m + E[\tilde{x}|\mathcal{H}_2] - F) + b + wage \end{aligned}$$

where $\mathbb{I}_{\tilde{x} \geq F}$ is the indicator function denoting the realization of \tilde{x} is greater than F . Let us define the manager's threshold probability, ϕ_m , as the probability cutoff below which she invests in the safe project. Then, manager investment in the risky project requires

$$\phi \geq \phi_m = \frac{y_m + E[(\tilde{x} - F + \frac{b}{e})\mathbb{I}_{\tilde{x} \leq F}|\mathcal{H}_2]}{y_h + E[(\tilde{x} - F + \frac{b}{e})\mathbb{I}_{\tilde{x} \leq F}|\mathcal{H}_2]} \quad (2.3)$$

Note that the board has no private benefit to solvency. Thus

$$\phi_B = \frac{y_m + E[(\tilde{x} - F)\mathbb{I}_{\tilde{x} \leq F}|\mathcal{H}_2]}{y_h + E[(\tilde{x} - F)\mathbb{I}_{\tilde{x} \leq F}|\mathcal{H}_2]} \quad (2.4)$$

Since $E[(\tilde{x} - F)\mathbb{I}_{\tilde{x} \leq F}|\mathcal{H}_2] < 0$, $\phi_B < \phi^* = \frac{y_m}{y_h}$ which is the optimal investment threshold. The equity aligned board will want to invest ex-post in the risky project under more realizations of ϕ than optimal, as equity holders benefit from the increased risk. If the board observes a realization of $\phi \in [\phi_B, \phi_m]$, it may intervene ex-post in the project decision¹².

Contract Decision

Before observing the project signal ϕ , the board chooses managerial compensation to maximize the following objective function:

$$\begin{aligned} \max_{e, wage} & \underbrace{E[\max\{\tilde{y} + \tilde{x} - F, 0\}|\mathcal{H}_1]}_{\text{residual value to original shareholders}} - coupon \\ & - e \times E[\max\{\tilde{y} + \tilde{x} - F, 0\}|\mathcal{H}_1] - wage \end{aligned}$$

such that

$$coupon = F - E[\min\{\tilde{y} + \tilde{x}, F\}|\mathcal{H}_1] \quad (\text{Par Debt})$$

¹²The general perception is that the board simply rubber-stamps the investments brought to the table by management. Even so, it is understood that boards have the power to veto investment decisions. This can be mapped to a situation where boards pro-actively choose investment by having the board reject the safest projects in a menu submitted by management, thereby increasing the overall risk of the firm. For instance, boards could deem certain hedging positions that accompany investment projects as unnecessary.

$$R = e \mathbb{E}[(\tilde{y} + \tilde{x} - F)^+ | \mathcal{H}_1] + \text{wage} \quad (\text{Fixed Compensation})$$

Thus the board chooses e , to maximize $\mathbb{E}[\tilde{x} + \tilde{y} | \mathcal{H}_1] - R - F$ or

$$\underbrace{\mathbb{E}[\tilde{x}; g]}_{\text{Payoff to board monitoring}} + \underbrace{(1 - \Lambda(g))\mathbb{E}_{\phi_m}[\tilde{y}; g, e]}_{\text{Project choice of manager}} + \underbrace{\Lambda(g)\mathbb{E}_{\phi_B}[\tilde{y}; g]}_{\text{Project choice of the board}} - R. \quad (2.5)$$

where we have as before $\mathbb{E}_{\phi_i}[\tilde{y}] = \frac{1-\phi_i^2}{2} \times y_h + \phi_i \times y_m$. Here, we note that the only role of managerial compensation (e) is to modify the project choice of the manager.¹³

Lemma 2.1. *The board chooses the equity share of the manager's compensation to be $e^* = -\frac{\mathbb{E}[b\mathbb{1}_{\tilde{x}<F} | \mathcal{H}_1]}{\mathbb{E}[(\tilde{x}-F)\mathbb{1}_{\tilde{x}<F} | \mathcal{H}_1]}$. At this share of equity compensation, the manager's threshold choice is optimal ex-post for the total firm, $\phi_m = \phi^*$, and the manager does not engage in risk shifting.*

Proof. of Lemma 2.1

The proof follows from the equivalence of the three statements:

1. Equation 2.3 implies that $\phi_m = \phi^*$ if $e = e^*$.
2. $\mathbb{E}_{\phi_i}[\tilde{y}]$ is maximized at $\phi_i = \phi^*$.
3. Ex-ante firm value (equation 2.5) is directly proportional to $\mathbb{E}_{\phi_i}[\tilde{y}]$.

Thus $e = e^*$ maximizes the ex-ante firm value. □

It is worth noting that the result is independent of board strength, g . At the project decision stage, board strength is predetermined. When the manager is compensated optimally, she will not benefit from inducing risk-shifting as any increase in the value of her equity compensation is offset by the corresponding decrease in her expected private benefit to solvency. It can be shown that the ex-ante firm value depends on e only via its dependence on ϕ_m (equation 2.5). Because the manager's contract allows the board to credibly commit against risk shifting in the outcomes where the manager's investment decision is not overruled, the board will induce the manager to act optimally.

Board Leniency

Proposition 2.1. *The manager is replaced if the signal on her ability is less than a critical threshold, $\hat{\alpha} < \alpha_c$: where α_c is the value of $\hat{\alpha}$ that solves the following condition*

$$\mathbb{E}[\tilde{x}; \alpha_0, \tau_0] + \Lambda(g)E_{\phi_B}[\tilde{y}; \alpha_0, \tau_0] = \mathbb{E}[\tilde{x}; \alpha_2(\hat{\alpha}), \tau_2] + \Lambda(g)E_{\phi_B}[\tilde{y}; \alpha_2(\hat{\alpha}), \tau_2]$$

¹³This is essentially a consequence of fixed compensation assumption. If the manager's private benefits are internalized by shareholders, then we no longer have an unique optimal contract. The board then trades off the cost of managerial compensation with the agency cost to debt. The final contract may make the manager's compensation less sensitive to performance inducing her to choose a sub optimally low level of risk as a concession to debt holders. I avoid this richer interplay of costs to focus on the board's role in risk shifting.

1. $\forall g, \alpha_c(g, F = 0) \geq \alpha_c(g, F \geq 0)$.
2. $\forall F \in (0, y_m], \frac{\partial \alpha_c}{\partial g} \leq 0$. The board is more lenient in managerial replacement with increasing board strength.

Proof. of Proposition 2.1

The proof of the first part of the proposition is as follows.

1. Define α_c^{mean} as the value of $\hat{\alpha}$ which solves $E[\tilde{x}; \alpha_0, \tau_0] = E[\tilde{x}; \alpha_2(\hat{\alpha} = \alpha_c^{mean}), \tau_2]$. Note that when $F = 0$, $E_{\phi_B}[\tilde{y}; \alpha, \tau, F = 0] = E_{\phi^*}[\tilde{y}]$, which is not a function of the manager's perceived ability. Thus $\alpha_c(F = 0) = \alpha_c^{mean}$, as the manager's ability plays no role in the investment decision of the board.
 - We may solve for α^{mean} as $\alpha_2(\alpha^{mean}) = \frac{\tau_\epsilon \alpha^{mean} + \tau_1 \alpha_1}{\tau_1 + \tau_\epsilon} = \alpha_0 \Rightarrow \alpha^{mean} = \alpha_0 - (\alpha_1 - \alpha_0) \frac{\tau_1}{\tau_\epsilon}$.
2. Differentiating equation 2.4 with respect to α_2 , we see that $\frac{\partial E_{\phi_B}[\tilde{y}; \alpha_2, \tau_2]}{\partial \alpha_2} \propto \frac{\partial E[(\tilde{x} - F)\mathbb{1}_{x \leq F}; \alpha_2, \tau_2]}{\partial \alpha_2}$. The board's investment threshold is increasing in a short position of a put option in $\tilde{x}(\alpha)$ with strike F . Define α_c^{put} as the value of $\hat{\alpha}$ which solves

$$E[(\tilde{x} - F)\mathbb{1}_{x \leq F}; \alpha_0, \tau_0] = E[(\tilde{x} - F)\mathbb{1}_{x \leq F}; \alpha_2(\hat{\alpha} = \alpha_c^{put}), \tau_2]$$

- Using the distributions for truncated normals, the above can be expressed as

$$(\alpha_0 - F)\Phi((F - \alpha_0)\sqrt{\tau_0}) - \frac{\phi((F - \alpha_0)\sqrt{\tau_0})}{\sqrt{\tau_0}} = (\alpha_2 - F)\Phi((F - \alpha_2)\sqrt{\tau_2}) - \frac{\phi((F - \alpha_2)\sqrt{\tau_2})}{\sqrt{\tau_2}}$$

where Φ is the CDF of the standard normal distribution and ϕ is the PDF of the standard normal distribution.

3. Note that α_c is a combination of α_c^{mean} and α_c^{put} . Since $\alpha_c(F = 0) = \alpha_c^{mean}$, it is sufficient to show that $\alpha_c^{put} \leq \alpha_c^{mean}$.
4. Equivalently, manager replacement occurs in an unlevered firm if $E[\tilde{x}; \alpha_0, \tau_0] > E[\tilde{x}; \alpha_2, \tau_2] \Rightarrow \alpha_2 \leq \alpha_0$. Thus $\alpha_c^{put} \leq \alpha_c^{mean}$ if $E[(\tilde{x} - F)\mathbb{1}_{x \leq F}; \alpha_0, \tau_0] > E[(\tilde{x} - F)\mathbb{1}_{x \leq F}; \alpha_2, \tau_2] \Rightarrow \alpha_2 \leq \alpha_0 - constant$, where $constant$ is a positive number.
5. Suppose $\hat{\alpha} = \alpha^{mean}$. Then $\alpha_2 = \alpha_0$ and $constant \geq 0$ implies $\alpha_c^{put} \leq \alpha_c^{mean}$. Thus, we need to show

$$\begin{aligned} & E[(\tilde{x} - F)\mathbb{1}_{x \leq F}; \alpha_2 = \alpha_0, \tau_2] \geq E[(\tilde{x} - F)\mathbb{1}_{x \leq F}; \alpha_0, \tau_0] \\ \Rightarrow & (F - \alpha_0) \left[1 - \frac{\Phi((F - \alpha_0)\sqrt{\tau_0})}{\Phi((F - \alpha_0)\sqrt{\tau_2})} \right] + \frac{1}{\sqrt{\tau_2}} - \frac{1}{\sqrt{\tau_0}} \left[\frac{\phi((F - \alpha_0)\sqrt{\tau_0})}{\phi((F - \alpha_0)\sqrt{\tau_2})} \right] \leq 0 \end{aligned}$$

6. The above equation is less than zero for all $F > \alpha_0$ and for all $\tau_2 > \tau_0$. This completes the proof of the first part of the proposition.

The second part of the proposition, $\frac{\partial \alpha_c}{\partial g} \leq 0$, follows from the fact that $\Lambda(g)$ is increasing in g . As $\Lambda(g)$ increases, so does the relative importance of the board's project choice, $E_{\phi_B}[\tilde{y}; g]$, versus the better match between manager and firm, $E[\tilde{x}]$, in equation 2.5. This increases the relative weight of α^{put} to α^{mean} . Invoking the first part of the proposition, $\forall F > 0$, increasing g reduces α_c . □

The intuition behind the proposition follows from the insight that replacing the manager with a draw from the labor pool is inherently risky as less is known about the replacement. The board, maximizing shareholder's *ex-ante* value, trades-off the gain from the higher

expected ability of the replacement manager with a safer, though lower, expected return of the incumbent manager. This retention ex-ante of a below average manager makes the final payoffs safer and increases the value to debt holders. This in turn ameliorates the agency cost to debt and increases the ex-ante firm value. For non zero levels of debt, the threshold for retention of the incumbent is lower as the board internalizes the cost of replacing the manager to debt holders. As board strength increases, the board's preference for the safer incumbent manager also increases as a concession to debt holders for the increased possibility of risk shifting ex-post. Thus, the board's replacement policy is based not only on the manager's perceived ability to increase firm returns but also incorporates the benefit to the firm's debt from decreased risk if the ability of its manager is well known.

Note that the impact of leverage on leniency need not be monotonic. As the level of debt grows large compared to the manager's ability, the increased risk from replacement makes little difference to the probability of default and the critical default threshold is mainly driven by the signal on the manager's mean ability. Thus there can exist an interior solution to a minimum face value of debt where the leniency of the board is the greatest.

Optimal board strength with exogenous debt

The firm's choice of board strength (g^*) solves the following objective function given the information set at time 0, \mathcal{H}_0 .

$$\begin{aligned} \underset{g}{\operatorname{argmax}} \quad & \underbrace{\mathbb{E}[\tilde{x}; \alpha_1, \tau_1] + \mathbb{E}_{\phi^*}[\tilde{y}]}_{\text{Value with no governance}} + \underbrace{g \times \Delta_{\tilde{x}}(g)}_{\text{Increased firm value from governance}} \\ & - \underbrace{\Lambda(g) \times \Delta_{\tilde{y}}(g)}_{\text{Governance induced distortion}} \end{aligned} \quad (2.6)$$

where

$$\begin{aligned} \Delta_{\tilde{x}}(g) &= \int_{-\infty}^{\alpha_c(g,F)} \mathbb{E}[\tilde{x}; \alpha_0, \tau_0] f_{\hat{\alpha}} d\hat{\alpha} + \int_{\alpha_c(g,F)}^{\infty} \mathbb{E}[\tilde{x}; \alpha_2, \tau_2] f_{\hat{\alpha}} d\hat{\alpha} - \mathbb{E}[\tilde{x}; \alpha_1, \tau_1] \\ \Delta_{\tilde{y}}(g) &= \mathbb{E}_{\phi^*}[\tilde{y}] \\ &\quad - g \times \left(\int_{-\infty}^{\alpha_c(g,F)} E_{\phi_B}[\tilde{y}; \alpha_0, \tau_0] f_{\hat{\alpha}} d\hat{\alpha} + \int_{\alpha_c(g,F)}^{\infty} E_{\phi_B}[\tilde{y}; \alpha_2, \tau_2] f_{\hat{\alpha}} d\hat{\alpha} \right) \\ &\quad - (1-g) \times E_{\phi_B}[\tilde{y}; \alpha_1, \tau_1] \end{aligned}$$

The maximization takes the expectation over the possible realizations of the signal $\hat{\alpha}$ assuming that the manager is optimally compensated, $\phi_m = \phi^*$. $\Delta_{\tilde{x}}(g)$ is the differential value of the firm with and without governance and it takes into account the option value of replacing the manager. $\Delta_{\tilde{y}}(g)$ is the expected distortion induced from risk shifting by the board over all realizations of the signal. Any non zero level of debt and board strength induces an expected distortion. ($\Delta_{\tilde{y}}(g) > 0$ if $F > 0$.)

Proposition 2.2. *The optimal level of monitoring g^* is the value that maximizes equation 2.6. $\exists \tau^*$, a threshold level of precision, such that if $\tau_1 \geq \tau^*$, then the optimal level of monitoring is weakly decreasing in the value of debt;*

$$\frac{\partial g^*}{\partial F} \leq 0$$

Proof. of Proposition 2.2

The proof of the proposition is presented as follows:

1. First, we stipulate sufficient conditions on the objective function's concavity that permit an interior solution. An interior solution helps establish the decreasing value of g^* with F . This is only weakly true in a corner solution.
2. Once we have constrained the objective function, we determine the necessary second order conditions to make the solution unique.
3. Next, we invoke the implicit function theorem to sign comparative statics. This requires us to decompose the implicit value function into marginal benefits and marginal costs.
4. Finally we show that marginal benefits decrease and marginal costs increase with rising debt obligations, after a certain threshold value of τ_1 .

Step 1: First, we consider the conditions required for the optimal board strength to be an interior solution. Convex costs are already established via assumption 2.1. We may specify a few simple boundary conditions consistent with assumption 2.1 for an interior solution.

$$\Lambda(0) = 0, \Lambda(1) = 1, \Lambda'(0) = 0, \Lambda'(1) > 0 \text{ and } \Lambda''(g) > 0$$

The first order derivative of the firm value function (equation 2.6) is as follows

$$\begin{aligned} \frac{\partial FirmValue}{\partial g} &= \Delta_{\tilde{x}}(g) + \left(g \times \frac{\partial \Delta_{\tilde{x}}(g)}{\partial g} \right) - \left(\frac{\partial \Lambda(g)}{\partial g} \times \Delta_{\tilde{y}}(g) \right) - \left(\Lambda(g) \times \frac{\partial \Delta_{\tilde{y}}(g)}{\partial g} \right) \\ &= \Delta_{\tilde{x}}(g) + \Lambda(g)\Gamma(g) - \frac{\partial \Lambda(g)}{\partial g} \Delta_{\tilde{y}}(g) \end{aligned} \quad (2.7)$$

The second line follows from the first by the invocation of proposition 2.1, i.e. $E[\tilde{x}; \alpha_0, \tau_0] + \Lambda(g)E_{\phi_B}[\tilde{y}; \alpha_0, \tau_0] = E[\tilde{x}; \alpha_2(\hat{\alpha} = \alpha_c), \tau_2] + \Lambda(g)E_{\phi_B}[\tilde{y}; \alpha_2(\hat{\alpha} = \alpha_c), \tau_2]$. The first and second terms are the marginal benefit to governance from the option value of managerial replacement. The third term, the marginal cost of board intervention, is the distortion induced in the firm's project choice.

For an interior solution, the above derivative, which also denotes the marginal firm value, needs to be positive at $g = 0$ and negative at $g = 1$. The first condition is satisfied because receiving a signal on managerial quality, even at a level of zero governance, is valuable as there is an option value to replacing the manager.

$$\Delta_{\tilde{x}}(0) > 0$$

The second condition requires that the value of the firm after the signal is revealed and the manager replacement decision is made is smaller than the distortion induced by the risk shifting. This returns the following sufficient condition.

$$\Delta_{\tilde{x}}(1) + \Lambda(1)\Gamma(1) < \Lambda'(1)\Delta_{\tilde{y}}(1)$$

where $\Gamma(g) = \left(\int_{-\infty}^{\alpha_c} E_{\phi_B}[\tilde{y}; \alpha_0, \tau_0] f_{\hat{\alpha}} d\hat{\alpha} + \int_{\alpha_c}^{\infty} E_{\phi_B}[\tilde{y}; \alpha_2, \tau_2] f_{\hat{\alpha}} d\hat{\alpha} \right) - E_{\phi_B}[\tilde{y}; \alpha_1, \tau_1]$.

Step 2: For this interior solution to be unique, we may place the appropriate restrictions on the second order derivative of firm value, given below, to ensure that it is negative $\forall g \in [0, 1]$.

$$\begin{aligned} \frac{\partial^2 FirmValue}{\partial g^2} &= \frac{\partial}{\partial g} \left(\Delta_{\tilde{x}}(g) + \Lambda(g)\Gamma(g) - \frac{\partial\Lambda(g)}{\partial g}\Delta_{\tilde{y}}(g) \right) \\ &= \frac{\partial\Lambda(g)}{\partial g} \left(g\frac{\partial\Gamma(g)}{\partial g} + 2\Gamma(g) \right) - \Delta_{\tilde{y}}(g)\frac{\partial^2\Lambda(g)}{\partial g^2} \end{aligned}$$

In the above I have used, $\frac{\partial\Delta_{\tilde{x}}(g)}{\partial g} + \Lambda(g)\frac{\partial\Gamma(g)}{\partial g} = 0$ (Leibniz conditions at the critical value as dependence on g only enters through the limit of the integrals) and $\frac{\partial\Delta_{\tilde{y}}(g)}{\partial g} = -\Gamma - g\frac{\partial\Gamma(g)}{\partial g}$. Its also worth noting that $\frac{\partial\Delta_{\tilde{x}}(g)}{\partial g} = \frac{\partial\alpha_c}{\partial g} \times f_{\hat{\alpha}=\alpha_c} \times (E[\tilde{x}; \alpha_0, \tau_0] - E[\tilde{x}; \hat{\alpha} = \alpha_c, \tau_2])$ is weakly less than zero and $\frac{\partial\Gamma(g)}{\partial g} = \frac{\partial\alpha_c}{\partial g} \times f_{\hat{\alpha}=\alpha_c} \times (E_{\phi_B}[\tilde{y}; \alpha_0, \tau_0] - E_{\phi_B}[\tilde{y}; \hat{\alpha} = \alpha_c, \tau_2])$ is weakly larger than zero, where $f_{\hat{\alpha}} = \frac{e^{-\frac{(\hat{\alpha}-\alpha_1)^2}{2\sigma^2}}}{\sqrt{2\pi}\sigma}$ is the PDF of the signal and $f_{\hat{\alpha}=\alpha_c}$ is the PDF evaluated at α_c . Requiring the above second order condition to be negative for all values of g returns the following necessary conditions.

$$\Gamma(1) < 0, \text{ and } 2|\Gamma(g)| > g\frac{\partial\Gamma(g)}{\partial g}$$

$\Gamma(g, F)$ is the differential value of the board's investment decision under the prior and the posterior after receiving the signal on managerial quality. In general, this value is likely to be negative. We see that the board's project choice is proportional to being short a put option (from proof of proposition 2.1), and the increased volatility from replacing increases the differential. The first condition states that this differential persists even at high levels of governance. The second condition requires that twice the level of the differential is larger at all levels of governance than the marginal decrease in the differential with increasing g . This is essentially a limiting condition on the concavity of Γ in g . Since most of the functions used are bounded and concave in g , this condition is likely to also be satisfied.

Step 3: Having established the conditions for an unique interior solution, I continue the rest of the proof by signing the comparative statics and using the implicit function theorem to weight the marginal costs and benefits.

At the optimum g^* , the second order condition is negative. Applying the implicit function theorem to the equation (2.6), $Sign\left(\frac{\partial FirmValue}{\partial F \partial g}\right) \Leftrightarrow Sign\left(\frac{\partial g^*}{\partial F}\right)$.

Since we have established conditions on interior optima, we may use the implicit function theorem to analyze the (well-behaved) features of the optimal board strength. Differentiating equation 2.7 with respect to the debt obligation F to returns

$$\frac{\partial FirmValue}{\partial F \partial g} = \frac{\partial\Delta_{\tilde{x}}(g)}{\partial F} + \Lambda(g)\frac{\partial\Gamma(g)}{\partial F} - \frac{\partial\Lambda(g)}{\partial g}\frac{\partial\Delta_{\tilde{y}}(g)}{\partial F}. \quad (2.8)$$

Now we consider the three terms in the equation 2.8 separately.

- First note that the first term can be expanded as follows.

$$\frac{\partial\Delta_{\tilde{x}}(g)}{\partial F} = \frac{\partial\alpha_c}{\partial F} \times f_{\hat{\alpha}=\alpha_c} \times (E[\tilde{x}; \alpha_0, \tau_0] - E[\tilde{x}; \hat{\alpha} = \alpha_c, \tau_2]) \leq 0$$

The first term is weakly negative because

- At the replacement threshold α_c , the expected value of the replacement manager is weakly higher (as the board is lenient at manager replacement as a concession to bondholders.) Furthermore, this leniency is increasing (weakly) in the level of debt, since it increases the weight of the distortion from asset substitution. Thus $E[\tilde{x}; \alpha_0, \tau_0] - E[\tilde{x}; \hat{\alpha} = \alpha_c, \tau_2]) \geq 0$.

- Next, note that from proposition 2.1, $\frac{\partial \alpha_c}{\partial F} \leq 0$.
- Finally, $f_{\hat{\alpha}=\alpha_c} > 0$
- Next, we consider the third term of equation 2.8. The key derivative is the rate of change of $\Delta_{\tilde{y}}(g)$ with debt, which is always positive and is given by

$$\frac{\partial}{\partial F}(-gE_{\phi_B}[\tilde{y}; prior] - (1-g)E_{\phi_B}[\tilde{y}; \alpha_1, \tau_1]) > 0$$

where we note both $E_{\phi_B}[\tilde{y}; \alpha_1, \tau_1]$ and $E_{\phi_B}[\tilde{y}; prior]$ are decreasing in F . Since $\frac{\partial \Lambda(g)}{\partial g} \geq 0$,

$$-\frac{\partial \Lambda(g)}{\partial g} \frac{\partial \Delta_{\tilde{y}}(g)}{\partial F} \leq 0$$

- Finally, we consider the second term of equation 2.8, which is the governance induced distortion from asset substitution in a firm that receives no signal on the incumbent. The key part of this second term, $\frac{\partial \Gamma}{\partial F}$, may be further split into two more and is given by

$$\frac{\partial \alpha_c}{\partial F} \times f_{\hat{\alpha}=\alpha_c} \times (E_{\phi_B}[\tilde{y}; \alpha_0, \tau_0] - E_{\phi_B}[\tilde{y}; \hat{\alpha} = \alpha_c, \tau_2]) + \frac{\partial}{\partial F}(E_{\phi_B}[\tilde{y}; prior] - E_{\phi_B}[\tilde{y}; \alpha_1, \tau_1])$$

where

$$\frac{\partial E_{\phi_B}[\tilde{y}; prior]}{\partial F} = \left(\int_{-\infty}^{\alpha_c} \frac{\partial E_{\phi_B}[\tilde{y}; \alpha_0, \tau_0]}{\partial F} f_{\hat{\alpha}} d\hat{\alpha} + \int_{\alpha_c}^{\infty} \frac{\partial E_{\phi_B}[\tilde{y}; \alpha_2, \tau_2]}{\partial F} f_{\hat{\alpha}} d\hat{\alpha} \right).$$

From our analysis of the first term of equation 2.8, we have already shown that

$$\frac{\partial \alpha_c}{\partial F} \times f_{\hat{\alpha}=\alpha_c} \times (E_{\phi_B}[\tilde{y}; \alpha_0, \tau_0] - E_{\phi_B}[\tilde{y}; \hat{\alpha} = \alpha_c, \tau_2]) \leq 0.$$

It remains to show that

$$\frac{\partial}{\partial F}(E_{\phi_B}[\tilde{y}; prior] - E_{\phi_B}[\tilde{y}; \alpha_1, \tau_1]) \leq 0.$$

We tackle that in the final step.

Step 4: I now claim that $\exists \hat{\tau}$ such that for a managerial prior precision τ_1 above this threshold, the optimal board strength (g^*) is decreasing in debt. It is sufficient to show that equation (2.8) is asymptotically negative as $\tau_1 \rightarrow \infty$.¹⁴

Note that $\frac{\partial E_{\phi_B}[\tilde{y}]}{\partial F}$ is negative, since increasing F decreases ϕ_B and causes further distortion from the optimal ϕ^* . Again, this is because we are essentially short a put option whose value decreases with increasing strike; here the default barrier F . However as precision increases, the incremental decrease from increasing F for $E_{\phi_B}[\tilde{y}; \alpha_1, \tau_1]$ is smaller than that for $E_{\phi_B}[\tilde{y}; prior]$. To show this,

First, note that

$$\frac{\partial E_{\phi_B}[\tilde{y}]}{\partial F} = \frac{\partial E_{\phi_B}[\tilde{y}]}{\partial \phi_B} \frac{\partial \phi_B}{\partial E[(\tilde{x} - F)\mathbb{I}_{\tilde{x} \leq F}]} \frac{\partial E[(\tilde{x} - F)\mathbb{I}_{\tilde{x} \leq F}]}{\partial F} \leq 0$$

¹⁴As an aside, term 1 and term 3 of equation 2.8 also tend to zero. Term 1 tends to zero as $f_{\hat{\alpha}=\alpha_c} \rightarrow 0$ and the other components of term 1 stay finite. Term 3 is proportional to

$$\frac{\partial}{\partial F} \left(\int_{-\infty}^{\alpha_c} E_{\phi_B}[\tilde{y}; \alpha_0, \tau_0] - E_{\phi_B}[\tilde{y}; \alpha_1, \tau_1] f_{\hat{\alpha}} d\hat{\alpha} + \int_{\alpha_c}^{\infty} E_{\phi_B}[\tilde{y}; \alpha_2, \tau_2] - E_{\phi_B}[\tilde{y}; \alpha_1, \tau_1] f_{\hat{\alpha}} d\hat{\alpha} \right)$$

As $\tau_1 \rightarrow \infty$, $\alpha_c \rightarrow -\infty$ implies that the first integral vanishes as the limits converge. Furthermore, since $\alpha_2 \rightarrow \alpha_1$, the integrand of the second integral converges to zero. Thus the third term of 2.8 converges to zero as τ_1 asymptotes to infinity.

since $\frac{\partial \mathbb{E}_{\phi_B}[\tilde{y}]}{\partial \phi_B} > 0$ and $\frac{\partial \mathbb{E}[(\tilde{x}-F)\mathbb{I}_{\tilde{x}\leq F}]}{\partial F} \leq 0$.

As τ_1 asymptotes, for a high value of precision, $[\mathbb{I}_{\tilde{x}\leq F}|\alpha_1, \tau_1] \approx 1$, given $F > \alpha_1$. Thus,

$$\frac{\partial \mathbb{E}[(\tilde{x}-F)\mathbb{I}_{\tilde{x}\leq F}|\alpha_1, \tau_1]}{\partial F} \approx \frac{\partial \mathbb{E}[(\tilde{x}-F)|\alpha_1, \tau_1]}{\partial F} = -1.$$

However, $\frac{\partial \mathbb{E}[(\tilde{x}-F)\mathbb{I}_{\tilde{x}\leq F}|\alpha_0, \tau_0]}{\partial F} \approx -1 + (\text{a negative term})$. Thus, asymptotically we have

$$\frac{\partial \mathbb{E}[(\tilde{x}-F)\mathbb{I}_{\tilde{x}\leq F}|\alpha_1, \tau_1]}{\partial F} \geq \frac{\partial \mathbb{E}[(\tilde{x}-F)\mathbb{I}_{\tilde{x}\leq F}|\alpha_0, \tau_0]}{\partial F}.$$

Furthermore, as τ_1 asymptotes, $\tau_2 > \tau_1$ and $\alpha_2 \rightarrow \alpha_1$. Thus we have

$$\frac{\partial \mathbb{E}[(\tilde{x}-F)\mathbb{I}_{\tilde{x}\leq F}|\alpha_1, \tau_1]}{\partial F} \approx \frac{\partial \mathbb{E}[(\tilde{x}-F)\mathbb{I}_{\tilde{x}\leq F}|\alpha_2, \tau_2]}{\partial F} \approx -1$$

since $[\mathbb{I}_{\tilde{x}\leq F}|\alpha_2, \tau_2] \approx [\mathbb{I}_{\tilde{x}\leq F}|\alpha_2, \tau_2] \approx 1$.

Combined with the fact that $\alpha_2 \rightarrow \alpha_1 \Rightarrow \frac{\partial \mathbb{E}_{\phi_B}[\tilde{y}|\alpha_1, \tau_1]}{\partial \phi_B} \rightarrow \frac{\partial \mathbb{E}_{\phi_B}[\tilde{y}|\alpha_2, \tau_2]}{\partial \phi_B}$, note that

$$\frac{\partial}{\partial F}(\mathbb{E}_{\phi_B}[\tilde{y}; \alpha_1, \tau_1]) \rightarrow \frac{\partial}{\partial F}(\mathbb{E}_{\phi_B}[\tilde{y}; \alpha_2, \tau_2]).$$

Using Jensen's inequality and the concavity of $\frac{\partial \mathbb{E}_{\phi_B}[\tilde{y}|\alpha]}{\partial F}$ in α ,

$$\begin{aligned} \frac{\partial}{\partial F}(\mathbb{E}_{\phi_B}[\tilde{y}; \text{prior}]) &= \left(\int_{-\infty}^{\alpha_c} \frac{\partial \mathbb{E}_{\phi_B}[\tilde{y}; \alpha_0, \tau_0]}{\partial F} f_{\hat{\alpha}} d\hat{\alpha} + \int_{\alpha_c}^{\infty} \frac{\partial \mathbb{E}_{\phi_B}[\tilde{y}; \alpha_2, \tau_2]}{\partial F} f_{\hat{\alpha}} d\hat{\alpha} \right) \\ &\approx \text{weighted average of term smaller than } \left(\frac{\partial \mathbb{E}_{\phi_B}[\tilde{y}; \alpha_1, \tau_1]}{\partial F} \right) \text{ and } \left(\frac{\partial \mathbb{E}_{\phi_B}[\tilde{y}; \alpha_1, \tau_1]}{\partial F} \right). \end{aligned}$$

Thus

$$\frac{\partial}{\partial F}(\mathbb{E}_{\phi_B}[\tilde{y}; \text{prior}] - \mathbb{E}_{\phi_B}[\tilde{y}; \alpha_1, \tau_1]) \leq 0$$

and the sign of equation 2.8 is asymptotically negative. This is sufficient to establish the proposition. \square

Discussion: At any given period, the board balances the benefit of monitoring with the increase in agency costs of debt. However, as the precision of the prior on the manager (τ_1) increases, more is known about the incumbent manager and thus the less the benefit of evaluating her. The value of the option to fire the manager is decreasing in the precision and thus her tenure (Hermalin and Weisbach 1998). However, the marginal cost to the firm from debt issuance is largely unaffected by managerial tenure. Thus as tenure increases, a proportional rise in the firm's debt leads to a larger decrease in the firm's governance intensity. Thus the firm's debt obligations exert a stronger force for weaker boards as managerial tenure increases.

Managerial Discretion over Leverage

In this section, I consider an extension to the model where the incumbent manager chooses the default level of the firm F to maximize her ex-ante objective function after the firm's

governance decision is made; i.e. she takes the governance, g , as given. Here I analyze only the manager's incentives to issue debt. The manager's trade-off is between the increased probability of being retained as the board becomes more lenient when the firm is levered and the increased risk of bankruptcy and thus lower private benefit to solvency upon retention. The manager's objective functions is as follows.

$$\begin{aligned} \max_F \quad & \mathbb{E} [\{e (\tilde{y}(q) + \tilde{x}(\alpha) - F)^+ + b \mathbb{I}_{\text{Firm Solvent}} + w\} \mathbb{I}_{\text{Manager Retained}} | \mathcal{H}'_0] \\ = \quad & \mathbb{E} [\{R + b \mathbb{I}_{\text{Firm Solvent}}\} \mathbb{I}_{\text{Manager Retained}} | \mathcal{H}'_0] \end{aligned} \quad (2.9)$$

where

$$\mathbb{E}[\mathbb{I}_{\text{Manager Retained}} | \mathcal{H}'_0] = (1 - g) + g\mathbb{E}[\alpha_c(F) \leq \hat{\alpha} | \mathcal{H}'_0]$$

and $\mathcal{H}'_0 = \mathcal{H}_0 - \{F\}$.

Proposition 2.3. *Define F^* as the value of F that maximizes the manager's objective function given governance, g , fixed. Then F^* is weakly decreasing in $\|\alpha_1 - \alpha_0\|$ and b and weakly increasing in $\|\tau_1 - \tau_0\|$ and R .*

Proof. From equation 2.9 we see that

$$\begin{aligned} F^* \in \quad & \operatorname{argmax}_F \quad R \times \mathbb{E}[\mathbb{I}_{\text{Manager Retained}} | \mathcal{H}'_0] \\ & + b \times \mathbb{E}[\mathbb{I}_{\text{Firm Solvent}} \mathbb{I}_{\text{Manager Retained}} | \mathcal{H}'_0] \\ \frac{\partial \text{Manager Objective}}{\partial F} \Big|_{F=F^*} \quad & = 0 \end{aligned}$$

Next, consider the marginal value to the manager of debt. Taking the derivative of equation 2.9 with respect to debt returns

$$\begin{aligned} \frac{\partial \text{Manager Objective}}{\partial F} \quad & = (R + b\mathbb{E}[\mathbb{I}_{\text{Firm Solvent}} | \text{Manager Retained}, \mathcal{H}'_0]) \times \frac{\partial \mathbb{E}[\mathbb{I}_{\text{Manager Retained}} | \mathcal{H}'_0]}{\partial F} \\ & + b \times \mathbb{E}[\mathbb{I}_{\text{Manager Retained}} | \mathcal{H}'_0] \times \frac{\partial \mathbb{E}[\mathbb{I}_{\text{Firm Solvent}} | \text{Manager Retained}, \mathcal{H}'_0]}{\partial F} \end{aligned}$$

It will be shown that the first term in the objective function is the marginal benefit to debt to the manager and the second term is a marginal cost. First, consider the marginal benefit term. The manager is retained if not evaluated (with probability $1 - g$) or if evaluated with probability g , retained if the value of the signal is greater than the critical value ($\alpha_c(F) \leq \hat{\alpha}$). Thus,

$$\begin{aligned} \frac{\partial}{\partial F} \mathbb{E}[\mathbb{I}_{\text{Manager Retained}} | \mathcal{H}'_0] \quad & = \frac{\partial}{\partial F} ((1 - g) + g\mathbb{E}[\alpha_c(F) \leq \hat{\alpha} | \mathcal{H}'_0]) \\ & = g \frac{\partial}{\partial F} \mathbb{E}[\alpha_c(F) \leq \hat{\alpha} | \mathcal{H}'_0] \\ & = g \frac{\partial}{\partial F} [1 - \Phi((\alpha_c - \alpha_1)\sqrt{\tau_1})] \\ & = -g\phi((\alpha_c - \alpha_1)\sqrt{\tau_1})\sqrt{\tau_1} \frac{\partial \alpha_c}{\partial F} \end{aligned}$$

From proposition 2.1, we see that $\frac{\partial \alpha_c}{\partial F} \leq 0$. This implies that the above term is (weakly) positive. From the discussion surrounding proposition 2.1, we note that the term is more positive as the role of α^{put} increases. The magnitude of the choice based on α^{put} is decreasing in $\|\alpha_1 - \alpha_0\|$ and increasing in $\|\tau_1 - \tau_0\|$.

Next consider the marginal cost term.

$$\begin{aligned} \frac{\partial \mathbb{E} [\mathbb{I}_{\text{Firm Solvent}} | \text{Manager Retained}, \mathcal{H}'_0]}{\partial F} &= \frac{\partial}{\partial F} \left[g\Lambda(g) \times \left(1 - \frac{(1 - \phi_B(\hat{\alpha}_2))^2}{2} \mathbb{E}[\alpha_2(F) \leq \hat{\alpha} | \mathcal{H}'_0] \right) \right] \\ &\quad + \frac{\partial}{\partial F} \left[(1-g)\Lambda(g) \times \left(1 - \frac{(1 - \phi_B(\hat{\alpha}_1))^2}{2} \mathbb{E}[\alpha_1(F) \leq \hat{\alpha} | \mathcal{H}'_0] \right) \right] \end{aligned}$$

Here we sign two important terms in the above equation.

$$\begin{aligned} \frac{\partial}{\partial F} \mathbb{E}[\alpha_2(F) \leq \hat{\alpha} | \mathcal{H}'_0] &= \frac{\partial \Phi((F - \alpha_2)\sqrt{\tau_2})}{\partial F} \\ &= \phi((F - \alpha_2)\sqrt{\tau_2}) \left(1 - \frac{\partial \alpha_2}{\partial F} \right) \sqrt{\tau_2} \\ &\geq 0 \end{aligned}$$

where in the above we have used the results of proposition 2.1 to claim $\frac{\partial \alpha_2}{\partial F} \leq 0$. The next term to sign is

$$\begin{aligned} \frac{\partial}{\partial F} (1 - \phi_B(\alpha_2))^2 &= 2(1 - \phi_B(\alpha_2)) \frac{\partial \phi_B(\alpha_2)}{\partial F} \\ &\propto - \frac{\partial}{\partial F} \frac{y_m + \mathbb{E}[(\tilde{x} - F)\mathbb{I}_{\tilde{x} \leq F}]}{y_h + \mathbb{E}[(\tilde{x} - F)\mathbb{I}_{\tilde{x} \leq F}]} \\ &\geq 0 \end{aligned}$$

Combining these two terms, it can be shown that

$$\frac{\partial \mathbb{E} [\mathbb{I}_{\text{Firm Solvent}} | \text{Manager Retained}, \mathcal{H}'_0]}{\partial F} \leq 0.$$

The rest of the proposition follows from noting that the marginal costs are increasing in b and the marginal benefits are increasing in R , $\|\tau_1 - \tau_0\|$ and decreasing in $\|\alpha_1 - \alpha_0\|$. \square

Discussion: Here we note that the manager has an incentive to maximize her probability of being retained. If she takes the board's governance decision as given, then she has a motive to issue debt such that if monitored (with probability g), the critical replacement threshold signal (α_c) is as low as possible. Using the insights of prop 2.1 we can show that there exists a non-zero face value of debt F which minimizes α_c .

However, the manager only has a motive to issue debt in a narrow regime where she is only slightly better than her replacement but more is known about her ability than her replacement's. Outside this region, the replacement threshold is too large or too small to be changed enough by the issuance of debt. Thus under this extension, there is a positive correlation between mediocre managers and leverage when the manager's tenure has been long. This suggests that a long serving incumbent manager with a string of poor performances has an incentive to issue more debt.

Furthermore, the larger the managers compensation, R , the larger her incentive to issue debt. As might be expected, the manager's private benefit to solvency, b , works to diminish her desire to issue debt.

An equilibrium model of debt and governance

Though the analysis thus far has relied on the assumption of exogenous debt, in reality debt and board strength are likely determined simultaneously. The choice of the firm's leverage is often the purview of the manager and we have seen that she has an additional incentive to issue debt since the probability that the manager is retained is a decreasing function of g . From proposition 2.2, board strength is ex-ante decreasing in leverage. However, firm value in this model is also a decreasing function of leverage. Thus there are benefits to being a first mover, for the board or the manager.

Proposition 2.4. *The optimal level of debt obligation F^* in the simultaneous equilibrium game is weakly larger than in the sequential game where the board has a first mover advantage. Since debt induces agency costs, the value of the firm in the simultaneous equilibrium is lower.*

Proof. A sequential equilibrium is defined as the outcome where the board chooses its strength g to maximize ex-ante firm value. The manager takes this board strength as given and chooses to issue debt at face value F . In a simultaneous equilibrium is defined as the outcome where the manager's choice of F influences the board's choice of g directly.

In a sequential equilibrium, the manager's marginal incentive to issue debt is given by proposition 2.3. The marginal benefit of debt to the manager is given by

$$g \frac{\partial}{\partial F} \mathbb{E}[\alpha_c(F) \leq \hat{\alpha} | \mathcal{H}'_0]$$

The board, when maximizing ex-ante shareholder value and thus total firm value, takes into account the manager's response to their governance decision and balances the benefits of manager evaluation with the costs to the firm from risk shifting. The board's objective function is similar to equation 2.6 with the caveat that $F = F(g)$.

However, in a simultaneous equilibrium, the manager now takes into account the fact that her choice of debt directly affects the board's incentive to choose strength g . Following the methodology of proposition 2.3, the marginal benefit to the manager from debt is given by

$$\frac{\partial}{\partial F} \mathbb{E}[\mathbb{I}_{\text{Manager Retained}} | \mathcal{H}'_0] = -\frac{\partial g}{\partial F} \mathbb{E}[\alpha_c(F) \leq \hat{\alpha} | \mathcal{H}'_0] + g \frac{\partial}{\partial F} \mathbb{E}[\alpha_c(F) \leq \hat{\alpha} | \mathcal{H}'_0].$$

From the above equation, we see that the marginal benefit to debt is larger by the new first term, since from proposition 2.2, $\frac{\partial g}{\partial F} \leq 0$. Since the marginal benefits of issuing debt to the manager has increased (and the marginal costs are unchanged), the manager's choice of F in the simultaneous equilibrium is larger.

Now consider equation 2.5. From the proof of proposition 2.1

$$\frac{\partial \mathbb{E}[\tilde{x}]}{\partial F} \leq 0,$$

since

$$\frac{\partial \alpha_c}{\partial F} \leq 0.$$

Furthermore,

$$\frac{\partial \mathbb{E}_{\phi_B}[\tilde{y}]}{\partial F} < 0.$$

Thus, $\frac{\partial \text{Firm Value}}{\partial F} \leq 0$.

Thus the firm value is lower in the sequential equilibrium. □

Proposition 2.4 explains the insight that managers have incentives to choose sub-optimally high levels of debt to induce agency costs of debt and thus weaker boards.¹⁵ The board may preempt the manager by credibly committing to an ex-ante board strength and retaining the first mover advantage. A staggered or classified board may be one such commitment device. This suggests a positive correlation between staggered boards and mediocre but long serving managers. This is a novel implication for staggered boards, not based in the canonical channels of board capture or of takeover defenses.

2.5 Data

The data for managerial turnover comes from COMPUSTAT Execucomp. The key variables used from this database are the date the executive was hired as a CEO and the date of the CEO's departure from the position. In addition to the standard fields in Execucomp, I also use data on the reason for the CEO's departure; whether it was forced or voluntary. This data is provided for a subset of the sample period from 2000-2005 (Peters and Wagner 2008). The Execucomp database also provides information on the CEO's equity based incentive compensation.

The data on the board of director characteristics comes from RiskMetrics' Directors database. The key variable used is the director affiliation with the company, whether independent, employee or linked. The sample period extends for 10 years from 1996 to 2006. Balance sheet data on firm leverage and total debt comes from the COMPUSTAT database and firm's annual reports. Leverage ratios are constructed following standard practices in the literature (Lemmon, Roberts, and Zender 2008). The firm's performance is measured by its equity returns from the CRSP database.

2.6 Empirical Analysis

First, from lemma 2.1, we expect negative correlation between equity-based incentive compensation and firm leverage. Higher incentive compensation induces larger risk taking in managers. As the firm's leverage increases, the share of equity compensation in the manager's contract decreases (John and John 1993). Next, from proposition 2.1, we expect that boards of firms with high leverage will be more lenient in managerial turnover. Increased volatility of cash flows is detrimental to a levered firm.

Proposition 2.2 implies a negative correlation between board strength and debt. Following the literature, I use board independence as a proxy for board strength. The correlation between weak or less independent boards and managerial tenure has been documented

¹⁵As an aside, note from equation 2.6, g increasing in $\Delta(\tilde{x})$. However, from the definition of $\Delta(\tilde{x})$ in equation 2.6, increasing $\Delta(\tilde{x})$ also increases $\frac{\partial \alpha_c}{\partial F}$ and thus further increases the marginal benefit of debt to manager (prop 2.3). Thus the manager's objective to issue debt is increasing as the firm's marginal benefit of increasing board strength.

(Hermalin and Weisbach 1998). However, since strong boards may face larger risk shifting costs, board independence decreases with managerial tenure faster for firms with higher leverage. Finally proposition 2.4 suggests that, for managers who control their firm's financing decisions, leverage decreases as managerial tenure increases. Managers may use leverage to induce weaker boards, but the need to avoid monitoring decreases as the manager becomes established as a good match for the firm.

Compensation and leverage

To analyze the correlations between debt and incentive compensation for CEOs, I use data from the COMPUSTAT database (fundamental annuals plus execucomp). Table 2.1 illustrates the importance of the agency cost of debt to managerial incentive compensation evidenced by a significant negative correlation between leverage and CEO incentive compensation, consistent with other findings in the literature ((Bryan, Hwang, and Lilien 2000), (Ortiz-Molina 2006) , (Sundaram and Yermack 2007)). The dependent variable, incentive compensation, is the proportion of the manager's total compensation that is not salary or base pay and generally includes options, bonuses and equity grants. In addition to confirming the negative correlation between incentive compensation and leverage, I document the reduction in incentive compensation as CEO tenures increase. There is a significant negative pairwise correlation between leverage and tenure (-0.1445) in the sample. This result is consistent with proposition 2.3.

Board leniency and leverage

To analyze the effect of debt on forced CEO turnover, I use the dataset from Peters and Wagner 2010. I regress the measure of forced turnover on equity performance, a book measure of excess debt over industry mean and an interaction between the excess debt and performance. I use one year lagged equity performance, the CEO's age¹⁶, and the industry mean debt as the main controls. Results are shown in table 2.2. Here we see that the interaction term between debt and performance is negative. This implies that firms with higher leverage exhibit lower performance turnover sensitivity for management. Sorts by board independence show that the effect is concentrated in the most independent boards. This is consistent with the hypothesis that the strong boards of levered firms, which may face the highest agency costs, are more lenient and less inclined to replace managers based on performance.¹⁷

Several algorithms used in the literature to classify voluntary turnover are known to be subjected to a misclassification bias as many supposedly voluntary turnovers occur after

¹⁶Here, the CEO's age proxies for how close the CEO may be to retirement. This might mean that the CEO turnover might be driven more by retirement concerns rather than performance. However Jenter and Lewellen 2012 have shown that many retirements often follow poor performance.

¹⁷However, firms with higher leverage are positively correlated with higher levels of forced turnovers on average.

Variable	Coefficient
	(Std. Err.)
Leverage	-0.162*** (0.043)
Tenure	-0.006*** (0.001)
collateral	0.021 (0.086)
RnD	0.045 (0.044)
TaxStatus	-0.002 (0.001)
Size	0.075*** (0.011)
Intercept	-0.119 (0.148)
<hr/>	
N	7158
R ²	0.476
F _(20,1198)	16.623

Table 2.1: Sample contains data from 1992-2008. The table presents parameter estimates from a simple panel OLS regression of CEO incentive compensation (equity, option grants and bonuses) on various predictors. The panel regression includes year and firm fixed effects. Firms with high leverage or high managerial tenure are associated with decreased incentive compensation.

poor performances. To attempt to correct for this bias, I use an aggregated performance of a CEO over a five year tenure window (Jenter and Lewellen 2010). This method measures the cumulative probability of turnover for a CEO over the minimum of her total tenure or for five years from being hired. CEO cumulative performance is separated by quintiles and variation in CEO turnover across the performance quintiles is analyzed. Using the CEO-tenure as a single observation, I also cumulate the excess debt and the excess board independence over industry means over the tenure window. The industries follow the Fama-French 48 classification.

Table 2.3 shows the variation in turnover probability as measured by a logit regression. Here, the estimation treats the bottom performance quintile CEOs as a benchmark and shows the turnover probability of quintiles of higher performance. As expected, quintiles of

Variable	Coefficient (Std. Err.)	(1)	(2)	(3)
Board Tercile	All	Least Indep	Mid Indep	Most Indep
Performance (1 yr lag)	-0.018*** (0.004)	-0.024*** (0.007)	-0.037*** (0.011)	-0.039* (0.021)
Excess Debt	0.167** (0.068)	0.103 (0.179)	0.346 (0.194)	0.602* (0.319)
Interaction	-0.003*** (0.001)	0.001 (0.003)	-0.013 (0.01)	-0.037** (0.019)
Industry excess leverage	0.166** (0.070)	0.127 (0.184)	0.354 (0.204)	0.582* (0.309)
CEO age	-0.014*** (0.002)	-0.010*** (0.003)	-0.018*** (0.005)	-0.008 (0.006)
Intercept	0.954*** (0.109)	0.705** (0.186)	1.089*** (0.317)	0.444 (0.388)
N	540	104	88	53
R^2	0.155	0.26	0.255	0.196

Table 2.2: Sample covers firms in Execucomp from 1993-2005. Coefficient estimates presented are from a panel regress of forced turnover as classified in Peters and Wagner 2010 on controls under various subsamples (terciles) sorted by board independence. The novel contribution is the parameter estimate on the interaction term. Here the interaction is performance at 1 year lag multiplied by excess debt over industry mean. The results are consistent with the claim that the most independent boards with high levels of excess debt have reduced performance turnover sensitivity.

higher performance have significantly reduced probability of turnovers. We also notice that CEOs who face boards that are more independent than the industry mean are also more likely to be replaced. A novel result is the significant negative correlation between excess debt and turnover. CEOs with larger leverage ratios over their tenures as compared to the industry average are more likely to be retained. This result is consistent with the board leniency channel discussed in proposition 2.1.

Table 2.4 breaks up the effect of the cumulative excess debt measure by board terciles. We see that excess leverage is correlated with lower turnover for CEOs who face very independent boards compared to the industry means. While performance is still predictive for turnover at all board independence levels, debt is not. This is consistent with the hypothesis that leverage induces leniency for strong boards but has less implication for firms with weak boards. This is because weak boards may not induce very high risk shifting costs thus

Variable	Coefficient	(Std. Err.)
tenindep	0.002	(0.001)
debtmeasure	-0.028	(0.010)
perfquint_2	-0.712	(0.224)
perfquint_3	-0.982	(0.235)
perfquint_4	-1.514	(0.272)
perfquint_5	-1.683	(0.309)

Table 2.3: Sample covers firms in Execucomp from 1993-2005. Logit regression of cumulative turnover probability on tenure aggregated performance quintiles (perfquint), board independence (tenindep) and excess debt to industry mean (debtmeasure). Regression also includes controls from (Jenter and Lewellen 2010), which are not shown here for the sake of brevity. These include two year lagged Market-to-book ratio, two year lagged log of the firm’s assets, three year lagged ROA and two year excess return from manager’s start date.

removing the link between leverage and board leniency.

High performing CEOs have a signaling motive to issue debt (Berger, Ofek, Yermack, et al. 1997). Pairwise correlations between performance and debt measures and predictive regressions on the debt measure with the performance measure are insignificant in the sample. A robust examination of the debt versus equity issuance decision with board strength, firm performance and managerial tenure will be a natural extension to the results presented here.

Board independence and leverage

I check if board independence, managerial tenure and the interaction between them can predict leverage. Pairwise correlations in the data between board independence and leverage are significant and positive (0.0654) and between tenure and leverage are negative (-0.0681). The correlation between independence and tenure is negative (-0.04). To identify risk shifting effects, I sort on convertible debt and on scaled industry leverage. As a measure of convertible debt, I bifurcate firms based on the presence of convertible debt on the balance sheet. I also consider sorts by industry leverage by constructing terciles based on the normalized distance from the industry mean leverage (market value) scaled by the industry standard deviation of leverage. I look at pre and post year 2002 data to identify possible effects of Sarbannes Oxley regulation on board means, tenure and leverage.

From table 2.5, we may note that board independence and firm leverage is negatively correlated for firms in industries where high leverage ratios are prevalent. However, this correlation turns positive as the mean leverage ratio of the industry decreases. If industries with high leverage ratios bear larger agency costs of debt, this result is consistent with the hypothesis that board independence, which serves as a proxy for board strength, may exacerbate the asset substitution problem. The presence of convertible debt does not seem to affect the results much. Regressions run on pre- and post- SOX regulations show that

Variable	Coefficient (Std. Err.)	(1)	(2)	(3)
Board Tercile	All	Least Indep	Mid Indep	Most Indep
perfmeasure	-3.435*** (0.433)	-3.898*** (1.477)	-6.005*** (1.108)	-4.060*** (0.950)
debtmeasure	-0.010** (0.005)	-0.030 (0.030)	-0.022 (0.026)	-0.030** (0.013)
mblag2	0.008 (0.015)	-0.115 (0.117)	-0.067 (0.071)	0.058 (0.118)
lnsizelag2	-0.041 (0.039)	0.076 (0.099)	-0.082 (0.082)	0.003 (0.090)
avgroa3yr	-0.395 (0.527)	1.117 (2.289)	-1.049 (1.406)	-0.402 (1.623)
exretma2	-0.033 (0.026)	-0.112 (0.078)	0.010 (0.049)	0.006 (0.077)
Intercept	-0.835*** (0.295)	-1.98** (0.919)	0.308 (0.678)	-0.955 (0.749)
N	1543	370	349	325
Log-likelihood	-685.315	-135.14	173.98	-160.17
$\chi^2_{(6)}$	78.8	11.43	37.25	28.37

Table 2.4: Logit regression on cumulative turnover probability with tenure aggregated performance (perfmeasure) and excess debt to industry mean (debtmeasure) broken out by board independence terciles. Controls from Jenter Lewellen include two year lagged Market-to-book ratio, two year lagged log of the firm's assets, three year lagged ROA and two year excess return from manager's start date.

the negative correlation between tenure and debt disappears post SOX. One explanation may be that regulations requiring more independent boards leads to higher persistence of strong boards. This discourages managers who would have otherwise issued debt to interfere with the board's inference problem from increasing the firm's leverage ratio. Regulation here provides a precommitment device for strong boards maintaining their independence.

I also look at dual sorts on pre and post SOX and terciles of debt risk scaled by industry (table 2.6). For safe debt (low leverage compared to industry average), board independence is positively correlated with leverage only pre-SOX. There is no effect in tenure or independence for middle ranges of debt risk. But for risky debt (high leverage compared to industry average), board independence is negatively correlated with debt pre-SOX and the interaction term is positive. All predictive ability seems to vanish post SOX. Manager tenure also is no longer negatively correlated with debt post SOX as perhaps newly inflexible boards make it less appealing for managers to issue debt.

Regressions using leverage and maturity as dependent variables are complicated by endogeneity and simultaneity concerns as board strength and leverage may be jointly determined. To try and correct for that, I consider regressions of newly issued debt spreads on board independence and tenure. A direct effect of tenure and its interaction with board independence to determine spreads is hard to tease out of the regressions. However, preliminary results show that board independence is correlated with lowered spreads on debt only when managerial tenure is low in the post Sarbannes-Oxley era (which may be when boards were shocked out of their equilibrium level via regulation). Results are shown in table 2.7.

2.7 Takeaways

Managerial compensation can be a commitment device against risk shifting. A key feature of this chapter is that active monitoring by a board of directors aligned with shareholders may weaken this commitment, imposing a cost to governance. To compensate for this increased risk, boards of levered firms may be lenient in replacing managers. This is because replacing an incumbent manager is inherent volatile if less is known about the replacement's ability. Thus debt may have an ex-ante cost to the firm via a governance channel. In the absence of tax shield or monitoring benefits of debt, governance may be decreasing in leverage. Managers with a benefit to solvency may have a bias towards debt financing and use leverage to induce boards to self-limit their monitoring intensity.

Though evidence of causation is beset by the problem of simultaneity in the data, a number of correlations and regressions are consistent with the model predictions. One of the novel empirical findings is that performance turnover sensitivity decreases for strong boards with high leverage. I also identify a regime based relationship between board independence and leverage; specifically a negative correlation between the two when sorted into industry sectors with high leverage.

Table 2.5: Sample contains firms in Compustat from 1996-2008. Parameter estimates shown are OLS panel regression of the market value of leverage on various controls. Different specification of terciles of industry debt levels and of convertible debt are considered. Year and industry fixed effects are included in the regression and standard errors clustered by firms.

Variable	Coefficient (Std. Err.)	(2)	(3)	(4)	(5)
Industry Tercile	Low	Middle	High	all	all
Convertible Debt	all debt	all debt	all debt	no convertible	only convertible
Board Independence	0.018*** (0.006)	0.009 (0.007)	-0.039* (0.021)	0.011 (0.020)	-0.017 (0.035)
tenure	0.000 (0.000)	0.000 (0.000)	-0.001 (0.000)	-0.001* (0.000)	-0.001 (0.001)
Ln(Size)	0.007*** (0.001)	0.000 (0.001)	0.003 (0.003)	0.020*** (0.003)	0.000 (0.005)
Market-Book	-0.002*** (0.000)	-0.017*** (0.002)	-0.136*** (0.011)	-0.034*** (0.004)	-0.051*** (0.007)
Profitability	-0.030*** (0.006)	-0.048** (0.019)	-0.370*** (0.044)	-0.398*** (0.047)	-0.401*** (0.053)
Tangibility	0.035*** (0.008)	0.030*** (0.009)	0.022 (0.027)	0.070*** (0.025)	0.097** (0.046)
Industry D/A	0.004 (0.020)	0.104*** (0.024)	0.434*** (0.068)	0.773*** (0.059)	0.685*** (0.104)
Cash Flow var	-8.6e-9*** (1.12e-9)	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)
Intercept	-0.003 (0.008)	0.180 *** (0.011)	0.464*** (0.050)	-0.027 (0.045)	0.268*** (0.052)
N	3877	3766	3601	8030	1951
R ²	0.837	0.804	0.52	0.51	0.513
F	8.970	8.10	23.684	46.34	16.636

Table 2.6: Dependent variable: Leverage (market value). Sample contains firms in Compustat from 1996-2008. Parameter estimates shown are OLS panel regression of the market value of leverage on various controls. Different specification of terciles of industry debt levels over different sample periods, corresponding to SOX, are considered. Year and industry fixed effects are included in the regression and standard errors clustered by firms.

Variable	Coefficient		(2)	(3)	(4)	(5)	(6)
	(Std. Err.)						
Industry Leverage Tercile	Low	Low	Low	Low	High	High	High
Sample Period	all	Pre 2002	Post 2002	Post 2002	all	Pre 2002	Post 2002
Board Independence	0.018*** (0.006)	0.023*** (0.008)	0.006 (0.012)	-0.075*** (0.026)	-0.081*** (0.029)	-0.067 (0.045)	
tenure	0.000 (0.000)	0.000 (0.000)	-0.001 (0.000)	-0.004*** (0.001)	-0.005*** (0.001)	-0.002 (0.003)	
Interaction	0.000 (0.000)	0.000 (0.001)	0.001 (0.001)	0.005*** (0.002)	0.007*** (0.002)	0.004 (0.004)	
Ln(size)	0.007*** (0.001)	0.006*** (0.001)	0.007*** (0.001)	0.002 (0.003)	0.001 (0.002)	0.005 (0.005)	
Market/Book	-0.002*** (0.000)	-0.001*** (0.000)	-0.003*** (0.001)	-0.137*** (0.011)	-0.151*** (0.014)	-0.012*** (0.014)	
profitability	-0.030*** (0.006)	-0.030*** (0.007)	-0.021*** (0.008)	-0.368*** (0.044)	-0.405*** (0.051)	-0.288*** (0.076)	
tangibility	0.035*** (0.008)	0.047*** (0.009)	0.023** (0.011)	0.023 (0.027)	0.016 (0.031)	0.037 (0.037)	
industry D/A	0.004 (0.020)	0.024 (0.027)	-0.017 (0.045)	0.435*** (0.068)	0.448*** (0.087)	0.288** (0.112)	
Intercept	-0.003 (0.008)	-0.011 (0.010)	-0.004 (0.013)	0.499*** (0.051)	0.534*** (0.068)	0.481*** (0.056)	
N	3877	1814	2063	3601	2114	1487	
R ²	0.837	0.871	0.807	0.52	0.498	0.572	
F	8.504	7.23	9.93	22.71	20.62	13.08	

Table 2.7: Spreads on newly issued debt regressed on board independence. Sorted by manager tenure scaled by industry. Post 2002 sample. Controls for leverage (scaled within industry) and issue rating (higher numerical value implies higher rating). Year and industry fixed effects included. Standard errors clustered by firm.

Variable	Coefficient (Std. Err.)	(2)	(3)	(4)	(5)
Industry Tenure	lowest		middle		highest
indep_mean	-91.802* (50.693)	-136.429* (69.561)	-6.455 (81.859)	17.274 (51.497)	39.049 (50.926)
scaledinduslev	20.867** (9.089)	30.855*** (9.050)	66.670*** (16.524)	39.431*** (13.424)	39.136** (15.025)
issuerating	-29.705*** (3.753)	-28.410*** (4.115)	-32.531*** (3.666)	-28.172*** (3.221)	-29.140*** (3.445)
Intercept	794.469*** (83.865)	806.370*** (121.050)	854.979*** (90.117)	684.560*** (81.401)	757.281*** (86.111)
N	184	172	197	166	140
R ²	0.716	0.788	0.591	0.735	0.775
F	18.866	12.295	20.586	16.854	20.406

Chapter 3

Capital Structure with Multiple Monitors

In this chapter, I consider the interactions of debt and equity claimants when both monitor the actions of a manager. I postulate that debt and equity claimants contribute in different ways to mitigating agency effects. Monitoring focuses on two main dimensions; monitoring of risk and monitoring of return. Debt claims are structured to incentivize monitoring project choice to control risk. Equity claims are structured to incentivize monitoring to prevent the manager from misappropriating cash flows or exerting suboptimal effort. I find that debt and equity monitoring may serve as both complements and as substitutes depending on the firm's leverage. The key trade-off balances the benefits from the increased participation of debt claimants with the subsequent cost that arises when debt monitoring substitutes for equity monitoring. An agency cost to debt is induced as equity aligned monitors engage in value destroying actions to shift the burden of monitoring onto debt claimants ex-post to issuing debt.

Literature on capital structure has widely explored the fundamental role of the composition of debt and equity claims in aligning the incentives of management with those of the stakeholders. For example, debt concentrated with a single bank lender facilitates monitoring of a manager's project choice (Harris and Raviv 1991). Large institutional shareholders and strong boards provide useful checks on value destroying projects and monitor the underlying cash flows of the firm to prevent misreporting or stealing (Becht, Bolton, and Röell 2002). Thus, the participation of equity and debt claimants and the structure of those claims may enhance firm value by mitigating various agency costs to the firm. In this chapter, I analyze the roles of equity and debt holders in monitoring a manager who may both misappropriate cash flows and select sub-optimal projects. The objective is to understand the co-existence of both debt and equity monitors in firms. Debt is often an important part of an optimal contract to induce high managerial effort. However, active monitoring of managers via board composition and block holder participation offers an alternative channel in controlling managerial decisions. I assume that debt and equity claimants resort to a division of labor over their choice of monitoring duties. In this chapter, debt claimants exclusively monitor the

project choice of the manager and evaluate risk and equity holders monitor the level of cash flows reported by the manager.

This assumption could be justified by noting that risk shifting is often an important agency problem facing debt claimants. Because seasoned creditors such as banks are likely to have made loans to a variety of firms, they have a comparative advantage in assessing the various projects in which the firm may choose to invest. This gives them the ability to check if the manager has properly identified the projects with the highest return commensurate with the level of risk. Debt holders may restrict the project choice through covenants or through renegotiation of loan terms with management. Control of the manager by debt holders may be enforced by penalties for the violation of covenants. Such violations might lead to acceleration of payments and constriction of capital lines from the creditor. Another effective limit to managerial choice would be the transfer of control rights to the creditors after a covenant violation. Assuming that technical defaults or restructuring triggered by covenant violations have an impact on the career concerns of a manager, the threat of debt monitoring might serve as an incentive for the manager to exert high effort. The focus of this work is on managerial effort rather than inefficient liquidation.

Equity governance, such as boards or active block holders, is closer to the day to day decision making process of management. By both negotiating directly with management or via proxy resolutions, large block holders can demand and implement improvements to firm performance. Similarly, corporate boards can review operational and budgetary decisions of the manager and curtail wasteful expenditures, overconsumption of perquisites and empire building investments. Given that any large firm is likely to be subject to many such frictions, a natural division of monitoring might prove efficient.

I posit that the equity and debt claimants balance their individual costs and benefits of monitoring, while also considering the effect of their decision on the other. I interpret the costs of monitoring via the lens of corporate governance. For instance, high costs to equity monitoring may imply diffuse shareholders or weak boards. High costs to debt monitoring may imply covenant light public debt. I show that a firm's debt risk regime determines its level of corporate governance. A novel result is that there are regimes of credit risk where weaker debt monitoring and weaker corporate governance may be ex-post beneficial to equity holders, albeit at the cost of reducing the total value of the firm ex-ante.

3.1 Model

In this section, I present a model of the interaction between the monitoring choices of the debt and equity holders and the optimal capital structure and composition of the firm. The model is predicated on the assumption that debt and equity claimants monitor separate aspects of manager behavior and that such monitoring is mutually exclusive. Each claimant may have a comparative advantage in monitoring one aspect of managerial shirking. Thus each investor would choose to specialize in whether they will lend as equity or as debt and this specialization will determine the monitoring regime employed. The optimal structure of

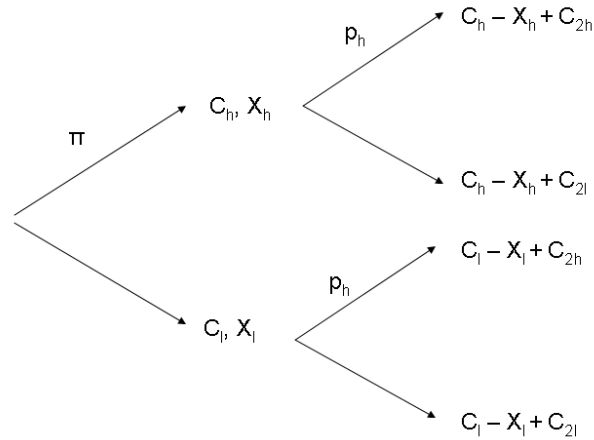


Figure 3.1: A Simple model detailing the nature of the payoffs and the primary agency problem of the firm

debt and equity claims is set to mitigate these agency costs in balance with the monitoring costs. In this version of the model, I ignore other important drivers of capital structure including taxes, bankruptcy costs, financing constraints and dilution costs from asymmetric information.

Setup

The model setup is illustrated in figure 3.1. States of the world are determined both by nature and by agents' actions. The model is decomposed into two stages. However, cash flows from both stages are realized contemporaneously. Nature chooses the probability of the first stage cash flow, which may be either high or low ($C_h > C_l$) with the probability of receiving C_h given by π . The manager may misappropriate an amount X_i once the cash flow is realized. The second stage cash flows are denoted as C_{2h} and C_{2l} . The probability of the high second stage cash flow given by p_h . The level of p_h is related to the effort the manager exerts in choosing good projects; the greater the effort exerted by the manager in evaluating the project, the higher the probability of choosing the high cash flow project. The manager's objective is increasing in X_i , the amount of the first stage cash flow appropriated and decreasing in probability of the high second stage return p_h via a disutility to exerting effort. I do not consider the role of optimal contracting for the manager. Her actions are

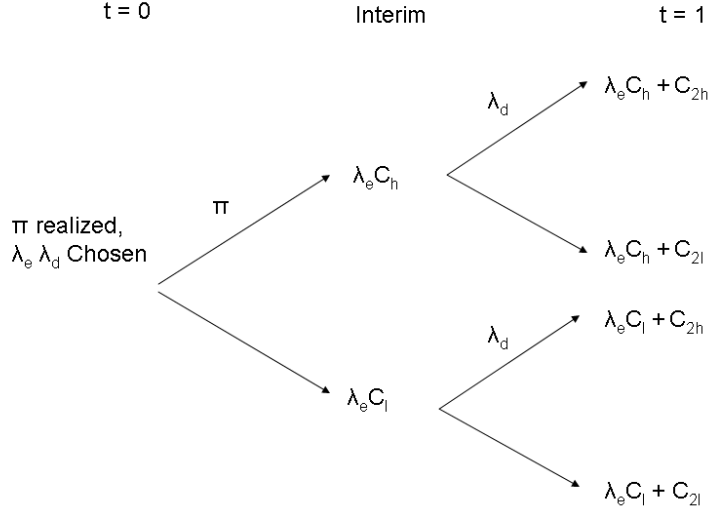


Figure 3.2: The model with the final period cash flow realizations and illustration of how debt and equity monitoring levels affect the cash flows.

fully determined by the decisions of the debt and the equity claimants.

The misappropriation and shirking by the manager may be verifiable, but verification requires costly monitoring by the outside debt and equity claimants. Debt and equity claimants may observe each other's level of monitoring. However, they do not observe the behavior of the manager that the other claim monitors. Debt and equity claimants choose their monitoring intensities ex-ante. The level of equity monitoring, $\lambda_e \in [0, 1]$, determines the amount of the first stage cash flows that the manager may misappropriate. The larger the level of monitoring, the less the cash flows that leave the firm. This relationship is captured by the equation $X_i = (1 - \lambda_e)C_i$. The probability of high second stage cash flows is determined by debt claimant's monitoring choice $\lambda_d \in [0, 1]$. The higher the level of debt monitoring, the more effort exerted by the manager and thus the higher the probability of larger second stage cash flows. Thus, $p_h = \lambda_d$. The costs to monitoring for creditors and shareholders are given by $K_e \frac{\lambda_e^2}{2}$ and $K_d \frac{\lambda_d^2}{2}$ respectively, where K_e and K_d are cost scalars to monitoring. The payoffs to debt holders and equity aligned board of directors in various states of the world are given in the table below, where D is the face value of debt.

I make the following simplifying assumptions. To avoid model complexity that arises from limited liability associated with direct equity claims, I assume that the costs borne by the shareholders in monitoring is a non monetary cost that is paid in all states of the world. This assumption is innocuous in two respects; it does not change the qualitative nature of the

results, and it may reflect reality since the costs borne by boards in overruling management are largely reputational and an aversion to contradict management. I have abstracted from director compensation which I assume to be fixed and limit the cost of monitoring to be proportional to its intensity and not any outside participation constraints. I further assume that $C_{2l} = 0$. The final setup is illustrated in figure 3.2.

Table 3.1: Debt and Equity Payoffs in the various possible realizations of cash flows

State	Probability	Equity Payoff	Debt Payoff
C_h, C_{2h}	$\pi * \lambda_d$	$Max(\lambda_e * C_h + C_{2h} - D, 0)$	$Min(\lambda_e * C_h + C_{2h}, D)$
C_h, C_{2l}	$\pi * (1 - \lambda_d)$	$Max(\lambda_e * C_h - D, 0)$	$Min(\lambda_e * C_h, D)$
C_l, C_{2h}	$(1 - \pi) * \lambda_d$	$Max(\lambda_e * C_l + C_{2h} - D, 0)$	$Min(\lambda_e * C_l + C_{2h}, D)$
C_l, C_{2l}	$(1 - \pi) * (1 - \lambda_d)$	$Max(\lambda_e * C_l - D, 0)$	$Min(\lambda_e * C_l, D)$

In solving the model, it is important to note that I do not focus explicitly on the action space or the strategies of the manager. The focus is on debt and equity claims as inputs to a value function of the firm which face commensurate monitoring costs. The value of each claim and its associated monitoring decisions is a function of the other claimant's monitoring decision. The equilibrium concept is Nash, where each claimant's choice is a best response function to the other claimant's decision.

I interpret the level of monitoring (λ) as unobservable actions that determine monitoring intensity. Such monitoring could involve private decisions by the board to overrule management or by investments not undertaken due to the presence of bond covenants. The cost scalars for each claimants monitoring costs (K) are the strength of the corresponding principal's ability to monitor. As such high K_d might indicate that bond covenants are expensive to enforce (perhaps due to inability to verify ex-post outcomes in court) and high K_e might reflect board strength or weakness (perhaps the number of insiders on the board who align with the CEO). The following subsections show how total firm value and the value of equity and debt claims vary with the costs to equity and debt monitoring.

Model Outcomes

The optimal levels of debt and equity monitoring maximizes the total cash flows of the firm while minimizing the costs to monitoring.

$$\max_{\lambda_e, \lambda_d} \left[\underbrace{\lambda_e \{ \pi C_h + (1 - \pi) C_l \} + \{ \lambda_d C_{2h} \}}_{\text{Total cash flows to firm}} - \underbrace{K_e \frac{\lambda_e^2}{2} - K_d \frac{\lambda_d^2}{2}}_{\text{monitoring costs}} \right]$$

The first order conditions with respect to λ_e and λ_d give the following optimal levels of monitoring and optimized firm value.

$$\lambda_e^* = \frac{\pi C_h + (1 - \pi)C_l}{K_e} \quad (3.1)$$

$$\lambda_d^* = \frac{C_{2h}}{K_d} \quad (3.2)$$

$$TotalFirmValue = \frac{(\pi C_h + (1 - \pi)C_l)^2}{2K_e} + \frac{C_{2h}^2}{2K_d} \quad (3.3)$$

The monitoring intensities, λ_e and λ_d while chosen jointly, are independent. This is driven by the assumption that debt and equity monitoring are mutually exclusive. Since there does not exist a single financier who can monitor both aspects of the firm's cash flows, this optimal firm value is not attainable.

A fully equity financed firm

A fully equity financed firm will not be able to monitor the second stage cash flows of the firm. This insures that there is no monitoring in the second state ($\lambda_d^* = 0$) and that the manager always chooses a low level of effort in the second stage.

$$\lambda_e^* = \frac{\pi C_h + (1 - \pi)C_l}{K_e}$$

$$Firmvalue = \frac{(\pi C_h + (1 - \pi)C_l)^2}{2K_e}$$

A fully debt financed firm

Similar to the previous case, debt claimants may not monitor first stage cash flows ($\lambda_e^* = 0$) ensuring that the manager diverts all of C_1 .

$$\lambda_d^* = \frac{C_{2h}}{K_d}$$

$$Firmvalue = \frac{(C_{2h})^2}{2K_d}$$

For ease of computation, I assume that $C_{2h} \leq K_d$ and $\pi C_h + (1 - \pi)C_l \leq K_e$ which ensures that the intensity of monitoring is bounded in the unit interval and can be interpreted as a probability.

Levered Firm Values

When the firm is levered, the levels of monitoring are chosen as best responses to the other claimants monitoring choice, the amount and the composition of monitoring varies with the firm's capital structure. The optimal levels of debt and equity monitoring jointly solves the

following first order conditions:

$$\begin{aligned}
\frac{\partial Equity}{\partial \lambda_e} &: \pi * \lambda_d * C_h * \mathbf{I}_{\lambda_e * C_h + C_{2h} > D} + (1 - \pi) * \lambda_d * C_l * \mathbf{I}_{\lambda_e * C_l + C_{2h} > D} + \\
&\pi * (1 - \lambda_d) * C_h * \mathbf{I}_{\lambda_e * C_h > D} + (1 - \pi) * (1 - \lambda_d) * C_l * \mathbf{I}_{\lambda_e * C_l > D} \\
&- \lambda_e * K_e = 0 \\
\frac{\partial Debt}{\partial \lambda_e} &: \pi * \{Min(\lambda_e * C_h + C_{2h}, D) - Min(\lambda_e * C_h, D)\} \\
&(1 - \pi) * \{Min(\lambda_e * C_l + C_{2h}, D) - Min(\lambda_e * C_l, D)\} \\
&- \lambda_d * K_d = 0
\end{aligned}$$

The value of the firm is a function of the relative importance of the first and second stage cash flows and thus the relative importance of monitoring by creditors and shareholders. The importance of debt financing depends on the relative importance of the second stage cash flows (C_{2h}) to the differential benefit to the first stage cash flows from board monitoring, $\lambda_e^*(C_h - C_l)$. I consider the interplay of monitoring decisions in different regimes of debt's riskiness.

Safe Debt

The regime of safe debt requires that $D < \lambda_e C_l$. Equilibrium levels of debt and equity monitoring are given by $\lambda_e = \frac{(\pi C_h + (1 - \pi) C_l)}{K_e}$ and $\lambda_d = 0$. Since this condition requires that $D < \frac{(\pi C_h + (1 - \pi) C_l) C_l}{K_e}$, firms with safe debt have large expected values of high first stage cash flows (πC_h) and low costs to the monitoring by the board of directors (K_e).

Low leverage

A firm with low leverage is defined as one that faces default in only one state of the world. The low leverage firm satisfies one of two case conditions: $\lambda_e C_l < D < \lambda_e C_h$ or $\lambda_e C_l + C_{2h}$. In this regime, equilibrium levels of monitoring are given by

$$\begin{aligned}
\lambda_e^{low} &= \frac{(1 - \pi)^2 C_l D + \pi C_h K_d}{K_e K_d + (1 - \pi)^2 C_l^2} \\
\lambda_d^{low} &= \frac{(1 - \pi)(DK_e - \pi C_h C_l)}{K_e K_d + (1 - \pi)^2 C_l^2}
\end{aligned}$$

Moderate leverage Moderate leverage in a firm is defined by default in two out of the four states of the world. A firm with moderate leverage satisfies either of the following case conditions.

Order 1: $\lambda_e C_h < D < \lambda_e C_l + C_{2h}$

Order 2: $\lambda_e C_h > D > \lambda_e C_l + C_{2h}$

The states in which default may occur is determined by the relative values of $\lambda_e(C_h - C_l)$ and C_{2h} . In this regime $\lambda_e = \frac{\lambda_d(\pi C_h + (1-\pi)C_l)}{K_e}$ and $\lambda_d = \frac{(D - \lambda_e(\pi C_h + (1-\pi)C_l))}{K_d}$. Equilibrium levels of monitoring under order 1 are given by

$$\lambda_e^{mod1} = \frac{D * (\pi C_h + (1 - \pi) C_l)}{K_e * K_d + (\pi C_h + (1 - \pi) C_l)^2}$$

$$\lambda_d^{mod1} = \frac{D * K_e}{K_e * K_d + (\pi C_h + (1 - \pi) C_l)^2}$$

and under order 2 by,

$$\lambda_e^{mod2} = \frac{\pi * C_h}{K_e}$$

$$\lambda_d^{mod2} = \frac{(1 - \pi) * C_{2h}}{K_d}$$

High Leverage A firm with high leverage has a high value of debt such that the only state of solvency of the firm is when both first and second stage cash flows are high: $\{\lambda_e C_l + C_{2h}, \lambda_e C_h\} < D < \lambda_e C_h + C_{2h}$. In this regime $\lambda_e = \frac{\lambda_d \pi C_h}{K_e}$ and $\lambda_d = \frac{\pi(D - \lambda_e C_h) + (1 - \pi)C_{2h}}{K_d}$. Equilibrium levels of monitoring are given by

$$\lambda_e^{high} = \frac{\pi C_h (\pi * D + (1 - \pi) C_{2h})}{K_e * K_d + (\pi C_h)^2}$$

$$\lambda_d^{high} = \frac{K_e (\pi * D + (1 - \pi) C_{2h})}{K_e * K_d + (\pi C_h)^2}$$

3.2 Results

Lemma 3.1. *The intensity of monitoring of creditors and shareholders is weakly increasing in debt for levered firms; i.e*

$$\frac{\partial \lambda_e}{\partial D} \geq 0, \quad \frac{\partial \lambda_d}{\partial D} \geq 0$$

For all proofs, please see the appendix.

The firm benefits from leverage because increase debt induces the debt holders to monitor and thereby (weakly) increases firm value. Since equity holders receive the residual value of the firm, increased monitoring by debt holders also (weakly) increases the board's incentive to monitor.

Lemma 3.2. *The intensity of monitoring of debt claimants is weakly increasing in the cost scalar of equity monitoring for levered firms; i.e*

$$\frac{\partial \lambda_d}{\partial K_e} \geq 0.$$

Similarly, the intensity of monitoring by equity claimants is weakly increasing in the cost scalar of debt monitoring for levered firms:

$$\frac{\partial \lambda_e}{\partial K_d} \geq 0.$$

Debt claimants monitor more if boards are weak to substitute for the slack in monitoring by equity claimants. This is true when debt monitoring can affect the firm's likelihood of bankruptcy. Furthermore, lemma 3.2 is the basis for the complementary nature of debt and equity monitoring. Later we see how equity holders may benefit from this complementarity ex-post, but may suffer for it ex-ante.

Levered Firm Value and Monitoring

In this section we consider the conditions required for a firm to lever and the corresponding comparative statics for the firm value with K_e , the cost scalar of equity monitoring. The scalar cost of monitoring could be a proxy for board strength, with a higher value of K_e corresponding to a weak board.

Lemma 3.3. *In all regimes of leverage, whether low, moderate or high, the value of the firm is increasing in debt.*

The regimes are characterized by the interaction of leverage and monitoring, which are intertwined functions of each other. Unique equilibrium levels of debt and monitoring are elusive. Solutions are specified as a range of equilibria within which firm values are stable. As limits of the regime are attained, first derivatives and firm values become discontinuous. Thus a firm's choice of leverage is described as the firm's preferred regime of debt risk, given exogenous expected first and second stage cash flows (π, C_h, C_l, C_{2h}) . Furthermore, optimal leverage and monitoring levels depend on the relative values of first and second stage cash flows. Solutions are different in order 1, where $C_{2h} > \lambda_e(C_h - C_l)$ than in order 2, where $C_{2h} < \lambda_e(C_h - C_l)$.

Lemma 3.4. *Moderate to High leverage is suboptimal when first stage cash flows dominate second stage cash flows (order 2).*

Lemma 3.4 shows that firm does not benefit enough from debt monitoring to justify leverage's effect in reducing equity claimants incentive to monitor. Within each regime, higher debt is preferred but as we transition between regimes, benefit of monitoring by shareholders accrues more to debt claimants as the leverage of the regime rises. Since debt monitoring increases the expectation of second stage cash flows at the cost of reduced probability of receiving first stage cash flow from equity monitoring, the firm value is optimized at low levels of leverage and debt monitoring. This intuition is formalized in proposition 3.1

Proposition 3.1. *Under order 2 conditions, the value of the firm is optimized when the firm's debt level falls into the low leverage regime under the following sufficient condition:*

$$\frac{C_{2h}^2}{K_d} > \frac{C_l^2}{K_e}.$$

It is worth noting that the optimal level of debt under dominant second stage cash flows may span all regimes of debt risk, given different combinations of $\pi, C_h, C_l, C_{2h}, K_e$ and K_d . Thus I specify the debt regime to be exogenous. I do not consider optimal debt except to say that there exist sufficient conditions to allow interior values of leverage in both relative orders of first and second stage cash flows as specified in the corollary below. Note that interior debt requires the dominance of C_{2h} over the expected return from the first stage cash flows $\pi C_h + (1 - \pi)C_l$.

Corollary 3.1. *As a corollary to proposition 3.1, the following condition is sufficient to ensure an interior optimum value of leverage in order 1:*

$$\frac{C_{2h}^2}{K_d} > \frac{(\pi C_h + (1 - \pi)C_l)^2}{K_e}.$$

It is further worth noting that while within each regime, both debt and equity monitoring (λ_e, λ_d) increase with the debt level (D), this need not be true across regimes. Equity and debt monitoring in the low leverage regime maybe both higher and lower than values in the higher leverage regimes.

Proposition 3.2. *The leverage ratio that maximizes the firm value is increasing in the cost scalar of equity monitoring; i.e. as K_e increases, the regime of debt that optimizes firm value increases from safe debt to levered risky debt.*

Proposition 3.2 illustrates the simple relationship between debt and equity monitors as complements. As the importance of second stage cash flows to the firm increase, the firm issues more debt to induce greater participation by debt monitors. Furthermore, it illustrates regimes where debt and equity monitoring are substitutes: as the cost scalar to equity monitoring (K_e) rises, the firm transitions to risky debt to induce debt monitors to pick up the slack. Thus firms with increased leverage may be correlated to weak boards.

In general, ex-ante firm value decreases with monitoring cost. However, ex-post to floating debt, equity claimants may find weaker boards optimal within a given debt risk regime as the debt overhang to monitoring mitigates the equity holder's incentives. The intuition is formalized in the following proposition.

Proposition 3.3. *When second stage cash flows dominate the first (order 1) and at low levels of leverage, ex-post equity value increases with increasing board strength. However for moderate to high levels of leverage, ex-post to floating debt, the shareholders may benefit from weaker boards as debt holders are induced to bear the brunt of monitoring costs.*

$$\frac{\partial Equity}{\partial K_e} < 0 \text{ when leverage is low.}$$

$$\frac{\partial Equity}{\partial K_e} > 0 \text{ when leverage is high, but distance to default is large.}$$

Shareholders of levered firms with high second stage cash flows benefit ex-post from weak boards. Because of the debt overhang induced by leverage, the benefits of equity monitoring accrue mostly to creditors. Since debt is risky enough to incent debtholder participation, reduction in shareholder monitoring lead to increases in debt holder monitoring to compensate. Thus shareholders of levered firms may actually benefit from monitoring the manager less, though this is a suboptimal outcome ex-ante.

Corollary 3.2. *Staggered boards may increase firm value as they provide a credible commitment against ex-post weakening of boards of directors.*

For a firm with large second stage cash flows, moderate to high leverage may be the optimal ex-ante regime. However, if the firm can change its board strength (and thus its scale cost of monitoring K_e) ex-post, debt holders anticipate the monitoring overhang and the value of the amount of capital the firm can raise for a given level of debt D is diminished (i.e., the ex-ante market value of the debt claimant falls and “interest rates” rise). Shareholders of the firm could avoid this time inconsistency by committing to a strong board ex-ante and then staggering the board and thus entrenching board strength. This leads to a correlation between levered firms and staggered boards.

Firm values with exogenous debt: An example

Let us consider a firm with low second stage cash flows where equity holders seek to minimize debt within each regime. In this example the debt level D is exogenous.

Case 1: A low levered firm. $\lambda_e C_l + C_{2l} < D < \lambda_e C_l + C_{2h}$

Default will occur in the low realizations of first and second stage cash flows only. Debt and equity values are best responses to the other claimant’s monitoring decision. Equity monitoring is increasing in the level of debt monitoring but debt monitoring is decreasing in the level of equity monitoring. Since monitoring by shareholders is relatively more important with low leverage, I illustrate equity and debt monitoring value when the face value of debt is set to its minimum level. This returns the following equations.

$$\lambda_d^* = 0, \lambda_e^* = \frac{\pi C_h}{K_e} \quad (3.4)$$

$$Equity1 = \frac{\pi^2 C_h^2}{2K_e} - \frac{\pi^2 C_h C_l}{K_e} \quad (3.5)$$

$$Debt1 = D = \frac{\pi C_h C_l}{K_e} \quad (3.6)$$

$$Total1 = \frac{\pi^2 C_h^2}{2K_e} + \frac{\pi(1 - \pi)C_h C_l}{K_e} \quad (3.7)$$

Case 2: A moderately levered firm. $\lambda_e C_l + C_{2h} < D < \lambda_e C_h$

Default occurs if the first stage cash flows are low. In this case, the optimal levels of monitoring for debt and equity claimants are independent of each other. Again, setting the face value of debt to its minimum level, we have the following solutions.

$$\lambda_e^* = \frac{\pi C_h}{K_e} \quad (3.8)$$

$$\lambda_d^* = \frac{(1 - \pi)(C_{2h})}{K_d} \quad (3.9)$$

$$Equity2 = \frac{\pi^2 C_h^2}{2K_e} - \frac{\pi^2 C_h C_l}{K_e} + \frac{\pi(1 - \pi)(C_{2h})^2}{K_d} - \pi(C_{2h}) \quad (3.10)$$

$$Debt2 = \frac{\pi C_h C_l}{K_e} + \frac{(1 - \pi)^2 (C_{2h})^2}{2K_d} + \pi(C_{2h}) \quad (3.11)$$

$$Total2 = \frac{\pi^2 C_h^2}{2K_e} + \frac{\pi(1 - \pi)C_h C_l}{K_e} + \frac{(1 - \pi)(1 + \pi)(C_{2h})^2}{2K_d} \quad (3.12)$$

Case 3: A highly levered firm. $\lambda_e C_h < D < \lambda_e C_h + C_{2h}$

In this case, default occurs in all but the highest state of first and second stage cash flows. The solutions to this case are given by the equations below.

$$\lambda_e^* = \frac{\pi \lambda_d C_h}{K_e} \quad (3.13)$$

$$\lambda_d^* = \frac{(C_{2h}) + \pi(D - \lambda_e C_h - C_{2h})}{K_d} \quad (3.14)$$

Again, as a specific example, I set the level of D to its minimum constraint.

$$\lambda_e^* = \frac{\pi(1 - \pi)C_h(C_{2h})}{K_e K_d}, \lambda_d^* = \frac{(1 - \pi)(C_{2h})}{K_d}$$

$$Equity3 = \frac{\pi(1 - \pi)(C_{2h})^2}{K_d} - \frac{\pi^2(1 - \pi)C_h^2(C_{2h})}{2K_e K_d^2} \quad (3.15)$$

$$Debt3 = \frac{\pi C_h C_l}{K_e} * \frac{(1 - \pi)(C_{2h})}{K_d} +$$

$$\frac{\pi^2(1 - \pi)C_h(C_h - C_l)(C_{2h})}{K_e K_d} + \frac{(1 - \pi)^2(C_{2h})^2}{2K_d} \quad (3.16)$$

$$Total3 = \frac{\pi C_h C_l}{K_e} * \frac{(1 - \pi)(C_{2h})}{K_d} +$$

$$\frac{\pi^2(1 - \pi)C_h(C_{2h})}{K_e K_d} * \left[\frac{C_h(2K_d - 1)}{2K_d} - C_l \right]$$

$$+ \frac{(1 - \pi)(C_{2h})^2}{K_d} * \left[\frac{\pi + 1}{2} \right] \quad (3.17)$$

Transitioning Between Cases: Effects of the Default Level

In this section, by deriving conditions under which any one case dominates another, I posit some illustrative results from changing capital structure regimes.

Result 3.1. *When the firm has low to moderate levels of debt risk, having risky debt will be beneficial to the firm value. This benefit of increasing the riskiness of debt might mainly accrue to debt holders at the expense of equity holders.*

By inspection, we see total firm value increases when debt is levered up from default in the lowest state of cash flows (case 1, equation 3.7) to a point where there is default in low first stage cash flows (case 2, equation 3.12). This is because debt levels in case 1 are set to essentially the risk free level. In case 2, when equity is constrained by the case conditions to choose risky debt, the gains to the total firm value accrue to the debt holders. The intuition behind the result is the following. If equity claimants were in full control, they might opt to exclude debt from the capital structure. The cost to the equity claim of having the debt monitor, in that it has to share a greater portion of the firm's cash flows, outweighs the benefits of a debt monitor who keeps the manager from choosing poor projects. In cases such as these, other frictions such as financial constraints or taxes may incentivize equity to choose higher debt levels.

Result 3.2. *As a firm transitions between moderate and high levels of debt risk, both debt and equity benefit from riskier levels of debt. Under the following condition, total firm value is larger in this regime of risk debt than an all equity financed firm.*

$$(C_{2h})^2 > \frac{(1 - \pi)K_d}{(1 + \pi)K_e} C_l^2 \quad (3.18)$$

The intuition behind the condition is that the return to leverage is higher when there is a larger benefit to debt monitoring. Debt participation in monitoring is more valuable as the second stage cash flows increase. The condition in the above result specifies a sufficient level of debt for this to be the case.

I further posit sufficient conditions under which both debt and equity values are larger in case 3 (where equity may default in all states but the highest) than in case 2 (where equity defaults in low first period cash flows). Equity in case 3 (moderate leverage, equation 3.15) is larger than case 2 (low leverage, equation 3.10) if the following two conditions hold.

$$\begin{aligned} 2C_l &> C_h \\ C_h^2 &< \frac{2K_d K_e}{\pi(1 - \pi)} * K_d \end{aligned}$$

Comparing debt in case 3 (equation 3.16) to debt in case 2 (equation 3.11) we see that the

dominance of case 3 is sufficient under the following two conditions.

$$\lambda_d^* = \frac{(1 - \pi)(C_{2h})}{K_d} \geq 1 \quad (3.19)$$

$$C_h(C_h - C_l) > \frac{K_d K_e}{\pi(1 - \pi)} \quad (3.20)$$

The first condition may bind at best, but does not hold true in general. The second condition is the same as the case 3 boundary condition. Thus we see that if debt values are large enough that the slack in the second condition is large enough to make up for the deficit in the first, case 3 might dominate for both equity and debt. Here, levels of the first stage cash flows drive this decision.

Because, second stage cash flows do not dominate the first stage cash flows, equity value ex-post is generally higher with lower leverage. However, under the condition given by equation 3.18, the total firm value of a highly levered firm dominates the fully equity financed firm ex-ante.

Comparative Statics Of Debt And Equity Claims

The main comparative statics of interest are with respect to the exogenous costs and benefits of monitoring (π, C_{2h}, K_e, K_d) . In all cases, the value of the firm and the intensity of equity and debt monitoring (λ_e, λ_d) are increasing in the probability of high cash flows (π) . The total firm value and the monitoring intensities are also increasing in the difference between second stage cash flows (C_{2h}) , which is the incremental benefit to debt monitoring. The total firm value and the monitoring intensities are decreasing in both cost scalars of monitoring (K_e, K_d) .

Trivially, the intensity of monitoring by each claimant is increasing in its benefits and decreasing in its costs. However, in certain cases monitoring by the debt claimant enriches the equity claim (and vice versa). In such cases, the level of monitoring and claim value is decreasing in the cost of the other claim. I present a novel result where the ex-post value of an equity claim is *increasing* in the scale costs to equity and debt monitoring.

Result 3.3. *The value of the equity claim is decreasing in the scale cost to debt monitoring (K_d) . Similarly, the value of the debt claim may be decreasing in the scale costs to equity monitoring (K_e) .*

In Case 1, we note the evidence of the first cross link in that the value of debt is decreasing in the cost to equity monitoring. This is illustrated by noting that the first derivative of debt in case 1 (equation 3.6) with respect to the monitoring scale cost to equity is negative. Similar implications also hold for case 2 (where now, equity is also a function of debt monitoring

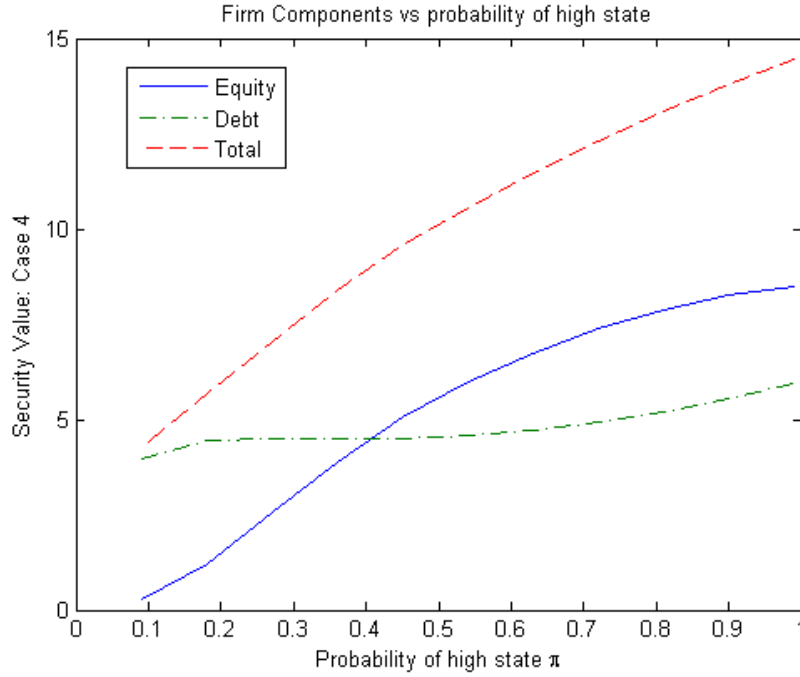


Figure 3.3: Comparative statics with the probability of the high first stage cash flows for the various security values. This is the case where default occurs in low first stage cash flows. π proxies for the relative importance of the equity and debt agency.

scale costs.)

$$\frac{\partial Debt_2}{\partial K_e} = \frac{-\pi C_h C_l}{K_e^2} < 0$$

$$\frac{\partial Equity_2}{\partial K_d} = -\frac{\pi(1-\pi)(C_{2h})^2}{K_d^2} < 0$$

Result 3.4. *The larger the probability of high first period cash flows, the lower the optimal monitoring intensity of debt.*

$$\frac{\partial \lambda_d^*}{\partial \pi} = \frac{-(C_{2h})}{K_d} < 0$$

The intuition for this result is rooted in the fact that the benefits of debt monitoring accrue to debt holders primarily in the states where the firm has defaulted. However, as the probability of high first stage cash flows grows, the probability that the firm will default in this case decreases reducing the incentive of the debt holders to monitor. Since the relative level of π , given a fixed level of C_h and C_l , determines the relative importance of debt and equity monitoring, the leverage ratio may also vary with π . Of course, the larger the

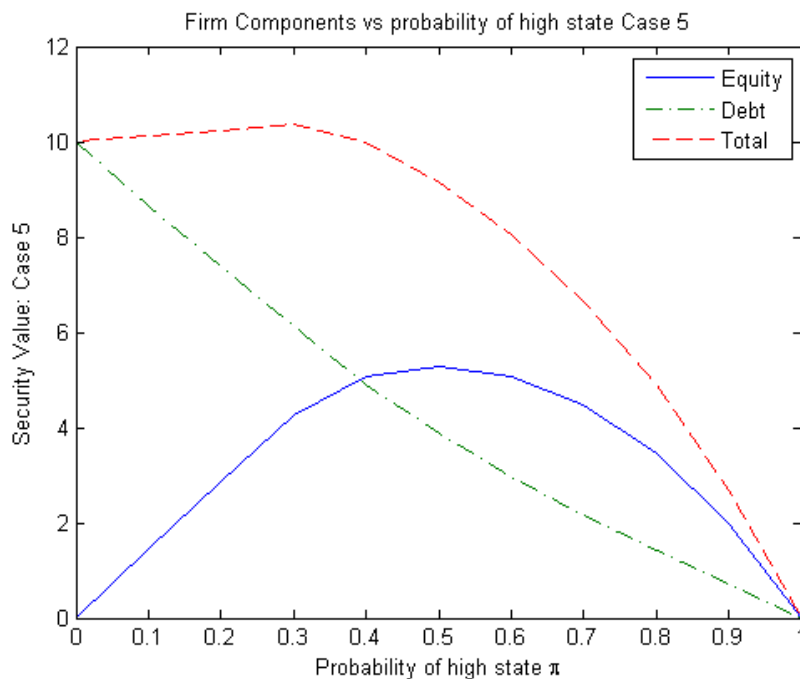


Figure 3.4: Comparative statics with the probability of the high first stage cash flows for the various security values in the case where default occurs in all states except those with the highest first and second stage cash flows. Equity value reaches a maximum and then begins to decrease as π increases.

probability of high first stage cash flows, the larger the value of the firm. These features are illustrated in figure 3.3 which tracks the values of securities in the case with moderate leverage (case 2).

Result 3.5. *The value of the total firm and of the equity claim decrease as π gets larger in moderately and highly levered firms (cases 2 and 3).*

This might illustrate the fact that as π increases, the level of debt monitoring falls. However, since its importance to the final cash flows of the firm has not changed in relative terms, the firm's value begins to decrease. This feature is illustrated in the figure 3.4. Larger leverage is beneficial for firms with low likelihood of reaching the high first stage cash flow state.¹

Result 3.6. *Even though total firm value is larger as the cost scalars to equity monitoring decreases, equity benefits from the cost savings of decreased monitoring. This is illustrated*

¹However, equity value is maximized at a higher π than what is optimal for the total firm. This might have interesting implications if the prior on the probability of high first stage cash flows differs between equity and debt.

by the following equations.

$$\frac{\partial Equity3}{\partial K_e} = \frac{\pi^2(1-\pi)C_h^2(C_{2h})}{2K_e^2K_d^2} > 0 \quad (3.21)$$

$$\begin{aligned} \frac{\partial Debt3}{\partial K_e} = & -\frac{\pi C_h C_l}{K_e^2} * \frac{(1-\pi)(C_{2h})}{K_d} + \\ & \frac{-\pi^2(1-\pi)C_h(C_h - C_l)(C_{2h})}{K_e^2 K_d} < 0 \end{aligned} \quad (3.22)$$

$$\begin{aligned} \frac{\partial Total3}{\partial K_e} = & -\frac{\pi C_h C_l}{K_e^2} * \frac{(1-\pi)(C_{2h})}{K_d} + \\ & \frac{-\pi^2(1-\pi)C_h(C_{2h})}{K_e^2 K_d} * \left[\frac{C_h(2K_d - 1)}{2K_d} - C_l \right] < 0 \end{aligned} \quad (3.23)$$

Here equation (3.21) shows that the value of the equity claim increases with the cost to equity monitoring. We note that the comparative static on equity value with respect to the cost of equity monitoring is positive while the partial derivative of the other securities with the same variable are negative. This is because costlier equity monitoring leads to a lower optimal level of equity monitoring in equilibrium and thus lower total monitoring costs paid by the equity claimants.

$$\frac{\partial \lambda_e^*}{\partial K_d} = -\frac{\pi(1-\pi)C_h(C_{2h})}{K_e K_d^2} < 0$$

Equity holders benefit from the accrual of these cost savings and they are able to credibly commit to a lower monitoring level in equilibrium. However, the debt holders here would prefer equity holders to have a higher monitoring level but no equilibrium mechanism exists to change the scale factor (equation 3.22). This is also value destroying from a total firm perspective. This result might imply that for some firms, weak corporate governance might increase the value of the equity claims. If equity holders could endogenously choose a weak board, they credibly signal their inability to perform a valuable but costly monitoring function to the debt holders.²

A corollary of the above result is that the equity value with respect to the cost scalar of debt monitoring. As illustrated by figure 3.2, equity value increases in the cost to debt monitoring for a range of parameter values before following the expected decreasing pattern. The mathematical parameterization of the result is as follows.

$$\frac{\partial Equity3}{\partial K_d} = -\frac{\pi(1-\pi)(C_{2h})^2}{K_d^2} + \frac{\pi^2(1-\pi)C_h^2(C_{2h})}{K_e K_d^3}$$

²Note that equity does not choose its level of K_e . However a minimum bound on K_e may exist to avoid violations of equity participation/limited liability constraints.

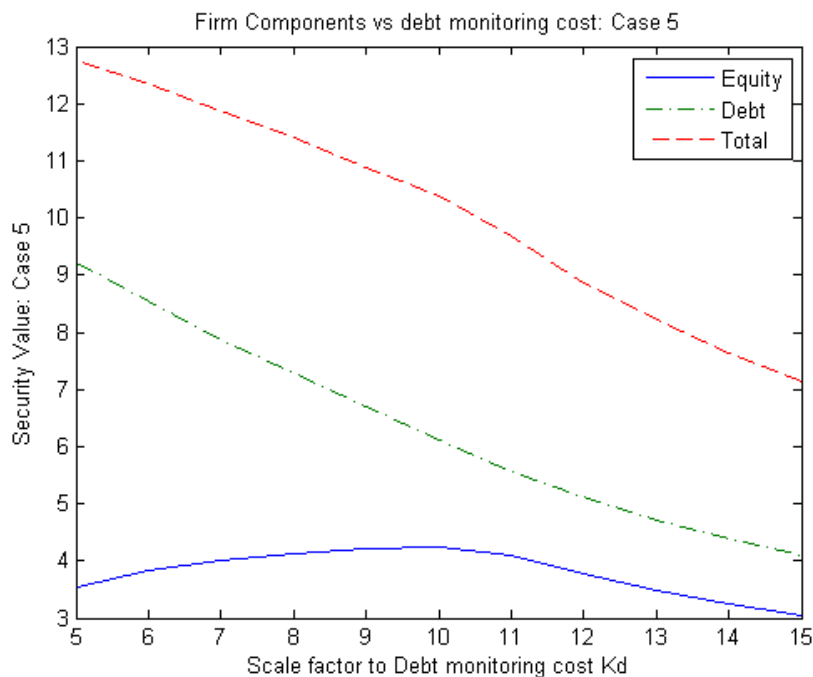


Figure 3.5: Comparative statics with the debt monitoring costs. Equity value is rising in rising debt monitoring costs in certain regimes. In such regimes, the cost savings from less equity monitoring accrues largely to the equity monitors for the given parameter values.

Discussion of Results

The model re-confirms the prediction that for a financially constrained firm with highly volatile investment choices, more debt monitoring will be beneficial. Thus the composition of debt financing will likely consist of bank loans or covenant-heavy bonds. Furthermore, a moderately levered firm with strong corporate governance might benefit from an increase in the riskiness of debt. This incentivizes both claim holders to increase their monitoring levels. In this regime where monitoring by debt and equity claimants are substitutes, we often see that firms with block holders or strong boards also have bank loans and covenant heavy bonds.

For highly levered firms, a weaker board or other such barriers to monitoring may be ex-post optimal for the shareholders. However, firms with weaker boards may have lower debt capacity, as they shift the burden of monitoring onto creditors, thereby increasing the costs to debt financing. From an ex-ante perspective, a precommitment to board strength via staggered boards may be beneficial to the firm. Monitoring by debt claimants is crucial for firms with high second stage cash flows. Staggered boards keep debt monitoring high by removing the time inconsistency of the equity monitor's incentives. Furthermore, when transitioning between regimes of moderate to high levels of debt risk, staggered boards may

force debt holders to engage in beneficial monitoring.

3.3 Takeaways

The monitoring decisions of debt and equity matter for the firm's capital structure and the structure of its monitors. Comparative statics on the costs of monitoring and the riskiness of debt help categorize firms into primarily debt monitored, primarily equity monitored and mixed. Debt and equity claimants' monitoring actions may be either complements or substitutes. Equity claimants may have an incentive to artificially increase monitoring costs, via weak boards for example, to shift the burden of monitoring onto debt claimants. Since this can be detrimental to ex-ante firm value, precommitment devices such as staggered boards may help mitigate such agency costs.

Chapter 4

Conclusions

This dissertation builds on the literature of the agency conflict between debt and equity. Its novel contributions include the effect of this agency cost on corporate governance. Misalignment between debt and equity claimant incentives affect each claimant's monitoring decisions, the division of labor between multiple monitors and the role of security design in mitigating the problem.

The primary chapter considers capital structure's implication for corporate governance. Incentive contracts align managers with the total firm; shareholders and creditors alike. Furthermore, incentive contracts are verifiable and may serve as a commitment device for shareholders to guard against risk shifting. However, when monitors also have an advisory role to play, a complete division of control is not possible. Thus agency costs to debt are an endogenous cost to equity monitoring as well. In a Bayesian updating model of the board of directors, I find that stronger boards may counter intuitively be more lenient in replacing management. The optimal level of monitoring is decreasing in the firm's default barrier; i.e. debt is a cost to governance. When managers determine the firm's capital structure, they have an incentive to issue debt and exploit the conflict between debt and equity claimants. Thus there are benefits to a first mover advantage to the board of directors. The entrenching of the firm's boards of directors may rise as a feature of this interaction between the creditor, board and manager.

The next chapter deals with the coexistence of monitors of management who are affiliated with either debt or equity claims. I claim that debt based monitors such as banks or heavily covenanted debt add to the firm value in a partially orthogonal dimension to shareholder monitors such as boards or blockholders. Though this generally makes debt and equity monitors complementary, they may act as substitutes. Risky debt is necessary to incentivize debt claimants to monitor. In such regimes, debt and equity monitoring are substitutes; as the costs to equity monitoring increase, debt monitoring intensity increases to compensate. However, the cost of monitoring is borne by each claimant ex-post. Thus after debt is issued, equity monitors have an incentive to increase their monitoring costs; for example, via weakening their boards of directors. This shifts the burden of monitoring onto debt claimants. As with the previous chapter, shareholders may require a commitment device to

mitigate this agency problem. Staggered boards may yet again be an effective solution.

4.1 Current Challenges

Robust modeling of the complex interactions of creditors, shareholders and managers is fraught with challenges. Two main challenges stand out above the rest. First, a unified theory of the strategic interaction of the three actors of creditors, shareholders and management in a Nash equilibrium is theoretically challenging. A joint best response function to the various possible strategies has eluded the scope of this thesis. What is presented is a largely simplified framework. Modeling assumptions based on the timing of the moves makes the problem more tractable. Individual pairwise interactions between two of the three actors are analyzed here. These insights have been combined in this dissertation and hopefully, some synergies have been achieved.

Next, endogeneity remains a concern on any theory of equilibrium. As such, much of the empirical tests are simply suggestive evidence of correlation and not necessarily of causation. Some clean instruments could exist given the various policy changes surrounding both capital structure and governance. However, this has not been the primary focus of this paper. Two illustrative papers that consider some of the pairwise interactions to establish causation are Becker et al. 2010 and Chhaochharia (Chhaochharia and Grinstein 2007).

4.2 Future Directions

This dissertation considers the role of debt and its effect on corporate governance. To some extent, it does not as thoroughly consider the role of corporate governance on capital structure. Implicit in this work is the assumption that capital structure is innate to the firm. A few recent papers lend credence to this assumption by identifying persistent patterns in capital structure (Lemmon, Roberts, and Zender 2008). Also relevant are papers on capital structure at IPOs, and papers that look at capital structure over the very long run such as Longstaff Strebulyev 2012. Nevertheless, governance structure is widely considered to be more inflexible than capital structure. Indeed many of the results of this dissertation justify that inflexibility. Isolating these drivers of governance structure and the subsequent effects on capital structure is a natural complement to this dissertation. Indeed, this is essential to understanding the joint optimization that leads to the firm's endogenous choice of both capital and governance structures.

Finally, this dissertation does not fully capture the multiplicity of the components of governance. While alluding to both managerial incentives and monitoring by banks, this paper ignores the external governance market and the role of takeovers. It also does not fully integrate the role of debt structure. Incorporating these components is left to future research.

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Appendix A

Appendix to Chapter 3

A.1 Proofs

Proof of lemma 3.1.

Proof. In the case of safe debt, neither λ_e or λ_d are functions of the debt level (D) and thus the derivatives are zero in this regime. In every other case of low, moderate and high leverage, the monitoring intensity is increasing in debt. This can be shown by taking the appropriate derivatives and noting that they are all weakly positive. \square

Proof of lemma 3.2.

Proof. The derivatives of λ_d with respect to k_e in the low, moderate and high leverage cases are given respectively by

$$\frac{(1 - \pi)C_l((1 - \pi)^2C_lD + \pi C_h K_d)}{(K_e K_d + (1 - \pi)^2C_l^2)^2}, \frac{D * (\pi C_h + (1 - \pi)C_l)^2}{(K_e * K_d + (\pi C_h + (1 - \pi)C_l)^2)^2}$$

and

$$\frac{(\pi C_h)^2(\pi * D + (1 - \pi)C_{2h})}{(K_e * K_d + (\pi C_h)^2)^2}$$

all of which are greater than zero. Similarly, derivatives for λ_e with respect to K_d can also be shown to be positive. In the case of moderate leverage in order 2, debt and equity monitoring is independent of debt level within the regime. \square

Proof of lemma 3.3.

Proof. From lemma 3.1, we know that λ_e and λ_d are weakly increasing with debt in all regimes. The proof of the lemma follows from noting that $\lambda_e^{safe,mod,high} \leq \lambda_e^{FirstBest}$ and $\lambda_d^{safe,mod,high} \leq \lambda_d^{FirstBest}$ at the upper bounds in each state. \square

Proof of lemma 3.4.

Proof. Given the results of lemma 3.3, we have the following four pairs of debt and equity monitoring intensities at the upper bounds of debt face value D in each regime.

$$\begin{aligned}\lambda_e^{safe} &= \frac{\pi C_h + (1 - \pi)C_l}{K_e}, & \lambda_d^{safe} &= 0 \\ \lambda_e^{low} &= \frac{\pi C_h + (1 - \pi)C_l * \frac{(1-\pi)C_{2h}}{K_d}}{K_e}, & \lambda_d^{low} &= \frac{(1-\pi)C_{2h}}{K_d} \\ \lambda_e^{mod} &= \frac{\pi C_h}{K_e} & \lambda_d^{mod} &= \frac{(1-\pi)C_{2h}}{K_d}, \\ \lambda_e^{high} &= \frac{\pi C_h}{K_e} * \frac{(1 - \pi)C_{2h}}{K_d}, & \lambda_d^{high} &= \frac{(1-\pi)C_{2h}}{K_d}\end{aligned}$$

Given that $\frac{(1-\pi)C_{2h}}{K_d} \leq 1$, we note that $\lambda_e^{low} \geq \lambda_e^{mod} > \lambda_e^{high}$ and λ_d is unchanged in each regime. This combined with insight that the firm value is increasing in λ_e is sufficient to establish that the firm value in low leverage regimes dominates the moderate and high leverage regimes. \square

Proof of proposition 3.1.

Proof. The proof follows the following steps: first we consider conditions under which firm value under moderate leverage is larger than firm value for safe leverage. Then we consider debt levels of D where low leverage dominates moderate leverage. First we note:

$$\begin{aligned}FV^{safe} &= \frac{(\pi C_h + (1 - \pi)C_l)^2}{2K_e} \\ FV^{mod} &= \frac{(\pi C_h + (1 - \pi)C_l)^2}{2K_e} + \frac{\pi C_l^2}{K_e} + \frac{(1 - \pi)^2}{2} \left[\frac{C_{2h}^2}{K_d} - \frac{C_l^2}{K_e} \right]\end{aligned}$$

The above equations take advantage of the fact that the monitoring intensity in the moderate leverage regime is independent of the debt level D . We see that $FV^{mod} > FV^{safe}$ if $\frac{C_{2h}^2}{K_d} > \frac{C_l^2}{K_e}$. Next, we consider debt levels where $FV^{mod} < FV^{low}$ which is implied by $\lambda_e^{mod} < \lambda_e^{safe}(D)$. The transition level of D_{trans} is given by $\lambda_e^{mod} = \lambda_e^{safe}(D_{trans})$ which implies that $D = \frac{\pi C_h}{K_e}$. For all C_l greater than 1, $D_{trans} < D$ in the low leverage regime. \square

Proof of corollary 3.1.

Proof. The proof, if tedious, is straight forward. $FV^{mod1}(D)$ is calculated directly from $\lambda_e^{mod1}, \lambda_d^{mod1}$. Comparison with FV^{safe} , returns the above sufficient condition. \square

Proof of proposition 3.2.

Proof. The proof of this proposition is best illustrated by considering order 2 and the transition between safe debt and low leverage for the firm. First, note that

$$FV^{safe} = \frac{(\pi C_h + (1 - \pi)C_l)^2}{2K_e}$$

$$FV^{low} = \frac{(\pi C_h + (1 - \pi)C_l)^2}{2K_e} + \frac{(1 + \pi)(1 - \pi)^2 C_{2h}}{2K_d} - \frac{(1 - \pi)^2 C_l^2}{2K_e} \left(1 - \frac{(1 - \pi)C_{2h}}{K_d}\right)^2$$

The firm value is indifferent between safe and low leverage risky debt when $FV^{safe}(K_e^{trans}) = FV^{low}(K_e^{trans})$ where K_e^{trans} is the transition level of equity monitoring cost or board strength between safe and risky debt. This leads to the following solution:

$$K_e^{trans} = \frac{1 - \pi}{1 + \pi} \left(\frac{C_l}{C_{2h}}\right)^2 \left(1 - \frac{(1 - \pi)C_{2h}}{K_d}\right)^2 K_d$$

As C_l increases, the transition level of K_e increases making safe debt more likely. Similarly, when C_{2h} increases or K_d decreases, low leverage becomes optimal. Finally, we note that as K_e increases beyond K_e^{trans} , firm value is optimized at low levels of risky debt as opposed to safe debt. \square

Proof of proposition 3.3.

Proof. Consider the relevant comparative static for the three cases individually; low leverage, moderate leverage under order 2 and moderate leverage under order 1. First with low leverage,

$$\frac{\partial Equity}{\partial K_e} = (\pi(C_h - \lambda_d C_l) - K_e \lambda_e) \frac{\partial \lambda_e}{\partial K_e} - \frac{\lambda_e^2}{2} + \pi(C_{2h} - \lambda_e C_l) \frac{\partial \lambda_d}{\partial K_e}$$

For the comparative static to be positive, the following condition must be satisfied

$$\frac{\lambda_e}{2} + \frac{\lambda_d C_l K_d}{K_e K_d + (1 - \pi)^2 C_l^2} < \frac{\pi(1 - \pi)C_l(C_{2h} - \lambda_e C_l)}{K_e K_d + (1 - \pi)^2 C_l^2}$$

which violates the assumption of bounded probabilities of λ_e and λ_d . Next consider the case of moderate leverage in order 1.

$$\frac{\partial Equity}{\partial K_e} = (\pi C_h - K_e \lambda_e) \frac{\partial \lambda_e}{\partial K_e} - \frac{\lambda_e^2}{2} + \pi C_{2h} \frac{\partial \lambda_d}{\partial K_e}$$

which simplifies to $-\frac{(\pi C_h)^2}{2K_e^2}$ which is always negative. Finally we consider the case of moderate leverage in order 2.

$$\frac{\partial Equity}{\partial K_e} = (\pi C_h + (1 - \pi)C_l \lambda_d - K_e \lambda_e) \frac{\partial \lambda_e}{\partial K_e} - \frac{\lambda_e^2}{2} + (\pi C_h + (1 - \pi)C_l \lambda_e + C_{2h} - D) \frac{\partial \lambda_d}{\partial K_e}$$

Which is positive under the following condition

$$C_{2h} > D \frac{K_e K_d - (\pi C_h + (1 - \pi) C_l)^2}{2(K_e K_d + (\pi C_h + (1 - \pi) C_l)^2)}$$

Here we note that C_{2h} is larger than the default barrier or debt level D though we are in a high leverage regime. Equity claimants do not necessarily benefit if default is imminent. \square