The Design of Internal Control and Capital Structure

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We study the design of internal control and capital structure. We pose the question, When is control allocated only to shareholders and when is it allocated to other stakeholders, such as debtholders, or the management team? We show that shareholders (debtholders) get control when the firm's cash flow is relatively sensitive (insensitive) to managerial effort. Our theory implies that the signs of the correlations between endogenous variables when shareholders have absolute control are reversed when debtholders have veto power. In particular, debt level and firm value are negatively (positively) correlated when debtholders have veto power (shareholders have absolute control).

In modern corporations, control over resources is delegated to a management team that is responsible for day-to-day decision making. Consequently, internal and external control mechanisms that allocate resources to the best managers and discipline these

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managers are very important. External control refers to the market for corporate control where managers are replaced and disciplined via takeovers. Internal control refers to arrangements within the firm, like the control of the board of directors over the management team and contractual agreements such as bond covenants. Internal control is an indispensable part of the structure of any corporation and only when it is ineffective is external control necessary to replace and discipline managers. Moreover, internal control has become even more important recently, as antitakeover legislation has reduced the effectiveness of external control.

In this article we study the design of internal control and capital structure. We do not assume that only shareholders have control over the management team. Instead, we pose the question, Why and when is control allocated to other stakeholders, such as debtholders, or the management team? Our thesis is that control allocation and capital structure are designed to influence future strategic decisions of a firm.

We consider an entrepreneur who hires a manager, issues securities, and allocates control to each security and the management team. We focus on two types of securities: fixed claim securities, such as debt and preferred stock, and residual claim securities, such as common stock. Each security is allocated control that enables its holders to affect hiring and firing of managers. The firm's cash flow is affected by both the manager's effort and ability. After the manager exerts effort, but before the cash flow is realized, security holders observe a nonverifiable signal that reveals the cash flow under the current manager. Given the signal, they decide whether to replace the manager with an alternative manager that will produce an uncertain cash flow, retain the manager, or liquidate the firm. The manager never quits voluntarily because she derives private benefits from managing the firm.

The managerial replacement decision determines the quality of the manager and affects the effort she exerts. The replacement rule that maximizes expected managerial quality implies that a manager whose ability is below the average ability of alternative managers (a below average manager) is replaced, and a manager whose ability is above the average ability of alternative managers (an above average manager) is retained. Any deviation from this rule imposes a cost on the firm. Nevertheless, such a deviation may be beneficial, because it may motivate the manager to exert more effort. The optimal replacement rule is obtained by balancing these costs and benefits.

We show that when the marginal product of managerial effort is relatively high in the sense that the distribution of the cash flow is sensitive to managerial effort, it is optimal to be *aggressive*, that is, to replace some above average managers. In this case, setting a higher

standard for the manager motivates her to work harder to beat the standard. When the marginal product of managerial effort is relatively low, it is optimal to be *conservative*, that is, to retain some below average managers. In this case, a higher standard for the manager will discourage her since it will become too costly for her to get within "shooting range."

When the optimal replacement rule involves either replacing above average managers or retaining below average managers, an implementation problem arises. This problem can be best demonstrated for the case of an all-equity firm. After observing the signal and learning the manager's ability, shareholders' best action is to replace the manager if and only if her ability is below average. At this stage, the effort level has already been exerted, and managerial quality is the only relevant consideration for shareholders. Therefore, implementing a different replacement policy requires a credible commitment by the entrepreneur at the outset. This commitment is achieved via the design of internal control and capital structure.

To understand how the design of internal control and capital structure supports the desired replacement policy, consider a firm with both fixed and residual claims outstanding. After the signal has been observed, the cash flow under the incumbent manager is known with more precision. Replacing the manager at this stage introduces uncertainty regarding the cash flow.[1] This uncertainty generates value for residual claimholders, whose payoff function is convex, at the expense of fixed claimholders, whose payoff function is concave. Therefore, residual claimholders are more aggressive and would like to replace the manager more often than fixed claimholders. Consequently, when the entrepreneur would like to commit the firm to replace some above average managers, he issues fixed claim securities and gives absolute control to residual claimholders. When the entrepreneur would like to commit the firm to retain some below average managers, he issues fixed claim securities and allocates fixed claimholders enough control to enable them to affect managerial replacement.[2] Fixed claimholders do not get absolute control to prevent them from liquidating the firm. This allocation of control is equivalent to giving residual claimholders control but giving fixed claimholders veto power over their decision.

A higher level of fixed claims makes decision makers (residual

[1] It is possible that, counter to our assumption, replacing the manager will reduce the riskiness of the cash flow, as in Dewatripont and Tirole (1994). We discuss the implications of this scenario in Section 6.

[2] It should be noted that, while the riskiness of debt is instrumental in implementing the desired replacement rule, state contingent transfer of control, such as bankruptcy before the terminal cash flow is realized, has no role in implementing the replacement rule.

or fixed claimholders) more aggressive, thereby increasing the cutoff level of ability below which the manager is replaced. Therefore, for every replacement rule there exists a unique combination of internal control allocation and capital structure that implements it.

The result that debtholders are allocated control is new and is yet to be empirically tested. The following casual observations are at least consistent with this hypothesis. First, debtholders are represented on boards of directors, see Bacon and Brown (1975), Franks and Mayer (1994), and Kracaw, Lummer, and McConnell (1990). Second, some debt contracts include covenants allowing creditors to veto managerial replacement. Third, creditors who have a specific relationship with a firm can affect decisions by threatening to cut needed short-term financing to the firm.[3]

The empirical implications of our theory highlight the importance of internal control. The predicted signs of the correlations between endogenous variables when shareholders have absolute control are reversed when debtholders have veto power. In particular, firm value and debt level are positively correlated when shareholders have absolute control, and are negatively correlated when debtholders have veto power. Therefore, empirical work that does not control for the allocation of internal control may yield ambiguous results.

In related articles, Aghion and Bolton (1992), Dewatripont and Tirole (1994), Kalay and Zender (1991), and Zender (1991) consider the allocation of cash flow and control to securities. They show that the optimal allocation of cash flow and control to securities is state contingent. In the "good states" the optimal securities resemble debt without control and equity with control. In the "bad states" control is transferred to the debtholders. In our article, control is allocated at the outset and is not transferred contingent on future states of nature.

Hirshleifer and Thakor (1991, 1994) consider the interaction between internal and external control mechanisms. They consider the implications of takeover threats to the effectiveness of the board of directors in monitoring the manager. In these papers, the role of the board of directors (internal control) is to gather information about the management team. In contrast, we focus on how internal control affects managerial incentives.

In our article, the role of risky debt is to provide managers with incentives to exert effort via its effect on managerial replacement decisions. This is different from Chang (1993), Grossman and Hart (1982), Harris and Raviv (1990), Hart and Moore (1989), and Kalay and Zender

[3] For example, a creditor may have private knowledge about a firm's quality that enables him to provide credit with better terms to the firm. In this case, the creditor can influence the firm's replacement decision by threatening to terminate the specific relations [see Rajan (1992)].

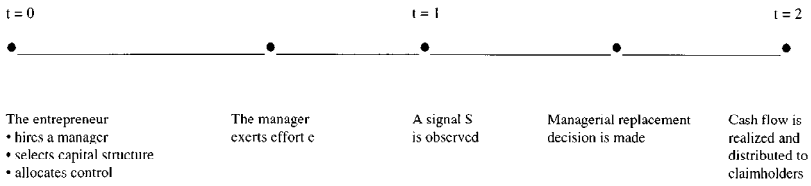

Figure 1
Sequence of events and decisions

(1991), where the incentive or monitoring roles of debt are achieved via a default or a bankruptcy mechanism.

This article is organized as follows. Section 1 describes the model. Section 2 characterizes the desired managerial replacement policy and shows the problem in implementing it. Section 3 shows how internal control and capital structure can be designed to credibly commit the firm to the desired replacement policy. Section 4 solves for the optimal internal control allocation and capital structure. Section 5 describes institutional arrangements that implement our optimal design and relate them to observed control mechanisms. Section 6 provides the empirical implications. Section 7 discusses the robustness of our results to the inclusion of direct wage contracts. Section 8 concludes. All proofs are relegated to the Appendix.

1. The Model

Consider a firm that is established in period 0 and operates for two more periods — period 1 and period 2. The sequence of events and decisions, summarized in Figure 1, is as follows. In period 0, the entrepreneur hires a manager and determines the firm's capital structure and control allocation. We restrict attention to securities with either a claim to the residual cash flow — ***residual claim securities*** (e.g., common stock) — or a fixed claim to the firm's cash flow — ***fixed claim securities*** (e.g., risky debt, preferred stock).[4] Fixed claimholders are entitled to a fixed payment D in period 2.

The control rights of a security enable its holders to influence the replacement of managers.[5] There are several ways to implement differ-

[4] We abstract from the issue of the optimal design of securities' cash flows.

[5] Our model can be also applied to other long-term strategic planning of the firm. See the discussion in Section 8.

ent control allocations. To fix ideas, we focus on the decision making of a board of directors consisting of representatives of security holders and the management team.[6] Directors have the right to appoint and dismiss managers, and decisions are made by voting. Directors vote in the best interest of the group they represent, but do not have the right to change the terms of the securities they represent.[7] A security or the management team may have absolute control, partial control, or no control. When a security or the management team has ***absolute control***, their representatives have the majority of the votes, enabling them to replace the manager unilaterally. When a security or the management team has ***partial control***, their representatives can influence the replacement decision by forming a coalition with other representatives, but cannot unilaterally replace the manager. When a security or the management team has ***no control***, their representatives have no say in managerial replacement.

In period 1, the manager organizes the firm's operations. For example, she selects workers, organizes them in production teams, selects the line of business, et cetera. We model these start-up activities as a choice of an unobservable effort level, e. This effort level, together with managerial ability, α, determine the cash flow under the incumbent manager, y, in period 2. Managerial ability α is unknown to all when the manager selects the effort level e. For a given effort level e, the distribution of α induces a twice continuously differentiable cumulative distribution function, $G(y \mid e)$, over $\Re^+$ via the relationship $y = y(\alpha, e)$.[8] We assume that y is strictly increasing and differentiable in both effort level and managerial ability and that a larger effort level implies a stochastically larger income in the sense that the density function, $g(y \mid e)$, exhibits the monotone likelihood ratio property (MLRP) with respect to e: $g_e(y \mid e)/g(y \mid e)$ increases with y. Note that the MLRP implies that a higher effort level induces a better distribution function in the sense of first-order stochastic dominance: $G_e(y \mid e) < 0$, for every y.[9] Finally, we assume that $G_{ee} > 0$, $g_{ee} \geq 0$ and that, as $y \to \infty$, $yG_e(y \mid e) \to 0$.

As mentioned, the effort level e represents a nonpecuniary investment by the manager in starting up the firm's operations in period 1. The manager's disutility from effort is denoted by $k\psi(e)$, where k

[6] See Section 5 for other mechanisms to implement different control allocations.

[7] In Section 5 we show that it is optimal for the entrepreneur to write into the corporate charter that board members cannot change the terms of the securities they represent in order to enforce commitment.

[8] This transformation is similar to that in Holmström (1979) and Mirrlees (1974, 1976).

[9] See Milgrom (1981) and Rogerson (1985) for a proof that the MLRP implies first-order stochastic dominance.

is a positive constant and ψ is an increasing and convex function of e satisfying $\psi(0) = \psi'(0) = 0$. The manager draws nontransferable private benefits, B, from managing the firm.[10] We assume that the alternative wage for the manager is zero, that she does not have personal funds, that all agents are risk neutral, and that the discount rate is zero. The assumption that the risk neutral manager has no personal funds implies that she cannot buy the firm or pay directly for the right to control.

After the manager has exerted effort, security holders observe a nonverifiable signal, S, about the cash flow in period 2 under the current manager. The signal represents the ability of the incumbent manager in terms of the success of the start-up stage: it reflects production efficiency and costs, market conditions, the success of the chosen line of business, et cetera. The signal S is perfect: it reveals with certainty the cash flow that will be obtained in period 2 under the current management, $y(S)$.[11] Given the signal, security holders decide whether to continue with the current manager, replace her with an alternative manager, or liquidate the firm by selling it.

If a new manager is hired, the cash flow under her management is distributed according to the cumulative distribution function $H(y)$ and has a density function $h(y)$. This cash flow is realized in period 2 and has expected value $\bar{y}$, which is independent of the effort exerted in period 1 by the incumbent manager. This formulation assumes that an alternative manager uses the assets of the firm in a different way, so that the cash flow with the alternative manager is insensitive to the effort level of the incumbent manager.[12]

We assume that the liquidation value is the expected cash flow under an alternative manager, $\bar{y}$, and is obtained with certainty in period 1. This assumption represents the idea that the firm is sold for its value with an alternative manager, $\bar{y}$.[13]

Finally, in period 2, the cash flow y is realized and distributed to claimholders. Two comments are in order. First, we assume that no additional discretionary effort is exerted by either manager in period 2.

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[10] For example, the private benefits may include nonpecuniary perquisites, or the ability to exercise control over middle management [see Grossman and Hart (1988), Harris and Raviv (1988), and Jensen and Meckling (1976)].

[11] Since the signal is nonverifiable to a third party, no binding contracts that are conditioned on the signal can be written.

[12] This assumption simplifies the derivation of the empirical results. When the effort level of the incumbent manager affects the cash flow under an alternative manager, the results regarding the role of capital structure and control allocation remain the same. The empirical predictions remain the same as long as the cash flow under an alternative manager is not "too sensitive" to the effort exerted by the incumbent manager. Otherwise the empirical predictions are ambiguous.

[13] A lower liquidation value will not change the results in a substantial way. We discuss this possibility in Footnote 18.

Thus, our model is only consistent with additional nondiscretionary effort to be taken in the production stage. Second, our assumptions that the signal S is perfect and that the cash flow under an alternative manager is uncertain imply that replacing the manager increases the riskiness of the firm's cash flow. This represents the fact that the manager and investors have an opportunity to learn more about the current manager and the line of business she has chosen in period 1.[14]

The three alternatives — retaining the manager, replacing her, or liquidating the firm — affect both the expected cash flow and its risk. If the manager is retained, the cash flow is $y(S)$ with certainty. If the manager is replaced, the firm generates a risky cash flow with expected value $\bar{y}$. If the firm is liquidated, the cash flow is $\bar{y}$ with certainty. Since residual claimholders prefer a riskier cash flow, while fixed claimholders prefer a safer cash flow, different control allocations result in different replacement/liquidation decisions.

The replacement/liquidation policy has two important implications for the firm. First, it monitors the quality of the managerial team: if the cash flow under the current manager (her perceived ability) is "low enough," the manager is replaced. Second, it influences managerial incentives to exert effort by affecting the likelihood that the manager will remain with the firm and realize the private benefits. The optimal replacement rule takes both effects into account.

2. The Desired Replacement Policy and the Implementation Problem

In this section we characterize the optimal replacement rule and show that it cannot be implemented without a credible commitment. For this, consider a replacement policy such that the manager is replaced if and only if the signal S is below a critical level, S^c. Since the signal is perfect, the replacement policy can be represented by y^c such that the manager is replaced if and only if $y(S) < y^c$, where $y^c \equiv y(S^c)$.[15] To solve for the optimal y^c, we first analyze its effect on managerial effort. Given y^c, the manager chooses the effort level that maximizes

[14] An alternative assumption is that dismissing the current manager reduces the riskiness of a firm's cash flow. This would happen, for example, if the only alternative were to liquidate the firm and if the signal were not perfect. Dewatripont and Tirole (1994) explore the implications of this alternative formulation for control allocation and capital structure. We discuss in Section 6 the implications of this alternative assumption to our theory.

[15] This replacement rule is optimal if the density function g is not "too sensitive" to the effort level for high values of y. In this case, it dominates all other replacement rules because it provides the manager with the right incentive, while only the lowest quality managers are replaced. If instead g is very sensitive to effort in the upper tail of the distribution, the optimal replacement rule may be different.

her expected payoff as follows:

$$\max_{e} B[1 - G(y^c \mid e)] - k\psi(e). \tag{1}$$

The first expression is the expected private benefit to the manager: the probability of staying with the firm multiplied by the private benefits. The second term is the disutility of effort to the manager. The first-order condition for this problem is given by

$$-BG_e(y^c \mid e) - k\psi_e(e) = 0. \tag{2}$$

The manager equates her marginal payoff of effort, $-BG_e(y^c)$, to her marginal cost of effort, $k\psi_e(e)$. Our assumptions guarantee that Equation (2) has a unique interior solution, $e^*(y^c)$. For expositional convenience we denote $e^*(y^c)$ by e^*.

The effect of the replacement rule on managerial effort depends on the sensitivity of the distribution of the cash flow to managerial effort. The sensitivity of the distribution of the cash flow represents the marginal product of managerial effort. When the marginal product of managerial effort is relatively high, setting a higher standard for the manager by increasing the replacement rule motivates her to work harder to beat the standard. This case is shown in Figure 2, where an increase in the effort level from e_1 to e_2 shifts the density function of the cash flow enough so that the intersection of the two densities is to the right of y^c. Formally, this case corresponds to the condition $g_e(y^c) < 0$.

In contrast, when the distribution of the cash flow is insensitive to managerial effort, that is, when the marginal product of managerial effort is relatively low, setting a higher standard will frustrate the manager because it is too costly for her to get within "shooting range." In this case, reducing the standard for the manager will increase managerial effort, as it becomes more likely she will meet the standard. This case is shown in Figure 3, where an increase in the effort level from e_1 to e_2 does not shift the density function of the cash flow enough so that the intersection of the two densities is to the left of y^c. Formally, this case corresponds to the condition $g_e(y^c) > 0$. This discussion is summarized in Proposition 1.

Proposition 1. *The manager's effort level increases with y^c if $g_e(y^c) < 0$, and decreases with y^c if $g_e(y^c) > 0$.*

When the entrepreneur chooses y^c, he takes into account the effect of y^c on managerial effort and quality. The entrepreneur chooses y^c

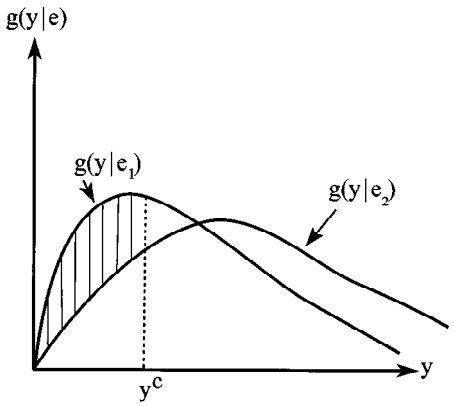

Figure 2
Changes in the density function of the cash flow when it is sensitive to managerial effort: $g_e(y^c) < 0$
The figure describes two density functions $g(y \mid e)$ where y denotes the period 2 cash flow under the incumbent manager, e denotes the effort level of the incumbent manager, and $e_2 > e_1$. y^c is the replacement rule such that the incumbent manager is replaced if and only if $y < y^c$. Consequently, the shaded area represents the increase in the probability that the manager will remain with the firm and obtain the private benefits when she increases the effort level from e_1 to e_2. When y^c shifts to the right, the shaded area and, therefore, the expected payoff to the manager increase with effort.

to maximize the firm's expected cash flow as follows:

$$\max_{y^c} V_0 = \int_{y^c}^{\infty} yg(y \mid e^*)\, dy + \bar{y}G(y^c \mid e^*). \tag{3}$$

The first term represents the firm's expected cash flow when the incumbent manager remains with the firm, and the second term represents the expected cash flow when she is replaced. For a given effort level, it is optimal to replace her if and only if $y(S) < y$. When $g_e(\bar{y}) < 0$, a small increase in the replacement rule above $\bar{y}$ induces the manager to exert more effort. Thus, the optimal replacement rule is above $\bar{y}$. Similarly, when $g_e(\bar{y}) > 0$, the optimal replacement rule is below $\bar{y}$. This result is summarized in Proposition 2.

Proposition 2. *The optimal replacement rule y^* is higher than the expected cash flow under an alternative manager, $\bar{y}$, if $g_e(\bar{y}) < 0$, and is lower than $\bar{y}$ if $g_e(\bar{y}) > 0$.*

We now demonstrate the difficulties in implementing an optimal replacement rule $y^* \neq \bar{y}$ in the absence of a credible commitment, by considering the replacement rule followed by an all-equity firm. The implementation problem is caused by the dynamic sequencing of events. The managerial replacement decision is made after the signal

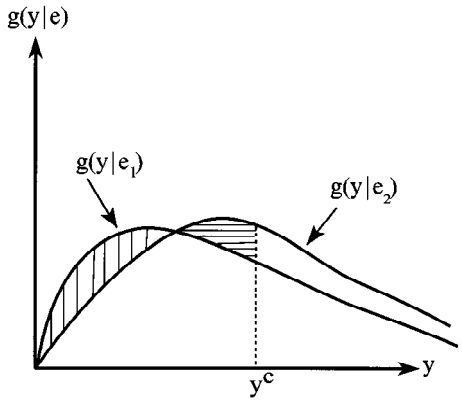

Figure 3
Changes in the density function of the cash flow when it is insensitive to managerial effort: $g_e(y^c) > 0$
The figure describes two density functions $g(y \mid e)$ where y denotes the period 2 cash flow under the incumbent manager, e denotes the effort level of the incumbent manager, and $e_2 > e_1$. y^c is the replacement rule such that the incumbent manager is replaced if and only if $y < y^c$. The shaded area to the left of the intersection point represents the increase in the probability that themanager will remain with the firm and obtain the private benefits when she increases the effort level from e_1 to e_2. The shaded area to the right of the intersection point represents the decrease in this probability. Therefore, the total increase in this probability is the shaded area to the left of the intersection point minus the shaded area to the right of the intersection point. When y^c shifts to the right, the shaded area to the right of the intersection point increases and, therefore, the expected payoff to the manager decreases with effort.

has been observed. Since effort has already been exerted at this stage, the replacement rule that maximizes shareholders' value is to replace the manager whenever the signal indicates that the cash flow under the manager is below the expected cash flow under an alternative manager, $\bar{y}$. Therefore, the decision rule that maximizes shareholders' value in period 1 does not take into account how the replacement rule affects the incentives for the manager to exert effort. The implementation of an optimal replacement policy that takes into account both managerial quality and incentives requires a credible commitment at the outset. In the next section we show how the entrepreneur can use capital structure and internal control allocation to credibly commit the firm to the desired replacement policy.

3. Commitment with Internal Control and Capital Structure

The replacement decision of a firm with both fixed and residual claims outstanding is different from that of an all-equity firm. In particular, when different security holders derive different payoffs from replacing the manager, different control allocations result in different replacement rules. All feasible control allocations are represented by

the following set:

$$\Gamma = \{\gamma_M, \gamma_F, \gamma_R, \gamma_P\} \tag{4}$$

where

γ_M = management team has absolute control (their representatives on the board of directors have a majority of the votes);

γ_F = fixed claimholders have absolute control (their representatives have a majority of the votes);

γ_R = residual claimholders have absolute control (their representatives have a majority of the votes); and

γ_P = each group has partial control (no group has a majority of the votes, but each can form a winning coalition with another group).

To solve for the optimal capital structure and control allocation, we first analyze the decision making of each group. The analysis of the cases where the management or fixed claimholders have absolute control (γ_M or γ_F) is straightforward. The manager always objects to replacement or liquidation because she draws private benefits only when she is retained. Therefore, under γ_M, the manager always remains with the firm. When fixed claimholders have absolute control (γ_F), they never replace the manager. They prefer to liquidate the firm whenever the cash flow under the manager is lower than the liquidation value, and retain the manager otherwise.[16] The analysis of the two remaining cases is given in Sections 3.1 and 3.2.

3.1 Residual claimholders have absolute control

Residual claimholders prefer replacing the manager over liquidation, because replacement yields the same expected cash flow with more risk. Thus, it remains to analyze their replacement decision. Residual claimholders prefer to replace the manager if the value of their claim under the incumbent manager is lower than its expected value under an alternative manager. The value of the residual claim under the incumbent manager is

$$V_R(I, D) = \max\{y(S) - D, 0\}. \tag{5}$$

The value of the residual claim when an alternative manager is hired is

$$V_R(A, D) = \int_D^\infty (y - D)h(y)\,dy. \tag{6}$$

[16] To see this, suppose $y(S) < D$. Debtholders can get $\min\{D, \bar{y}\}$ with certainty by liquidating the firm, or $y(S)$ by retaining the manager. Thus, they liquidate whenever $y(S) < \bar{y}$. Suppose now $y(S) > D$. If $\bar{y} < D$, they will retain the manager. If $\bar{y} > D$, fixed claimholders are indifferent between liquidation and retaining the manager. We assume that whenever they are indifferent they follow the optimal rule, that is, liquidate the firm if and only if $y(S) < \bar{y}$.

Residual claimholders replace the manager if $V_R(I, D) \leq V_R(A, D)$. Let y^R be the critical value of $y(S)$ such that residual claimholders would like to replace the manager for any value of $y(S)$ below y^R. Equating Equations (5) and (6) yields

$$y^R(D) = \bar{y} + \int_0^D (D - y)h(y)\,dy. \tag{7}$$

The second term on the right-hand side represents a wealth transfer from fixed claimholders to residual claimholders. Therefore, residual claimholders are more aggressive than owners of an all-equity firm, for which this term is zero. Since the wealth transfer increases with the level of debt, a higher debt level makes residual claimholders more aggressive. The following lemma shows that, by properly choosing the promised fixed payment D, the entrepreneur can commit the firm to any replacement rule y^R larger than $\bar{y}$.

Lemma 1. *$y^R(D)$ is continuously increasing in D, $y^R(0) = \bar{y}$ and $y^R(\infty) = \infty$.*

We denote by D^R the inverse of y^R. D^R is the level of debt that, together with absolute control to shareholders, enables the entrepreneur to implement the replacement policy y^R.

3.2 Partial control

For the case of partial control, liquidation does not occur because residual claimholders and the management team always object to it. Therefore, it is sufficient to analyze fixed claimholders' choice between replacing and retaining the manager. Fixed claimholders prefer to replace the manager if the value of their claim under the incumbent manager is lower than its expected value under an alternative manager. The value of the fixed claim under the incumbent manager is

$$V_F(I, D) = \min\{y(S), D\}. \tag{8}$$

The value of the fixed claim under an alternative manager is

$$V_F(A, D) = \int_0^D yh(y)\,dy + \int_D^\infty Dh(y)\,dy. \tag{9}$$

Fixed claimholders replace the manager if $V_F(I, D) \leq V_F(A, D)$. Let y^F be the critical value of $y(S)$ for which fixed claimholders would like to replace the manager for any value of $y(S)$ below y^F. The critical level y^F is obtained by equating Equations (8) and (9):

$$y^F(D) = \bar{y} - \int_D^\infty (y - D)h(y)\,dy. \tag{10}$$

Fixed claimholders are more conservative than the owners of an all-equity firm because a positive term is subtracted from $\bar{y}$. Since this positive term decreases with the level of debt, fixed claimholders become more aggressive as the level of debt increases. The following lemma shows that, by properly choosing the promised fixed payment, D, the entrepreneur can commit the firm to any replacement rule y^F smaller than $\bar{y}$.

Lemma 2. *$y^F(D)$ is continuously increasing in D, $y^F(0) = 0$, and $y^F(\infty) = \bar{y}$.*

We denote the inverse of y^F by D^F.

In the case of partial control, the manager is replaced according to fixed claimholders' replacement rule $y^F(D)$. Fixed claimholders control the replacement policy because management never supports its own replacement, and residual claimholders have a stronger incentive to replace the manager than fixed claimholders ($y^R > y^F$). Therefore, fixed claimholders cooperate with the manager if they want to block a replacement, and with residual claimholders if they want to replace the manager. In this respect, partial control is equivalent to either giving residual claimholders control and giving fixed claimholders the power to veto their decisions, or giving fixed claimholders control and allowing residual claimholders to veto a liquidation decision.

In summary, the analysis of this section shows that the entrepreneur can implement any replacement rule $y^c \in \Re^+$ by choosing the right pair of fixed payment D and control allocation γ_i. If the entrepreneur wants to implement an aggressive replacement rule, he allocates absolute control to residual claimholders and issues fixed claims with face value D^R. If the entrepreneur wants to implement a conservative replacement rule, he gives partial control to each group and issues fixed claims with face value D^F. Figure 4 provides graphical representation of how different pairs of debt level and control allocation implement different replacement rules.

4. The Design of Internal Control and Capital Structure

We now describe how the entrepreneur designs internal control and capital structure when he establishes the firm. At the outset, the entrepreneur sells debt and equity to outside investors.[17] Thus, the entrepreneur's problem is to select capital structure and control allocation $\{D, \gamma_i\}$ that maximize his proceeds. Since securities are sold at fair value, the entrepreneur's problem is reduced to maximizing

[17] The results would not change if the entrepreneur retained equity.

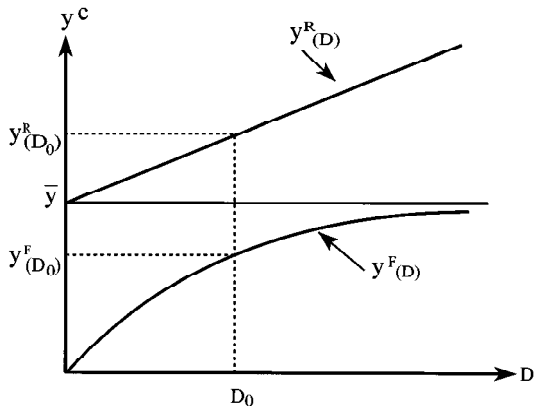

Figure 4
Implementation of different replacement rules
The figure describes different replacement rules y^c that are implemented by different debt levels and different control allocations. The line $y^R(D)$ describes the replacement rules that can be implemented by giving shareholders absolute control and issuing different debt levels D, and the line $y^F(D)$ describes the replacement rules that can be implemented by giving fixed claimholders veto power and issuing different debt levels D. For example, by giving shareholders absolute control and issuing debt level D_0, the firm implements a replacement rule where the incumbent manager is replaced whenever $y < y^R(D_0)$. Instead, by giving fixed claimholders veto power and issuing debt level D_0, the firm implements a replacement rule where the incumbent manager is replaced whenever $y < y^F(D_0)$.

the firm's expected cash flow. Let $y^c(D, \gamma_i)$ be the replacement rule corresponding to the pair $\{D, \gamma_i\}$. Then, the entrepreneur's problem is

$$\max_{D,\gamma_i} V_0 = \int_{y^c(D,\gamma_i)}^{\infty} yg(y \mid e^*)\, dy + \bar{y}G(y^c(D, \gamma_i) \mid e^*) \qquad (11)$$

subject to

$$e^* = \operatorname{argmax} B[1 - G(y^c(D, \gamma_i) \mid e)] - k\psi(e). \qquad (12)$$

Note that the only difference between the entrepreneur's problem and the problem described by Equations (1) and (3) is that $y^c(D, \gamma_i)$ replaces y^c. Therefore, the solution to Equations (11) and (12) is the combination of capital structure and control allocation $\{D^*, \gamma_i^*\}$ that implements the optimal replacement rule; that is, $y^c(D^*, \gamma_i^*) = y^*$. Thus, we can use the results of Section 3 to obtain the following proposition.

Proposition 3.

(i) If the entrepreneur wants to commit the firm to replace above average managers, he issues debt and allocates absolute control to residual claimholders, that is, if $y^* > \bar{y}$, then $\gamma_i^* = \gamma_R$ and $D^* = D^R$.

(ii) If the entrepreneur wants to commit the firm to retain below average managers, he issues debt and allocates partial control, that is, if $y^* < \bar{y}$, *then* $\gamma_i^* = \gamma_P$ *and* $D^* = D^F$.

It follows from Proposition 3 that residual claimholders always have some control, either absolute or partial control. In contrast, fixed claimholders never have absolute control, they either have partial or no control.[18] We now discuss how these results can be implemented and their relationship to observed control allocations.

5. Implementation of the Optimal Control Allocation

To implement the optimal replacement rule, the entrepreneur has to allocate control and issue debt and external equity, as described by Proposition 3. In doing so, the entrepreneur should make renegotiations of the terms of securities prohibitively expensive. Renegotiation costs are important because debt can be a useful commitment device only if its terms cannot be costlessly renegotiated. Otherwise there is always a negotiated deal that results in a replacement of managers if and only if their ability is below average. Thus, when renegotiation is costless, commitment to an aggressive or a conservative replacement rule breaks down.

The observation that costless renegotiations can undo the investment distortions caused by debt is well recognized. For example, Myers (1977) discusses how renegotiations can alleviate the underinvestment problem, but argues that it is generally expensive to renegotiate debt contracts.[19] One objection to Myers's view is that if debt creates distortion, the parties would design a costless renegotiation mechanism when they sign the debt contract. This objection does not apply to our theory because the ex post distortions caused by debt create value at the time contracts are signed. Therefore, the entrepreneur designs a costly renegotiation mechanism at the outset. We demonstrate this point below, where our premise is that renegotiation is prohibitively expensive when a security is held by a large number of investors.

[18] Debtholders do not get absolute control because of the assumption that the liquidation value equals $\bar{y}$. This assumption represents the idea that new outside investors can purchase the firm and employ an alternative manager. It may be the case that they are willing to pay less than $\bar{y}$, resulting in a lower liquidation value. A lower liquidation value does not have a significant effect on the results. The intuition is that because the firm is not liquidated in equilibrium when the liquidation value is $\bar{y}$, it is not liquidated when the liquidation value is less than $\bar{y}$. The only difference is that for a low enough liquidation value (e.g., zero), the threat of debtholders to liquidate becomes empty. Therefore, the desired replacement rule can be implemented by giving debtholders absolute control instead of veto power. In this case, partial control is equivalent to giving debtholders absolute control. All other results remain the same.

[19] Myers's (1977) argument is extendable to overinvestment.

There are several mechanisms that implement the results of Proposition 3. We first show how an entrepreneur can implement these results by designing the mechanism we have focused on, that is, a board of directors whose members vote in the interest of the group they represent, but do not have the right to change the terms of the securities.

5.1 Implementation of an aggressive replacement policy

When the entrepreneur would like to commit the firm to an aggressive replacement rule, $y^* > \bar{y}$, he does the following:

1. Issues the appropriate amount of widely held debt, as prescribed by Proposition 3.

2. Gives the majority of the votes to directors that represent the residual claimholders.

3. Specifies in the corporate charter that directors are not allowed to change the terms of securities without first approaching the security holders they represent and getting their explicit permission.

In the presence of debt, this shareholder-controlled board of directors implements an aggressive replacement policy. The commitment to an aggressive replacement policy is credible because it is expensive for the board of directors or any other party to initiate renegotiations that result in a change of the terms of the widely held debt. In fact, renegotiation of public debt is practically impossible because, as per the 1939 Debt Indenture Act, changes in the principle terms of a debt contract require approval of virtually all debtholders.[20] For the same reason, an attempt to purchase the outstanding debt and change its terms is also practically impossible.

5.2 Implementation of a conservative replacement policy

When the entrepreneur would like to commit the firm to a conservative replacement rule, $y^* < \bar{y}$, he does the following:

1. Issues equity to a large number of atomistic investors and the appropriate amount of debt (public or private), as prescribed by Proposition 3.

2. Nominates directors that represent all groups, with no group having a majority, that is, each group can form a winning coalition with any one of the other groups.

3. Specifies in the corporate charter that directors are not allowed to change the terms of securities without first approaching the security holders they represent and getting their explicit permission.

[20] Another difficulty in renegotiating the debt contract is the holdout problem. Gertner and Scharfstein (1991) show that in this case the most effective, yet expensive, way to renegotiate publicly held debt is in Chapter 11 of the bankruptcy code.

Under these conditions, the board implements a conservative replacement policy because the directors that represent the debtholders will form a winning coalition with the management team against residual claimholders whenever $y(S)$ is between y^* and $\bar{y}$, and with the representatives of residual claimholders against the manager when $y(S) < y^*$. The other groups will form a winning coalition against liquidation, if attempted by fixed claimholders.

The commitment to a conservative replacement policy is credible because it is expensive for board members who represent the shareholders to obtain explicit permission from the atomistic shareholders to change the terms of the debt contract. A potential way to go around this commitment would be for an outside raider to acquire the majority of the shares and renegotiate the debt contract. Nevertheless, because such a takeover attempt involves a replacement of an inferior manager that otherwise would be retained, she will try to resist the raider. Therefore, in this case, the entrepreneur would specify additional provisions in the corporate charter allowing the manager to use resistance strategies such as poison pills against the raider.[21] Note that either public or private debt can implement a conservative replacement policy as long as equity is widely held.

Since shareholders elect the board of directors, it may appear that in practice debtholders have no power in affecting managerial replacement. Nevertheless, Bacon and Brown (1975) have found that debtholders are represented on the board: "Some companies have long-standing relationships with a particular bank and customarily have someone from that bank sitting on the board." Kracaw, Lummer, and McConnell (1990) have found that, for a sample of 728 bank loans, 67 loans involve "interlocks," that is, an officer of the lending bank serves on the board of the borrowing firm, or vice versa. Franks and Mayer (1994) find that German banks hold 11 percent of seats and 26 percent of the chairmanships on supervisory boards.

There are yet other ways to give power to creditors. Veto power to debtholders can be implemented by giving shareholders control over the board and writing a covenant in the loan contract allowing creditors to veto managerial replacement. An example of such a covenant can be found in the Harrington Corporation case [Butters et al. (1987)], where it is stated in the debt indenture that no changes in management are permitted without written consent of the lender. Another way for a creditor to affect the decisions of the firm is to threaten to cut short-term financing to the firm. This is an effective way if the creditor has a specific relationship with the firm so that

[21] In some states, it is enough that the entrepreneur does not object to such resistance strategies.

it is costly for the firm to seek short-term financing elsewhere. If an entrepreneur wants to give control power to a creditor, he can design the loan structure accordingly.[22]

6. Empirical Implications

The standard comparative statics analysis has limited use in our model because it is difficult to observe the exogenous variables, B, k, and G. Therefore, we analyze the relations between the observable variables of our model, namely, capital structure, managerial replacement, and firm value (profitability). These variables are endogenous in our model, and are uniquely determined by the exogenous variables. Thus, to obtain variability in these endogenous variables, we change the exogenous variables. Different values of the exogenous variables result in different equilibria. In our comparative statics analysis we examine how firm value, debt level, and managerial replacement relate to each other across these equilibria. In Section 6.1 we analyze how, for different control regimes, changes in the private benefits,the cost of managerial effort, and the characteristics of the distribution functions affect the level of debt and the value of the firm. In Section 6.2 we discuss the implications of our theory to stock value, debt value, firm value, and managerial replacement.

6.1 The relations between capital structure and firm value

Consider a cross-sectional variation in the private benefits. For a given replacement policy, a manager with higher private benefits exerts more effort because the marginal benefit from effort is higher. Consequently, higher private benefits result in a higher firm value.[23] In addition, higher private benefits for the manager increase the importance of the replacement rule in providing managerial incentives. Thus, when shareholders have absolute control, the entrepreneur sets a higher standard for the manager by increasing y^*, while when debtholders have veto power, the entrepreneur reduces the standard for the manager by lowering y^*. To implement a higher y^*, the entrepreneur issues more debt, and to implement a lower y^*, the entrepreneur issues less debt. This discussion is summarized in Lemma 3.

[22] Rajan (1992) formalizes this relationship.

[23] The result that firm value and private benefits are positively correlated is in contrast to the negative correlation identified in the literature on capital structure and external control [e.g., Harris and Raviv (1988), Israel (1992), and Stulz (1988)]. The reason for this difference is that while in these papers private benefits lead to managerial entrenchment that reduces the probability of a value increasing takeover being consummated, in our model the risk of loosing the private benefits motivates the manager to exert more effort.

Lemma 3.

(i) Firm value increases with private benefits.

(ii) Debt level increases with private benefits when shareholders have absolute control, and decreases with private benefits when debtholders have veto power.

The following proposition highlights the importance of internal control to the predictions of our theory. It integrates the two parts of Lemma 3 and characterizes the relations between firm value and debt level that result from an exogenous change in the private benefits B.

Proposition 4. *In a sample of firms that differ in the private benefits, firm value and debt level are negatively correlated when debtholders have veto power, and are positively correlated when shareholders have absolute control.*

Consider now a cross-sectional variation in the cost of effort. To simplify, we assume variations only in the constant k. For a given replacement policy, a manager with a higher cost exerts less effort because the marginal cost of effort is higher. Consequently, a higher cost results in a lower firm value. Moreover, a higher cost for the manager decreases the effectiveness of the replacement rule in providing managerial incentives. Thus, when shareholders have absolute control, the entrepreneur sets a lower standard for the manager by decreasing y^*, and when debtholders have veto power, the entrepreneur increases the standard for the manager by increasing y^*. To implement a lower y^*, the entrepreneur issues less debt, and to implement a higher y^*, the entrepreneur issues more debt. This discussion is summarized in Lemma 4.

Lemma 4.

(i) Firm value decreases with the cost of managerial effort.

(ii) Debt level decreases with the cost of managerial effort when shareholders have absolute control, and increases with the cost of managerial effort when debtholders have veto power.

The following proposition shows that the predictions of our theory regarding the relations between debt level and firm value are the same for firms that differ in the cost of managerial effort and for firms that differ in their managers' private benefits.

Proposition 5. *In a sample of firms that differ in the cost of managerial effort, firm value and debt level are negatively correlated when debtholders have veto power, and are positively correlated when shareholders have absolute control.*

Consider now a cross-sectional variation in the sensitivity of the probability distribution of the cash flow to managerial effort. We capture this sensitivity by assuming that the derivative of the probability distribution function with respect to effort is larger in absolute value. Technically, we say that the probability distribution G^1 is more sensitive than the probability distribution G if $G_e^1 = \lambda G_e$, where λ is a constant larger than 1. Notice that, in this case, $g_e^1 = \lambda g_e$. To analyze the effect of the sensitivity of the probability distribution of the cash flow to managerial effort, we replace G_e with λG_e in the model, and analyze changes in λ.

Lemma 5.

(i) Firm value increases with the sensitivity of the probability distribution of the cash flow to managerial effort.

(ii) Debt level increases with the sensitivity of the probability distribution of the cash flow to managerial effort when shareholders have absolute control, and decreases with the sensitivity of the probability distribution of the cash flow to managerial effort when debtholders have veto power.

Proposition 6 characterizes the relations between debt level and firm value for variations in the probability distribution of the cash flow.

Proposition 6. *In a sample of firms that differ in the sensitivity of the probability distribution of the cash flow to managerial effort, firm value and debt level are negatively correlated when debtholders have veto power, and are positively correlated when shareholders have absolute control.*

Propositions 4, 5, and 6 imply that all three cross-sectional variations lead to the same relations between control allocation and leverage, namely, that firm value and debt level are positively correlated when shareholders have absolute control, and are negatively correlated when debtholders have veto power. Therefore, we expect these relations to hold unconditionally when the source of the cross-sectional variation is not controlled.[24]

To test our theory, a proxy for control has to be found. One measure of the control of a group is the number of representatives it has on the board of directors. Therefore, one way to test our theory is to separate the sample of firms into two groups, one with no debtholders or other fixed claimholders on the board, and the other with fixed claimholders on the board.

[24] A sufficient condition for this to hold is that the exogenous variables (B, k, and λ) are independently distributed across firms.

Most theories of capital structure (e.g., taxes, information, and agency) predict an unconditional positive correlation between leverage and firm value (profitability).[25] Therefore, our result that leverage and firm value are negatively correlated when debtholders have veto power and positively correlated when shareholders have absolute control can be used to empirically test our theory against other theories. The finding of Friend and Lang (1988), Kester (1986), and Titman and Wessels (1988) that leverage and profitability are negatively correlated is consistent with our theory, provided that the cases where debtholders have influence on firms' decisions are important enough. Clearly these findings are not direct evidence in favor of our theory, and future empirical research that will incorporate the allocation of control is needed.

It should be noted that the optimal control allocation and the empirical predictions presented above depend on our assumption that managerial replacement increases the riskiness of the firm's cash flow. Contrary to our assumption, it may be the case that managerial replacement reduces the riskiness of the firm's cash flow. This happens, for example, if managerial replacement is expected to be a part of a major reorganization in which the firm will be partially liquidated. When the cash receipts from liquidation are large enough, the reorganization reduces the riskiness of the cash flow. If this situation is likely when contracts are signed, the optimal control allocation is reversed: debtholders get control when the entrepreneur wants to implement an aggressive replacement policy, and shareholders get control otherwise. Consequently, the empirical predictions for this case are different from those derived here. Therefore, when testing our theory, the cases where managerial replacement is expected to increase the riskiness of the cash flow should be separated from the cases where managerial replacement is expected to decrease risk. A possible way to separate these cases is to examine traded options and to observe if the implied volatility of the equity increases or decreases when managers are replaced.

6.2 Managerial replacement and price effects

Managerial replacement is usually associated with the performance of the firm. Since the only performance measure in our model is the signal S, any variable that measures the firm's performance is represented by S. Therefore, if the firm's current earnings are correlated with future profitability, they can serve as a proxy for the signal S.

[25] See Table II in Harris and Raviv (1991) for a summary of the predictions of different capital structure theories.

With this interpretation, our theory predicts that lower current earnings imply a lower quality manager and, hence, a higher likelihood of managerial replacement. This is consistent with the findings of Blackwell, Brickley, and Weisbach (1992), Hermalin and Weisbach (1988), Kaplan and Minton (1992), Warner, Watts, and Wruck (1988), and Weisbach (1988).

To obtain predictions regarding price reactions to managerial replacement, we consider two alternative specifications of the timing and information structure of the signal S. First, the intermediate earnings S are publicly known at the time of the announcement of managerial replacement. Under this scenario, given a firm's current earnings, capital structure, and internal control allocation, the market knows whether the manager is about to be replaced. Consequently, our theory predicts that managerial replacements are fully anticipated and are not associated with stock price changes. This prediction is consistent with the findings of Warner, Watts, and Wruck (1988).[26]

In this case, the resolution of uncertainty and price reactions occur at the time the earnings become publicly known. Therefore, for a sample of firms that replaced their managers, stock and bond price reactions have occurred at the time the earnings were announced. The following proposition characterizes the price reactions.

Proposition 7.

(i) When shareholders have absolute control, total firm value and stock price of firms that replaced their managers decrease upon the earnings announcement prior to the replacement.

(ii) When debtholders have veto power, total firm value and debt value of firms that replaced their managers decrease upon the earnings announcement prior to the replacement.

The intuition for the results is as follows. The controlling group can always replace the manager, thereby securing some minimum value of their security. Therefore, they keep the manager only when the value of their security is higher than this minimum value. Replacing the manager signals that the controlling group has lost their option to get above this minimum value. Thus, if earnings indicate that the controlling group is about to replace the manager, the value of their claim decreases. A similar argument holds with respect to total firm value, where keeping the manager corresponds to high profits, and replacing her to low profits.

[26] Weisbach (1988) finds a positive average stock price reaction in response to top management resignations. Nevertheless, in most cases the excess returns are not significantly different from zero.

The second interesting scenario is when managerial replacement occurs before the market learns the intermediate earnings. Under this scenario, announcement of managerial replacement reveals the negative news regarding managerial quality and firm profitability. Therefore, the predictions of Proposition 7 hold at the time managerial replacements are announced, as opposed to the time when earnings are announced.

A comment on the relations between the likelihood of managerial replacement and control regimes is in order. Since shareholders are more aggressive than debtholders, it may appear that managers are more likely to be replaced when shareholders have absolute control than when debtholders have veto power. This is not true in general, because the distribution functions of the cash flow for firms that are controlled by shareholders are different from those of firms where debtholders have veto power. Therefore, we cannot draw a definite conclusion regarding the likelihood of managerial replacement under different control regimes.

7. Monetary Compensation Contracts

In this article we do not consider direct compensation contracts to the manager. It is possible that such contracts induce the manager to exert effort. This raises the question whether capital structure and internal control are valuable in inducing managerial effort even when wage contracts are allowed. We show, however, that given an optimal wage contract, capital structure and internal control are still instrumental in providing managerial incentives because the replacement rule still affects managerial effort. Therefore, internal control and capital structure are an important part of the design of more general contracts.

The general intuition as to why control allocation and capital structure are instrumental in providing managerial incentives when the manager can be motivated by a direct compensation contract is that allowing additional flexibility to a design problem can only increase value. To see this, consider an all-equity firm in which the manager's wage contract is $w^1(y)$ if she stays with the firm, and w^0 if she leaves the firm.[27] Shareholders replace the manager if and only if the signal S indicates that

$$y(S) - w^1(y(S)) < \bar{y} - w^0. \tag{13}$$

Assuming that $y(S) - w^1(y(S))$ is strictly increasing in $y(S)$, there exists

[27] Our assumption that the entrepreneur does not have personal wealth guarantees that $w^0 \geq 0$. Also, w^0 does not have to be a constant. It can depend on the cash flow under an alternative manager.

a replacement rule, $y^c(w)$, such that the manager is replaced if and only if $y(S) < y^c(w)$.[28]

The manager's problem is

$$\max_e \int_0^{y^c(w)} w^0 g(y \mid e)\, dy + \int_{y^c(w)}^{\infty} (B + w(y)) g(y \mid e)\, dy - k\psi(e). \quad (14)$$

The first-order condition for this problem is given by

$$-(B - w^0) G_e(y^c(w) \mid e) + \int_{y^c(w)}^{\infty} w(y) g_e(y \mid e)\, dy - k\psi_e(e) = 0. \quad (15)$$

Equation (15) implies that the wage contract has a direct effect on managerial incentives, because, by exerting more effort, the manager increases the likelihood of getting a higher wage if she remains with the firm. Equation (13) indicates that the wage contract has an indirect effect on effort by changing the replacement rule of an all-equity firm. Because of these conflicting effects of the wage contract, establishing the optimal replacement rule may come at the expense of direct incentives and vice versa. Therefore, the choice of internal control and capital structure, which can independently affect the replacement rule without affecting direct incentives, provides for flexibility that increases the value of the firm.

To illustrate this intuition, consider the case where the marginal product of effort is relatively low: $g_e(\bar{y}) > 0$. Given the wage contract, the replacement rule of an all-equity firm, $y^c(w)$, may be higher or lower than $\bar{y}$. Suppose first that $y^c(w) > \bar{y}$. In this case, it follows from Proposition 2 that incentives are enhanced by decreasing the optimal replacement rule, y^*, below $y^c(w)$. This is done by issuing debt and allocating control to debtholders, as shown in Proposition 3. Consider the alternative case where $y^c(w) < \bar{y}$. From Equation (13) we have that $w^0 > 0$. This cannot be optimal, because the entrepreneur can set $w^0 = 0$, issue debt, and allocate control to debtholders, so that the replacement rule remains the same. By doing so, the entrepreneur saves the wage payment, and as Equation (15) indicates, induces the manager to exert more effort.

8. Conclusions

In this article we have shown how capital structure and internal control are designed to motivate managers. When an aggressive replacement strategy is optimal, an entrepreneur issues risky fixed claims

[28] The argument presented below holds for more complicated replacement rules.

and allocates control to residual claimholders only. Replacing a known manager introduces uncertainty that shifts wealth from fixed claimholders to residual claimholders. Therefore, residual claimholders are more aggressive and replace managers more often. When a conservative replacement rule is optimal, an entrepreneur issues risky fixed claims and gives the claim holders veto power over shareholders' decisions. This is so because fixed claimholders are less inclined to replace a manager whose ability is known.

Our theory predicts that firm value and debt level are positively correlated when shareholders have absolute control, and are negatively correlated when debtholders have veto power. These predictions highlight the importance of incorporating internal control when studying financial policies of firms, and can be used to test our theory against other theories of capital structure.

In this article we have focused on managerial replacement. Internal control and capital structure can affect a broader set of strategic issues, such as long-term investment planning, product market competition, research and development, takeover activity, or project selection. If it is optimal to commit the firm to be tolerant toward risk in these future strategic decisions, the entrepreneur issues debt and control is allocated to shareholders. On the other hand, if it is optimal to commit the firm to be intolerant toward risk in these decisions, the entrepreneur issues debt and gives debtholders veto power.[29]

The predictions of the theory focused on debtholders as representing fixed claimholders. The theory and the empirical predictions apply to other fixed claimholders as well. For example, workers, suppliers, and lessors are also fixed claimholders that can affect the aggressiveness of a firm. In this respect, our theory provides a rationale for giving some control power to these stakeholders.

We have focused on the implementation of the optimal replacement rule via the security market: the replacement decision is made by a perfect representative of the security holders. Alternatively, the entrepreneur can give the directors contracts that compensate them

[29] An example of how our theory can be applied to long-term investment planning is as follows. Instead of alternative managers, the firm is facing mutually exclusive projects, with similar cash flow distributions. The manager has personal preference toward one of these projects, because she draws higher personal benefits from it. Each project involves an initial stage, in which the manager first exerts effort and then a signal about the profitability of the project is observed. Based on the signal, the next stage is either approved or the manager is forced to switch to another project.

Initially the manager is allowed to undertake the project with the higher personal benefits because this induces her to exert more effort. Internal control and capital structure are designed to affect the conditions under which the manager is forced to switch to another project. The switching rule affects managerial effort in the same fashion as the managerial replacement rule does in the original model. This example demonstrates the generality of the idea presented in this article.

in a way that induces them to follow the optimal replacement rule. In this way, the allocation of control may be separated from the choice of capital structure. The utilization of personal contracts is attractive if the implementation via capital structure imposes some costs on the firm (issuance costs, taxes, etc.). On the other hand, since the board is responsible for payments that are made by the firm, board members will supervise the payments for themselves. This discretion is not only expensive in terms of increased compensation for the directors, but it may also cause a distortion in the directors' incentives to follow the optimal replacement rule. A theory that incorporates both of these effects has the potential to explain boards' composition and the optimal compensation for board members. We think this is an interesting topic for future research.

9. Appendix

Proof of Proposition 1. Totally differentiating Equation (2) with respect to e and y^c yields

$$\frac{\partial e^*}{\partial y^c} = \frac{Bg_e(y^c \mid e^*)}{-BG_{ee}(y^c \mid e^*) - k\psi_{ee}}.$$

The second-order condition implies that the denominator is negative. The result follows immediately. ∎

Proof of Proposition 2. The first-order condition for the entrepreneur's maximization problem is

$$\frac{\partial V_0}{\partial y^c} = -y^c g(y^c) + \bar{y} g(y^c) + \frac{\partial e^*}{\partial y^c}\left[\int_{y^c}^{\infty} y g_e(y \mid e^*)\, dy + \bar{y} G_e(y^c \mid e^*)\right].$$

At the point $y^c = \bar{y}$,

$$\frac{\partial V_0}{\partial y^c} = \frac{\partial e^*}{\partial y^c}\left[\int_{\bar{y}}^{\infty} y g_e(y \mid e^*)\, dy + \bar{y} G_e(\bar{y} \mid e^*)\right].$$

Rearranging and using $\int_0^{\infty} g_e(y \mid e^*)\, dy = 0$ yields

$$\frac{\partial V_0}{\partial y^c} = \frac{\partial e^*}{\partial y^c}\left[\int_{\bar{y}}^{\infty} (y - \bar{y}) g_e(y \mid e^*)\, dy\right].$$

Integration by parts yields

$$\frac{\partial V_0}{\partial y^c} = \frac{\partial e^*}{\partial y^c}\left[\int_{\bar{y}}^{\infty} -G_e(y \mid e^*)\, dy\right].$$

Stochastic dominance implies that the integral is positive. Thus, at $y^c = \bar{y}$,

$$\frac{\partial V_0}{\partial y^c} > 0 \text{ iff } \frac{\partial e^*}{\partial y^c} > 0.$$

For the case $g_e(\bar{y}) < 0$, Proposition 1 implies that, at $y^c = \bar{y}$, $\frac{\partial e^*}{\partial y^c} > 0$, and therefore, $\frac{\partial V_0}{\partial y^c} > 0$. As $y^c \to \infty$, $\frac{\partial V_0}{\partial y^c} \to -\infty$. Therefore, there exists $y^* > \bar{y}$ that satisfies the first-order condition. The optimal solution cannot be below $\bar{y}$ because the MLRP implies that $g_e(y) < 0$ for all $y < \bar{y}$, and therefore, using Proposition 1, $V_0(\bar{y}) > V_0(y^c)$ for all $y^c < \bar{y}$.

The proof for the case $g_e(\bar{y}) > 0$ is similar. ■

Proof of Lemma 1. Clearly the integral term in Equation (7) increases with D toward ∞ and equals zero at $D = 0$. ■

Proof of Lemma 2. Follows from Equation (10). ■

Proof of Lemma 3.

(i) We first show that the value of the firm increases with B. Using Equation (2), holding y^c constant, the effort level e increases with B since

$$\frac{\partial e}{\partial B} = \frac{G_e(y^c \mid e)}{-BG_{ee}(y^c \mid e) - k\psi_{ee}} > 0.$$

Consider B_1 and B_2, where $B_2 > B_1$. Let y_1^* be the optimal replacement rule under B_1. A firm with B_2 and a replacement rule y_1^* has a higher value than a firm with B_1 because its manager exerts more effort. With its optimal replacement rule, y_2^*, its value is even higher.

(ii) Suppose $\gamma_i^* = \gamma_R$. The derivative of the first-order condition of the entrepreneur's problem [see the proof of Proposition (2)] with respect to B evaluated at the original y^*, the new effort level under y^*, and the new B is

$$(\bar{y} - y^*)g_e(y^*)\frac{\partial e}{\partial B} + \frac{\partial^2 e}{\partial y^* \partial B}\left[\int_{y^*}^{\infty} yg_e\, dy + \bar{y}G_e(y^*)\right] + \frac{\partial e}{\partial y^*}\left[\int_{y^*}^{\infty} yg_{ee}\, dy + \bar{y}G_{ee}\right]\frac{\partial e}{\partial B} > 0.$$

The first expression is positive since the derivative of e with respect to B is positive, $g_e(y^*) < 0$ and $\bar{y} < y^*$. The first-order condition implies that the term in the brackets in the second expression is positive. Also,

$$\frac{\partial^2 e}{\partial y^* \partial B} = \frac{-g_e(y^*)k\psi_{ee}}{(-BG_{ee} - k\psi_{ee})^2} > 0.$$

Therefore, the second expression is positive. Finally, it follows from Proposition 1 and the assumptions about the distribution function that the third expression is also positive, since thederivative of e with respect to B is positive. Therefore, the value function increases with the replacement rule at the point y^*, implying that the new replacement rule is higher than the original y^*. Thus, a higher debt level is required to implement it.

The proof for the case $\gamma_i^* = \gamma_P$ is similar. ■

Proof of Lemma 4.

(i) We first show that the value of the firm decreases with k. Using Equation (2), holding y^c constant, the effort level e decreases with k since

$$\frac{\partial e}{\partial k} = \frac{\psi_e}{-BG_{ee}(y^c \mid e) - k\psi_{ee}} < 0.$$

Consider k_1 and k_2, where $k_2 < k_1$. Let y_1^* be the replacement rule under k_1. A firm with k_2 and a replacement rule $y_1{}^*$ has a higher value than a firm with k_1, because its manager exerts more effort. With its optimal replacement rule, y_2^*, its value is even higher, implying that firm value decreases with k.

(ii) Suppose $\gamma_i^* = \gamma_R$. The derivative of the first-order condition of the entrepreneur's problem [see the proof of Proposition (2)] with respect to k evaluated at the original y^*, the new effort level under y^*, and the new k is

$$(\bar{y} - y^*)g_e(y^*)\frac{\partial e}{\partial k} + \frac{\partial^2 e}{\partial y^* \partial k}\left[\int_{y^*}^{\infty} y g_e \, dy + \bar{y}G_e(y^*)\right] + \frac{\partial e}{\partial y^*}\left[\int_{y^*}^{\infty} y g_{ee} \, dy + \bar{y}G_{ee}\right]\frac{\partial e}{\partial k} < 0.$$

The first expression is negative since the derivative of e with respect to k is negative, $g_e(y^*) < 0$ and $\bar{y} < y^*$. The first-order condition implies that the term in the brackets in the second expression is positive. Also,

$$\frac{\partial^2 e}{\partial y^* \partial k} = \frac{Bg(y^*)\psi_{ee}}{(-BG_{ee} - k\psi_{ee})^2} < 0.$$

Therefore, the second expression is negative. Finally, it follows from Proposition 1 and the assumptions about the distribution function that the third expression is also negative, since the derivative of e with respect to k is negative. Therefore, the value function decreases with the replacement rule at the point y^*, implying that the new replacement rule is lower than the original y^*. Thus, a lower debt level is required to implement it.

The proof for the case $\gamma_i^* = \gamma_P$ is similar. ■

Proof of Lemma 5.

(i) We first show that the value of the firm increases with λ. Using Equation (2), holding y^c constant, the effort level e increases with λ since

$$\frac{\partial e}{\partial \lambda} = \frac{BG_e(y^c \mid e)}{-B\lambda G_{ee}(y^c \mid e) - k\psi_{ee}} > 0.$$

Consider λ_1 and λ_2, where $\lambda_2 > \lambda_1$. Let y_1^* be the optimal replacement rule under λ_1. A firm with λ_2 and a replacement rule y_1^* has a higher value than a firm with λ_1, because the manager exerts more effort. With its optimal replacement rule, y_2^*, its value is even higher.

(ii) Suppose $\gamma_i^* = \gamma_R$. The derivative of the first-order condition of the entrepreneur problem [see the proof of Proposition 2)] with respect to λ evaluated at the original y^*, the new effort level under y^*, and the new λ is

$$\begin{aligned}\lambda(\bar{y} - y^*)g_e(y^*)\frac{\partial e}{\partial \lambda} + \lambda\frac{\partial^2 e}{\partial y^* \partial \lambda}\left[\int_{y^*}^{\infty} yg_e\,dy + \bar{y}G_e(y)\right] \\ + \lambda\frac{\partial e}{\partial y^*}\left[\int_{y^*}^{\infty} yg_{ee}\,dy + \bar{y}G_{ee}\right]\frac{\partial e}{\partial \lambda} \\ + \frac{\partial e}{\partial y^*}\left[\int_{y^*}^{\infty} yg_{ee}\,dy + \bar{y}G_{ee}\right] > 0.\end{aligned}$$

Following the proof of Lemma 4, it can be seen that the first three expressions are positive. The last expression is positive from the first-order condition in the proof of Proposition 2. As before, since y^* increases with λ, a higher debt level is required to implement it.

The proof for the case $\gamma_i^* = \gamma_P$ is similar. ■

Proof of Proposition 7. Suppose that shareholders have absolute control. Then, since managers are retained only when $y(S) > y^* > \bar{y}$, the conditional value of the firm is higher when the manager is retained. Moreover, since shareholders make the replacement decision, equity value is higher when the manager is not replaced.

Suppose debtholders have veto power. Since firm value under the incumbent manager is higher ex ante than firm value under an alternative manager [$\bar{y}(e^*) > \bar{y}$], then the conditional expectation of the cash flow under the incumbent manager when she is retained is above $\bar{y}(e^*)$, and therefore above firm value when the manager is replaced, $\bar{y}$. The result about firm value follows. The result for debt value follows because debtholders make the replacement decision. ■

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