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Control Rights and Maturity: The Design of Debt, Equity, and Convertible Securities

Zsuzsanna Fluck

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Zsuzsanna Fluck*

Department of Finance

Stern School of Business

New York University

44 West 4th Street, Suite 9-190

New York, NY 10012

Phone: (212)-998-0341

Fax: (212)-995-4233

e-mail: zfluck@stern.nyu.edu

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Abstract

This paper investigates the design of the control rights and the maturity of securities when management has the ability to divert or manipulate the cash flows, and when it is prohibitively costly for a third party, such as a court, to verify or prove any managerial wrongdoing. By endogenizing claim structures, control rights and maturity, I derive a diverse set of optimal contracts. Debt with a maturity shorter than the life of the assets is sustainable when investors have the contingent right to liquidate the firm's assets. Longer-term debt can be sustained by investors' right to dismiss management and take over the firm as a going-concern in the event of a default. Investors are willing to hold indefinite life equity if they are granted either the unconditional right to liquidate firm's assets or the unconditional right to dismiss management. Finally, convertible debt can be sustained by investors' right to dismiss management and take over the firm in the event of a default and by the holder's option to convert their debt contract to an equity contract prior to its expiration date. Consistent with empirical evidence, this model predicts that small entrepreneurial firms use short-term bank loans, convertible debt, or outside equity at their initial financing stage; as they show evidence of higher profitability, they can secure longer-term debt financing.

Keywords: security design, nonverifiability of cash flows, managerial moral hazard, control rights, maturity, managerial dismissal, asset liquidation, capital structure

JEL Classification: G34, L14

1 Introduction

Enterprises, small or large, rely heavily on long-term financing arrangements to fund their operations. However, it has proved difficult for financial theory to justify the use of long-term contracts when management has the ability to divert or manipulate the cash flows, and when it is prohibitively costly for a third party, such as a court, to verify any managerial wrongdoing. Why would investors enter into long-term financial contracts extending beyond the life of the firm's existing assets when such contracts rely on the manager to make repeated investments during the life of the contract? How can investors induce the entrepreneur-manager to make these investments when such investments cannot be contracted upon? Despite substantial progress in research on the design of financial contracts (Townsend (1979), Diamond (1984), Gale and Hellwig (1985), Hart and Moore (1989, 1994, 1995), Bolton and Scharfstein (1990), Dewatripont and Tirole (1994), Berglöf and von Thadden (1994), and Berkovitch and Israel (1996)), these questions remain largely open.

When cash flows are nonverifiable, contracts cannot be written on cash flows, since courts cannot verify their true realization (Grossman and Hart (1986)). When management has the ability to divert or manipulate the cash flows, incentive contracts cannot work either (Hart and Moore (1989)). Earlier literature (Hart and Moore (1989)) demonstrate that the threat of liquidation can sustain debt contracts whose maturity is shorter than the life of the assets. More recently, Fluck (1997) shows that the threat of dismissal can sustain outside equity of unlimited life. By showing that equityholders' right to dismiss management regardless of performance can sustain outside equity with unlimited life, Fluck establishes that there is at least one contract that induces management to make repeated investments to maintain the firm's assets over time.

The differences in the design of debt and equity have long been the focus of an academic

debate. Debt and equity naturally differ in their allocations of control rights; debtholders are granted control rights only in the event of a default, and equityholders are granted control rights in all states except default (Aghion and Bolton (1992)). Since the existing literature implies that debtholders enforce their claim by threatening to liquidate the firm's assets and equityholders by threatening to dismiss management, the question arises whether debt and equity systematically differ in the type of actions that investors take to effectively enforce their claims.[1] Can the investors' right to liquidate the firm's assets also sustain outside equity? Furthermore, can the investors' right to dismiss management and take over a going-concern firm sustain a debt contract with a maturity longer than the life of the physical assets? And if so, would investors and managements be indifferent between debt and equity, as Modigliani and Miller (1958) suggest, or would they prefer one contract over the other? These are the questions that this paper seeks to answer.

In this paper I investigate the design of control rights and maturity of securities when management has the ability to divert or manipulate the cash flows, and when it is costly for investors to verify or prove any managerial wrongdoing for a third party, such as a court. By endogenizing claim structures, control rights and maturity, this paper is the first to derive a rich set of debt- and equity-like securities as equilibrium contracts[2] in this setting. Arising from a model with nonverifiable cash flows, these contracts minimize the verification costs in equilibrium. My equilibrium contracts are short-, medium-, and long-

[1] Hart and Moore (1994) interpret liquidation as (1) selling assets individually for best alternative use; and (2) replacing management and recontracting with a new manager. The authors argue that (1) and (2) are essentially the same. In this paper I study (1) and (2) separately and show that, from the perspective of security design, liquidation and dismissal have strikingly different implications.

[2] Recognizing that the securities' value will be affected by the extent to which they induce value-enhancing takeovers, Harris and Raviv (1989) study the *assignment* of voting rights (the fraction of votes attached to claims), an important related issue. They suggest that voting rights are attached to claims to make it costly for an inferior contestant to win control.

term debt, perpetual bond, convertible debt, and outside equity with indefinite life. Debt with a maturity shorter than the life of the assets is sustainable when investors have the contingent right to liquidate the firms assets.[3] Rolled-over short-term debt, medium-, and long-term debt can be sustained by the investors' right to dismiss management and take over the firm as a going concern in the event of a default. Investors are willing to hold indefinite life equity if they are granted either the unconditional right to liquidate firm's assets or the unconditional right to dismiss management. Finally, convertible debt can be sustained by investors' right to dismiss management and take over the firm in the event of a default, and by the holder's option to convert their debt contract to an equity contract prior to its expiration date.

Since the seminal works of Jensen and Meckling (1976), Myers (1977) and Gavish and Kalay (1983), asset substitution has been a central issue in the corporate finance literature. Asset substitution occurs when the claimant in control chooses investments that benefit him at the expense of other claimants, or when the claimant in control, by rejecting profitable investments, transfers wealth from other claimants to himself. Examples of asset substitutions are risk shifting (shifting into a riskier project with identical or lower net present value) and asset switching (failing to maintain the assets, or failing to buy proper insurance). This paper studies the impact of managerial asset substitution on security design. I find that contracts with contingent control rights are more susceptible to asset substitution by management than are contracts with unconditional control rights. Since investors with contingent control rights cannot exercise control unless default has occurred, a man-

[3]This contract deserves a discussion on its own right for two reasons. First, until recently, in many countries debtholders' control rights were limited to liquidation (Strömberg (1997)). Secondly, as Proposition 2 will show later, short-term debt supported by the right to liquidate is one of only two equilibrium contracts available to those investors, whom, like US commercial banks, are prohibited to take equity positions in firms.

ager planning to default may start milking the assets prior to the default. To alleviate this potential asset substitution by management, equilibrium contracts with contingent control rights are designed either with a maturity shorter than the life of the physical assets (such as short-term debt), or, if they have a longer life (such as long-term debt), then they must offer substantially higher private benefits to the entrepreneur-manager. Short-term debt alleviates managerial asset substitution, since holders of short-term debt can liquidate the firm before the assets are depleted. Alternatively, long-term debt alleviates managerial tendencies towards asset substitution by allowing management to consume substantial private benefits, thus eliminating the manager's incentives to transfer wealth from long-term debtholders. To assure sufficiently high incentive payments to the entrepreneur-manager, projects that aim to secure longer-term debt financing must show evidence of higher profitability than those seeking equity financing. This finding is consistent with empirical evidence that firms are substantially larger when they have their first public debt issue than when they have their first public equity issue (Carey et al. (1993)).

The potential impact of contract design on managerial investment choices has been stressed by Holmstrõm (1982), Narayanan (1985), Stein (1989), Shleifer and Vishny (1990) and Goswami et al. (1994). Holmstrõm, Narayanan, Stein, and Shleifer and Vishny emphasize reputational considerations to rationalize the myopic bias in investment policies.[4] These authors argue that myopic investment decisions are attempts by managers to generate favorable evaluations in the short term. Goswami et al. (1994) show that short-term debt engenders myopic behavior by inducing a preference for short-term cash flows. In my model, equilibrium contracts differ whether or not investors can induce management to follow a

[4]For empirical evidence on myopic managerial tendencies, see Abegglen and Stalk (1985) and Jacobs (1991).

specific investment policy. I find that short-term debt allows the entrepreneur-manager to pursue the investment policy that maximizes his bargaining power and perks. Longer-term debt, convertible debt and equity induce management to follow the investment policy that investors prefer most.

To the extent that my model endogenizes which party's investment choice gets implemented, this work generalizes Aghion and Bolton (1992). In Aghion and Bolton, parties bargain over who chooses the investment. In my model, investment is always chosen by the entrepreneur-manager. However, in equilibrium, depending on the contract, the entrepreneur-manager may voluntarily select the same investment policy that investors desire.

The theory yields several interesting implications. Consistent with empirical evidence that small entrepreneurial firms typically rely on short-term bank loans (Blackwell and Kidwell (1988)), venture capital financing (Sagari and Gudotti (1992)) and private equity (Fenn et al. (1995)) to finance their operations, my model predicts that small entrepreneurial firms use short-term bank loans, convertible debt, or outside equity at their initial financing stage. In my model, as these firms show evidence of higher profitability, they can secure longer-term debt financing.[5] (Barclay and Smith (1995)). The firm's choice between short-term debt, convertible debt or outside equity depends on the liquidation value of the assets and the cost of replacing the entrepreneur-manager. Consistent with empirical evidence that (1) leverage increases with lack of growth opportunities (Kim and Sorensen (1986), Titman and Wessels (1988)) and with increases in liquidation value (Bradley et al. (1984), Long and Malitz (1985), Friend and Hasbrouck (1988), Friend and Lang (1988)); and (2) the

[5]This prediction is similar to that of Diamond (1991). In Diamond firms use bank debt first and as they develop a solid reputation, they subsequently issue longer-term public debt.

higher the market-to-book ratio is, the longer the maturity of the firm's debt is (Stochs and Mauer (1994)); my theory implies that companies with substantial assets-in-place use more short-term loans, but companies with significant growth opportunities use longer-term debt, convertible debt and outside equity financing.

The paper is organized as follows. Section 2 describes the model. Section 3 discusses the design of cash flow claims and control rights. Section 4 focuses on the maturity design of contracts that can be supported by investors' right to liquidate the firm. Section 5 characterizes equilibrium contracts that can be supported by investors right to dismiss management. Section 6 concludes.

2 The Model

Consider a risk-neutral entrepreneur who has no wealth and seeks financing for a project from risk-neutral investors. Both the investors and the entrepreneur use the same positive discount factor, δ, to value future payoffs, and both care only about monetary payoffs. The entrepreneur-manager maximizes the expected present value of his future payoffs, that is, the discounted sum of the cash flows in excess of his contractual obligations and of the cash flows that he chooses to divert as private benefits. His payoff depends on his actions (whether or not he diverts the cash flows, and which investment policy he adopts) and the actions of investors (whether they dismiss or retain the manager or liquidate the firm). Investors are Bertrand competitors, willing to finance projects if they break even.

The project yields a periodic operating cash flow, $\tilde{v}$. The cash flow, $\tilde{v}$, is an i.i.d. random variable that takes on the values $v + x > 0$ and $v - x > 0$ with equal probabilities. The project requires an investment outlay, I, and involves the operation of an equipment with economic life of two periods.

The project can be repeated over and over again. As long as the project continues, the entrepreneur-manager can seek external financing for the replacement of the physical assets at the beginning of each cycle (myopic investment policy), or he can renew the equipment each period at some cost a (responsible investment policy). If a is spent at time 1 and time 2, then further investment of I in period 2 can be avoided. We assume that both investment policy is feasible, that is, $v - x \geq a$. We also assume that these investment policies are equally costly to implement, that is, $I = \frac{a}{\delta} + a$. The two investment policies are not equivalent, since the liquidation values of the assets depend on which investment policy the entrepreneur-manager adopts.

If the equipment is replaced every other period, then it depreciates over time and its liquidation value varies from period to period. The equipment has a positive liquidation value, $L_1 < \delta I$, if investors choose to liquidate the firm's assets immediately after the investment is sunk. Alternatively, if investors choose to liquidate the assets immediately following the realization of period 1 cash flows, then the equipment has a liquidation value, $L_2 < L_1$. These liquidation values are distributed at time 1 and time 2, respectively. The salvage value of the equipment at the end of its operation is zero.

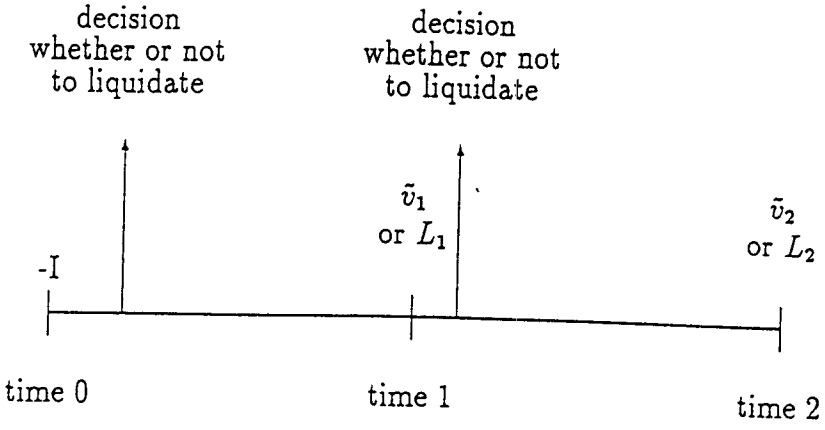

Figure 1: Myopic investment policy

Alternatively, if the equipment is renewed period after period, its liquidation value is equa to L_1 across periods. Notice that the time 2 liquidation value of the equipment is higher whe the responsible investment policy is adopted. The equipment can be periodically renewed i all cash flow realizations of the project exceed the cost of the renewal, that is, if $v - x \geq a$

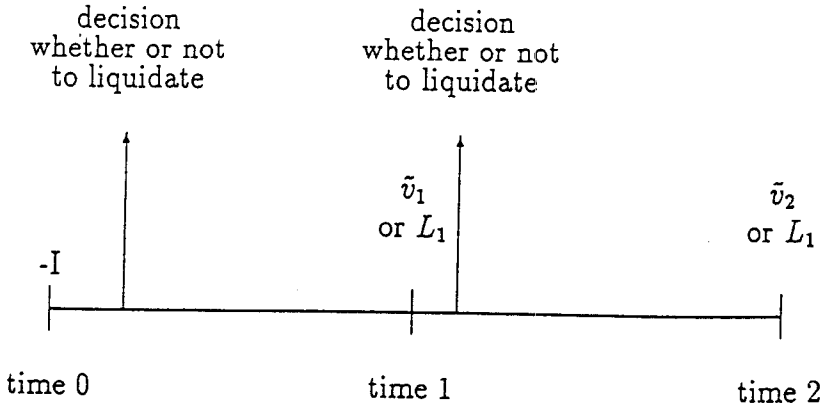

Figure 2: Responsible investment policy

Each period, management can divert the cash flows, and in each period, investors and management both learn the true realization of the cash flows. However, the true realization

of the cash flows is assumed to be nonverifiable by a third party, since contracts written on cash flows are prohibitively costly to verify in court.

Similarly, investors know whether or not the equipment has been renewed. This managerial investment policy is also nonverifiable for a third party, such as a court, unless the company is liquidated and the physical assets are foreclosed.

As a general principle, in this model only receipts of payments are verifiable. We assume that the true realization of all other financial and accounting variables are prohibitively costly to verify.

In this model, a security is a contract that is defined by its claim structure, control rights, and maturity. The entrepreneur-manager can either promise a fixed payment to investors or give them a claim on the project's cash flows. In exchange for the investment outlay, the entrepreneur-manager can also grant control rights to investors. These control rights specify the set of actions investors can take. We can thus distinguish between *the right to liquidate the firm* and *the right to dismiss the manager.* When no control challenge is initiated, the entrepreneur-manager decides on the investment policy and then makes payments to investors. Investors receive p_t, the payment on which the entrepreneur-manager has decided, and the entrepreneur-manager receives $v_t - a_t - p_t$ or $v_t - p_t$, depending on his investment policy.

In the event of a liquidation, the entrepreneur-manager receives no payoff and investors receive the liquidation value of the physical assets. In the event of a dismissal, a new manager takes charge and decides on the payments and the investment policy. The former entrepreneur-manager receives no payoff, and the investors bear the cost associated with replacing the manager. In either case, investors incur a cost when exercising their control rights: The cost of liquidation is the amount by which the liquidation value falls short of

recovering the cost of investment, and the cost of dismissal includes the cost of searching for a new manager, and golden parachute for the departing manager.

When the company is liquidated, the entrepreneur-manager can restart it, if he can raise the necessary financing.[6] When the manager is dismissed[7], company as a going-concern stays with the investors.[8]

Control rights also specify when the investor can take action. Thus, we can distinguish between *contingent control rights* and *unconditional control rights*. Unconditional control rights can be exercised regardless of the cash flows or managerial performance but contingent control rights can only be used in the event of a default.

Default occurs when the entrepreneur-manager fails to make a contractual payment. The entrepreneur-manager could default for strategic or liquidity reasons. *Liquidity default* occurs when the manager does not make payment because he lacks the funds. *Strategic default* happens when the manager does not make payment because he diverted the funds.

The difference between contingent and unconditional control rights is highlighted on Figures 3 – 6. Although holders of unconditional control rights can prevent default, holders

[6]As the following quote from *The Economist* illustrates, entrepreneurs in the United States can easily raise financing following the liquidation of their enterprise: "If you start a company in London or Paris and go bust, you have just ruined your future. Do it in Silicon Valley and you have just completed your entrepreneurial training. In America, would-be entrepreneurs are less afraid of failing because they know it will be easier to find a new job if they do." ("Adventures with Capital", *Economist*, Jan 25, 1997)

[7]Dismissal of the entrepreneur-manager presupposes that there is a market for hiring managers. Whereas the entrepreneur-manager could have the special skills to start a firm, other managers are often equally good in running an existing firm (Bhide (1992)).

[8]Dismissal from a job typically means losing more than just compensation from their former business. CEOs frequently lose their seats on other companies' boards following their dismissal from their primary job ("Ousted CEOs lose board seats," *Wall Street Journal*, November 24, 1995). In reality, the entrepreneur-manager can restart a new venture in the same business, but not without facing competition from his or her former business. Also, there are significant costs associated with competing against their former business. For example, starting a similar business and introducing similar products is often followed by lawsuits from the original business, alleging the steal of trade secrets ("Suit over trade secrets", *Wall Street Journal*, February 28, 1997).

of contingent control rights can act only after the default. Unconditional control rights give the first-mover advantage to investors; contingent control rights grant the first-mover advantage to the entrepreneur-manager.

Table 1 illustrates the set of feasible securities. These securities can mature in one period (in which case they have maturities shorter than the life of the assets), in $T \geq 2$ periods (in which case they have maturities longer than the life of the assets), or they might have no expiration date.

Table 1. Feasible Securities

	Promise of a fixed payment	Claim to the cash flows
unconditional right to liquidate	X	X
unconditional right to dismiss management and seize the firm as a going concern	X	X
contingent right to liquidate	X	X
contingent right to dismiss management and seize the firm as a going concern	X	X
contingent right to dismiss management and seize the firm as a going concern and the option to convert the contract	X	X

3 The Family of Potentially Sustainable Claim Structures and Control Rights

Can contingent or unconditional control rights sustain a claim to the cash flows in equilibrium when management has the ability to divert or manipulate the cash flows, and when it is prohibitively costly to verify any managerial wrongdoing for a third party, such as a court? Or can these control rights guarantee the promise of a fixed payment in equilibrium?

To answer these questions, suppose that investors transfer I to the entrepreneur-manager in exchange for a claim to the project's cash flows and some contingent control right. Then, when the cash flows are realized, it is in the entrepreneur-manager's interest to announce no earnings and make no payment to investors. Since cash flows can not be verified, investors cannot prove the entrepreneur-manager's default. As a result, they cannot discipline management by exercising their control rights, and consequently, they cannot recover their investment in equilibrium. Hence, no investor would be willing to hold a security that promises a claim to the cash flows and contingent control rights.

It is worth highlighting the fact that the reason the contract described above can not sustain investors' claims is that this particular contract makes it impossible for investors to prove whether or not default has occurred. However, there are two ways to design contracts that make it easier for investors to exercise control. First, instead of offering them a claim to the cash flows, the contract can promise them a fixed payment. Whether or not such a payment is met, it nevertheless is easy to verify. Hence, a contract with the promise of a fixed payment and contingent control rights is potentially sustainable. Second, investors can be granted unconditional control rights. With such rights, investors can get rid of the verification problem altogether, since there is no need to verify the cash flows. Thus, investors can take actions regardless of the cash flows or managerial performance.

When cash flows are nonverifiable and the entrepreneur-manager can divert or manipulate the cash flows, then contingent control rights can only support the promise of a fixed payment. In contrast, unconditional control rights can support a claim to the cash flows of the firm. Unconditional control rights can support both the claims that are dependent on cash flows and the claims that are independent of cash flows. The design of equilibrium contracts that grant investors claims to the cash flows and unconditional control rights is

described in the proofs of Propositions 1 and 2 in the Appendix.

The investigation above substantially narrows the family of sustainable securities. In particular, the remaining subset of contracts does not include contracts corresponding to cells (3,2), (4,2) and (5,2) of Table 1, where cell (i, j) refers to the cell in line i and column j.

In the rest of the paper I pair contingent control rights with a fixed payment and unconditional control rights, unless otherwise indicated, with a claim to the cash flows of the firm.

4 The Maturity Design of Contracts with the Right to Liquidate

In this section I characterize the maturities of equilibrium contracts that grant investors the right to liquidate the firm. First I focus on the case when investors are given unconditional rights, then on the case when investors are granted contingent rights.

4.1 Contract Design

Figure 3 presents the game in extensive form describing the actions and the resulting payoffs faced by the entrepreneur-manager and investors each period until the maturity of their contract, when the investors have the unconditional right to liquidate the firm.

Suppose that the parties write a one-period contract that promises investors a fixed payment and grants them the unconditional right to liquidate the firm. Let A denote the entrepreneur-manager's outside option following a liquidation. If investors decide not to liquidate the assets right after the investment outlay is sunk, then it is in the entrepreneur-manager's best interest to divert all the cash flows. By diverting the cash flows, the entrepreneur-manager can guarantee himself $v + \delta A$. Otherwise, he would receive only $v -$

$p+\delta A$. Consequently, if a one-period contract is written, investors liquidate the project right after the investment outlay is sunk. Since $L_1 < I$, this is equivalent to saying that investors would never agree to a one-period contract that would grant them unconditional right to liquidate the assets.

Next suppose, that the parties write a T-period contract, $T > 1$, which promises investors cash flow claims and the unconditional right to liquidate the firm. Using backward induction, we can see that if such a contract were ever written, the entrepreneur-manager would fail to renew the assets and would divert all the cash flows period after period.

If, however, the contract is designed with an indefinite maturity, it is potentially sustainable. When investors have the unconditional right to liquidate the project, an equilibrium strategy for investors, U_L^I, specifies not to liquidate the project at first and as long as the entrepreneur-manager makes equilibrium payments and follows responsible investment policy and to liquidate the project otherwise.[9]

The corresponding equilibrium strategy for the entrepreneur-manager, U_L^M, is to limit private benefits so that he can make equilibrium payments, and to follow responsible investment policy period after period as long as no deviation occured. If a manager finds himself on the job following a default, then he will divert all the cash flows. Investors are willing to liquidate the firm following a default, since, once the entrepreneur-manager has defaulted,

[9]This is by no means the only equilibrium strategy. There are many others. First of all, there always exists an equilibrium strategy pair that specifies for the entrepreneur-manager to divert the cash flows each period and for investors to liquidate the project. Since the liquidation value of the project is presumably less than the investment outlay, in this equilibrium investors do not finance any project. Secondly, there are other equilibrium strategy-pairs that can support the financing of more profitable projects. Such equilibria specify investors liquidating after the entrepreneur-manager's second default, while forgiving after the first default, or investors liquidating the firm with some probability following a default. It is important to emphasize that whenever a project can obtain financing there always exists U_L^I, the equilibrium strategy that specifies investors liquidating the firm with probability 1 following a default, whereas there do not always exist other types of firm-financing equilibria. Hence, contracts supported by U_L^I, *weakly dominate* all other contracts in the sense of Gale and Hellwig (1985).

the liquidation value of the assets exceeds the going-concern value of the firm.

The maturity design of the equilibrium contract is strikingly different when investors have the contingent right to liquidate the firm. Figure 4 presents the game in extensive form, describing the actions and the resulting payoffs faced by the entrepreneur-manager and investors each period until the maturity of their contract, when investors have the right to liquidate the firm in the event of a default.

There is a strategy in this extensive-form game that guarantees holders of a *one-period* contract to break even. This equilibrium strategy, C_L^I, specifies the liquidation of the assets if the entrepreneur-manager fails to make equilibrium payments. The corresponding equilibrium strategy for the entrepreneur-manager, C_L^M, is to limit private benefits so as to make equilibrium payments. Notice that liquidating only after a *strategic* default, but not liquidating after a *liquidity* default, is a strongly dominated strategy when investors have contingent right to liquidate the assets. Therefore, it is not part of any Nash equilibrium contract.

Worth highlighting that pursuing a responsible investment policy, the only investment policy that is compatible with long-term contracts, is not part of the equilibrium strategy for managers when investors have contingent right to liquidate the firm.[10] In fact, for the entrepreneur-manager the myopic investment policy always dominates the responsible investment policy. There are two reasons: (1) Since managerial investment policy is nonverifiable, deviation from an agreed-upon investment policy does not trigger a default; and (2) the eventual liquidation that the entrepreneur-manager faces when he strategically defaults does not

[10]These two contracts differ in other aspects as well. First of all, investors with unconditional control rights can preempt any action by the entrepreneur-manager . Consequently, their strategy specifies one additional decision point: "do not liquidate the firm *at first* and as long as the entrepreneur-manager ...", whereas investors with a contingent control right can only act after the fact, so their strategy specification depends on the entrepreneur-manager's action: "do not liquidate the firm as long as the entrepreneur-manager ..."

substantially constrain his opportunity set. Consequently, when the investors' right to liquidate the firm is contingent on the entrepreneur-manager not making a verifiable payment, investors cannot induce management to follow a specific investment policy.

In contrast, having unconditional control rights enables investors to liquidate the assets if the manager deviates from the responsible investment policy. Hence, investors with the unconditional right to liquidate the firm can induce management to follow the responsible investment policy.

However, unconditional rights are double-edged. They also allow investors to liquidate the firm even if management does follow a responsible investment policy, and thus these rights introduce a potential moral hazard problem on the part of investors. Since it is in the investors' best interest to liquidate the firm just before the contract expires, thus preventing the entrepreneur-manager from defaulting then, and since it is in the entrepreneur-manager's best interest to default right before liquidation, any contract that grants investors the unconditional right to liquidate the firm unravels if it has a prespecified expiration date.

The maturity design of the equilibrium contract can alleviate these problems. When the entrepreneur-manager issues a claim with a maturity shorter than the life of the physical assets, investors with a contingent right to liquidate can intervene early to avoid the consequences of managerial asset substitution. In this sense maturity plays the role of a covenant. Alternatively, by issuing a claim with no prespecified expiration date, the entrepreneur-manager can eliminate the incentives of investors with unconditional rights for excessive liquidation.

Proposition 1 *The right to liquidate the firm can sustain investors' claim if and only if either one of the following holds:*

(i) The investors' claim has a prespecified expiration date shorter than the life of the

physical assets and investors' right to liquidate the firm is contingent on the event of a default.

(ii) The investors' claim has indefinite life and investors have the unconditional right to liquidate the firm.

Proof: in Appendix.

The two contracts also differ in another respect, whether or not investors liquidate following a strategic or liquidity default. Investors with unconditional rights choose to liquidate only in the event of a strategic default.[11] They liquidate when the going-concern value of their claim falls below the liquidation value of the assets. In the event of a strategic default, this is exactly the case. Once the entrepreneur-manager has chosen to strategically default, then in equilibrium, the going-concern value of investors' claim is zero, that is, no greater than the liquidation value of the project.

When investors have the contingent right to liquidate the firm, they also liquidate following a liquidity default. This is because all equilibrium contracts granting investors the contingent right to liquidate the firm expire in one period; consequently, investors can always gain by liquidating the project at date 1, just before expiration. Since the project cannot get financing unless v is greater than L_2, such liquidation is always inefficient.[12]

[11]There is no liquidity default when investors have a claim to the cash flows: p_{v+x} is, by definition, less than $v + x - a$, and p_{v-x} is, by definition, less than $v - x - a$, and $v - x \geq a$.

[12]Renegotiation, such as bribing investors not to liquidate following a liquidity default, cannot improve on the situation, since the entrepreneur-manager is short of cash, and he can not commit to making any future payment. One possible way to bribe investors not to liquidate is to issue them a claim for indefinite life with an unconditional right to dismiss management. It is the equivalent of issuing *convertible debt* upfront.

4.2 Profitability Constraints

What projects can raise financing by issuing a security that matures in one period, promises a fixed payment, and grants investors the right to liquidate the assets in the event of a default? Can these projects also raise financing by issuing a security with an indefinite maturity that promises investors a claim to the cash flows and unconditional right to liquidate the assets?

Investors are willing to hold a one-period contract with a fixed payment and the right to liquidate the assets in the event of a default if, and only if, the entrepreneur's project meets one of the following conditions:

(C1) If $v - x \geq \frac{I}{\delta}$, then

$$v \geq \frac{I}{\delta^2}$$

(C2) If $v - x < \frac{I}{\delta}$, then

$$\delta v \geq 2\frac{I}{\delta} - 2\delta L_2$$

In contrast, investors are willing to finance the project in exchange for a claim to the cash flows and an unconditional right to liquidate the firm if, and only if

(C3) $p \geq \frac{(1-\delta)I}{\delta}$ and $\delta v \geq p_{v+x} + \delta p + (1+\delta)a$ hold.

Notice that (C1) and (C3) place the same constraint for projects that satisfy $v - x \geq \frac{I}{\delta}$ (see proof of Proposition 1 for details). For other projects, either (C2) or (C3) becomes more binding, depending on the discount factor, δ, and the liquidation value of the assets, L_2. For projects with low liquidation value, L_2, (C2) is more restrictive than (C3). In particular, when $\frac{2I}{\delta^2} - L_2 > p_{v+x} + \delta p + (1+\delta)a$, then entrepreneurs who can raise funds by issuing a claim with the unconditional right to liquidate the firm, might not be able to secure financing by issuing a claim with the contingent right to liquidate the firm.

Alternatively, if δ is low and L_2 is relatively high, that is, $\frac{2I}{\delta^2} - L_2 < p_{v+x} + \delta p + (1+\delta)a$,

then (C3) turns out to be more restrictive than (C2). When this is the case then, depending on the profitability of their projects, entrepreneurs who can secure financing by granting investors the contingent right to liquidate the firm, might not be able to raise financing by granting this as an unconditional right.

This implies that when a project is rejected for equity financing, it might still qualify for short-term bank loans. The reverse is also true: A project that does not qualify for bank loans, could still issue outside equity.

Although for projects that satisfy (C1), (C2), and (C3), investors are indifferent between bank loans and outside equity, in the spirit of Modigliani and Miller (1958), there is also a range of projects for which investors prefer one contract over the other. In particular, companies with assets that are either easy to liquidate or have high liquidation values could successfully apply for short-term bank loans even if they were rejected by investors for equity finance. Alternatively, companies that have less valuable tangible assets but more attractive growth opportunities could receive equity financing even when they are turned down by banks. Hence my theory predicts that companies with substantial assets-in-place use more short-term loans, and companies with significant growth opportunities use more outside equity financing.

5 The Maturity Design of Contracts with the Right to Dismiss Management

Can the right to dismiss management sustain investors' claim? In other words, would investors be willing to dismiss management and incur dismissal cost following a strategic default?

5.1 Contract Design

Figure 5 and 6 present the games in extensive form that describe the actions and the resulting payoffs faced by the entrepreneur-manager and investors each period until the maturity of their contract, when investors have either the unconditional or the contingent right to dismiss management. Since no investor is going to dismiss management and incur any dismissal costs right before the contract expires, this is the time when entrepreneur-manager's best interest to default. But recognizing that the entrepreneur-manager can gain from defaulting in the last period, neither does it pay for investors to replace management in the second-to-last period. Hence, any contract with a prespecified expiration date will unravel, regardless of whether the investors' right to dismiss management is contingent or unconditional. Since it is the expiration of the contract that distorts the parties' incentives, issuing a claim for indefinite life alleviates the moral hazard problem.

When investors have the unconditional right to dismiss management, an equilibrium strategy for investors, U_D^I, specifies that investors will not replace the entrepreneur-manager at first, and as long as he makes equilibrium payments and follows responsible investment policy. Otherwise, investors will replace him.

The corresponding equilibrium strategy for the entrepreneur-manager, U_D^M, is to limit private benefits so as to make equilibrium payments and to follow responsible investment policy period after period, as long as no deviation has occurs. If a manager finds himself on the job after deviating from the equilibrium, then he will divert all the cash flows. Similarly, for the new manager, the corresponding equilibrium strategy, U_D^{NM}, is to limit private benefits so as to make equilibrium payments and to follow responsible investment policy period after period as long as no deviation occurs during his tenure. If he finds himself on the job following a default, then he will divert all the cash flows.

When investors have the contingent right to dismiss management, their equilibrium strategy, C_D^I, is to replace the manager in the event of a strategic default and forgive him in the event of a liquidity default.[13] The corresponding equilibrium strategy for the entrepreneur-manager, C_D^M, and for any new manager, C_D^{NM}, is to limit private benefits so as to make equilibrium payments period after period. If a manager finds himself on the job following a strategic default, then he will divert all the cash flows.

Regardless of what contract is implemented, there is no strategic default in equilibrium. Furthermore, when investors have the right to dismiss management, then they forgive the entrepreneur-manager in the event of a liquidity default. Even though dismissal never occurs in equilibrium, these contracts are sustainable, because investors are *willing* to incur the cost of dismissal following a strategic default. They are willing to dismiss management, since $E\hat{p}^- + \frac{\delta E\hat{p}}{1-\delta}$, the going-concern value of the firm for investors if they dismiss management following a default, exceeds zero, the going concern value of the company for investors if they do not dismiss management.

It is important to note that even though investors cannot exercise *contingent* control rights when management fails to maintain the assets, when investors have the right to dismiss management, they can still *induce* the entrepreneur-manager to follow responsible investment policy in equilibrium. The intuition is that unlike liquidation, dismissal substantially constrains the entrepreneur-manager's future opportunities. Since a myopic investment policy can lead to an eventual default and dismissal, and since this dismissal can substantially limit the entrepreneur-manager's future opportunities, management voluntarily chooses to properly maintain the assets, regardless of the design of investors' dismissal rights.

[13]Replacing the entrepreneur-manager after a strategic default, but not replacing him after a liquidity default, dominates any alternative equilibrium specification in the sense of Gale and Hellwig (1985).

Proposition 2 characterizes the financial contracts that grant investors the right to dismiss management.

Proposition 2 *Investors' right to dismiss management can sustain their claim if, and only if, either one of the following holds:*

(i) Investors have the unconditional right to dismiss management and their claim has indefinite life.

(ii) Investors have the right to dismiss management contingent on the event of a default and their claim has indefinite life.

(iii) Investors have the right to dismiss management contingent on the event of a default and their claim has a prespecified maturity unless default occurs. In the event of a default, investors can take over the company as a going concern for the indefinite future, and can have the unconditional right to dismiss management.

(iv) Investors have the right to dismiss management contingent on the event of a default and their claim has a prespecified maturity. They also have the option to convert their claim to indefinite life, and their contingent right to dismiss management to an unconditional right, prior to the expiration of their claim.

Proof: in Appendix.

Contract (i) describes *outside equity* as finance practitioners know it. Contract (ii) describes either a *short-term debt* that the entrepreneur-manager periodically rolls over, or a perpetual bond. Contract (iii) depicts short-, medium-, and *long-term debt* contracts. Finally, contract (iv) characterizes *convertible debt.* Notice that contracts (iii) and (iv) rely on debtholders' willingness to take equity positions following a default. Therefore, these contracts cannot be held by investors, who, like U.S. commercial banks, are prohibited from

taking equity positions in firms.

Notice that only projects with indefinite growth opportunities can raise longer-term financing. Consistent with empirical evidence that the higher the market to book ratio is, the longer the maturity of the firm's debt (Stochs and Mauer (1996)), my theory implies that companies with significant growth opportunities can issue longer-term financing, such as medium- and long-term debt, convertible debt, and outside equity.

5.2 Profitability Constraints

Depending on the project, investors can be indifferent between equilibrium contracts that grant contingent or unconditional rights to dismiss management, or they might prefer having unconditional rather than contingent control rights. Since investors with contingent rights cannot exercise control unless the entrepreneur-manager has failed to make a verifiable payment, contracts with contingent rights are more susceptible to managerial asset substitution. In particular, a manager planning to default could start milking the assets prior to default.[14] When investors have the contingent right to dismiss management, then the entrepreneur-manager who plans to default in the second period will choose to make the first payment, but at the same time will divert funds from investment in the first period. If this happens, then investors who can only dismiss management in the event of a default will have to wait until the second period to discipline management. Therefore, these investors will capture less value in a default than will investors who have unconditional rights. As a consequence, entrepreneurs who can raise funds by issuing a claim with the *unconditional* right to dismiss management might not be able to secure financing by issuing a claim with *contingent* right

[14]Fluck, Holtz-Eakin, and Rosen (1997) find evidence that entrepreneurs start withdrawing their own funds from their failing business at a faster rate than investors.

to dismiss management.

To see this, I analyze the incentive compatibility conditions associated with each contract. A contract with the unconditional right to dismiss management (such as outside equity or convertible debt) is sustainable if, and only if:

$$\frac{\delta Ep}{1-\delta} \geq I \tag{1}$$

$$v + x - p_{v+x} - a + \delta\frac{v-p-a}{1-\delta} \geq v + x \tag{2}$$

$$v - x - p_{v-x} - a + \delta\frac{v-p-a}{1-\delta} \geq v - x \tag{3}$$

A contract with a contingent right to dismiss management is sustainable only if:

$$v + x - p_{v+x} - a + \delta\frac{v-p-a}{1-\delta} \geq a + \delta v \tag{4}$$

$$v - x - p_{v-x} - a + \delta\frac{v-p-a}{1-\delta} \geq a + \delta v \tag{5}$$

holds[15] in addition to (1), (2), and (3). The right-hand sides of equations (4) and (5) capture the notion that the entrepreneur-manager has an alternative way to default when investors have a contingent right to dismiss management: He would make the contractual payment in the first period, but would not maintain the assets and would divert all the cash flows in the second period. Since the investors' right to dismiss management is contingent on the

[15]In case of a debt contract, p_{v+x} is to be read as the payment in case of no liquidity default (good state) and p_{v-x} is the payment in a liquidity default (bad state). In case of outside equity p_{v+x} denotes the equilibrium payment in the good state and p_{v-x} the equilibrium payment in the bad state.

event of a default, the entrepreneur-manager would not be penalized for not maintaining the assets in the first period.

The choice between long-term debt, convertible debt, and outside equity depends on the variability of the cash flows, x, as well as the profitability of the project, v. Whenever $a + \delta v \leq v + x$, then projects that can raise convertible debt or outside equity can also raise longer-term debt. For projects with $a + \delta v > v + x$, the profitability threshold for securing longer-term debt is higher than that for securing convertible debt or outside equity. For a wide range of parameters, $a + \delta v$ exceeds $v + x$ (see Example 1).

Proposition 3 summarizes my finding on the availability of financing. The proof can be derived from the steps outlined above, and thus is omitted. Example 1 presents a project that can be financed by convertible debt and outside equity, but not by long-term debt.

Proposition 3 *If an entrepreneur can finance his project by giving investors contingent rights to dismiss management, he can also finance the same project by granting investors unconditional rights, but not vice versa.*

Example: Let v, the periodic expected cash flows of the project, be 100; x, the standard deviation of the cash flows be 15; and the investment outlay $I = 150$. Then, in the good state, the project yields 115, and in the bad state, 85.

Suppose that the discount factor $\delta = 0.9$. Using I and δ, I calculate a as 71. After substituting into (1), I find that the expected payment on the contract is 17.

In the bad state, the entrepreneur-manager cannot make full payment: After renewing the assets, he is left with only $85 - 71 = 14$, so payment should be set at 20 to assure that investors recover their investment. The entrepreneur-manager will default and will pay 14 in the bad state, and as long as he pays 14, he is forgiven for his liquidity default. In the good state, the entrepreneur-manager pays 20 in equilibrium.

Correspondingly, the entrepreneur-manager enjoys 25 in private benefits in the good state and no private benefits in the bad state. After checking each equilibrium constraint, we see that whereas (2) holds since substituting into (2) gives us $132 > 115$, (4) fails to hold since substituting into (4) we get $132 < 160$. Consequently, this project can be financed by convertible debt and outside equity, but not by long-term debt. □

Example 1 presents a positive net present value project that cannot raise long-term debt but can raise outside equity. The reason is that this project is not profitable enough to provide incentive payments for the entrepreneur-manager to honor investors' claim. If long-term debt is ever issued, then the entrepreneur-manager would find it optimal not to maintain the assets in the first period when the cash flow realization is high, and to strategically default in the following period. Nevertheless, the entrepreneur-manager can raise financing by issuing outside equity. This finding is consistent with empirical evidence that firms are substantially larger when they have their first public debt issue than when they have their first public equity issue (Carey et al. (1993)).

Notice that investors are indifferent between holding convertible debt and outside equity. Thus, convertible debt serves as back-door equity financing in our model. Investors will convert to equity in the down-side, in the event of managerial asset substitution.

6 Conclusion

By characterizing how the joint design of claims, control rights, and maturity sustains financing in equilibrium, I derive a variety of securities as equilibrium contracts in a setting where management can divert or manipulate the cash flows, or can shirk or follow a suboptimal investment policy and where it is prohibitively costly to verify or prove any managerial wrongdoing for a third party such as a court. These contracts are short-, medium-, and

long-term debt, convertible debt, and outside equity.

Focusing on individual securities, the theory yields interesting implications about the sequencing of financing. Consistent with empirical evidence, this model predicts that small entrepreneurial firms use short-term bank loans, convertible debt, or outside equity at their initial financing stage. As these firms show evidence of higher profitability, in my model they can secure longer-term debt financing. The firm's choice between short-term debt, convertible debt or outside equity depends on the liquidation value or the specificity of the assets. Moreover, its choice also depends on the cost of replacing the entrepreneur-manager, namely, the specificity of the entrepreneur's human capital (Shleifer and Vishny (1989)) and the cost of the collective action (Stulz (1990)).

Interestingly enough, in my model firms with indefinite growth opportunities can sustain *debt with a maturity longer than the life of the assets.* They do so by granting investors a contingent right to dismiss management and take over the firm as a going concern in the event of a default. Since holders of contingent control rights can only discipline management following a default, these contracts can be susceptible to asset substitution by management. As a consequence, entrepreneurs who can raise funds by issuing a claim with the unconditional right to dismiss management might not be able to secure financing if they issue a claim that has only a contingent right to dismiss management. To the extent that more projects have access to outside equity than to debt financing, my model is consistent with Stulz (1990), who finds that outside equity has an advantage over debt in alleviating underinvestment.

Worth noting that as long as the investment policy is nonverifiable, writing a covenant in the contract cannot make it any easier for the entrepreneur-manager to raise debt financing. In contrast, if managerial investment policy is verifiable, then *covenant debt* will do just as well in preventing managerial asset substitution as outside equity, and outside equity could

be replicated by a debt contract with an infinite covenant.

Appendix

Proof of Proposition 1:

1. Necessity:

Consider a security with a contingent right to liquidate the firm and the promise of a fixed payment. First, I show by backward induction that if such a security has a maturity of one period, it is sustainable, depending on the characteristics of projects.

Suppose first that $v - x \geq p$. If the entrepreneur-manager complies with the contract, then the present value of his payoff is either $\delta(v+x-p)+\delta^2 v$ or $\delta(v-x-p)+\delta^2 v$ depending on the cash flow realization of the project. Alternatively, if he defaults on the payment, he gets $v + x$ or $v - x$ in the first period, and faces liquidation, since it is the investors' best response to liquidate the project at that time. The entrepreneur-manager will comply with the contract if

$$\delta(v+x-p)+\delta^2 v \geq \delta(v+x)$$

and

$$\delta(v-x-p)+\delta^2 v \geq \delta(v-x)$$

that is, if $\delta v \geq p$.

Investors are willing to finance the project if $p \geq \frac{I}{\delta}$, provided that $v - x \geq p$. Recall that $\delta v \geq p$ and $v - x \geq p$, so we get

$$\min\{v-x, \delta v\} \geq \frac{I}{\delta}$$

as the financing condition.

A project can also raise financing even if $v - x < p$. If $p > v - x$, then the entrepreneur-manager will face a liquidity default whenever $\tilde{v}_1 = v - x$. In case of a liquidity default, investors' best action is to liquidate the project. Liquidation yields them L_2 at time 2.

Alternatively, if they choose not to liquidate, they can only guarantee themselves zero. Liquidation is efficient whenever $L_2 \geq v$, the expected cash flow in period 2, but excessive and inefficient otherwise. However, if the project is liquidated anyway following a liquidity default, then the manager's best action is not to make any payment when $\tilde{v}_1 = v - x$. Consequently, investors get δp when $\tilde{v}_1 = v + x$ and $\delta^2 L_2$ when $\tilde{v}_1 = v - x$. Similarly, the entrepreneur-manager's payoff is $\delta(v + x - p) + \delta^2 v$ when $\tilde{v}_1 = v + x$, and $\delta(v - x)$ when $\tilde{v}_1 = v - x$. Investors are willing to finance the project if $\frac{1}{2}\delta p + \frac{1}{2}\delta^2 L_2 \geq I$, that is, $p \geq \frac{2I - \delta^2 L_2}{\delta}$. This condition together with $\delta v \geq p$, the condition guaranteeing that the entrepreneur-manager will not strategically default, yields

$$v \geq 2\frac{I}{\delta^2} - L_2$$

as the condition for financing projects with $v - x \leq \frac{I}{\delta}$.

Next, consider a security that carries the unconditional right to liquidate the firm and a claim to the cash flows of the project. First I show that, depending on the characteristics of projects, such a security is sustainable if it has indefinite life. Notice that any contract with indefinite life presupposes that the entrepreneur-manager periodically renews the assets. Investors are willing to finance the project over its indefinite life if they break even, that is, if

$$\frac{\delta E p}{1 - \delta} \geq I \tag{6}$$

holds. The entrepreneur-manager is willing to make equilibrium payments if, and only if

$$v + x - p_{v+x} - a + \delta\frac{v - p - a}{1 - \delta} \geq v + x + \delta^2 A \tag{7}$$

and

$$v - x - p_{v-x} - a + \delta\frac{v - p - a}{1 - \delta} \geq v - x + \delta^2 A \tag{8}$$

where A denotes the value of the entrepreneur-manager's outside option following a liquidation that is equal to the present value of his payoff when he issues investors a claim to the cash flows with the unconditional right to dismiss management. (as we shall see from the proof of Proposition 2, the entrepreneur-manager can always issue a claim to the cash flows with the unconditional right to dismiss management following a liquidation.)

Investors will not liquidate unless default occurs, provided that $\frac{Ep}{1-\delta} \geq L_2$, a condition implied by (6). Investors are willing to liquidate if the entrepreneur-manager fails to make equilibrium payments whenever $\delta L_2 \geq 0$. The entrepreneur-manager will default again if he defaulted once, because $v + x \geq v + x - p_{v+x} - a$ and $v - x \geq v - x - p_{v-x} - a$ trivially hold. Consequently, a security that has a claim to the cash flows, the unconditional right to liquidate the firm, and an indefinite maturity is sustainable. The financing conditions from (6), (7) and (8) become $p = \frac{(1-\delta)I}{\delta}$ and $\delta v \geq p_{v+x} + \delta p + (1+\delta)a$.

When the project is sufficiently profitable so that liquidity default does not arise in equilibrium, the constraint for raising funds by issuing a claim with the unconditional right to liquidate project is as restrictive as $\delta^2 v \geq I$, the constraint for raising funds by issuing a claim with the contingent right to liquidate the firm. To see this, I substitute $\frac{\delta I}{1+\delta}$ for a, and $\frac{v-p-a}{1-\delta}$ for A, replace p_{v+x} by p (when the project is sufficiently profitable so that liquidity default does not arise in equilibrium, then it is straightforward to see that $p_{v+x} = p_{v-x} = p$ in equilibrium), plug in $\frac{(1-\delta)I}{\delta}$ for p in the right-hand side of $\delta v \geq p_{v+x} + \delta v + (1+\delta)a$ and obtain $\delta^2 v \geq I$.

If, however, the project is such that liquidity default does arise in equilibrium, then, depending on the characteristics of their projects, there are entrepreneurs who will not be able to raise financing by issuing a claim with the unconditional right to liquidate, but, and at the same time will be able to secure funds by issuing a claim with a contingent

right to liquidate, and vice versa. Notice that the right side of the debt-financing condition $v \geq 2\frac{I}{\delta^2} - L_2$ is decreasing in L_2 but independent of x, whereas the equity financing conditions are independent of L_2 but depend on x. Hence, when $\frac{2I}{\delta^2} - L_2 > p_{v+x} + \delta p + (1+\delta)a$, then some entrepreneurs who can raise funds by issuing a claim with the unconditional right to liquidate the firm, might not be able to secure financing by issuing a claim with a contingent right to liquidate the firm, but not vice versa. Alternatively, $\frac{2I}{\delta^2} - L_2 < p_{v+x} + \delta p + (1+\delta)a$, then, depending on the profitability of their projects, some entrepreneurs who can secure financing by granting investors a contingent right to liquidate the firm might not be able to raise financing by granting it as an unconditional right but *not* vice versa.

2. Sufficiency:

First I show that a contract with the contingent right to liquidate is not sustainable with maturity equal to or longer than the life of the assets.

Suppose that the maturity $T > 2$. Such a contract requires the entrepreneur-manager to periodically renew the assets. If the entrepreneur-manager fails to do so in period 1 and defaults in period 2, then the value of the assets at the time of the default becomes zero. By failing to renew the assets in period 1 and defaulting in period 2, then entrepreneur-manager can guarantee himself $v - p + \delta v + \delta^2 A$. This is greater than $v - p - a + \delta(v - p - a) + \delta^2 A$ which he can get by complying with the contract. Hence no contract with a claim longer than the life of the assets can be supported by the contingent right to liquidate the firm.

Suppose next that $T = 2$. Recall that a two-period contract does not require the entrepreneur-manager to maintain the assets and that by the end of period 2, the liquidation value of the assets falls to zero. The end of period 2 then becomes the most advantageous time to default. If the entrepreneur-manager defaults at the end of period 2, he can guarantee himself $v + \delta A$. Otherwise, he would receive $v - p + \delta A$.

Finally, I need to show that a contract with the unconditional right to liquidate is not sustainable if it has a prespecified expiration date. Suppose a contract is issued with the unconditional right to liquidate and that it matures in T periods. Solving for the subgame perfect equilibrium by backward induction, we can see that during the last cycle before the contract expires, the entrepreneur-manager will have no incentive to renew the assets. At time T, at the expiration of the contract, the entrepreneur-manager can guarantee himself $v + \delta A$ by diverting all the cash flows, whereas by not defaulting he would get only $v - p + \delta A$. Investors, foreseeing the default, will choose to liquidate in the second-to-last period. Liquidating will yield them δL_2 more than they could get otherwise.

However, given that investors liquidate in the last period, it is in the entrepreneur-manager's best interest to default in the second-to-last period. Whether or not he defaults then, there will be a liquidation. His opportunity payoff will be the same following the liquidation, but his second-to-last period payoff would be higher by diverting the cash flows and pocketing v than it would be by complying with the contract and getting $v - p$. Taking the argument further backward, we can see that the unconditional right to liquidate cannot sustain any claim with a prespecified expiration date, provided that $\delta I \geq L_1$. □

Proof of Proposition 2:

1. Necessity:

Contract (i):

Investors with the unconditional right to dismiss management are willing to finance the project if

$$\frac{\delta E p}{1-\delta} \geq I \tag{9}$$

holds. The entrepreneur-manager is willing to comply with the contract if

$$v + x - p_{v+x} - a + \delta \frac{v - p - a}{1-\delta} \geq v + x \tag{10}$$

and

$$v - x - p_{v-x} - a + \delta \frac{v - p - a}{1 - \delta} \geq v - x \tag{11}$$

hold.

Investors are willing to dismiss the entrepreneur-manager if he fails to comply with the equilibrium, because $E\hat{p}^- + \frac{\delta E\hat{p}}{1-\delta}$, the going-concern value of the firm for investors if they dismiss management following a default exceeds zero, the going-concern value of the company for investors if they do not dismiss the entrepreneur-manager who fails to make equilibrium payments or to renew the assets. The entrepreneur-manager will default again if he defaulted once, because $v + x \geq v + x - p_{v+x} - a$ and $v - x \geq v - x - p_{v-x} - a$ trivially hold. Finally, investors will not dismiss management unless default occurs, because $\frac{Ep}{1-\delta} > \frac{E\hat{p}^-}{1-\delta}$.

Contract (ii):

Investors with the contingent right to dismiss management are willing to finance the project if (9) holds. The entrepreneur-manager is willing to comply with the contract if (10), (11),

$$v + x - p_{v+x} - a + \delta \frac{v - p - a}{1 - \delta} \geq a + \delta v \tag{12}$$

and

$$v - x - p_{v-x} - a + \delta \frac{v - p - a}{1 - \delta} \geq a + \delta v \tag{13}$$

hold.

Investors are willing to dismiss the entrepreneur-manager following a strategic default since $E\hat{p}^- + \frac{\delta E\hat{p}}{1-\delta}$, the going-concern value of the firm for investors if they dismiss management following a default, exceeds zero, which would be the going-concern value of the company for

investors if they do not dismiss management following a strategic default. The entrepreneur-manager will choose to default again if he has strategically defaulted once and nevertheless remained on the job, since $v + x \geq v + x - p - a$ and $v - x \geq 0$ trivially hold.

Finally, investors will not dismiss management following a liquidity default, because $\frac{Ep}{1-\delta} > \frac{E\hat{p}^-}{1-\delta}$.

Contract (iii):

Investors with the contingent right to dismiss management are willing to finance the project if (9) holds. The entrepreneur-manager is willing to comply with the contract if (10), (11), (12) and (13) hold. Investors are willing to dismiss the entrepreneur-manager following a strategic default for the same reason as the equityholders in Contract (i) do. The entrepreneur-manager will choose to default again if he has strategically defaulted once and remained on the job because $v \geq v - p$ trivially holds. Finally, investors would not dismiss management following a liquidity default for the same reason as holders of Contract (ii) will not do so.

Contract (iv):

This contract is sustainable whenever Contract (i) is sustainable. The only difference between Contract (i) and Contract (iv) is that Contract (iv) is a debt contract to start with. Thus, we need to check what happens if there is a liquidity default. It is straightforward to see that holders of Contract (iv) will not dismiss management following a liquidity default for the same reason as holders of Contract (ii) will not do so, because $\frac{Ep}{1-\delta} > \frac{E\hat{p}^-}{1-\delta}$.

2. Sufficiency:

I need to show that no contracts other than (i), (ii), (iii), and (iv) are sustainable. That is, I need to prove that a claim with a prespecified expiration date cannot be supported by either the unconditional right to dismiss management or the contingent right to dismiss

management, unless the holder has the right to take over the firm as a going concern.

Suppose that a claim is issued with a prespecified expiration date, T, and with the unconditional right to dismiss management. Using backward induction, we can see that in period T, when the contract expires, it is in the entrepreneur-manager's best interest to divert all the cash flows. Since all managers will default in the last period, it never pays for investors to incur the cost of dismissal in the second-to-last period, either. If they dismiss the entrepreneur-manager following a default, then they will incur a loss after absorbing the cost of dismissal. Thus, by dismissing the entrepreneur-manager they can guarantee themselves less than the zero amount that they would receive by not dismissing the entrepreneur-manager following a default in the second-to-last period. Recognizing that he will not be dismissed following a default in the second-to-last period, the entrepreneur-manager will choose to strategically default in that period. Taking this argument further backward, we see that the entrepreneur-manager will divert the cash flows in each period in any subgame perfect equilibrium. Consequently, a claim with a prespecified expiration date cannot be sustained by granting investors the unconditional right to dismiss management. Similar reasoning establishes that no claim can be supported by a contingent right to dismiss management with a prespecified expiration date. □

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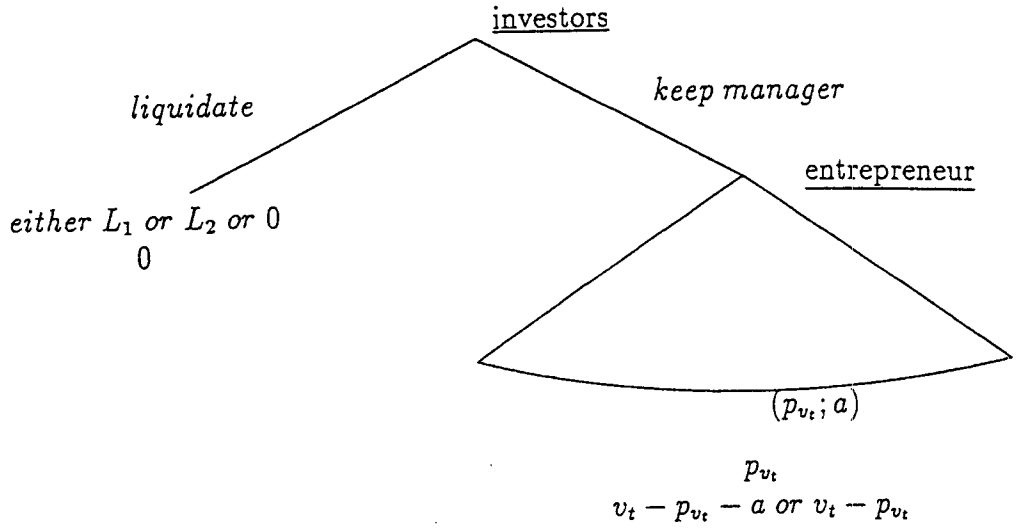

Figure 3: The component game when investors have unconditional right to liquidate the firm

In each period, investors decide simultaneously whether or not to liquidate the firm. As long as no challenge is initiated, the entrepreneur-manager decides whether or not to renew the equipment, and then makes payments to investors. When no challenge is initiated, investors receive p_t, the payment decided by the entrepreneur-manager, and the entrepreneur-manager receives $v_t - a_t - p_t$ or $v_t - p_t$, depending on his investment policy. In the event of a liquidation the entrepreneur-manager receives no payoff and investors receive the liquidation value of the physical assets. Depending on the investment policy, the liquidation value L equals L_1, L_2 or 0. The first element of the payoff vector is the payoff to investors, the second is the payoff to the entrepreneur-manager.

For simplicity, I do not indicate the possibility of partial liquidation in the diagram. Partial liquidation is also allowed in the model. In case of partial liquidation, investors gets the liquidation value of the foreclosed assets and the entrepreneur-manager continues to operate the remaning assets. In equilibrium partial liquidation is strongly dominated for investors by either no liquidation or full liquidation.

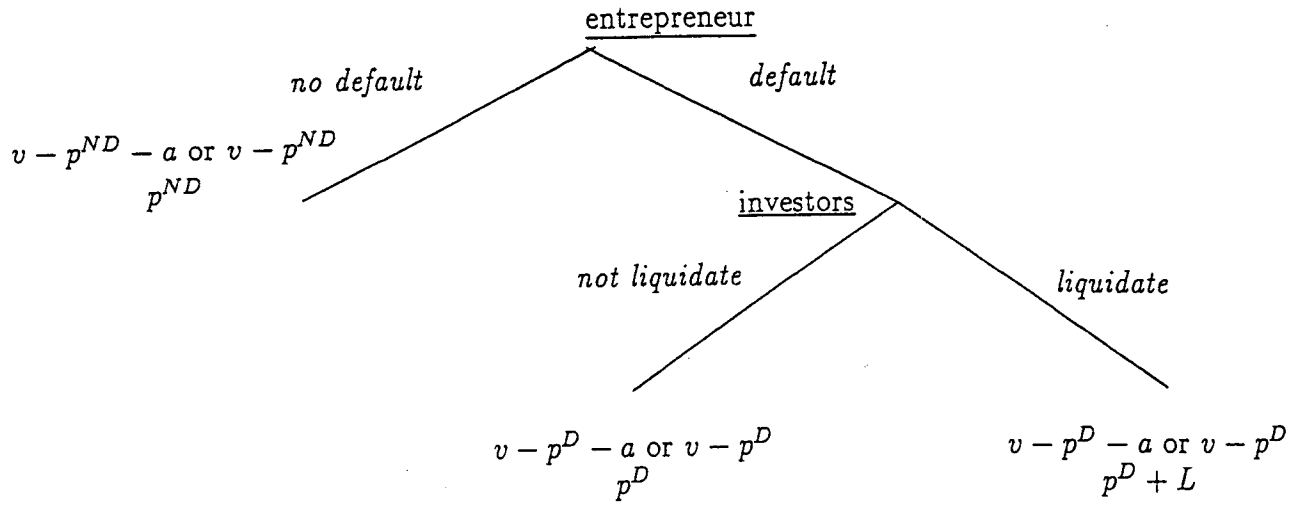

Figure 4: The component game when investors have contingent right to liquidate the firm

In each period, the entrepreneur-manager decides on the investment policy and then makes payments to investors. Investors receive p_t, the payment decided by the entrepreneur-manager, and the entrepreneur-manager receives $v_t - a_t - p_t$ or $v_t - p_t$, depending on his investment policy. In the event of a default, investors can decide whether or not to liquidate the firm. In the event of a liquidation, the entrepreneur-manager receives no more payoff and investors receive the liquidation value of the assets-in-place. Depending on the investment policy, the liquidation value L equals L_1, L_2 or 0.

Worth noting that when investors are granted contingent control rights, then the entrepreneur-manager has the first-mover advantage. Consequently, on the diagram, the first element of the payoff vector is the payoff to the entrepreneur-manager (the entrepreneur-manager is the first-mover when control rights are contingent) and the second element is the payoff to investors. The term p^{ND} denotes equilibrium payments to investors. The term p^D denotes the payment that triggers default.

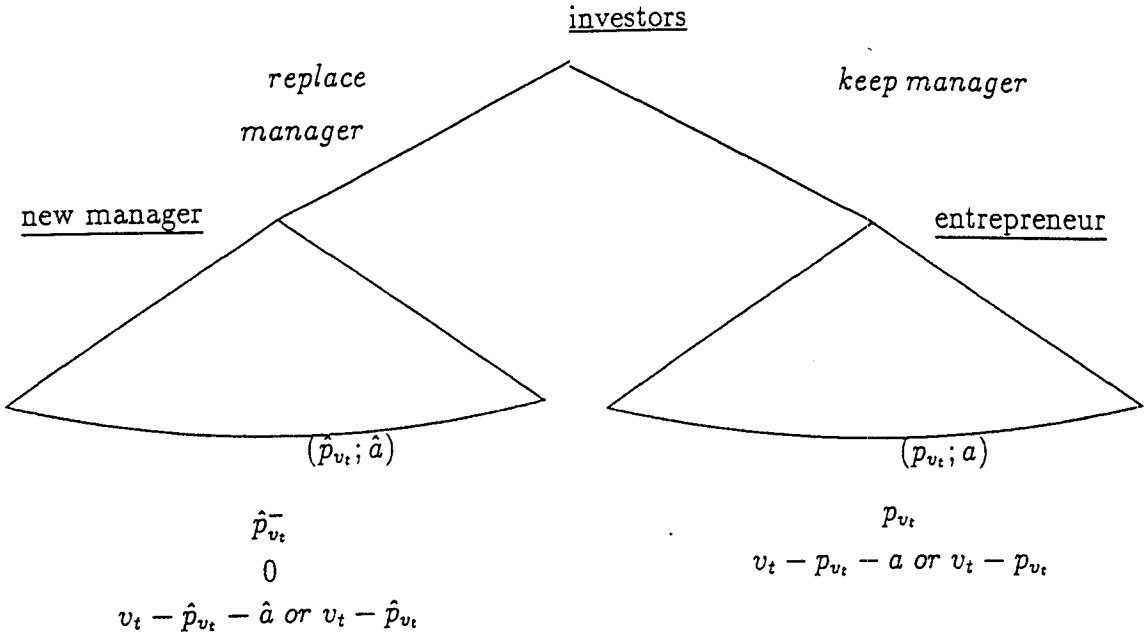

Figure 5: The component game when investors have unconditional right to dismiss management

In each period investors decide simultaneously whether or not to replace management. As long as no challenge is initiated, the entrepreneur-manager decides on the investment policy and then makes payments to investors. When no challenge is initiated, investors receive some p_t, the payment decided by the entrepreneur-manager, and the entrepreneur-manager receives $v_t - a_t - p_t$ or $v_t - p_t$, depending on his investment policy. In the event of a dismissal, a new manager takes charge, he decides on the payments and the investment policy, the entrepreneur-manager receives no payoff, and investors bear a cost associated with replacing the manager.

The first element of the payoff vector is the payoff to investors and the second is the payoff to the entrepreneur-manager. The third element, whenever applicable, indicates the payoff to the new manager who is replacing the entrepreneur-manager. The notation $\hat{p}_t$ and $\hat{a}$ refers to decision variables set by the incoming new manager, and p_t^- denotes payments investors receive net of the cost of replacing management.

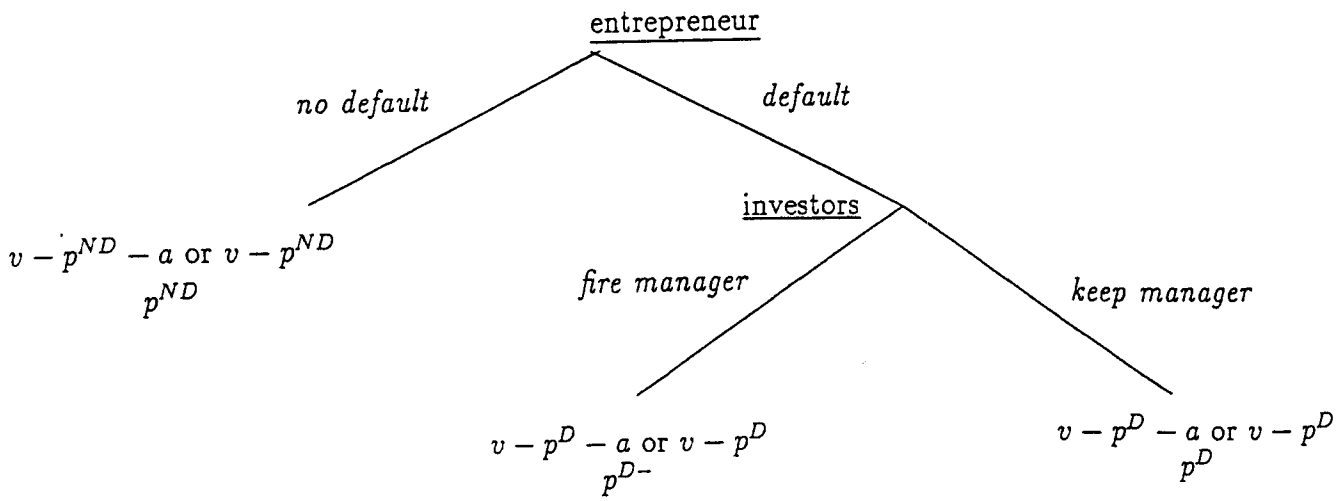

Figure 6: The component game when investors have contingent right to dismiss management

In each period, the entrepreneur-manager decides on the investment policy and then makes payments to investors. Investors receive p_t, the payment decided by the entrepreneur-manager, and the entrepreneur-manager receives $v_t - a_t - p_t$ or $v_t - p_t$, depending on his investment policy. In the event of a default, investors decide whether or not to dismiss management and seize the firm as a going concern. If the entrepreneur-manager is dismissed, a new manager comes in and decides on the investment policy and the payments to investors. The entrepreneur-manager who is dismissed receives no more payoff and investors receive the payment set by the incoming manager.

Worth noting that when investors are granted contingent control rights, then the entrepreneur-manager has the first-mover advantage. Consequently, on the diagram the first element of the payoff vector is the payoff to the entrepreneur-manager and the second element is the payoff to investors. The term p^{ND} denotes equilibium payments to investors and p^{D} denotes the payment that triggers default, p^{D-} denotes p^{D} net of the cost of dismissal.