Capital Structure Decisions in Small and Large Firms: A Life-cycle Theory of Financing

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Abstract

This paper focuses on the dynamic capital structure of firms: Why do firms use very different financial contracts in different stages of their life-cycles? In a model of optimal financial contracting, we investigate whether firms' subsequent financing decisions are affected by the outcome of their previous financing decisions. We find that the initial and subsequent financing decisions of the same firm may lead to different security choices. The firms' financing decisions will differ in two respect. First, there will be equilibrium contracts that investors would reject for some startup firm, but would accept for an otherwise identical ongoing firm (i.e. even when the two firms have identical projects). Secondly, even the *set* of the equilibrium financial contracts differs in different stages of the firm's lifecycle: some contracts which are never sustainable as an initial contract but become sustainable as a subsequent contract. The reason is the *stage-dependency* of the control rights of subsequent claimholders: in addition to their own rights, holders of subsequent security issues may also rely on the firm's existing investors to enforce their claims. Whether or not they can do so, depends on the priority structure of the claims.

Consistent with empirical evidence, our theory implies a life-cycle pattern of financing: firms will issue outside equity, short-term debt or convertible debt first, then use their retained earnings, issue longer-term debt, or outside equity to satisfy subsequent financing needs. Despite the presence of severe market imperfections, the Modigliani-Miller indifference result between debt and equity *does* hold for ongoing firms in our model, but at the same time, it fails to hold for entrepreneurial startups. Since the control rights of previous securityholders represent an externality for subsequent claimholders, the marginal decision of which security to issue next becomes irrelevant once a firm has sufficient contractual complexity in place.

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

In practice the financial structures of small entrepreneurial firms are typically very different from those of large, ongoing firms. Small entrepreneurial firms use convertible debt, private equity and short-term bank loans, whereas larger, ongoing companies typically issue outside equity and public debt. Interestingly, not only the types of the contracts differ for companies in different stages of their life-cycles but there are also significant differences in the terms (control rights and maturities) of the contracts even within the same class (debt or equity) (See for example Kaplan and Strömberg (1999)).

While the practice is well-documented, there is very little theory to explain the differences in the financing choices of firms and in the design of financial contracts in different stages of the firms' life cycles. Why are small entrepreneurial firms, startups so different from more established, ongoing firms? Why do firms have very different financial structures in different stages of their life-cycles?

The reason why no such investigation has been carried out earlier is that until recently most of the financial contracting literature focused almost exclusively on small entrepreneurial firms and ignored the financing decisions of more established, ongoing firms. Models that were developed for investigating the financing choices of entrepreneurs were then used to make predictions about the capital structure decisions of larger, established companies.[1] With this perspective corporate finance theory was unable to shed light on how

[1]Zwiebel (1996), Bolton and von Thadden (1998) and Fluck (1999a) are exceptions. In Zwiebel's model when the manager chooses the firm's capital structure he takes into account the impact the firm's capital

firms in various stages of their life-cycle differ in the financing choices they make.[2]

We model the capital structure decisions of the startup and the ongoing firm as different stages of the sequential decision-making process. The first stage is the financing of the firm's initial project (we call it "startup"), the second stage is the financing of the firm's expansion project (we call it "ongoing firm"). We model the startup as an entrepreneur

structure will have on his incentives and on his ability to stay with the firm in the future. Zwiebel shows that issuing debt commits the manager to make the right investment in the future and thereby enables him to avoid the threat of takeover. Bolton and von Thadden develop a model of a large firm to compare the liquidity benefits obtained through dispersed corporate ownership with the benefits of efficient management control achieved by some degree of ownership concentration. In Fluck's model of entrenched management and dispersed outside equity management chooses the distribution of equity ownership so as to maximize private benefits against the risk of potential control challenges. Our paper is related to Zwiebel (1996), Bolton and von Thadden (1998) and Fluck (1999a), since these papers also develop models of a large firm that are distinct from the traditional founder-entrepreneur model of a small firm. However, neither of these articles studies the financing decisions of firms in different stages of their life-cycles, that is the focus of our model.

[2]Diamond (1991) presents a model in which firms access different sources of financing as they develop reputation. Banks provide screening and monitoring of companies. Firms use bank financing in the early stages of their life-cycle or after a period of distress. As they develop a good reputation, companies can access cheaper form of financing such as public debt. Our paper is closest in spirit to Diamond (1991). Unlike in Diamond's model, the friction between the firm and financier in our model is not asymmetric information but the incompleteness of financial contracts. A further difference between the two papers is their focus: Whereas Diamond's concentrates on the choice of between two alternatives, bank debt and public debt, our focus is on the sequential financing decisions between various classes of debt and outside equity and on the interaction between equity and debt holders.

seeking financing for his initial project. Following Grossman and Hart (1986) and Hart and Moore (1989), we assume that the entrepreneur can divert or manipulate the firm's cash flows and it is prohibitively costly to prove any managerial wrongdoing for a third party such as a court. Hence contracts can not be written on cash flows because courts cannot verify their realizations. Our model of the ongoing firm is an enterprise which successfully operates and finances its initial project and seeks financing for an expansion project.

In this setting, we find that the initial and the subsequent financing decisions of the same firm may lead to different security choices. The firms' financing decisions will differ in two respect. First, there will be equilibrium contracts that investors would reject for some startup firm, but would accept them for an otherwise identical large firm (i.e. when the two firms have identical projects). The reason is the *stage-dependency* of the control rights of subsequent claim holders: in addition to their own rights, holders of subsequent security issues may also rely on the firm's existing investors to enforce their claims. As a consequence, investors require lower profitability threshold for financing a project in an ongoing firm than in an entrepreneurial startup. This enables the ongoing firm to issue securities that a startup firm with an identical project cannot. Whether or not holders of subsequent security issues can rely on the firm's existing investors to enforce their claims depends on the priority structure of the claims.[3]

Secondly, even the *set* of equilibrium financial contracts differs in different stages of

[3]The importance of a well-defined priority structure is also emphasized in Park(1999) in the context of monitoring incentives. In Park's model the optimal debt contract delegates monitoring to a single lender and seniority allows this lender to appropriate the full return from his monitoring activities.

the firm's life cycle. In particular, some contracts that are *never* sustainable at the initial financing stage may become sustainable at a subsequent financing stage. If investors are willing to write a financial contract for a startup, they are always willing to write the same contract for an otherwise identical ongoing firm but not vice versa: there are contracts that are only available for ongoing firms. Again, the intuition lies in the interaction between the control rights of existing and subsequent claim holders. Since holders of subsequent security issues may also rely on the firm's existing investors to enforce their claims, they are willing to enter into contracts that they would have otherwise rejected as an initial contract.

Since the seminal paper of Modigliani and Miller [M&M] (1958), a vast literature[4] has developed to investigate the robustness of their result about investors' indifference between debt and equity. These articles introduced taxes, asymmetric information, agency problems and incomplete contracting into the M&M framework. With the exception of Dybvig and Zender (1986),[5] the literature concluded that the Modigliani-Miller proposition fails to hold in the presence of market imperfections. A novel result of our analysis is that for a wide range of firms the M&M proposition is fairly robust to a particular class of market imperfections, contractual incompleteness. In our model, despite their inability to write complete financial contracts, investors are indifferent between debt and equity *in ongoing firms*, but they strongly prefer one over the other in entrepreneurial startups. The intuition is again

[4]See Harris and Raviv (1991, 1992), Hart (1995) and Allen and Winton (1997) for comprehensive surveys of this literature.

[5]Dybvig and Zender shows that the M&M proposition is valid in a large class of models with asymmetric information. The authors' proof relies on the assumption that managerial compensation is chosen optimally.

the interaction between the control rights of subsequent claimholders: Since the control rights of previous security holders represent an *externality* for subsequent claim holders, the marginal decision of which security to issue next becomes irrelevant once a firm has sufficient contractual complexity in place.

Since the different contracts require different profitability thresholds for the financing of an *initial* project, our theory also implies a life-cycle pattern of firm financing: firms will issue outside equity, or convertible debt first, then use their retained earnings, and finally issue long-term debt or outside equity to satisfy their subsequent financing needs. Interestingly, this pattern differs from the one implied by Myers's (1984) pecking order theory of finance in one important aspect: the initial financing choice of the firm. Myers predicts that firms will issue debt first and outside equity only later, whereas our theory suggests that the firm's first outside equity issue will precede its first public debt issue.[6] Carey et al. (1993) and Helwege and Liang (1996) presents evidence that small etrepreneurial firms frequently issue outside equity before they issue debt.

Our theory offers interesting implications about how financial contracts can limit man-

[6]This implication of our theory on the timing of debt and equity issues in small firms is related to Garmaise (1998) and Habib and Johnsen (1998). Garmaise develops a theory of small firms in which investors are better informed about the prospects of the entrepreneur's project than the entrepreneur. Given this informational asymmetry, small firms prefer to issue equity over debt. Habib and Johnsen shows that if investors are more informed about the primary use of the firm's assets than the entrepreneur, then the firm will sell them equity and alternatively, if investors are more informed about the secondary use of the firm's assets, then the firm will issue debt. Unlike our paper, neither of these articles develop a theory on the sequencing of firm financing.

agerial consumption of perks. Although in our model the manager has the ability to divert or manipulate the firm's cash flows and it is prohibitively costly to prove any managerial wrongdoing for a third party such as a court, a variety of financial contracts can effectively control the manager's appropriation of private benefits in equilibrium except for firms in economic distress.[7] And even though the manager will consume more perks in equilibrium as the firm grows, the managerial appropriation of private benefits is less of a concern for potential investors in ongoing firms than it is in entrepreneurial startups.

Our theory advances the Jensen and Meckling and the Fama and Jensen view of the firm as a nexus of contracts. We show that as the firm adds more layers of contracts, subsequent claim holders benefit from the control rights of the firm's existing security holders. Since the control rights of existing security holders represent a positive externality for subsequent claim holders, firms in later stages of their life-cycle can issue contracts that investors would reject at their initial financing stage.

The paper is organized as follows. Section 2 describes the model. Section 3 studies the initial financing of firms. Section 4 investigates the subsequent financing decisions of firms. Section 5 discusses the implications of the model for a life-cycle theory of firm finance. Section 6 extends the model to incorporate covenant debt and dispersed outside equity. Section 7 presents a theory of control changes over the firm's life-cycle. Section 8 discusses the implications of the model for asset substitution. Section 9 concludes.

[7] This result is consistent with Leland (1999) and Fluck (1999) who find that managerial asset substitution only becomes a serious problem when firms are in distress.

2 The Model

We consider two firms: a startup and an established, ongoing firm. We model the former as a risk-neutral entrepreneur who has no wealth and who seeks financing for a project from risk-neutral investors. We model the latter as an enterprise that successfully operates and finances its first project and seeks financing for an expansion project.

We assume that the firm's initial project and the expansion project are otherwise identical. Hence at the second stage the firm doubles its operation. We do so to make our point more transparent, i.e. even in the case of identical, perfectly positively correlated projects subsequent financing decisions may lead to different security choices.

2.1 The cash flows

The projects yield periodic operating cash flows, $\tilde{v}$. 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. Each project requires an investment outlay, I, and involves the operation of an equipment with economic life of two periods. Both the investors and the entrepreneur use the same positive discount factor, δ, to value future payoffs.

Each period the manager can divert the cash flows. 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 such as a court. Hence contracts written on cash flows are prohibitively costly to verify in court (Grossman and Hart (1986)).

2.2 The investment decision

The manager can repeat the projects over and over again. As long as a project continues, the manager can seek external financing for the replacement of the physical assets at the beginning of each cycle, or he can renew the equipment each period by retaining some of the earnings, a. If a is spent at time 1 and time 2, then further investment of I in period 2 can be avoided. We assume that each investment policy is feasible, that is, $v-x \geq a$. We also assume that these investment policies are equally costly to implement, that is, $I = \frac{a}{\delta} + a$. Notice that the liquidation values of the assets depend on which investment policy the 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.

Alternatively, if the equipment is renewed period after period, its liquidation value is equal to L_1 across periods. The equipment can be periodically renewed if all cash flow realizations of the project exceed the cost of the renewal, that is, if $v - x \geq a$.

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.

2.3 The financing decision

The entrepreneur can seek debt or equity financing from investors. In these financing arrangements investors offer I, the investment outlay to the manager in exchange of future payments and contingent or unconditional control rights. Investors may be granted the right to liquidate the assets, or the right to dismiss the manager. The firm must bear a fixed cost θ every time it issues a security. This cost is the same for each security the firm issues.

2.3.1 The model of outside equity

We define outside equity by its claim structure, control rights and maturity. In exchange of I the manager promises equityholders the project's cash flows (net of the manager's private benefits of control). Holders of outside equity are granted the unconditional right to dismiss the manager (i.e. the right to dismiss the manager regardless of the firm's cash flows or managerial performance) or to liquidate the firm's assets-in-place. Equity is issued with indefinite life.[8] The timing of the actions and the associated payoffs for outside equity are

[8]Fluck (1998) established that when cash flows are nonverifiable and the manager has the ability to divert or manipulate the cash flows, then the only outside equity that is sustainable is of unlimited life. This is because the threat of the manager's dismissal is not a credible threat when there is a prespecified expiration date on equity but becomes a credible threat when the equity has indefinite life. Her result follows from the inability of finitely-lived investment opportunities to provide the manager with an incentive not to consume v_t every period. Put simply, in the last period of the equity's life, the manager consumes v_t. Firing is not a credible threat since firing is costly to the equity and the new manager has the same incentives as the old manager. Since the manager knows she consumes v_t in the last period in the next to last period the manager

described in the next subsection.

2.3.2 The model of debt

We define debt as a contract that grants investors a fixed periodic payment and contingent control rights. The debtholders can exercise their control rights when the firm is in default, i.e. if the manager has failed to make the agreed-upon payment.[9] Upon default, the debtholders can either forgive the manager or dismiss the manager. The debtholders can also take over the firm as a going concern (take equity), or extend the maturity of the debt or they can liquidate the firm's existing physical assets. We distinguish between liquidity default (when the manager does not have the funds to make the payment) and strategic default (when the manager decides to divert the funds rather than make the payment).

A debt contract may be written with a prespecified maturity, T, or with indefinite maturity. If T exceeds the life of the firm's existing physical assets (in our model it is two periods) then we call the contract long-term debt. The debtholders' actions and their payoff-implications are described in details in the next subsection.

2.4 The set of actions and payoffs

When no control challenge is initiated, the manager decides on the investment policy and

can consume all of v_t since firing again is not a credible threat.

[9]Alternatively, if some accounting variables were verifiable in our model, then we could define default as either failure to make payment or violation of a bond covenant. Our results are easily applicable to covenant debt, since investors are frequently granted specific control rights when a covenant is violated (Smith and Warner (1979) and Kahan and Tuckman (1996)).

then makes payments to investors. Investors receive dividends d_t or debt payments p_t, on which the manager has decided, and the manager receives $v_t - a_t - p_t$ (or $v_t - a_t - d_t$) or $v_t - p_t$, (or $v_t - d_t$) depending on his investment policy. We denote the expected payment debtholders (shareholders) receive by p (d_t), the promised payment on debt (the equilibrium dividends in the high state) by p_{v+x} (d_{v+x}) and the equilibrium debt payment the manager pays in liquidity default (the equilibrium dividends in the low state) by p_{v-x} (d_{v-x}). We denote the managerial equilibrium payoff by M_{v+x} and M_{v-x}, respectively.

In the event of a dismissal, a new manager takes charge and decides on the payments, $\hat{p}_t$ and the investment, $\hat{a}_t$. The departing manager receives no payoff, and the equityholders bear c, the cost associated with replacing the manager.

If the debtholders take over the firm as a going concern (take equity) upon default, then from this date onward they will be holding unconditional control rights for the indefinite future and they will have a claim to a fraction of the firm's cash flows. We denote the discounted present value of the debtholders' future payoff from the time they have taken over the company as a going concern by $\frac{E\hat{p}^+}{1-\delta}$, which is equal to the value of the debtholders' remaining claim (or the value of the firm whichever is lower).

If the debtholders forgive the current payment and extend the maturity of the debt by one period, then the remaining (T+1-t) payments are rescheduled to times t+1,...,T+1.[10]

In the event of liquidation, the manager receives no payoff and investors receive the liquidation value of the physical assets.

[10]Alternatively, if the debtholders forgive but do not extend the maturity of the debt, then they simply agree to accept one less payment.

3 The entrepreneurial startup

There are several equilibrium financial contracts that can be issued for the financing of entrepreneurial startups. Those that do not involve inefficient liquidation (dismissal) in equilibrium are Pareto-optimal. These contracts impose zero verification cost on the parties, they involve no deadweight loss in equilibrium and the payoff of one party (investors or management) can be improved only at the expense of the other party.

In this section, we introduce three contracts for the financing of small entrepreneurial firms. These contracts are sufficient to establish that (i) investors set lower profitability thresholds for the financing of ongoing firms; and that (ii) the set of equilibrium financial contracts for ongoing firms is a superset of the set of equilibrium financial contracts for entrepreneurial startups. One of these contracts is outside equity and the other two are debt contracts. The two debt contracts differ in the control rights they assign to the holders. In Section 3 we will derive conditions under which these contracts are sustainable for small firms. Then in Section 4 we will revisit these contracts and show that (1) investors are indifferent between these contracts at a subsequent financing stage even though they are not indifferent at the firm's initial financing stage; and (2) ongoing firms can issue securities which are never equilibrium contracts for entrepreneurial startups.

3.1 Outside equity

The first security we introduce is outside equity. Recall from Section 2.3.1 that outside equity is a contract that promises investors a claim to the firm's cash flows, the uncondi-

tional right to dismiss management[11] or to liquidate the firm's physical assets and indefinite maturity. Then the following strategy-pair for the equity holders and the manager I^E, M^E constitutes a subgame perfect equilibrium.

For the equity holders: Equity holders do not replace the manager at first and until the manager paid equilibrium dividends and properly maintained the firm's assets[12] each period. If there is any deviation from the equilibrium, then they replace the manager next period.

For the (new) manager: The manager pays equilibrium dividends and maintains the firm's assets each period. If there is any deviation from the equilibrium, then he will divert the cash flows for ever. □

Investors are willing to hold outside equity if and only if (i) they can recover the outlay; and (ii) the present value of the stream of the managerial incentive payments exceeds any possible cash flow realizations (if it were not the case then the manager would prefer to take the cash flows and face dismissal). Formally,

$$\frac{\delta d}{1-\delta} \geq I. \tag{1}$$

$$M_{v+x} + \delta \frac{v-d-a}{1-\delta} \geq v + x; \tag{2}$$

[11]Hellmann and Puri (2000) document that venture capitalists (private equity) frequently replace entrepreneurs with a professional CEO if they are not satisfied with the firm's performance.

[12]In the context of venture-backed startups we can reinterpret the manager not paying equilibrium dividends or not properly maintaining the firm's assets as the equivalent of the firm not reaching key milestones in its development.

$$M_{v-x} + \delta \frac{v - d - a}{1 - \delta} \geq v - x. \tag{3}$$

The rest of the incentive compatibility conditions are shown in Appendix A1. For $c < a$, (1), (2) and (3) are necessary and sufficient conditions.

3.2 Debt contract with the right to dismiss management

In this section we introduce our first debt contract. This contract promises investors a fixed payment and grants them the right to dismiss the manager. Debt holders are also granted the right to take over the firm as a going concern or to extend the maturity of the debt in the event of a default. As shown in Fluck (1999b), such a contract provides the firm's manager can be written with maturity shorter or longer than the life of the firm's physical assets.

When investors have the contingent right to dismiss management and take over the firm as a going concern, then the following strategy-pair I^{LT}, M^{LT} constitutes a subgame perfect equilibrium.

For the debt holders: (i) The debt holders replace the manager and take over the firm in a strategic default (when the manager could make the payment but would rather default) in period t and forgive him and extend the maturity of the debt in a liquidity default (when the manager cannot make the payment) in period t; (ii) If the manager has strategically defaulted in period t but he has not been dismissed in this period and/or the firm has not been taken over, then the debt holders will dismiss him and will take over the firm next period regardless of the payment made; (iii) If the manager was dismissed in a liquidity

default in period t *or* the firm has been taken over, then the debt holders will dismiss the new manager and will take over the firm next period; (iv) If the debt holders have dismissed the manager *and* have taken over the firm in a liquidity default in period t, then from then onward (i) takes effect; (v) If there is a liquidity default in period t and investors forgive but do not extend the maturity of the debt, then from then onward (i) takes effect.

For the manager and the new manager: (a) If a (new) manager has not strategically defaulted until period t, then he will not default in period t; (b) if the manager finds himself on the job immediately following a strategic default in period t, then he will continue to divert the cash flows thereafter; (c) If the manager has been replaced following a default in period t but the company has not been taken over by the debt holders, then the new manager will divert the cash flows each period thereafter; (d) If the manager has been replaced immediately following a default in period t and the company has been taken over by the debt holders, then the new manager will not strategically default in the following period. □

The potential debt holders are willing to provide financing if (I) they can recover the outlay; and (II) the present value of all future managerial incentive payments exceed any possible cash flow realizations (otherwise the manager would prefer to take the cash flows and face dismissal). Formally, $\forall\ 0 \leq \tau < T$

$$p \sum_{t=\tau+1}^{T} \delta^{t-\tau} \geq I; \tag{4}$$

$$M_{v+x} + M \sum_{t=\tau+1}^{T} \delta^{t-\tau+1} + \delta^{T+1-\tau} M^{\infty} \geq v + x; \tag{5}$$

and

$$M_{v-x} + M \sum_{t=\tau+1}^{T} \delta^{t-\tau+1} + \delta^{T+1-\tau} M^{\infty} \geq v - x. \tag{6}$$

where M^{∞} is the period-(T+1) expected value of the manager's future payoffs once the contract has expired.

There are two additional incentive compatibility conditions required here. Since the debt holders can only act if the manager has failed to make the payment, a manager planning a strategic default can also devise a two-step default strategy: In the first period he would make the contractual payment but would milk the assets (i.e. divert a). Debt holders cannot intervene because their right is contingent on default. Then, in the second period he would divert all the cash flows and default on the contractual payment.

Thus, for the manager to comply with the contract it must be the case that the present value of all future managerial incentive payments also exceed $M_{v+x}+a+\delta v$ and $M_{v-x}+a+\delta v$, the payoffs the manager can guarantee himself from the two-step default strategy. Formally,

$$M_{v+x} + M \sum_{t=\tau+1}^{T} \delta^{t-\tau+1} + \delta^{T+1-\tau} M^{\infty} \geq M_{v+x} + a + \delta v; \tag{7}$$

$$M_{v-x} + M \sum_{t=\tau+1}^{T} \delta^{t-\tau+1} + \delta^{T+1-\tau} M^{\infty} \geq M_{v-x} + a + \delta v. \tag{8}$$

The remaining incentive compatibility conditions associated with the equilibrium strategies are presented in Appendix A2.

3.3 Short-term debt with liquidation rights

Alternatively, the manager can also promise investors a fixed payment and grant them the right to liquidate the firm's physical assets in default. This debt contract was introduced in Hart and Moore (1989).

The authors demonstrated that the maximum the manager can be induced to pay in this contract is the smaller of the period 1 and the period 2 cash flows in present value terms. In period 1 the entrepreneur cannot pay more than the current cash flows (liquidity default) and will not pay more than his valuation of the cash flows in period 2 (strategic default). Thus, the entrepreneur may default when realized cash flows are low and he is unable to make the payment. He may also default when current cash flows are high and future cash flows are low. In this case he could pay but he would rather default.

Since the debt holders can only assure a payment that is the smaller of (i) the present value of the future cash flows for the entrepreneur and (ii) the current cash flows plus the maximal amount that can be raised by liquidating the firm's physical assets so that the cash flows from the remaining assets make the entrepreneur-manager just indifferent to transfer the current cash flows as payment, the debt-financing condition will take the following form:

$$\delta E(min\left\{\delta\tilde{v}_2, max\left\{\tilde{v}_1, \tilde{v}_1 + \left(1 - \frac{\tilde{v}_1}{\delta\tilde{v}_2}\delta L_2\right)\right\}\right\}) \geq I. \tag{9}$$

This inequality places an upper bound on the variability of the project's cash flows.

Investors are willing to write such a contract only if x, the variability of the project's cash flows does not exceed $x_d(v, I, L_2, \delta)$, the value of x that solves (9) for equality.

In a two-period model, Hart and Moore (1989) showed that this contract can only be written for one period and that two-period debt contracts are not sustainable. This is because by the end of period 2 the firm's assets become worthless for both the entrepreneur and the investors. Since the investors cannot stop the entrepreneur to start a new firm and/or cannot seize the entrepreneur's future investment opportunities (because of the entrepreneur's limited liability), liquidation is no longer a threat when the assets are fully depreciated and the entrepreneur will not make any payment to the investors in period 2.[13]

Fluck (1998) generalized the above discussed result for the case when the firm's growth opportunities have indefinite life. She shows that when investors are promised a fixed payment and the right to liquidate the firm's physical assets in default, then in longer term debt contracts the entrepreneur can always benefit from skipping the investment and defaulting when the firm's assets are fully depreciated and the liquidation rights are worthless.

[13]Similar conclusion was reached in Bolton and Scharfstein (1990). In their model of two period projects, the projects require new outlay each period. The only right the investors have is to deny funding for the entrepreneur's next project. Since in the second period the projects will be over and the investors cannot enforce any payment from the managers, at the end of period 1 no investor would provide new funding for any period-2 project. In equilibrium the investors and the entrepreneur agree to a two-period contract in which the investors automatically provide the entrepreneur with new funds in the second period (even though it is not subgame perfect for them to do so) unless default occurs in the first period. This contract will induce the entrepreneur to make payment at the end of the first period but he will always default in the second period.

To illustrate that the manager can indeed benefit from breaching any contract with maturity $T \geq 2$ and can raise financing for a new firm following the liquidation of the assets of his old enterprise, consider a debt contract with maturity $T > 2$. Such a contract requires the periodic renewal of the firm's assets. First consider the marginal project with respect to this contract, one that is just able to provide the managerial incentive payments in addition to returning the outlay and providing for the renewal of the assets.

A necessary condition for the manager to comply with the contract is that there exist (M_{v-x}, M_{v+x}) such that

$$M_{v-x} + \delta \frac{M}{(1-\delta)} \geq v - x; \tag{10}$$

$$M_{v+x} + \delta \frac{M}{(1-\delta)} \geq v + x. \tag{11}$$

A necessary condition for this marginal project to meet debt payments is

$$I \leq \sum_{t=1}^{T} \delta^t p + \delta^T I. \tag{12}$$

The first term on the right side is the sum of the payments to investors that can be met in any period. The second term is the extra payment (the equivalent of the depreciation account) that can be made during the last cycle when the need for internal financing is over. Reorganizing this condition, we get

$$I \leq \frac{\delta p}{1-\delta} \tag{13}$$

that will hold as equality for our marginal project. Notice that (13) is the equivalent of (1).

Consequently, (1), (10) and (11) are necessary conditions to raise any (off-equilibrium) debt with maturity $T > 2$ for our marginal project. They are also sufficient conditions to raise outside equity for the marginal project. Thus, the entrepreneur can always guarantee outside equity financing for his marginal project following a default on a debt contract with maturity $T > 2$. Obviously, any project that is more profitable than the marginal project is also able to raise outside equity. Consequently, the entrepreneur can always benefit from defaulting on a debt contract with maturity $T > 2$ in period 2, starting a new firm and financing it with outside equity. As a result, such a debt contract is *never* an equilibrium contract for startups.

3.4 Profitability constraints:

Whenever $L_2 < v - x$, then (9) implies (1), (2) and (3). In other words, if a project can raise short-term debt by offering investors the right to liquidate the firm's physical assets then it can also raise outside equity but not vice versa. It follows from Section 3.3 that if either (7) or (8) fails to hold then the entrepreneur cannot raise debt by granting investors the right to dismiss management and to take over the firm as a going concern or to extend the maturity of the debt but it may still be able to raise outside equity. Moreover, a debt contract which grants the holders the right to liquidate the firm's physical assets and matures in $T \geq 2$ periods is never an equilibrium contract for startups.

From now on we will assume that the project's cash flows satisfy (1), (2) and (3) but fail (9) and either (7) or (8). Under these conditions a startup firm cannot raise debt but it

can issue outside equity to finance its project. This happens if a firm has significant growth opportunities but little assets-in-place. The rest of the paper will focus on the financing choice of firms whose initial project is financed by outside equity.

4 The ongoing firm

Recall that in our model the firm's expansion project is identical to and is perfectly positively correlated with its initial project. Thus, when starting the new project, the firm doubles its existing operation. We will show that this second project can be financed by debt even if the firm could not raise debt financing for its initial project.

4.1 The profitability threshold for financing the expansion project

Recall from our earlier discussion on startups in Section 3.2 that when the firm is financed by long-term debt, the manager has access to more profitable default strategies than when the firm is financed by equity. In order to prevent strategic default, long-term debt contracts must offer the manager higher incentive payments. As a consequence, creditors will only finance the project if (7) and (8) also holds in addition to (1), (2) and (3).

Interestingly, however, this conclusion does not necessarily carry over to larger ongoing firms. The reasoning is as follows. In case of a large firm the firm already successfully operates and finances one project. Outside equity holders are willing to supply the initial financing for the firm's original project, since their threat of dismissal provides the manager with sufficient incentives to comply with the contract and to properly maintain *project 1*'s

assets. When the firm expands and debt is issued to finance the new project, then the potential debt holders will take into consideration the managerial incentives provided by outside equity. In particular, if holders of a subsequent debt issue can count on existing equity holders to dismiss the manager whenever he fails to renew *project 2's* assets, then a strategic default in the large company will not yield the manager more than the current cash flows of the firm and hence the debt holders would be willing to finance the firm's expansion project even if (7) and (8) fail to hold.

Whether or not debt holders can rely on equity holders to enforce their claim depends on the priority of their claims. If debt holders can take over the operation of both projects (up to the value of their claim), then the equity holders will guard the debt holders' investment, because their interests will coincide in equilibrium. Equity holders would do so even if they do not expect any cash flows from the second project (i.e. even if all cash flows above the debt payments and depreciation accrue to the manager as private benefits) because otherwise they will lose their dividends from project 1.

Alternatively, if the debt holders can take over the second project only (project finance)[14] and the equity holders do not expect any dividends from the second project (since all cash flows above the debt payments and depreciation accrue to the manager as private benefits),

[14]In a model of complete financial contracts Berkovitch and Kim (1990) shows that project finance is optimal in reducing managerial incentives for under- and overinvestment. In our model of incomplete financial contracting incentives for managerial overinvestments are not present. Here granting debt seniority can achieve more than project finance can: issuing senior debt enables large firms to raise debt financing for projects that small firms cannot.

then the debt holders cannot rely on the equity holders to protect their interest. In the latter case the manager must be given higher incentive payments to comply with the contract and to properly maintain the firm's assets. Hence potential debt holders will make the same financing decision for ongoing firms and startups. Proposition 1 summarizes the result.

Proposition 1 *Suppose that a firm successfully operates one project and finances it by outside equity. Suppose furthermore that the firm seeks to finance its second project by issuing debt. Then, if the debt holders are granted the right to dismiss the manager and take over the firm (the operation of both project 1 and project 2 up to the value of their claim) as a going concern in default, then they would be willing to hold debt whenever* $c < a$ *and* p *satisfies (1), (2) and (3). Alternatively, if the debt holders are granted only the right to take over project 2 as a going concern in default and if equity holders do not expect any cash flows from project 2 in equilibrium (i.e. all cash flows above the debt payments and depreciation accrue to the manager), then the manager can not raise debt unless conditions (7) and (8) hold.*

The corresponding equilibrium strategies can be obtained by combining I^E, I^{LT}, M^E and M^{LT}. In this equilibrium the equity holders will dismiss the manager if the manager has failed to maintain project 2's assets. The debtholders's action will depend on whether or not the equityholders have dismissed the manager for failing to maintain the firm's assets prior to default. In particular, the debt holders' equilibrium strategy will specify to forgive and extend the maturity of the debt in a default that resulted from the manager's failure to maintain the firm's assets if the manager has been dismissed by the equity holders by the time default has taken place. In contrast the debt holders' equilibrium strategy will specify

to dismiss the manager and to take over the firm as a going concern had the manager stayed on. Formally,

For the equity holders: Equity holders do not replace the manager at first and until the manager paid equilibrium dividends and properly maintained the firm's assets each period. If there is any deviation from the equilibrium, then they replace the manager next period.

For the debt holders: (i) The debt holders replace the manager and take over the firm in a strategic default and in any default that resulted from or is accompanied by the current manager's failure to maintain the firm's assets. The debt holders will forgive the manager and extend the maturity of the debt in a liquidity default and in any default that resulted from the previous manager's failure to maintain the firms' assets; (ii) If the manager has strategically defaulted in period t or if the manager has defaulted in period t but has failed to maintain the firms' assets and he has not been dismissed and/or the firm has not been taken over, then the debtholders will dismiss the manager and will take over the firm next period regardless of the payment made; (iii) If the manager was dismissed or if the firm has been taken over in a liquidity default in period t or in any default that resulted from the previous manager's failure to maintain the firms' assets, then the debt holders will dismiss the new manager and will take over the firm next period; (iv) If the debt holders have dismissed the manager and have taken over the firm in a liquidity default in period t or in any default that resulted from the previous manager's failure to maintain the firms' assets, then from then onward (i) takes effect; (v) If there is a liquidity default in period t or a default that resulted from the previous manager's failure to maintain the firms' assets and the debt holders forgive

but do not extend the maturity of the debt, then from then onward (i) takes effect.

For the manager and the new manager: (a) The (new) manager will pay equilibrium dividends and maintain the firm's assets at first; (b) If a (new) manager has paid equilibrium dividends and maintained the firm's assets each period and has not strategically defaulted until period t, then he will continue to pay equilibrium dividends, will maintain the firm's assets and will not strategically default in period t; (c) If there is any deviation by any party from the equilibrium, then the (new) manager will divert the cash flows for ever. □

Interestingly, the corresponding incentive compatibility conditions for the debtholders will coincide with those for outside equity. In particular, (7) and (8) do not have to be satisfied for a large firm to obtain debt financing. This is so because, given the equilibrium strategies of the equityholders, the manager can no longer guarantee himself $M_{v+x} + a + \delta v$ or $M_{v-x} + a + \delta v$ when he plans a strategic default (he knows he will be replaced right after he diverts a). The most the manager can pocket in a strategic default is v, which is the same that he can guarantee himself off-the-equilibrium-path in an all-equity firm. The incentive compatibility conditions associated with the equilibrium strategies above are presented in Appendix A4.

Thus, a key implication of Proposition 1 is that an ongoing firm can obtain debt financing for the same project that a startup cannot. Furthermore, the conditions investors set for the debt or outside equity financing of a firm's expansion project are identical. Hence when financing the firm's expansion project investors are indifferent between debt and equity, even though these same investors frequently prefer to hold outside equity over debt in startups.

This implies that despite the investors' inability to write complete financial contracts, the Modigliani and Miller (1958) result on the irrelevance of the financing choice *does* hold for ongoing firms in our model, but it fails to hold for entrepreneurial startups. The intuition lies in the interaction between the control rights of subsequent claim holders. Since the control rights of previous security holders represent a positive externality for subsequent claim holders, therefore the marginal decision of which security to issue next becomes irrelevant once a firm has sufficient contractual complexity in place.

It is important to emphasize that the debtholders' "collateral" (the value they can foreclose in default) does *not* even appear in the managerial incentive compatibility conditions (7) and (8). Hence it is *not* the increase in the value of the collateral that is driving the result (the increase in the value of the collateral appears only in the debtholders' incentive compatibility conditions off-the-equilibrium path). Potential debtholders are more willing to finance ongoing companies because in these firms they can rely on the control rights of the firms' existing security holders.

It is worth to highlight that the second part of the proposition gives rise to an underinvestment problem that is closely related to Myers's debt overhang problem. In both scenarios equity holders choose to pass up valuable investment opportunities when all the benefits would accrue to debt holders. In Myers (1977) the manager (who himself is the equity holder) decides not to invest because returns from the investment will only benefit the debt holders. In the present model, because the manager would benefit from the investment but cannot commit to periodically renew the assets, some projects will fail to obtain

financing. Equity holders are willing to induce management to properly maintain the new investment's assets but only if their interest coincides with those of the debt holders. When this is not the case, then debt holders will refuse the financing of project 2.

4.2 The set of equilibrium contracts

In this subsection we will show that ongoing firms can also sustain contracts that are *never* equilibrium contracts for startups. In particular, we will show that larger ongoing firms can issue longer-term debt by granting investors liquidation rights. Recall from Section 3.3 that these are off-equilibrium contracts for startups (Section 3.3). These contracts further strengthen our result on the irrelevance of the financing choice.

To see the intuition, suppose that the entrepreneur issues debt with maturity $T > 2$ by promising investors the right to liquidate the firm's physical assets in default. It follows from our earlier discussion in Section 3.3 that for the financing of a startup firm investors would refuse to hold this contract. Since the value of the assets the debt holders can foreclose (and thereby the debt holders' bargaining position) depends on the manager's decision whether or not to maintain these assets, it is in the the manager's best interest to default in period 2 by depleting the firm's assets and leaving an empty shell. By doing so, the manager will take a in the first period and will divert the second period cash flows, v.

This conclusion, however, does not carry over to subsequent financing decisions. If the firm's second project is financed by debt and debt has priority (i.e. if debt holders have the right to liquidate both project 1's and project 2's assets up to the value of their claim), then the equity holders will discipline the manager as soon as the he skips the investment. The

equityholders would act to protect their own investment directly (project 1's assets) and indirectly by protecting the interest of the debt holders (project 2's assets). Since equity holders have residual control they can discipline the manager as soon as the manager skips the investment, so the manager will be replaced before he is able to deplete the firm's assets. Once a new manager is hired to run the company, the value of the old manager's outside option to start a replica of his old company will diminish. Thus, the maximum the manager can guarantee himself by strategically defaulting in the large company is the current cash flows of the firm. But since (2) and (3) are satisfied (by the very fact that the firm was able to raise outside equity in the first place), i.e. $\forall v_t = v + x, v - x : \ M_{v_t} + \delta \frac{M}{1-\delta} \geq v_t$, therefore, it is not profitable for the manager to strategically default if the most he can guarantee himself from default is v_t, the current cash flows of the firm. Proposition 2 summarizes this result.

Proposition 2 *Suppose that a firm successfully operates one project and finances it by outside equity. Suppose furthermore that the firm seeks to finance its second project by issuing debt. Then, if the debt holders are granted the right to liquidate both project 1's and project 2's assets in default (up to the value of their claim), then they would be willing to hold debt whenever $c < a$ and (1), (2) and (3) hold for p. Alternatively, if the debt holders are granted the right to liquidate only project 2's assets in default and if the equity holders do not expect any cash flows from project 2 (i.e. all cash flows above the debt payments and depreciation accrue to the manager in equilibrium), then the debt holders will not finance the project unless condition (9) holds.*

The equilibrium strategies associated with Proposition 2 are presented below.

For the equity holders: Equity holders do not replace the manager at first and until the manager paid equilibrium dividends and properly maintained the firm's assets each period. If there is any deviation from the equilibrium, then the equityholders will replace the manager next period.

For the debt holders: (i) The debt holders will liquidate the firm's physical assets upon default (with the most valuable assets first, up to the value of their claim), if the manager has not been replaced in the period following (1) a strategic default; or (2) the manager's failure to renew any of the firm's physical assets. Otherwise, the debt holders will forgive the manager and extend the maturity of the debt in default; (ii) If the manager has not been dismissed in the period following (1) or (2) above and the debtholders have not liquidated, then the debtholders will liquidate the firm's assets next period regardless of the payment made; (iii) If the firm's assets were partially liquidated in default in period t and the debtholders still have outstanding claim, then the debt holders will liquidate the firm's assets next period regardless of payment made; (iv) If the equilibrium strategy specified the debt holders to forgive the manager and to extend the maturity of the debt and the debt holders forgave the manager, but did not extend the maturity of the debt, then next period onward (i) takes effect.

For the manager and the new manager: (a) The (new) manager pays equilibrium dividends and maintains the firm's assets at first; (b) If a (new) manager has paid equilibrium dividends and maintained the firm's assets each period and has not strategically defaulted

until period t, then he will continue to pay equilibrium dividends, will maintain the firm's assets and will not strategically default in period t; (c) If there is any deviation by any party from the equilibrium, then the (new) manager will divert the cash flows for ever. □

The incentive compatibility conditions associated with the equilibrium strategies are presented in Appendix A4. As it is shown there, the incentive compatibility conditions are the same whether the firm's expansion project is financed by debt or outside equity.

A key implication of Proposition 2 is that even *the set of equilibrium contracts differs* in different stages of a firm's life cycle: some contracts which are never sustainable at the initial financing stage become sustainable at a subsequent financing stage. The intuition is again the stage-dependency of the control rights of subsequent claim holders: in addition to their own rights, holders of subsequent security issues may also rely on the firm's existing investors to enforce their claims. Whether or not they can do so, depends on the priority structure of the claims.

Interestingly, however, the reverse of this statement is not true: If a contract can be sustained for the financing of a startup, it can always be sustained for the financing of an ongoing firm. Furthermore, since it follows from Proposition 2 that the debt and outside equity financing conditions are the same for ongoing firms (provided that the debt claim has priority over equity), investors are indifferent between financing the firm's expansion project with debt or equity. Thus the financing choice is irrelevant for ongoing firms, even though it is relevant for entrepreneurial startups. As a consequence, the simplest debt contract that the manager can issue for the financing of project 2 is a one-period debt that is periodically

rolled over. Even though this contract is not an equilibrium contract for startups, it becomes an equilibrium contract for ongoing firms.

5 Implications for a life-cycle theory of firm finance

One of the implications of our model is that investors set different profitability thresholds for the financing of firms' *initial* and *subsequent* projects. The presence of these different thresholds implies a life-cycle pattern of firm financing: firms can issue different securities at different stages of their life-cycles. In particular, our theory predicts that firms with significant growth options (and little assets-in-place) will issue outside equity or convertible debt first. These firms will then use their retained earnings, and finally will issue longer-term debt or outside equity to satisfy their subsequent financing needs. This prediction is consistent with Kaplan and Strömberg (1999) who documents on a sample of venture capital financed startups that these firms use finanical contracts that grant all the control to the

investors at their initial financing stage.

Interestingly, the life-cycle pattern of financing that our theory predicts differs from the one implied by Myers's (1984) pecking order theory of finance in one important aspect: the initial financing choice of the firm. Myers predicts that firms will issue debt first and outside equity only later, whereas our theory suggests that firms will frequently use outside equity financing (such as venture capital or private equity) before they use any debt finance.

6 Priority of the claims

So far we assumed that the subsequently issued financial claim has full priority over the previously issued claim. In this section we will show that subsequent claimholders can benefit from the control rights of the previous securityholders even if they share priority: i.e. if the initial claim has priority in some states of the world and the subsequent claim in other states of the world.

6.1 Covenant Debt

The basic model focused on the subsequent financing decisions of firms whose initial financing is provided by private equity. The model can be extended to incorporate firms whose initial financing is private debt with extensive covenants. While private debt generally relies on a variety of covenants, most public debt issues lack any protective covenant in practice (Kahan and Tuckman (1996)).

A direct application of our Proposition 1 would suggest that if public debt holders' claim is senior to those of private debt holders then the public debt holders can rely on their private counterparts to protect their interest, but if it is strictly junior they cannot. In practice private debt is typically senior to public debt. However, violation of absolute priority is common in Chapter 11 and private debt restructurings in practice (see for example Kalay and Zender (1995)). If future violation of absolute priority is anticipated by private debt holders, they will be willing to act so as to protect the total value of the debt claims and thereby the interests of public bondholders. If this is the case, then our model predicts that

bonds would be cheaper to issue in companies that have private debt outstanding than in those that do not.

6.2 IPOs

Until now we have assumed that the controlling equity holder stays with the firm when the next stage of financing approaches. Interestingly, this does not have to be the case. Our results hold even if the controlling equity holder sells his stake in an IPO to dispersed outside equity.

Evidence shows that even though dispersed outside equity holders have difficulty in coordinating their control challenge against the manager, they do succeed occasionally (Strickland et al. (1996)). Hence one way to model dispersed outside equity is as a group of investors who has difficulty to coordinate: They can succeed only with some probability p (Fluck (1999)). According to this view, dispersed outsiders can successfully challenge the manager but it may take them much longer to win. But since their right is unconditional, dispersed outside equity can potentially punish the manager for milking the firm's assets.

Our next step is to incorporate dispersed outside equity into our model. Suppose that the manager of a publicly held firm (with dispersed outside equity) issues debt for the financing of the firm's expansion project. Then the maximum the manager can guarantee himself by strategic default is $M_{v+x} + a + (1-p)\delta v$. This is more than what the manager can gain from defaulting if the project is financed by private equity (v_t) but less than what he can get if there is no outside equity issued ($M_{v+x} + a + \delta v$ as described in Section 3.2). This

implies that potential debt holders benefit from the presence of dispersed outside equity, since the latter reduces the expected profit the manager can make when he strategically defaults. Consequently, the incentive payments the manager has to be paid in equilibrium will be less than in the case of pure debt finance. Thus the presence of dispersed outside equity makes creditors more willing to provide subsequent financing in publicly held firms than to provide initial financing in otherwise identical startups.

7 A life-cycle theory of control

The prediction of our model is consistent with Kaplan and Strömberg (1999) who document that venture capital financed companies grant strong control to investors at their initial financing stage and as time goes on the investor will give up control in the good state but will take control in the bad state. In our model of a firm with substantial growth opportunities (and with little assets-in-place) the firm's initial project is financed by investors who are granted unconditional rights, so all the control is given to the investors at first. If these investors want to exit, they can do so if the firm is doing well. In this case they can sell out to dispersed outside equity and the rest of the firm's operation can be financed by debt. Consistent with Aghion and Blton (1992) and Dewatripont and Tirole (1994), the resulting financial structure will leave control with the manager in the good state and with the investor in the bad state.

For the venture capitalist to exit via an IPO, in our model it must be the case that the project is sufficiently profitable, i.e. the expected cash flows of the firm are substantially

higher than the venture capitalist's initial investment. If this is the case, the price dispersed outside equity holders (who can enforce less from management than private equity) are willing to pay would provide attractive return on the venture capitalist's investment. Even though the venture capitalist can enforce more from the manager than dispersed outside equity if he continues to stay with the firm, he would prefer to exit if his outside opportunities yield more than this value-differential.[15] This assumption on the profitability of ventures that go public is in line with empirical evidence reported in Gompers(1995). According to Gompers the only firms that VCs take public are those with attractive profitability prospects. If the project is not sufficiently profitable, then in our model the initial financier can only sell part of his stake and will keep part of the control.

This implication of the model also provides a rationale for firms to use both debt and (dispersed) outside equity financing. Equity is needed because debt relies on the positive externality that the control rights of dispersed outside equity represent and would not be willing to provide financing in the absence of equity finance. On the other hand, dispersed outside equity can enforce relatively little from the manager, therefore, they may not be willing to come up with the investment outlay that is needed for the expansion project, so some expansion projects with higher outlay will have to be partially financed by debt.

This theory also implies that in countries where the legal protection of shareholders is weak and dispersed investors can enforce very little from managers, companies will have difficulty to obtain outside equity financing from small investors (La Porta et al.(1997a,

[15]In practice, venture capitalists must exit the companies they finance within a few years. This is because the venture capital funds themselves have very short lives.

1997b)). Our model suggests that this constraint will be most binding in the *second stage of financing*. At the initial financing stage entrepreneurs may obtain financing from wealthy individuals in exchange for a large stake in their companies, or by groups or by relatives and family members. But in countries where shareholders' legal protection is weak, there will be no way for these financiers to exit unless another wealthy individual or concentrated owner is willing to buy their stake in the firm. This implication is consistent with La Porta et al. (1997a, 1997b) who find a negative relationship between shareholders' legal protection and the number of IPOs across countries.

8 Asset substitution

It is worth to mention that in our model asset substitution by managers and equityholders is not a problem except for firms in distress. To see this, let us extend the model and suppose that the manager has two investment strategies one which produces higher NPV with lower variance and another which produces lower NPV and higher variance for the firm. In this model it is an equilibrium strategy for the debt holder to extend the maturity of the debt in liquidity default if investment 1 is implemented, but dismiss the manager and take over the firm as a going concern or dismiss the manager and liquidate the assets if investment 2 is implemented. As long as the manager's incentive compatibility conditions hold, the manager would prefer to stay away from investment 2 (and so would the equity holders). When the managerial incentive compatibility conditions fail to hold, then the firm can sustain neither debt nor equity and this is when the manager will switch to investment 2. This occurs only

when the firm is in distress. It is straightforward to see that the above described equilibrium weakly dominates all other equilibria in the sense of Gale and Hellwig (1985).

9 Conclusion

This paper develops a dynamic capital structure theory to explain why small firms have different capital structure from large firms. In a model of optimal financial contracting we show that the initial and subsequent financing decisions of the same firm will lead to different security choices.

The firm's financing decisions will differ in two respect. First, there will be equilibrium contracts that investors would reject for some small firm, but accept them for an otherwise identical large firm (i.e. when the two firms have identical projects). Secondly, even the *set* of the equilibrium financial contracts differs in different stages of the firm's life cycle: some contracts which are never sustainable as an initial contract for a small firm become sustainable for large firms. The reason is the *stage-dependency* of the control rights of subsequent claim holders: the control rights of previous security holders represent an externality for subsequent claim holders. In addition to their own rights, holders of subsequent security issues may also rely on the firm's existing investors to enforce their claims. Whether or not they can do so, depends on the priority structure of the claims.

Appendix

A1. The remaining incentive compatibility conditions for equity:

Equityholders are better off repeating the project and replacing the manager following the manager's failure to pay equilibrium dividends and/or to renew the firm's assets than repeating the project and keeping the manager, that is,

$$\hat{d}_{v+x} - c + \frac{\delta \hat{d}}{1-\delta} - a \geq -a; \tag{14}$$

$$\hat{d}_{v-x} - c + \frac{\delta \hat{d}}{1-\delta} - a \geq -a. \tag{15}$$

Equityholders are better off repeating the project and replacing the manager following the manager's failure to pay equilibrium dividends and/or to renew the firm's assets than abandoning the project, that is,

$$\hat{d}_{v+x} - c + \frac{\delta \hat{d}}{1-\delta} - a \geq 0; \tag{16}$$

$$\hat{d}_{v-x} - c + \frac{\delta \hat{d}}{1-\delta} - a \geq 0. \tag{17}$$

Assuming that the new manager pays the same equilibrium dividends as his predecessor does, condition (1) is sufficient for conditions (14)–(17) to hold for every $c < a$. □

A2. The remaining incentive compatibility conditions for debt when the debt holders are granted the right to dismiss management and take over the firm as a going concern in default:

The debt holders are willing to keep the manager and extend the maturity of the debt following a liquidity default rather than dismiss him and extend the maturity of the debt if

$\forall\ 0 \leq \tau < T$

$$\sum_{t=\tau+1}^{T+1} \delta^{t-\tau} p \geq -c + \sum_{t=\tau+1}^{T+1} \delta^{t} \hat{p} \tag{18}$$

The debt holders will keep the manager and extend the maturity of the debt following a liquidity default rather than dismiss the manager and take over the company if $\forall\ 0 \leq \tau < T$

$$\sum_{t=\tau+1}^{T+1} \delta^{t-\tau} p \geq -c + \frac{E\hat{p}^{+}}{1-\delta}. \tag{19}$$

The debt holders are willing to dismiss the manager, provide I and write a new debt contract for the renewal of the assets and take equity in exchange for their remaining claim following a strategic default at time τ,[16] rather than keep him and refinance the project or keep him and do nothing if $\forall\ 0 \leq \tau < T$

$$-I + \sum_{t=\tau+1}^{T+\tau} \delta^{t-\tau} \hat{p} + \frac{E\hat{p}^{+}}{1-\delta} - c \geq -I; \tag{20}$$

$$-I + \sum_{t=\tau+1}^{T+\tau} \delta^{t-\tau} \hat{p} + \frac{E\hat{p}^{+}}{1-\delta} - c \geq 0. \tag{21}$$

The incoming manager is willing to make payments and to periodically renew the assets if the debt holders have taken over the company at the time of his arrival and if he has not strategically defaulted since, if

[16] It is sufficient to consider only the two-step default strategy here, since this strategy makes the investors worst off.

$$\hat{M}_{v+x} + \hat{M} \sum_{t=\tau+1}^{T} \delta^{t-\tau} + \delta^{T-\tau+1}\hat{M}^{\infty} \geq v + x \tag{22}$$

$$\hat{M}_{v-x} + \hat{M} \sum_{t=\tau+1}^{T} \delta^{t-\tau} + \delta^{T-\tau+1}\hat{M}^{\infty} \geq v - x \tag{23}$$

$$\hat{M}_{v+x} + \hat{M} \sum_{t=\tau+1}^{T} \delta^{t-\tau} + \delta^{T-\tau+1}\hat{M}^{\infty} \geq \hat{M}_{v+x} + a + \delta v \tag{24}$$

$$\hat{M}_{v-x} + \hat{M} \sum_{t=\tau+1}^{T} \delta^{t-\tau} + \delta^{T-\tau+1}\hat{M}^{\infty} \geq \hat{M}_{v+x} + a + \delta v. \tag{25}$$

Given that the debt holders will dismiss the manager following a strategic default and will keep dismissing him thereafter, the manager will keep diverting the cash flows each period following a strategic default since $v + x \geq M_{v+x} and v - x \geq M_{v-x}$.

Given that the debt holders will dismiss the manager if the firm has been taken over following a liquidity default, the manager will divert the cash flows next period since $v + x \geq M_{v+x}$ and $v - x \geq M_{v-x}$.

Given that investors will dismiss the new manager if the firm has not been taken over following a default, the new manager will divert the cash flows next period $v + x \geq \hat{M}_{v+x}$ and $v - x \geq \hat{M}_{v-x}$. □

A3. Incentive compatibility conditions associated with Proposition 1:

The equity holders are willing to provide the financing of project 1 if (1) holds.

The equityholders are willing to dismiss the manager following the manager's failure to pay equilibrium dividends and/or to renew project 1's assets if (14)–(17) hold.

The equityholders are willing to dismiss the manager following the manager's failure to renew project 2's assets, since

$$\hat{d}_{v+x} - c + \frac{\delta \hat{d}}{1-\delta} \geq 0; \tag{26}$$

$$\hat{d}_{v-x} - c + \frac{\delta \hat{d}}{1-\delta} \geq 0. \tag{27}$$

The equityholders are willing to dismiss the manager following the manager's failure to renew project 1's and project 2's assets, since

$$\hat{d}_{v+x} - c - a + \frac{\delta \hat{d}}{1-\delta} \geq 0; \tag{28}$$

$$\hat{d}_{v-x} - c - a + \frac{\delta \hat{d}}{1-\delta} \geq 0. \tag{29}$$

The debt holders are willing to provide financing for project 2 if (1) holds for p.

The debt holders are willing to extend the maturity of the debt in a liquidity default rather than dismiss the manager and take over the firm, since

$$\sum_{t=\tau+1}^{T+1} \delta^{t-\tau} \hat{p} \geq \frac{\delta^2 E\hat{p}^+}{1-\delta} - \delta c - \delta a \tag{30}$$

The debt holders are willing to extend the maturity of the debt in any default that

resulted from the previous manager's failure to renew the firm's assets and/or taking the cash flows rather than take over the firm, since

$$\sum_{t=\tau+1}^{\hat{T}} \delta^{t-\tau}\hat{p} - a \geq \frac{\delta^2 E\hat{p}^+}{1-\delta} - \delta c - \delta a \tag{31}$$

where $\hat{T}$ is such that $\sum_{t=\tau+1}^{\hat{T}} \delta^{t-\tau}\hat{p} = \frac{\delta E\hat{p}^+}{1-\delta} + a$.

In case of a default, the debt holders are willing to dismiss the manager and to take over the firm as a going concern (up to the value of their claim) if the manager has not been dismissed in the period following (1) a strategic default; or (2) the manager's failure to renew any of the firm's physical assets, since

$$\frac{\delta E\hat{p}^+}{1-\delta} + a - c - a \geq 0$$

The manager is willing to comply with debt and equity if

$$M_{v+x} + M\sum_{t=\tau+1}^{T} \delta^{t-\tau+1} + \delta^{T+1-\tau}M^{\infty} \geq v + x; \tag{32}$$

and

$$M_{v-x} + M\sum_{t=\tau+1}^{T} \delta^{t-\tau+1} + \delta^{T+1-\tau}M^{\infty} \geq v - x. \tag{33}$$

Given that the debt holders will dismiss the manager following a strategic default and will keep dismissing him thereafter, the manager will keep diverting the cash flows each period following a strategic default or the manager's failure to renew the firm's assets, since $v + x \geq M_{v+x}$ and $v - x \geq M_{v-x}$.

It is straightforward to see that $c < a$ and (1), (2) and (3) are sufficient for the rest of the conditions to hold.□

A4. Incentive compatibility conditions associated with Proposition 2:

The equity holders are willing to provide the financing of project 1 if (1) holds.

The equityholders are willing to dismiss the manager following the manager's failure to pay equilibrium dividends and/or to renew project 1's assets if (14)–(17) hold.

The equityholders are willing to dismiss the manager following the manager's failure to renew project 2's assets, since

$$\hat{d}_{v+x} - c + \frac{\delta \hat{d}}{1-\delta} \geq 0; \tag{34}$$

$$\hat{d}_{v-x} - c + \frac{\delta \hat{d}}{1-\delta} \geq 0. \tag{35}$$

The equityholders are willing to dismiss the manager following the manager's failure to renew project 1's and project 2's assets, since

$$\hat{d}_{v+x} - c - a + \frac{\delta \hat{d}}{1-\delta} \geq 0; \tag{36}$$

$$\hat{d}_{v-x} - c - a + \frac{\delta \hat{d}}{1-\delta} \geq 0. \tag{37}$$

The debt holders are willing to provide financing for project 2 if (1) holds.

The debt holders are willing to extend the maturity of the debt in a liquidity default rather than liquidate the firm's assets, since

$$\sum_{t=\tau+1}^{T+1} \delta^{t-\tau} \hat{p} \geq \min\{ \sum_{t=\tau+1}^{T+1} \delta^{t-\tau} p; 2L \} \tag{38}$$

where $L = L_1, L_2, L_2 + a$.

The debt holders are willing to extend the maturity of the debt in any default that resulted from the previous manager's failure to renew the firm's assets and/or taking the cash flows rather than liquidate the firm's assets, since

$$\sum_{t=\tau+1}^{T+1} \delta^{t-\tau} \hat{p} - a \geq \min\{ \sum_{t=\tau+1}^{T+1} \delta^{t-\tau} p; 2L_2 \} \tag{39}$$

In case of a default, the debt holders are willing to liquidate the firm's physical assets (with the most valuable assets first, up to the value of their claim) if the manager has not been dismissed in the period following (1) a strategic default; or (2) the manager's failure to renew any of the firm's physical assets, since $L \geq 0$.

The manager is willing to comply with debt and equity if

$$M_{v+x} + M \sum_{t=\tau+1}^{T} \delta^{t-\tau+1} + \delta^{T+1-\tau} M^{\infty} \geq v + x; \tag{40}$$

and

$$M_{v-x} + M \sum_{t=\tau+1}^{T} \delta^{t-\tau+1} + \delta^{T+1-\tau} M^{\infty} \geq v - x. \tag{41}$$

Given that the debt holders will dismiss the manager following a strategic default and will keep dismissing him thereafter, the manager will keep diverting the cash flows each period following a strategic default or the manager's failure to renew the firm's assets, since $v + x \geq M_{v+x}$ and $v - x \geq M_{v-x}$.

It is straightforward to see that $c < a$ and (1), (2) and (3) are sufficient for the rest of the conditions to hold.□

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