The Internal Governance of Firms[1]

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We develop a model of internal governance where the self-serving actions of top management are limited by the potential reaction of subordinates. We find that internal governance can mitigate agency problems and ensure firms have substantial value, even without any external governance. Internal governance seems to work best when external conditions do not fluctuate dramatically and where both top management and subordinates are important to value creation. We then examine the interaction between internal governance and the governance provided by external financiers and find situations where they complement each other, as well as undermine each other. Finally, we explore how the internal organization of firms may be structured to enhance the role of internal governance. Our paper could explain why young firms, and firms in countries with poor external governance, can have substantial value, and why improving external governance may not be a panacea for all governance problems.

The common view of the public corporation is that of an organization run by top managers, and monitored by a board of directors on behalf of public shareholders. The separation of decision management (the CEO) from decision control (the board) and from risk-bearing (public shareholders) is thought of as a reasonable way to structure firm governance (see Fama and Jensen (1983 a b), Jensen (2000)), and so long as decisions are made in the interests of the residual claimants, efficiency is maximized.

Yet the clear evidence that the public corporation has survival value has to be set against the equally clear evidence that most shareholders have little control over boards (see, for example, Monks (2007)), that many boards are poorly informed and have little ability to scrutinize top management's decisions (see, for example, Mace (1971)), and some CEOs are self interested rather than working for shareholders (see, for example, Jensen (1986, 1993), Morck, Shleifer and Vishny (1989), and Shleifer and Vishny (1997)). Admittedly, the market for corporate control can offer some discipline, but it is hard to see it as effective in controlling operational decisions. How then do we reconcile the survival, and hence presumed efficiency, of the public corporation with the ineffectiveness of the supposed channels through which it is governed?

We will argue in this paper that there are important stakeholders in the firm, such as critical employees, who care about its future even if the CEO has short horizons and is self-interested and shareholders are dispersed and powerless. These stakeholders, because of their power to withdraw their contributions to the firm, can force a self-interested myopic CEO to act in a more public spirited and far-sighted way. We call this process "internal governance".

The main departure of this paper from much of the existing literature is to not treat the firm as a monolithic single employee entity, but to see it as composed of diverse agents with different horizons, different opportunities for misappropriation or growth, and different interests. Specifically, we model a firm run by an old CEO who is about to retire, and who has a young manager working under him. Three ingredients go into producing the firm's current cash flows.

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First, the firm's capital stock; Second, the CEO's ability to manage the firm based on his talent and his knowledge of its specific problems; Third, the young manager's effort, which allows her to learn to deal with the firm's specific issues.

The CEO has to commit some fraction of current cash flows to increasing capital stock. He can appropriate what is uncommitted. Because the CEO has a short horizon, he is free to invest nothing for the future, and instead, appropriate all the cash. However, in order to generate the cash in the first place he needs the effort of young manager. If she sees little future in the firm because the CEO invests nothing, the young manager will have little incentive to exert effort in management and on-the-job learning, thus reducing current cash flows. The CEO therefore will commit to invest some fraction of these cash flows in order to preserve a future for his young employee, thereby motivating her. Intuitively, the need for "co-investment" by employees to produce cash flows essentially forces the CEO to appropriate less, and invest more, than he otherwise would.[2]

We show that internal governance is most effective when neither the CEO nor the manager dominate in contributions to the firm's cash flows. Intuitively, if the CEO dominates, he has no desire to provide incentives for the manager. If the manager's contributions dominate, the manager has little incentive to learn because she cannot appropriate cash flows today, and the learning will be of little use when she does become CEO and can appropriate cash flows. Also, because internal governance works off contemporaneous and forward looking elements of the business environment in widening the horizons of participants, it works best when the business environment is stable.

Our point, more generally, is that the traditional description of the firm in the first paragraph falls short on three counts. First, control need not be exerted just top down, or from

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[2] It is hard to write contracts with the CEO on investment since both the quantity and quality of investment should depend on business conditions, and the CEO's business judgment, all of which are hard to specify ex ante. Managerial learning effort is equally hard to contract upon, though it can be rewarded ex post through promotion (see Prendergast (1993)).

outside, it can also be asserted bottom-up. Put differently, the CEO has to give his subordinates a reason to follow, and this, implicitly, is how they control him. Second, the view that there is one residual claimant in the firm, the shareholder, is probably too narrow. Anyone who shares in the quasi-rents generated by the firm has some residual claims and thus there is no easy equivalence between maximizing shareholder value and maximizing efficiency. Third, the fact that different parties have claims to different residual rents at different horizons means each one has to pay attention to others' residual claims in order to elicit co-operation. The checks that parties inside the firm impose on each other ensure the firm functions reasonably well, even though the primary supposed residual claimant, the shareholder, is ineffectual.

While our CEO is myopic and self interested, in reduced form he appears to act as if he cares about his subordinates and the survival of the firm. Indeed, Donaldson and Lorsch (1983) suggest from their interviews of top CEOs that continuity of the firm, rather than maximizing shareholder value, appears to be the primary stated objective of CEOs. Of course, most CEOs are not the caricatures that economic models like ours make them out to be, yet it is reassuring that even though we imbue them with no redeeming qualities, they end up doing reasonably good things for the firm within the confines of the model.

Perhaps then one should think of the firm less as a top-down hierarchy led by a board-monitored CEO, and more as a restricted market where it is not from the benevolence of the participants that we expect value creation but from the checks and balances they impose on each other in furthering their own interest. Implicit in our framework is, therefore, a theory of the firm and its boundaries. In our view, the firm is an agglomeration of assets and specialized human capital which give it unique capabilities (see, for example, Penrose (1959), Grossman and Hart (1986), Hart and Moore (1990), and Rajan and Zingales (1998, 2001)). The literature suggests the ability to control access to the rents the firm generates is top management's source of control. In this paper, we focus on the "bottom-up" influence over firm actions, exercised by those who have access but do not yet have explicit control, because of their ability to affect the firm's rents. More

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generally, internal checks and balances may be an important, and under-researched, aspect of firm governance.

If the investment the firm makes is in intangible assets such as the human capital of employees or client relationships, then thus far we have essentially described a partnership, where senior partners are kept in check by junior partners. But what if the investment were instead in tangible assets, such as machines or land, which could be seized and sold? This would then offer a role for outside equity, and would allow the firm to be structured as a public corporation.

To see this, we assume that, in the spirit of Myers (2000), outside equity has the capacity (through the board of directors) to periodically exercise its fairly crude ownership right of taking over control of the assets. Outside equity thus has no direct effect over the investment or effort decision – it has no operational influence. Even so, it turns out that the act of going public followed by the exercise of even these crude control rights can greatly enhance investment by the CEO and the value of the firm. In our framework, the improvement is not because outside equity monitors the actions of the CEO, but primarily because the need to pay outside equity gives the incumbent CEO the incentive to invest more.

Indeed, in this second best world, giving dispersed outside equity more protection – for instance, the right to get a payout in cash rather than a deferred payment in capital – could have detrimental effects on overall value. Similarly, eliminating the rents managers hope to get, can give them less of a stake in the future, and the CEO less of an incentive to motivate them by investing rather than misappropriating funds. Thus, while some outside control can complement internal governance, excessive external control can undermine it, and make the firm worse off.[3] In this sense, there may well be an optimal interior amount of external governance (see also Burkart, Gromb, and Panunzi (1997) and Myers (2000)).

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[3] This point is reminiscent of Shleifer and Summers (1988), but their focus was on raiders breaking implicit contracts in the firm and thus transferring value.

We turn next to the role of short-term external debt. Debt differs from equity in that its claim can be fixed ex ante, but we assume that failure to pay gives debt the same control right as that of dispersed outside equity – the right to take control of the assets. Short-term debt leads to an interesting trade-off. On the one hand, it helps a CEO monetize (and thus internalize) the contributions of today's investment to future cash flows; this lengthens the horizon of the otherwise myopic CEO and gives him strong incentives to invest, which in turn motivates the manager also. On the other hand, the risk of default next period acts as a disincentive to the young manager to learn. In general, the tradeoff implies that the CEO will find it optimal to issue an amount of short term debt that in equilibrium has at least some risk of default.

Whether the issuance of short-term debt improves outcomes or worsens them depends on the relative importance of the CEO to the manager. We show that when the CEO is relatively less important, short-term debt can make the CEO over-invest in order to induce more learning by the young manager. In such circumstances, long term debt may be more efficient a form of borrowing, suggesting that internal governance considerations could drive debt maturity structure.

Finally, we show how internal organization can itself shape the process of internal governance. For instance, competition between subordinates to succeed the CEO can enhance the effectiveness of internal governance. So can the need to attract a substantial share of the workforce anew every year. By contrast, an ageing workforce may not exert much governance pressure.

The model can be applied to answer a variety of questions, ranging from why stocks in countries with poor minority investor protection have non-negligible value, to when firms are most likely to overinvest, and when firms ought to go public or private. It also offers some novel implications, for example on the relative importance of external governance in firms with a young CEO or workforce versus its importance in firms with an older CEO or workforce.

Our model resembles Fama (1980) where concerns about the adverse reputational consequences of misappropriation on his post-retirement career keep the CEO on the straight and

narrow. In contrast to the ex-post settling up in that model, the settling up in our model is contemporaneous and by parties whose interests are intimately involved – employees endogenously penalize excessive misappropriation. The difference is important, for instance in explaining the effects of capital structure.

We are, of course, not the first to analyze the phenomenon of internal governance. Fama and Jensen (1983 a and b) as well as Hansmann (1996) refer to mutual or internal monitoring, though they do not undertake a detailed analysis. Unlike Landier, Sraer, and Thesmar (2006), we do not appeal to the independence of top executives (as measured by their having preceded the CEO into the firm). Instead, we rely on their self interest - the fact that they typically have career concerns inside the firm. The mechanism through which they have impact is not through coordinated action or through appeal to a Board, but through their propensity to get de-motivated. This is neither exit nor voice, in the felicitous terminology of Hirschman (1970), nor active whistle-blowing as in Dyck, Morse and Zingales (2007), but an uncoordinated, even implicit, strike.

Our model of internal governance in a setting with overlapping generations of short-term CEO and managers vying for the CEO role next period is similar in spirit to the model sketched by Allen and Gale (2000, Chapter 12), though the details are quite different. Allen and Gale also underscore the fact that requiring efforts of CEO and managers *jointly* in cash flow production can lengthen the horizon of myopic decision-makers. They appeal to implications of such a model to explain and help understand the relative merits of the "stakeholder"-focus of governance of Japanese firms at one extreme and the "shareholder"-focus of Anglo-Saxon firms at the other extreme, with French and German firms somewhere in between. [4]

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[4] Allen, Carletti and Marquez (2007) study the effect of stakeholder capitalism in a setting where firms' concerns about employees and suppliers soften competition in product markets and enhance shareholder value. A model that is somewhat less related to ours in a modeling sense, but germane in an overall sense, is that of Kreps (1990) on the role played by reputation effects in lengthening decision-making horizons of myopic agents. Kreps considers a model where an overlapping set of managers co-operate, by mutually

The rest of the paper is as follows. In section I, we present the framework for a simple model; in section II, we solve it and analyze different outcomes. We then explore the role of dispersed outside equity and debt in section III, and discuss extensions of the model, especially to internal organization issues, in section IV. We conclude in with a discussion of the empirical implications of the model.

I. The model

Consider a firm with a two-level managerial hierarchy. At the top of the managerial hierarchy is a CEO who is old. In the second layer is a manager who is young. Each agent can work, at most, for 2 periods.

At the beginning of each period t, the current CEO decides how much of the period's cash flow will be committed to investment, and thus what the firm's end-of-period capital stock, k_t, will be. The manager then decides how much he will engage in firm specific learning effort, s_t, at a personal cost of s_t.

1.1. Learning by doing

Firm-specific learning is important for a manager to be effective – in a consumer product firm, for example, it may entail visiting vendors and the customers in the market repeatedly and understanding the ways they buy and use the product. Not only does such learning contribute to firm cash flows when the manager is young (it is thus a form of effort and we will use the terms "learning" and "effort" interchangeably), it also helps him make better decisions if he is made CEO – for even though such knowledge may be critical for the CEO to function effectively, it may be much harder to acquire at the CEO level where vendors and customers will be far more

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trusting each other, since a manager next period buys the reputational capital of the current manager and this keeps the current manager in check, preventing defections motivated by short-termism.

circumspect, and the CEO's time more limited.[5] More specifically, at the end of any period t, the firm generates cash flows

$$C_t(k_{t-1}, s^{CEO}, s_t) = \theta_t \left(k_{t-1} \right)^{\gamma} [f(s^{CEO}) + g(s_t)] \qquad (1.1)$$

θ_t is a measure of how favorable the business environment is at time t for generating cash flows, and γ is a constant less than one. Function f indicates the CEO's contribution to cash flows, and its argument, s^{CEO}, is the firm-specific learning acquired by the CEO when he was a young manager (that is, in period t-1). Function g captures the manager's contribution to cash flows, with s_t being the learning effort the manager exerts at time t. Both f and g are increasing and concave. All agents maximize the present discounted value of their remaining lifetime income. The discount rate applied to next period's cash flows is (1+r).

1.2. Appropriation

We assume employee wages are normalized to zero. We also assume an extreme form of agency problem to fix ideas; The CEO appropriates the cash flow and assets that are not committed to the capital stock at the end of the period. That is, he appropriates

$C_t + k_{t-1} - k_t = C_t - (k_t - k_{t-1}) = Cashflow - investment$.

At the end of every period, the current CEO retires, so he has no direct incentive to preserve firm value for the future. The next CEO is the current manager, who is the only one with the necessary human capital to succeed. We will later examine more detailed models of selection.

1.3. Timing.

Critical in what follows is that the CEO will determine investment before the manager engages in learning effort. Investment is really not a one-off action such as buying a milling machine. Instead it consists of the articulation of a strategy and the necessary preliminary actions that will inexorably determine investments over time. For instance, the CEO may lay out a vision

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[5] A part of the literature has thus called such learning by doing as "organizational capital" (Atkeson and Kehoe, 2005, and Lustig, Syverson and Nieuwerburgh, 2008, being some recent examples).

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indicating he wants to expand sales into China so that it eventually accounts for half the firm's sales, and start by opening a branch office in Shanghai. Through frequent visits to speak with the Chinese authorities and frequent missives to the firm, he will put his prestige behind his vision and build commitment to deliver it. Further needed investments will follow out of cash flows. It is natural, therefore, to think of the CEO's commitment to the investment strategy as coming first in a leader-follower relationship.[6] The timing each period then is

Period t   Period t+1…

CEO hires manager.	CEO commits to end-of-period capital stock k_t	Manager engages in learning effort s_t	Cash generated. Investment made. CEO gets residual.	CEO retires. Manager becomes CEO.

Figure 1: Timeline

II. Outcomes

We now solve the model and see what it implies for CEO investment and managerial effort.

2.1. First best level of investment.

Inspection suggests that the first best level of capital is

$$k_t^{FB} = \left[\frac{\theta_{t+1}}{1+r} \left(f(s_t^{FB}) + g(s_{t+1}^{FB}) \right) \right]^{\frac{1}{1-\gamma}} \tag{1.2}$$

where s_t^{FB}, s_{t+1}^{FB} are first best levels of learning effort.[7] Similarly, s_t^{FB} solves

$$\frac{\theta_{t+1}}{1+r} \left(k_t^{FB} \right)^{\gamma} f'(s_t^{FB}) + \theta_t (k_{t-1}^{FB})^{\gamma} g'(s_t^{FB}) = 1 \tag{1.3}$$

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[6] Indeed, CEO's inability to deviate ex post from an investment path could also be viewed as an outcome of the monitoring, or more generally, internal governance, imposed by second-line managers. In alternate settings, such commitment may arise as "leadership" on part of a long-term CEO, attempting to coordinate actions of subordinates in a time-consistent manner (Bolton, Brunnermeier and Veldkarmp, 2008).
[7] Formally, the first-best solves for investment and managerial learning pairs (k_t, s_t) for all t, so as to maximize the discounted sum of cash flows net of investment and managerial effort, where the net cash flow in period t is given by $C_t(k_{t-1}, s_{t-1}, s_t)$, as in equation (1.1), minus $[(k_t - k_{t-1}) + s_t]$.

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Thus the first-best level of investment increases with the prospective quality of the business environment, θ_{t+1}, and importantly, does not directly depend on the current business environment θ_t. In contrast, the first-best level of managerial learning depends both on the current as well as the future business environment since it affects current as well as future cash flows.

2.2. Second best

In the second best, there is no direct rationale for the current CEO to commit to invest any of the cash flow. Investment puts the cash flow beyond his reach and his limited horizon implies he will see none of the future returns from investment.

However, there is a kind of contemporaneous settling up because the CEO's investment affects the future income of his manager, and therefore their incentive to engage in learning effort, and thus the firm's cash flows, today. To see this simple point, start first by writing down the CEO's income. It is

$$C_t(k_{t-1}, s^{CEO}, s_t^{SB}) - (k_t - k_{t-1}) = \theta_t \left(k_{t-1}\right)^{\gamma} [f(s^{CEO}) + g(s_t^{SB})] - (k_t - k_{t-1}) \qquad (1.4)$$

where s_t^{SB} is the manager's (second-best) equilibrium learning. Differentiating w.r.t. k_t, we see that the CEO's marginal net return from investing is

$$\theta_t \left(k_{t-1}\right)^{\gamma} g' \frac{ds_t^{SB}}{dk_t} - 1 \qquad (1.5).$$

The net return depends on current business conditions θ_t and capital stock k_{t-1} because these determine the cash flow impact of any increase in the manager's learning effort induced by CEO investment. Critically, it also depends on $\dfrac{ds_t^{SB}}{dk_t}$ - how the manager's optimal learning effort varies with investment. Indeed, this *sensitivity* of effort to investment is the channel through which the CEO's investment feeds back into contemporaneous cash flows, and will be a central

focus in what follows. To see how this is determined, first note the manager chooses s_t^{SB} to

maximize his future rents as CEO. That is, he maximizes

$$\frac{1}{1+r}\left[\theta_{t+1}(k_t)^\gamma\,[f(s_t)+g(s_{t+1})]-(k_{t+1}-k_t)\right]-s_t. \tag{1.6}$$

Differentiating and setting equal to zero, we get

$$\frac{\theta_{t+1}}{1+r}(k_t)^\gamma\,f'(s_t^{SB})=1 \tag{1.7}$$

So $s_t^{SB}=f'^{-1}\left(\dfrac{1+r}{\theta_{t+1}(k_t)^\gamma}\right)$. Since f' is decreasing, we see that, ceteris paribus, the less the

future is discounted or better the expected future environment, θ_{t+1}, or more the capital stock k_t

the CEO leaves behind, the greater the learning.

Now totally differentiating the manager's first order condition (1.7) and rearranging,

$$\frac{ds_t^{SB}}{dk_t}=\frac{-\gamma f'}{k_t f''} \tag{1.8}$$

which is positive, implying that even a myopic CEO has incentives to invest for the future in

order to motivate his manager today. Further specialization of functions allows us to obtain

closed form solutions.

2.3. Specializing functions.

Let $\alpha g=f$, that is for the same amount of learning, the contribution of the CEO to cash flows

is α times that of the managers. Further, let $f(s_t)=\dfrac{1}{b-1}(a+bs_t)^{\frac{b-1}{b}}$ with $a\geq 0$ and $b>1$.

Substituting these assumptions in (1.8), then (1.5), we get,

$$k_t=\theta_t(k_{t-1})^\gamma\,\frac{\gamma}{\alpha}\left(a+bs_t^{SB}\right)^{\frac{b-1}{b}} \tag{1.9}$$

Substituting f in (1.7) and rearranging, we get

$$\left(a+bs_t^{SB}\right)^{\frac{1}{b}}=\frac{\theta_{t+1}}{1+r}(k_t)^\gamma \tag{1.10}$$

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This then gives us

$$s_t^{SB} = \frac{-a}{b} + \frac{1}{b}\left(\frac{\theta_{t+1}}{1+r}(k_t)^\gamma\right)^b \tag{1.11}$$

Note that given capital stock k_t, the manager's effort, s_t^{SB}, depends only on the future

business environment and the end-of-period capital stock, even though it affects current cash

flow. This is because the manager does not share in current period rents – his horizon is different.

Of course, the current environment will affect his choice, but only through k_t. Substituting

(1.10) in (1.9) and simplifying, we get

$$k_t = \left[\frac{\gamma}{\alpha}\theta_t\left(\frac{\theta_{t+1}}{1+r}\right)^{b-1}\right]^{\frac{1}{1+\gamma-\gamma b}}(k_{t-1})^{\frac{\gamma}{1+\gamma-\gamma b}} \tag{1.12}$$

Interestingly, the business environment today, θ_t, and beginning-of-period capital stock,

k_{t-1} influence the end-of-period capital stock, even though they have no effect on the returns

produced by that capital stock (which are driven by θ_{t+1}). The intuition is simple – end-of-period

capital adds to the CEO's income only by enhancing his subordinate's learning by doing today.

That, in turn, matters more for current cash flows if today's business environment is good or if

current capital stock is high. Put another way, appropriating an additional dollar is more attractive

for the CEO if today's environment is bad, or if the firm's capital stock is small, because the

associated decline in effort by his employee does less absolute damage. Finally, the greater the

relative contribution of the manager to cash flows, $\frac{1}{\alpha}$, the greater is the desire of the CEO to

motivate learning effort by increasing investment.

Steady state

In steady state, $\theta_{t+1} = \theta_t = \theta^{SS}$ and the second best steady state $k_t = k_{t-1} = k^{SB}$.

Substituting in (1.12), and simplifying, we get

$$k^{SB} = \left[\frac{\gamma}{\alpha} \frac{\left(\theta^{SS}\right)^b}{(1+r)^{b-1}} \right]^{\frac{1}{1-\gamma b}}$$

(1.13)

From (1.12) and (1.13) we have

$$\frac{k_t}{k^{SB}} = \left(\frac{k_{t-1}}{k^{SB}}\right)^{\frac{\gamma}{1+\gamma-\gamma b}} = \left(\frac{k_0}{k^{SB}}\right)^{\left(\frac{\gamma}{1+\gamma-\gamma b}\right)^t}$$

(1.14)

Thus any initial capital stock converges to steady state if $b < \dfrac{1}{\gamma}$. Steady state managerial

learning and cash flow net of investment and learning effort can also be calculated using

equations (1.11) and (1.1).

In Figures 2a, 2b and 2c, we plot the convergence to the steady state of investment,

managerial learning and net cash flow, respectively, for two initial conditions – one that has

initial investment above the steady state and one that has below. This numerical example (and

the ones to follow) employ benchmark parameter values $(1+r)^{-1} = 0.95$, $\gamma = 0.2$, *(b-1)/b = 0.3*, $\alpha =$

0.5, *a = 0*, and $\theta^{SS} = 1$. As the plots reveal, convergence is almost fully achieved within five CEO

tenure periods. Further, as is clear from equation (1.14) and the plots, the convergence rate is

faster when the firm is farther from the steady state in its initial condition.

Comparison to the first-best steady state

We can also determine the steady state under the first best. Substituting the specific form

for f and g in (1.2) and (1.3), simplifying and solving, we get

$$k^{FB} = \left[\frac{\gamma}{\alpha} \left(\frac{\theta}{1+r}\right)^b \left(\frac{1+\alpha}{b-1}\right) \left(\frac{1+r+\alpha}{\alpha}\right)^{b-1} \right]^{\frac{1}{1-\gamma b}}$$

(1.15)

Comparing the ratio of the second best steady state in (1.13) with the first best steady state capital

stock above, we get $\dfrac{k^{SB}}{k^{FB}} = \left[\dfrac{(1+r)}{\left(\dfrac{1+\alpha}{b-1}\right)\left(\dfrac{1+r+\alpha}{\alpha}\right)^{b-1}} \right]^{\frac{1}{1-\gamma b}}$ (1.16). It can be shown that the ratio in

(1.16) is smaller than one. Note that (somewhat surprisingly) the ratio is independent of the

steady state business conditions. Finally, as can be verified analytically and as also shown in

Figure 3a, as $\alpha \to 0$ or $\alpha \to \infty$, the ratio in square brackets tends to zero, suggesting that the

capital stock under the second best agency solution tends to zero relative to the first best level.

The intuition is interesting. α represents the relative importance of the CEO in generating cash

flows. If α is very high, the CEO does not really need the manager's effort, and hence sees little

need to invest. If α is very low, today's manager, who reaps the benefit of his effort only when

he is CEO, sees little merit in exerting effort, because that effort will do little to enhance his

future rents. Indeed it is easily seen the ratio is maximized at a positive, finite level of α.

Turn next to cash flows. $\dfrac{CF^{SB}}{CF^{FB}} = \dfrac{\left(k^{SB}\right)^{\gamma}(1+\frac{1}{\alpha})f(s^{SB})}{\left(k^{FB}\right)^{\gamma}(1+\frac{1}{\alpha})f(s^{FB})}$. Substituting values[8], we get

$$\frac{CF^{SB}}{CF^{FB}} = \left[\frac{(1+r)}{\left(\frac{1+\alpha}{b-1}\right)\left(\frac{1+r+\alpha}{\alpha}\right)^{\frac{b-1}{\gamma b}}} \right]^{\frac{\gamma b}{1-\gamma b}} \tag{1.17}$$

As with investments, the ratio of the agency-modulated second-best cash flow to the first best

cash flow is smaller than one and independent of steady-state business condition. From an

efficiency standpoint, it is more appropriate to focus on cash flows net of investment and

managerial effort. It turns out that in this case too, the ratio of second-best outcome to the first-

best is small when $\alpha \to 0$ or $\alpha \to \infty$ (for the same reasons) and maximized at an interior level of

α (again, see Figure 3a). We summarize this discussion in the following two lemmas.

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[8] From (1.10), we get $f(s^{SB}) = \dfrac{1}{b-1}\left(\dfrac{\theta}{1+r}\left(k^{SB}\right)^{\gamma}\right)^{b-1}$. Similarly, we can show from (1.3) that

$f(s^{FB}) = \dfrac{1}{b-1}\left(\dfrac{\theta}{1+r}\cdot\dfrac{1+r+\alpha}{\alpha}\left(k^{FB}\right)^{\gamma}\right)^{b-1}$.

Lemma 1: Under stable business conditions, second-best investment, managerial learning and cash flows (gross as well as net of investment and managerial effort) are all smaller relative to their first-best counterparts.

Lemma 2: Under stable business conditions, the efficiency of the organization in generating cash flows (relative to the first best) is maximized when the CEO's contribution to cash flows is neither too large nor too small relative to the manager's contribution.

2.4. Discussion and implications

We have shown that internal governance can be moderately effective in disciplining the CEO's actions, and ensuring the firm creates value. Even though the CEO cares only about today, while the manager cares only about the future, because of their mutual interdependence, they have the incentive to act in the broader interest. This is brought out starkly by Lemma 2, where once either party becomes irrelevant to the generation of cash flows, the second best solution becomes very inefficient relative to the first best.

Cash flow correlation with investment

Interestingly, internally-governed firms may naturally display a correlation ("sensitivity") between investments and current cash flows. The rationale is as follows. Current cash flows in our model is a function of business conditions, as well as contributions from the CEO and from managers. Managerial effort anticipates future business conditions *and* also responds to the CEO's current investments. Since the CEO's current investment is determined in part by current business conditions, there is a correlation of investment with cash flows, even after controlling for future business conditions.

To see this, we report in Figure 3b the coefficients from regressing investment normalized by past capital stock (i_t / k_{t-1}) on cash flows $(Cashflow_t / k_{t-1})$ and business conditions (θ_{t+1}), from a simulation of 500 periods around our benchmark example, where each period, business condition is drawn to be a random variable that is uniformly distributed

$\left(\theta_{t+1} \sim Unif[0.5,1.5]\right)$. The regression is designed to match closely the kind of regressions employed in the investment-cash flow sensitivity literature starting with Fazzari, Hubbard, and Peterson (1988). The figure shows that the sensitivity of investment to cash flows in our model is the highest when the relative importance of CEO (α) is low and declines monotonically as α increases. The intuition is that when α is low, managerial effort is the primary determinant of cash flow, and it responds positively to CEO-determined investment -- hence, the stronger correlation.

In our model, cash flows are sufficient to undertake investments. The correlation emerges not because firms are credit constrained (unlike Fazzari, Hubbard, and Peterson (1988)) but because of a common factor driving investments and cash flows. Indeed, Kaplan and Zingales (1997) suggest that it does not appear that many firms that have high cash flow investment correlations actually face financial constraints.

Temporary shocks to business conditions

Better current business conditions increase the CEO's incentives to invest, even though they have no direct influence on the cash flows produced by the investment, because of the indirect effect they have on managerial incentives. If business conditions fluctuate a lot, these dependencies may lead to significant inefficiencies. As an illustration, consider Figure 3c wherein we retain all parameters as in the earlier cases but "shock" the business condition at date t=1 to two possible values of $\theta_1 = 1.5$ or 0.5 compared to the steady-state value $\theta^{SS} = 1$. Even though an unexpected temporary shock to business conditions should not affect investment for the future, as the plot shows, the investment in period t=1 moves substantially (depending on the shock), taking about four CEO tenure periods to revert to the steady-state (once business conditions revert to the steady-state starting at t=2).

If, however, business conditions are stable, the differing horizons of the CEO and the manager (the former focused on contemporaneous cash flows, the latter on future cash flows)

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could combine to make cash flows, appropriately sensitive to business conditions. This is what we see both in (1.16) and (1.17), where, in steady state, the ratio of second best to first best capital stock or cash flows do not depend on business conditions. It is in this sense that internal governance may work best when conditions are stable, rather than when conditions fluctuate dramatically.

Finally, we have been silent about who owns the capital stock (since the CEO appropriates everything, there are no residual cash flows apart from amounts invested in the capital stock). One view is that the capital stock consists of intangible or non-tradable assets such as human capital or relationships. In that case, what we have described is a partnership (with the CEO having control because of his superior ability to perform the functions of the CEO). An alternative view is that the assets are tangible and tradable, but they are owned by outside equity owners who have no control rights. We will shortly examine what happens when they do acquire control rights.

We also have not examined the process by which managers are appointed. If there are substantial rents associated with being CEO, the appointing agent could well recoup these rents from managers when they are appointed by paying them below market wages. Alternatively, it may be that managers have no wealth at the time of appointment (and their salaries are too low, even collectively, for them to pay over time for the rents they would get as CEO). In that case, CEO appropriation is a pure rent going to those who are lucky enough to get into the firm. These different views matter when we consider the firm value that can go to outsiders. Under the first assumption, if outsiders control appointment, firm value is maximized when inefficiencies from investment distortion and effort distortion are minimized – CEO misappropriation is "paid for" up front and is thus irrelevant apart from the distortions it creates. Alternatively, if the CEO controls appointment, his rents are enhanced even more. Under the second assumption, CEO misappropriation is a cost to outside claimholders, in addition to the costs of the distortions it creates.

2.5. Essential aspects of the mechanism of internal governance

We have assumed external governance to be weak, that the CEO's objective function has no forward looking components, and that the CEO is self-interested – the future welfare of the firm or its employees has no weight in his objective function. All this can be relaxed.

But our goal is to see precisely what conditions are necessary for internal governance to work and to see where it could be an important support to corporate performance. Consider the necessary ingredients: the CEO should believe that undertaking a future-oriented action should increase current cash flows, and thus his take, today. Clearly, this requires key stakeholders to be interested in the future, even if the CEO is not. For instance, the airlines who buy from an airplane manufacturer would be most interested in its continued health (if nothing else, so that spare parts continue to be available), and would likely reduce their purchases if they saw too little investment. Exit by customers is therefore one source of discipline (see Hirschman (1970), Titman (1984)). Customers are, however, typically at a distance, and leaving aside the purchase of high value durable goods or large amounts of intermediate goods, are unlikely to be appropriately informed or concerned about a supplier's future health.

This then leaves employees as the stakeholders most concerned and most able to observe and do something about mismanagement. Again, whether they can be a reliable part of a mechanism of internal governance depends on whether they have a sizeable long term stake in the firm. This requires some firm-specific rents. The rents may come from some specific ability that is possessed only by top management that have served an apprenticeship inside the firm. The absence of such rents, either because external governance severely limits what senior management can appropriate, or because top management in the industry is interchangeable across firms, would render internal governance ineffective.

A second requirement for effective internal governance is that the actions the managers need to take to enhance current cash flows also contribute to acquiring future rents. If, for example, the actions are unrelated to the firm-specific rents because they are rewarded anyway in

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the market place – the manager works hard because performance can be observed by other firms, and they will pay more for a good performer – then the prospect of acquiring firm-specific rents will not motivate actions. Thus it is only if learning effort results in firm-specific knowledge that does not translate easily to other firms, or if effort leads to a greater prospect of within-firm promotion, that effort and rents will be linked.[9]

Also, the desired action by the CEO should lead to more learning effort by managers. Investment in our model is assumed to have that character. But one could envisage situations where weaker actions by the CEO lead to more compensating effort by the managers. What, for example, if managers greatly feared the opprobrium and the reputational taint associated with bad corporate performance? More underinvestment by the CEO might lead them to greater effort as they struggled to keep the firm out of bankruptcy. Of course, countries or situations where external governance is weak are also likely to be situations where the market inflicts few reputational penalties.

Finally, we have assumed that the CEO cannot force employees to produce the desired level of effort. However, this is not critical. As we will see later, even if managerial actions can be coerced so that incentives are not needed, internal discipline can be imposed on the CEO through the need to hire new employees.

In summary, the existence of future firm-specific rents can make employees far more effective in exerting internal governance. However, they do not do this by asserting voice (probably an easy way to get fired) in Hirschman's terminology, but by reducing effort or by being reluctant to join. None of this needs any coordination on the part of employees, or any appeal to the Board or to forces of outside control.

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[9] Employees could, of course, be mobile but not be able to monetize their learning – for instance, because it is firm-specific or because other firms cannot verify the quality or extent of the learning, and therefore hesitate to promote the imported employee into a leadership position. This would be sufficient for us to obtain the desired effects.

III. Capital Structure

Thus far, we have examined a simple model where outside capital plays no role in constraining top management. In particular, top management was constrained in its opportunism only by the rest of the organization. In practice, the CEO's actions will also be constrained by the product market (see Titman (1984) and Scharfstein (1988)), the capital market, and the market for corporate control. In what follows, we will focus on the capital market, leaving the disciplinary role of other markets in the context of our framework to future work. Interestingly, capital markets may not play as much of a role in "disciplining" the firm's management, as in moving the firm to a better equilibrium. To allow a role for external control, let us assume that the capital stock consists of tangible assets that can be seized and sold by outside capital.

3.1. Arm's Length Outside Equity

Consider first outside equity. Following Myers (2000), we model outside equity holders, working through the board, as having a simple control right – the right to take the firm's capital stock at the beginning of each period if they believe the firm's announced dividend, d_t, out of cash flow is inadequate (as with investment, we assume the CEO can make a commitment at the beginning of the period to pay the announced dividend out of the cash flows generated in the period). In the beginning of period t, outside equity thus has the right to take k_{t-1}. It will leave the assets in for one more period if it gets an adequate return for leaving them in, that is, if $d_t + k_t \geq (1+r)k_{t-1}$. This then implies that the dividend is

$$d_t \geq Max[(1+r)k_{t-1} - k_t, 0] \tag{1.18}$$

Note that if the expected growth rate of capital stock is r or greater, the required dividend is zero – because the rate of growth of the equity holders' ability to extract value in the future (by threatening to take over the capital stock) exceeds their required rate of return. We first analyze

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the dividend and investment decisions of a going concern (where equity was issued in the past); then calculate the value of equity at IPO stage; then, we examine the CEO's investment decision at time of IPO; finally, we discuss the efficiency of outcomes under equity financing.

Going concern

Consider the objective function of a CEO who runs the firm *after* it has gone public. It is:

$$\max_{k_t, d_t} \theta_t \left(k_{t-1} \right)^{\gamma} [f(s^{CEO}) + g(s_t)] - (k_t - k_{t-1}) - d_t, \tag{1.19}$$

subject to the dividend constraint in (1.18). Let λ be the Lagrange multiplier on the constraint, with $\lambda \geq 0$. Differentiating with respect to the dividend and capital stock, we get $(-1 + \lambda)$ and

$$\left[\theta_t \left(k_{t-1} \right)^{\gamma} g' \frac{ds_t^{SB}}{dk_t} - 1 + \lambda \right].$$ As is evident from these derivatives, the going-concern CEO finds it

cheaper to "pay through capital" than to "pay through dividends", *provided investing in capital*

has the benefit of eliciting greater managerial effort $\left(\dfrac{ds_t^{SB}}{dk_t} > 0 \right).$ In our benchmark model so far,

this is always satisfied so that internally governed firms *never* pay any cash dividends to their equity claimants.

Intuitively, when $k_t < (1 + r)k_{t-1}$, there is no cost to the CEO of investing more capital out of cash flows (because he would otherwise have to make an equivalent cash payment as dividend to equity investors), while there is some benefit – since the effort by the manager is increased. This means that in the presence of outside equity, $k_t^E = Max[k_t^{SB}, (1 + r)k_{t-1}^E]$, where k_t^{SB} is the (second best) value that would have been chosen in the absence of outside equity (given past actual capital stock, k_{t-1}^E), and k_t^E is the capital stock that is actually chosen. In sum, because outside equity has the power to protect its claim but no power to control the CEO's actions, the CEO chooses to pay outside equity in the most privately beneficial way possible, paying through capital rather than through cash.

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Can the investment k_t^E always be financed? It can be verified that if

$Cashflow > rk_{t-1}^E$, then investment k_t^E is feasible; else, outside equity seizes capital k_{t-1}^E. This

would happen when the business conditions in period t become sufficiently adverse. Let us

denote the first date at which this occurs as T and the corresponding liquidating dividend as k_{T-1}^E.

Equity value

Before moving to the IPO-stage investment decision, let us tie down equity value or the

proceeds raised in the IPO, assuming the IPO occurs at date t. This equity value amounts

to $\dfrac{k_{T-1}^E}{(1+r)^{T-t}}$. Here is why. We have just seen that with outside equity, the rate of growth of

capital stock will be at least r, as long as this growth rate is feasible, failing which outside equity

collects a liquidating dividend k_{T-1}^E. Therefore, the value of equity is the discounted value of this

liquidating dividend $\dfrac{k_{T-1}^E}{(1+r)^{T-t}}$. In particular, if the growth rate of capital in absence of equity is

smaller than r even at the time of the IPO (for example, if the firm is in steady state), then capital

simply grows at the rate of r until liquidation, and therefore, equity value at the time of IPO is

just $\dfrac{k_t}{(1+r)}$.

Investment at the Time of the IPO

Let us now assume that the firm is private (effectively owned by the CEO) at beginning

of period t and the CEO intends to take it public through an initial public offering (IPO). In

keeping with the spirit of our analysis, he should be able to appropriate the proceeds from the

offering entirely (especially if he is the owner). The CEO chooses investment k_t to maximize

$$\theta_t \left(k_{t-1} \right)^\gamma [f(s^{CEO}) + g(s_t)] - (k_t - k_{t-1}) + \frac{k_{T-1}^E}{(1+r)^{T-t}} \tag{1.20}$$

where k_{T-1}^E depends on k_t recursively through the investment decision of the going concern in the presence of equity: $k_t^E = Max[k_t^{SB},(1+r)k_{t-1}^E]$. Now, the first-order condition for CEO's investment is given by

$$\theta_t \left(k_{t-1}\right)^\gamma g' \frac{ds_t^E}{dk_t} - 1 + \frac{1}{(1+r)^{T-t}} \frac{\partial k_{T-1}^E}{\partial k_t}. \tag{1.21}$$

In the non-trivial case where liquidation does not occur in the period just after the IPO, that is, equity is long-term in nature, the structure of our CEO-manager overlap ensures that managerial effort in the IPO period s_t^E is the same as the second-best in absence of equity s_t^{SB} (given the same capital stock k_t). More importantly, since the going-concern capital grows *at least* at the rate of r, we obtain that $\frac{1}{(1+r)^{T-t}} \frac{\partial k_{T-1}^E}{\partial k_t} > 0.$ Hence, the CEO at the time of IPO has a greater incentive to invest compared to the second-best in absence of equity: a higher end-of-period capital stock also increases the proceeds he gets from the IPO. [10]

We summarize this discussion in the following proposition:

Proposition 1: (i) In the presence of arm's length outside equity, the capital stock is always (weakly) higher than in the absence of arm's length equity, so long as the cash flow generated by beginning-of-period capital is greater than r times capital. (ii) In the periods after the IPO, the capital stock of a going concern is given by $k_t^E = Max[k_t^{SB},(1+r)k_{t-1}^E]$, where k_t^{SB} is the value that would have been chosen in the absence of outside equity. (iii) Whenever cash flow generated is smaller than r times capital, outside equity seizes the beginning-of-period capital; in other words, the firm is forced to pay a liquidating dividend.

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[10] Note that the CEO effectively acts as if he has all the stock in this example. In general, because stock based compensation will focus the CEO on growing assets rather than cash flows, it will not eliminate incentive distortions. Of course, in most realistic situations, the CEO will own only a fraction of the stock, and the direct effects of his actions on his take will far outweigh the benefits from seeing the value of his stockholdings grow.

When does equity financing improve outcomes?

Does outside equity help ameliorate the fundamental agency problem? Outside equity would have no effect if, for instance, the CEO had enough incentives to grow the capital stock fast. Indeed, as (1.14) in the basic model suggests, growth is fastest when the firm is young and its capital stock is small relative to the steady state. This is when outside equity control adds nothing. As the growth of capital stock slows, it eventually would slip below the discount rate – were it not for the constraints imposed by outside equity – as it moves asymptotically to the second best steady state. At this point, the presence of outside equity would keep capital stock growing at the discount rate. This reduces underinvestment if the capital stock would otherwise be less than the first best.

Eventually, though, if the return on capital falls, cash flows will fall. Outside equity will force a liquidating dividend if the cash flows are not enough to pay an adequate return on the capital stock. Note that because this is a condition on the average return on capital stock rather than on the marginal return, the firm may be overinvesting substantially before outside equity decides to shut it down.

Even before, though, top management may decide to pay dividends rather than investing if investments in capital do not elicit greater managerial effort $\left(\dfrac{ds_t}{dk_t} < 0 \right)$. This would then imply natural limits to the size of the capital stock (see Section 4.1), and a natural time to commence dividends.

An Example

Now let us consider a private firm whose CEO decides to take it public at t=10, after it has reached steady state. In steady state, k_t =0.055 and s_t = 0.28. Cash flow is 1.696, and the CEO's "take-home" is 1.641 (see Figures 4 a,b,c). In the period of the IPO, k_{10}^{IPO} =1.46 and s_t = 0.72. Cash flow is 1.90 and the CEO's "take-home" is 1.83. Clearly, the IPO has boosted

investment substantially, and also managerial effort. However, overall cash flow are boosted only by 0.21 from the steady state despite the increase in capital stock by about 1.4. This is why the CEO would have little incentive to set this level of capital stock, were it not for the added incentive coming from the extra equity value he can raise through the IPO if he ups investment.

Finally, post-IPO, the presence of equity sets a floor on the growth rate of capital stock. With capital stock growing, managerial effort also picks up, and cash flows and the CEO's take are substantially greater than pre-IPO.

Which then leads to the obvious question – what is it that the IPO does to make a small stagnant firm explode with energy? Interestingly, it is not the financing – in our example, the CEO at the time of the IPO could have financed the addition to capital stock with internal cash flows. One reason why the firm expands is the IPO changes his investment incentives in the period of the IPO. But this would not be enough for sustained growth, for in the absence of outside equity, both capital stock and effort would subsequently decline to the steady state. Outside equity prevents such decline in an interesting way; Subsequent CEOs are required to compensate outside equity, but allowed to defer payment by building additional capital stock. This immediately alters the investment incentives of future CEOs, ensuring also that managerial effort remains high. As a result, the IPO moves the firm to a better equilibrium.

Timing of IPOs

The CEO in place at the time of the IPO boosts investment and therefore income (since he does not face the full cost of the capital he invests). Clearly, the boost is proportional to business conditions, and the CEO has the greatest income from the IPO if the capital stock would even otherwise be high because of good business conditions. Moreover, the control rights exercised by equity would keep the capital stock growing, even after business conditions returned to normal. This implies that IPOs should be especially clustered around times when business is strong and that there may well be a tendency for these firms to overinvest over time. Conversely, going private transactions may be most appropriate when business conditions weaken (for

example, as industries mature and stabilize to steady but low-growth cash flows), and equity-induced-overinvestment becomes more pronounced.

Control rights

It is noteworthy that even with crude control rights, outside equity has such an influence on the firm's growth path. Indeed, in our framework, outside equity's control rights are irrelevant so long as the firm is growing its capital stock at a rate greater than r. It may well be then that outside equity has value at that early stage even if its control rights are weak to the point of non-existence, so long as it will acquire them eventually. And as processes become more stable and well-defined, and as management become more professional and standardized (see Hellman and Puri (2002)), outside equity will acquire the capacity to threaten to replace management. Thus internal governance may be sufficient to preserve substantial firm value initially, and when it weakens, external governance may have become sufficiently developed to add support.

Perhaps then this also explains why firms in emerging markets can issue outside equity, even when minority shareholder rights are currently poorly protected; The firm's resources will keep growing because of the pressures from internal organization, and the control rights exercisable by outside equity over these resources will improve over time as the country develops, and as firms become more clearly structured. These will eventually allow equity to be paid, and hence give it value long before equity protection is in place.

3.2. Short-term Debt

Now consider the CEO's decision to finance with short term debt. For simplicity, we assume this will be the only claim outstanding, so it could be that the firm also has outside equity outstanding with no control rights, or the CEO owns the equity but it has no resale value (because equity has no control rights) so a debt issuance is the only way he can appropriate future value. The CEO decides on the face value F of the debt he will issue at the same time as he commits to a level of investment k_t. The amount of resources he raises is the expected value of such debt, discounted back to period t, denoted by $D(F, k_t, s_t)$.

For simplicity, we assume debt is demandable and debt holders dispersed, so debt holders cannot be negotiated with. At the beginning of period t+1, after observing business conditions θ_{t+1}, debt holders will seize the capital stock k_t if they rationally anticipate the CEO will not be able to generate enough cash flow to make the promised payment. If the CEO is allowed to continue, cash flows first go to repaying debt, then to committed investment, and finally to the CEO.

There is essentially one important difference between debt and equity – debt is a fixed claim, which can be set far above the value of the assets and cannot be [cheaply] renegotiated, while equity is a contingent claim that varies with the value of the assets.

To allow for default risk, we assume that business conditions in period t+1 are uncertain: θ_{t+1} is drawn from a distribution $h(\theta_{t+1})$ with support $[\theta_{min}, \theta_{max}]$ where $\theta_{min} > 0$. Since default results in the seizure of the firm's capital stock, the CEO in period t+1 has incentives to keep the firm alive by raising additional financing if necessary. We denote the maximum value of such additional financing as $A_{t+1}(\theta_{t+1})$. A plausible assumption for most forms of corporate financing is that $A_{t+1}(\theta_{t+1})$ is non-decreasing in θ_{t+1}.

Given this set-up, the period t+1 CEO will make the investment k_{t+1} that maximizes free cash flow, $C_{t+1} - (k_{t+1} - k_t) + A_{t+1}$, if the resulting free cash flow (henceforth *FCF*) is smaller than the promised payment *F*. In such a case, creditors would simply seize the capital stock k_t at beginning of period t+1. If *FCF* is increasing in business condition θ_{t+1}, then there exists a critical level θ^{Def} of business conditions below which there is default. Also, we denote the risk-free level of debt as F^{RF} where $F^{RF} = FCF(\theta_{min})$.

The amount of resources the issuing CEO can raise in period t then is

$$D = \frac{1}{(1+r)}\left[F - (F - k_t)^+ \Pr(\theta < \theta^{Def})\right]. \tag{1.22}$$

Outcomes

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The CEO's investment and financing problem in period t is

$$\max_{k_t, F} \quad \theta_t \left(k_{t-1}\right)^\gamma \left[f(s^{CEO}) + g(s_t)\right] - (k_t - k_{t-1}) + D\left(F, k_t, s_t\right) \qquad (1.23)$$

where debt proceeds in period t are appropriable by the period-t CEO. In turn, the period-t
manager chooses learning effort to maximize

$$\max_{s_t} \frac{1}{1+r} E\left[\theta_{t+1}\left(k_t\right)^\gamma \left[f(s_t) + g(s_{t+1})\right] - \left[k_{t+1}(\theta_{t+1}) - k_t\right] + A_{t+1}(k_{t+1}(\theta_{t+1}), \theta_{t+1}) - F \mid \theta_{t+1} \geq \theta^{Def}\right] - s_t$$

$$(1.24)$$

Note that the CEO now cares about the future, not just because he cares about the manager's
effort, but because he cares about the proceeds from debt issuance – debt monetizes a portion of
future cash flows. This is important in what follows. Now consider the date t manager's first
order condition in setting learning effort. It is:

$$E\left(\theta_{t+1} 1_{\{\theta_{t+1} \geq \theta^{Def}\}}\right)\left(k_t\right)^\gamma f'(s_t) = 1. \qquad (1.25)$$

Denoting the solution as $s_t^D(k_t)$, we show in the appendix that $\dfrac{ds_t^D}{dF} \leq 0$. In words, managerial

learning declines in the level of debt F – intuitively, the manager knows that a higher F increases
the states where he is forced to default as CEO in period t+1, where his learning is rendered

useless. This will lead to under-provision of learning effort. We also show $\dfrac{ds_t^D}{dk_t} \geq \dfrac{ds_t^{SB}}{dk_t} \geq 0$

when evaluated at the same set of outcomes (k_t, s_t). Thus learning increases in investment k_t at a
rate that is greater than in the absence of debt financing. The intuition here is that not only does
more investment have the standard effect of enhancing the impact of learning effort on next
period cash flows, it also reduces the probability of default, both directly (through higher cash
flows) and indirectly (through higher learning).

Next, consider the period t CEO's problem. He chooses k_t s.t.

$$\theta_t\left(k_{t-1}\right)^{\gamma} g'(s_t^D) \frac{ds_t^D}{dk_t} - 1 + \frac{\partial D}{\partial k_t} + \frac{\partial D}{\partial s_t^D} \frac{ds_t^D}{dk_t} = 0. \tag{1.26}$$

The CEO's incentives to invest are enhanced in the presence of short-term debt through three effects. First, managerial effort is more responsive to CEO investment whenever debt is risky. Second, higher investment today raises the free cash flow tomorrow and expands the amount raised (for a given face value F) by lowering the probability of default. This allows the CEO to monetize and appropriate a portion of future cash flows. And, third, higher managerial effort also expands the amount raised and this further incentivizes the CEO to invest.

The CEO chooses the amount of debt face value *F* to issue so that:

$$\frac{\partial D}{\partial F} + \theta_t\left(k_{t-1}\right)^{\gamma} g'(s_t^D) \frac{ds_t^D}{dF} + \frac{\partial D}{\partial s_t^D} \frac{ds_t^D}{dF} = 0. \tag{1.27}$$

On the one hand, raising the face value of debt enables the CEO to (weakly) raise more money and monetize future cash flows. Set against this, managerial effort declines in the level of debt ($\frac{ds_t^D}{dF} \leq 0$), which lowers this period's cash flows (the second term in (1.27)). Also, lower managerial effort lowers debt proceeds (because it lowers the cash flow the manager will generate as CEO). Thus the last two terms in (1.27) are negative. The tradeoff faced by the CEO – the ability to raise more money against the cost of under-provision of effort determines the amount of debt the CEO will take on.

Lemma 3: As long as the level of debt is below F^{RF}, debt is risk-free and CEO investment and managerial learning is the same as in the absence of any debt financing.

Proof: See Appendix I.

This lemma suggests the incentive effects of debt come precisely from its riskiness.

Proposition 2: In equilibrium, the CEO in period t, chooses a level of debt *F* that is greater than

F^{RF} , as long as $h(\theta_{min})$ is sufficiently small. In this case, debt has default risk and the resulting

CEO investment k_t is greater than the investment in the absence of debt financing.

Proof: See Appendix I.

The mild technical condition in the proposition (that $h(\theta_{min})$ be sufficiently small)

ensures that as debt is increased from its risk-free level, the managerial under-provision problem

does not "jump up" too much but gets worse only gradually. Note that managerial learning with

risky debt may be higher than in the absence of debt, despite the lower incentive to provide effort

for a given level of investment. This is because risky debt gives the CEO incentives to invest

more, which in turn motivates the manager to exert greater effort. Now consider an example.

An Example

The example builds upon the example of Section 2.3. The additional assumptions are as follows:

(1) The world is assumed to end at period t+1. This simplifies the problem of investment and

additional financing in t+1 to pay off debt: $k_{t+1} = k_t$, $A_{t+1} = 0$ and $s_{t+1} = 0$ for all θ_{t+1} . The

default condition is thus given by: $C_{t+1}(\theta^{Def}) + k_t = F$.

(2) θ_{t+1} is distributed uniformly over its support.

Given these assumptions, we can calculate the optimal level of short term debt, investment and

managerial learning under the second-best with risky debt. We also calculate investment and

learning under the debt-free first-best (evaluated at average value of θ_{t+1}) and the second best

with risk free debt (given by equations (1.5) and (1.7) also evaluated at average value of θ_{t+1}).

The support of θ_{t+1} is [0.1, 2] and the initial state (k_{t-1} , s_{t-1}) is set to the steady-state values (2.56,

0.85) obtained under $\theta = 1$. The parameter that is freely varied is α, the relative importance of

CEO in generating firm's cash flows.

In figures 5a and 5b, we plot the CEO investment (k_t) under the three cases. 5a shows investments under the first-best and second best; 5b shows it for the second-best with risky debt (on a separate plot since the scales of investment are completely different). As is clear, while the investment under risk-free financing is below the first-best, risky debt induces the CEO to pursue extremely high levels of investment, especially as he becomes less important to cash flow generation (low α). Figure 5c shows that CEO investment is high because he wants to motivate managers. While with risk-free financing, managerial learning (s_t) is below the first-best level, with risky debt, managerial learning is in fact higher than the first-best level for high values of α.

Is high investment and managerial learning efficient? Figure 5d shows that this is not always the case. It plots the expected cash flow over the two periods net of investments and net of managerial learning effort under the three cases. For relatively large values of α, risky debt issuance by the CEO improves the second-best. In fact, as α becomes sufficiently large, the second-best with debt converges to the first-best!

The intuition is as follows. Suppose that α is high, so that the CEO is quite important in generating cash flows. Then, the manager's learning today is far more important for future cash flows than for today's cash flows. In the absence of debt, the CEO cares about the manager's learning only in so far as *today*'s cash flows are concerned, and thus invests little. When issuing risky debt, the CEO also cares about the cash flows the manager will generate next period as CEO – the issuance of risky debt effectively lengthens his decision-making horizon, and causes him to invest more. In the limit, as α becomes very large, the positive incentive effects of debt dominate.

In contrast, for smaller values of α, availability of debt finance in fact aggravates the distortions. In this case, the manager's learning today is far more important for today's cash flows than for future cash flows. But debt makes the CEO focus also on the future. The CEO invests a lot more than is warranted, increasing his private take but over-exerting his managers in the process (while in the second best solution without debt, he would invest little – see Figure 5c).

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The result is that organization's efficiency is reduced as a result of the CEO's ability to issue debt when α is low.

When does short-term debt improve outcomes?

The above discussion suggests that in firms where α is large (so decisions by CEOs have important effects on cash flows), their ability to issue risky debt improves outcomes. This is consistent with the structure of leveraged buyouts or private equity transactions: firms are highly levered; CEOs are important (as evidenced by their higher pay); firms seem to grow revenues and earnings substantially after levering and going private, compared to their industry peers and pre-LBO levels; debt seems to be a motivating factor for junior management rather than a disincentive.[11] By contrast, when top management is not so important, debt may give top management unintended incentives to overinvest (in order to incentivize subordinate learning), and may be a dominated form of financing.[12] We conjecture based on analysis in Appendix II that when top management is not so important, long-term debt may be more desirable than short-term debt.

IV. Internal Organization

Thus far, we have examined the effects of capital structure on the incentives for internal governance. Let us now turn to ways the internal structure of the firm itself may affect internal governance. Internal organization typically will alter the sensitivity of the manager's effort to the CEO's investment, and will thus affect outcomes. We explore how.

4.1. Probability of promotion and firm size.

We have assumed that the manager is fully assured of being promoted next period, and is the sole possible successor. Furthermore, we have assumed that no additional managers are

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[11] Of course, in LBOs, equity is not passive. One way of thinking about this is that the CEO in our model also represents the LBO partners.

[12] Thus, for example, an underperforming firm, where management's contribution can be sizeable, may be a better candidate for an LBO than an adequately performing firm.

needed as the firm's capital stock grows. What if, instead, more managers are needed as the firm's capital stock grows, and each manager's chances of promotion fall proportionately?

Suppose therefore that $N(k_t)$ managers are needed to produce with k_t of capital stock and each manager's chance of getting the CEO's rents are $\dfrac{1}{N(k_t)}$, with $N' > 0$.[13] Modifying the manager's maximization problem in (1.6) and following some simple algebra, we have

$\dfrac{ds_t^{SB}}{dk_t} = \dfrac{-f'}{f''}\left[\dfrac{\gamma}{k_t} - \dfrac{N'}{N}\right]$. This has to be positive for the current CEO to want to invest to motivate effort, and will be the case if $\gamma > \dfrac{\frac{N'}{N}}{k_t}$, that is, if the marginal rate of growth of managers with additional capital stock is significantly less than the average managers per unit of capital. Put differently, if there are scale economies in management (N is concave so the number of managers does not increase as fast as the capital stock), then internal governance can still have salutary effect on incentives because, even though a larger capital stock means more managers, the associated rents grow disproportionately compared to the number of managers who expect to share it. But if, for example, there are scale diseconomies in management (N is convex), then internal governance becomes unable to provide the CEO incentives for investment beyond a certain level of capital stock – managers see too little possibility of future rents to be motivated by CEO investment, and consequently the CEO does not invest. This will limit the size of the firm.

Interestingly, the possibility that once the firm reaches a certain size, managers may get demotivated by additional investment, suggests a rationale why the CEO may start paying outside equity in cash dividends rather than in more investment. This can be seen by reverting to equation

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[13] We assume other managers leave when they do not get the top job. The issue of how the CEO is selected and whether the Board can extract rents from managers when appointing one to the job is interesting, but left to future research.

(1.19) on the dividend and investment decision of going concern in presence of equity. If

$\dfrac{ds_t^{SB}}{dk_t} < 0,$ for sufficiently high capital, then the CEO will find it optimal to pay equity partly

through a cash dividend d_t, in particular, up to the point that capital $k_t = \left[(1+r)k_{t-1} - d_t \right]$ can

be brought down to a level such that $\dfrac{ds_t^{SB}}{dk_t} = 0$ (when managerial incentives are marginally

unaffected by additional investment). This may help explain why young and small firms do not

pay dividends until they have grown sufficiently large. Our model makes it clear that the relevant

incentive to make additional investment is not just to pursue growth, but also to motivate

employees. The switch to cash dividends in our model is a response to the second incentive no

longer being operative.

4.2. Promotion Tied to Effort

In the case discussed above, one manager's promotion was as likely as another's,

independent of the effort she exerted. What if a manager is more likely to get promoted if she

exerts more effort, while if she does not exert much effort, it will be easier for the board to find a

comparable replacement outside?

To see how this would affect our results, let us go back to the case of one manager, but

let her be promoted to CEO only with probability $p(s_t)$, where $p' > 0$. Again, modifying her

maximization problem in (1.6) and simplifying, we get $\dfrac{ds_t^{SB}}{dk_t} = \dfrac{-\gamma}{k_t \left(\dfrac{p'}{p} + \dfrac{f''}{f'} \right)}$. The CEO can

provide more incentives for effort through investment if the right hand side is high. Comparing

with (1.8), and recognizing the first term in the parentheses in the denominator is positive while

the second is negative, we see that the firm can offer the best incentives for the CEO to invest if

$\dfrac{p'}{p}$ reaches its highest positive value (but below $\dfrac{f''}{f'}$ in magnitude).

Consistent with intuition, the manager's effort will be more sensitive to CEO investment if her chances of capturing the future rent associated with the investment also increase in effort. Therefore, for any given probability of promotion, p, making promotion sensitive to effort will increase the strength of the internal governance effect. Conversely, any form of succession planning, which forces a high p while reducing p', would tend to diminish the importance of this effect. [14]

4.3. Labor Market, Reservation Wage, and Entry

Suppose now that the firm is in a competitive labor market where it has to hire the manager. It will have to pay the manager her reservation utility, $\bar{u}$. Thus far, we have assumed future rents are more than enough to compensate for the (zero) reservation utility. What if the reservation wage is positive, implying the firm has to attract the manager away from other lucrative sources of employment, and that the manager's anticipated future rents at the second-best investment level are below the reservation wage. The CEO has a choice of paying for the shortfall of future rents through a greater cash wage w_t or through greater investment (which will give the manager greater future rents). To explore this, note the CEO's maximization problem is

$$\max_{k_t, w_t} \quad \theta_t \left(k_{t-1}\right)^\gamma \left[f(s^{CEO}) + g(s_t)\right] - (k_t - k_{t-1}) - w_t$$

$$\text{s.t.} \quad \frac{1}{1+r}\left[\theta_{t+1}\left(k_t\right)^\gamma \left[f(s_t) + g(s_{t+1})\right] - (k_{t+1} - k_t)\right] - s_t + w_t \geq \bar{u}$$

$$\text{where } s_t \in \arg\max_{\hat{s}_t} \frac{1}{1+r}\left[\theta_{t+1}\left(k_t\right)^\gamma \left[f(\hat{s}_t) + g(s_{t+1})\right] - (k_{t+1} - k_t)\right] - \hat{s}_t$$

Setting up the Lagrangian and taking the partial w.r.t. k_t, we get

$$\theta_t \left(k_{t-1}\right)^\gamma g'(s_t)\frac{ds_t}{dk_t} - 1 + \lambda \frac{1}{1+r}\left[\theta_{t+1}\gamma\left(k_t\right)^{\gamma-1}\left[f(s_t) + g(s_{t+1})\right]\right] \geq 0, \text{ which means}$$

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[14] The sensitivity comes from comparing the effect of an increase in effort with the effect of an increase in investment, which is why p' is scaled by p. A possible extension would be to examine the effects of an internal tournament between managers on CEO incentives to invest.

$$\lambda = \frac{1 - \theta_t \left(k_{t-1} \right)^{\gamma} g'(s_t) \dfrac{ds_t}{dk_t}}{\dfrac{1}{1+r} \left[\theta_{t+1} \gamma \left(k_t \right)^{\gamma-1} \left[f(s_t) + g(s_{t+1}) \right] \right]}$$

(1.28)

The numerator is the cost to the CEO of the marginal unit of investment – note that this is less than 1 because the CEO obtains some benefits from the manager's consequent greater effort. Indeed, the numerator is zero at the unconstrained optimal. The denominator is the incremental rent the CEO generates for the manager next period through an additional unit of investment today. So if λ is less than 1, the CEO can generate more than a dollar of present value of rent for the manager tomorrow by incurring an incremental dollar of net investment cost today. Clearly, he would then prefer "paying through investment" than paying through cash, and would therefore exceed the investment he would make in the absence of a binding reservation wage.

The alternative to paying the manager through investment is to pay through current wage, w_t. Differentiating the CEO's Lagrangian w.r.t. w_t, we find the CEO wants to increase the current cash wage if $\lambda > 1$. Finally if λ starts out less than 1, as the CEO pushes investment higher λ could reach 1 (from below) before the CEO has met the reservation wage. In that case, he will pay part in investment and the remainder in cash wages.

In sum then, if the CEO cannot meet the manager's reservation wage with the promise of rents at the unconstrained second best optimal, she will have an incentive to invest above that today so as to generate the "currency" with which to pay the current manager her reservation wage. This is over and above any investment intended to elicit managerial effort. This then suggests that the need to entice managers to participate in the firm today may offer the CEO greater incentive to invest for the future.

More generally, new recruits to the typical firm in the industry anticipate they will get future rents and thus are willing to settle for low initial salaries. To the extent that they see the CEO compromising the future, they will demand additional compensation, which can reduce the

appropriable cash flows to the CEO substantially. Thus the CEO of a firm which requires a steady substantial intake of new entrants – either because its hiring in the past has been staggered or because it is on a fast growth path currently – will have strong incentives to not compromise the future, especially if the new entrants contribute quickly to the bottom line.

4.4. Who determines firm internal organization and capital structure?

Finally, it is useful to ask who determines internal organization and capital structure. One view is that it is the CEO, in which case when we examine alternative structures, the one we expect to observe is the one that maximizes CEO take. Clearly, founder managed firms and firms with weak boards are likely to go this route. Another possibility is that internal organization and capital structure are large, observable, strategic decisions that the board has control over, even if it has no control over operational decisions. Furthermore, if the board can get the benefit of more "efficient" decisions because it can get managers to pay for future rents up front, then the board may choose the value-maximizing structures. Clearly, which possibility is more relevant depends on the situation and the decision being made, and is a subject for future work.

V. Discussion and Conclusion

We have taken a simple model, indeed a caricature of managerial behavior, and taken it to its logical conclusions. Top management is both myopic and self interested, and the board ineffective. Yet, considerable value is preserved in the organization because of the need for top management to motivate younger managers who are needed to generate cash flows. Bottom-up governance could play an important role. Indeed, a characteristic of many self-governing human capital intensive organizations is that substantial rents are concentrated at the top, for example among partners. The watchful eyes of subordinates, who hope to gain access to those rents, can keep partners from milking those rents excessively as they age.

If internal governance is an important factor in a number of corporations and countries, it is worth considering whether the move towards ever-greater shareholder rights, public disclosure,

and minority investor protection is always a good thing. In a second-best world, internal governance may reach where external governance cannot. But if the board, myopically exercising its functions, or forced by laws protecting investors, limits rents at the top, it might dissuade subordinates from focusing on the long term, and taking actions to dissuade egregious CEO misbehavior. Greater external governance may stunt internal governance. Of course, this is not an attempt to justify any and all payments to CEOs, only a comment that payments should be viewed from a broader perspective of trading off internal and external governance.

Indeed, going private transactions may be viewed as ones which take place when external governance is seen at the same time as both excessive (in curbing CEO freedom and pay) and ineffectual (in limiting distortionary behavior). Many commentaries (see, for example, Baker and Wruck, 1988) suggest that the LBO partnership's forte is not ever more intrusive micromanagement. Instead, it loads the firm up with debt, and gives top management considerable rents if they are able to pay down the debt and create value. Of course, if only the CEO were thus motivated, it would be hard to argue that the firm would generate value. If however, senior and middle management are also motivated, not just by the prospect of current pay but by the prospect of participating eventually in the enormous rents at the top, it creates strong incentives for exercising internal governance. Thus the strength of going private transactions could, in part, be seen as their ability to reenergize internal governance.

Our model also suggests why it may be so hard for firms to shrink gracefully, and why it may make sense for a firm (like Philip Morris) in a mature, declining, industry like tobacco to diversify into a growing industry like food (by acquiring Kraft). If the firm were to stay in the declining industry, it would either have to overinvest or see a collapse of incentives, and worse, a collapse of the discipline imposed by internal governance. Rather than see the value destruction associated with such a decline, the second best option might be to "morph" into a new business. Large old firms don't just shut down, they transform themselves. What might be thought of as empire building by top management may be just a reaction to pressure from below. Indeed, Gort,

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Grabowski and McGukin (1985) find that unfavorable expectations of marginal returns to investment in existing businesses are an important spur to diversification, a finding consistent with the implications of our model, but also with others.

We would expect diversifying mergers by large firms in mature industries to be treated less harshly by the market than the typical diversification, with diversification being the least bad of the possible alternatives. There is some evidence of positive returns associated with conglomerate diversification programs (see Schipper and Thomson (1983)) for example, and with the conglomerate wave of the 1960s (see Matsusaka (1993) and Hubbard and Palia (1998)) but also strong evidence of a conglomerate discount (see, for example, Montgomery and Wernerfelt (1988), Lang and Stulz (1994), Berger and Ofek (1995)). Our explanation would be that diversification is better than the expected alternative of continued wasteful overinvestment in the existing business, but because the firm is not as good in the new business, or because of problems in managing an acquisition (see Rajan, Servaes and Zingales (2000) or Scharfstein and Stein (2000)), the diversified firm trades at a discount.

Finally, our paper suggests a rich interaction between the internal structure of firms, the strength of internal governance, and the need for any external governance. Internal governance may be quite effective in growing firms with young staff, where human capital is firm specific. By contrast, external governance may be much more important in mature firms in declining industries with aging staff where the required management skills are fairly generic. More generally, there is a rich vein of research to be mined in seeing the linkages between the internal organization of firms, internal governance, and external financing and governance. We have just touched the surface in this paper. More research clearly needs to be done.

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Figure 2a: Convergence of investment in second-best to the steady state
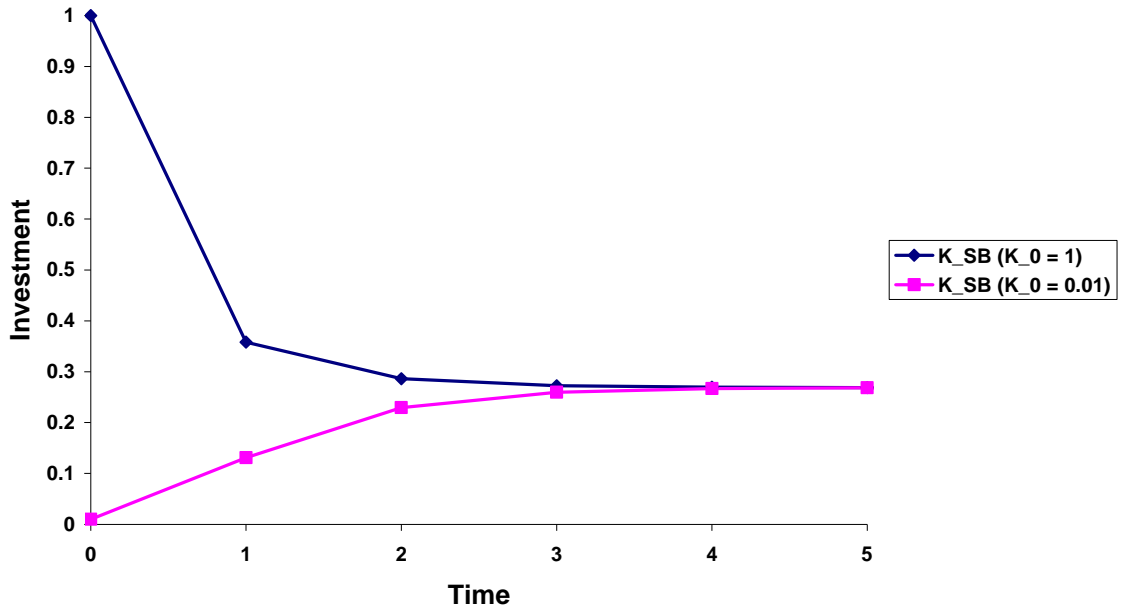
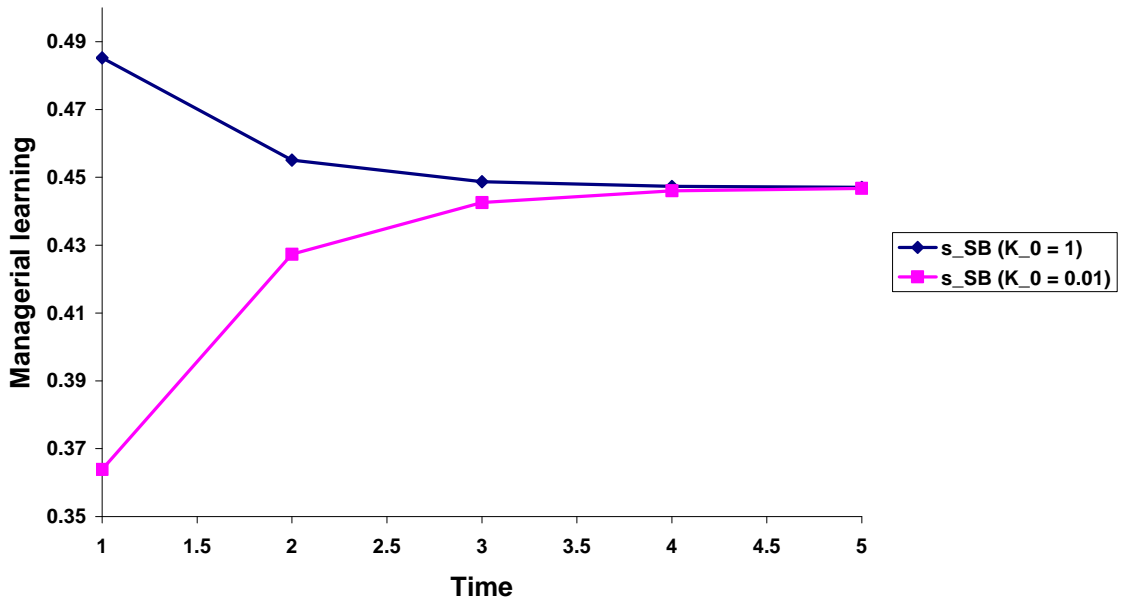**Figure 2b: Convergence of managerial learning in second-best to the steady state**

Figure 2c: Convergence of net cash flow in second-best to the steady state
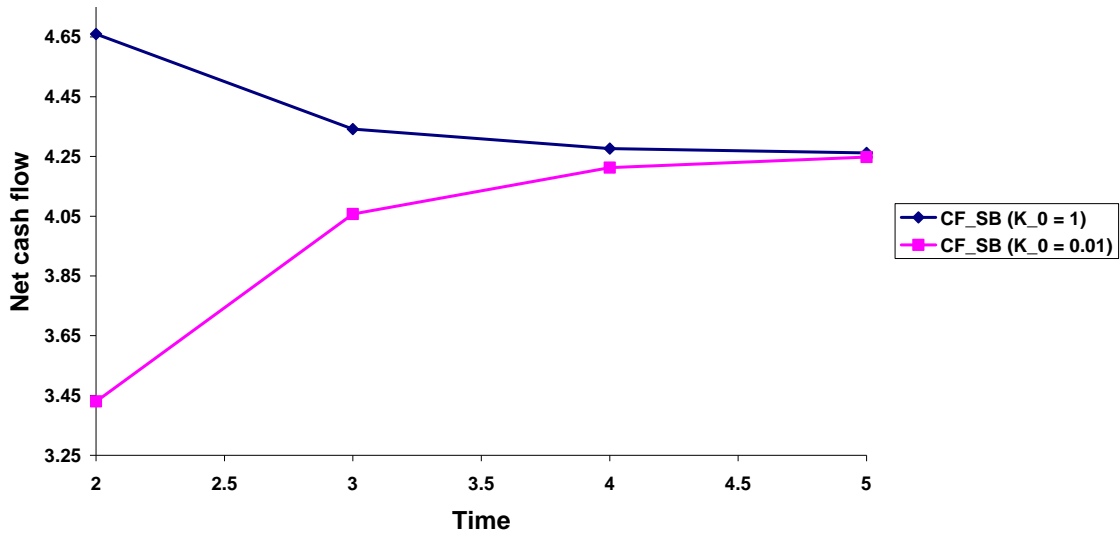

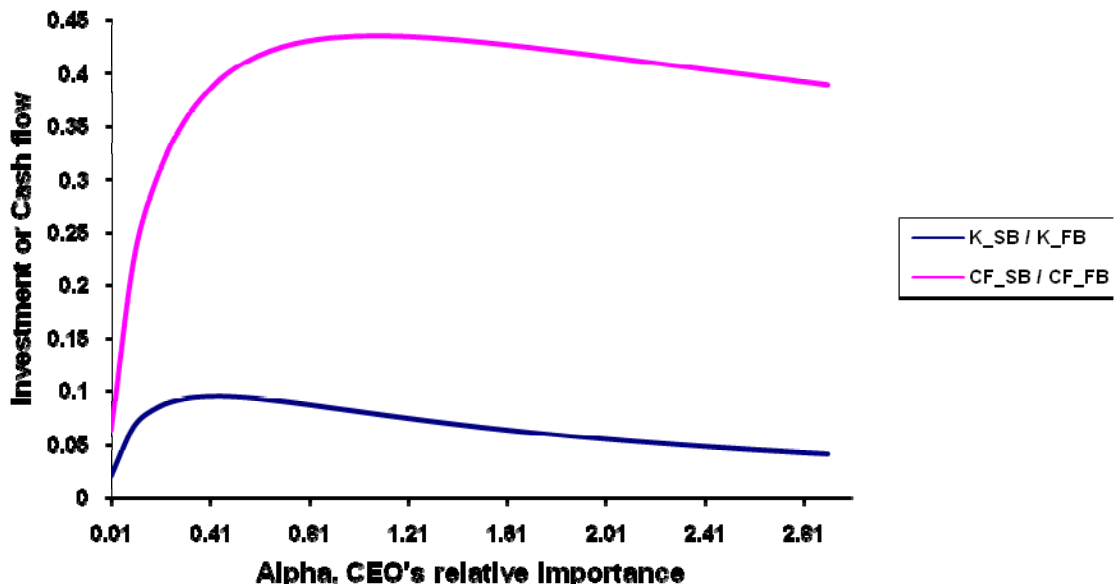**Figure 3a: Ratio of steady-state outcomes between SB and FB**

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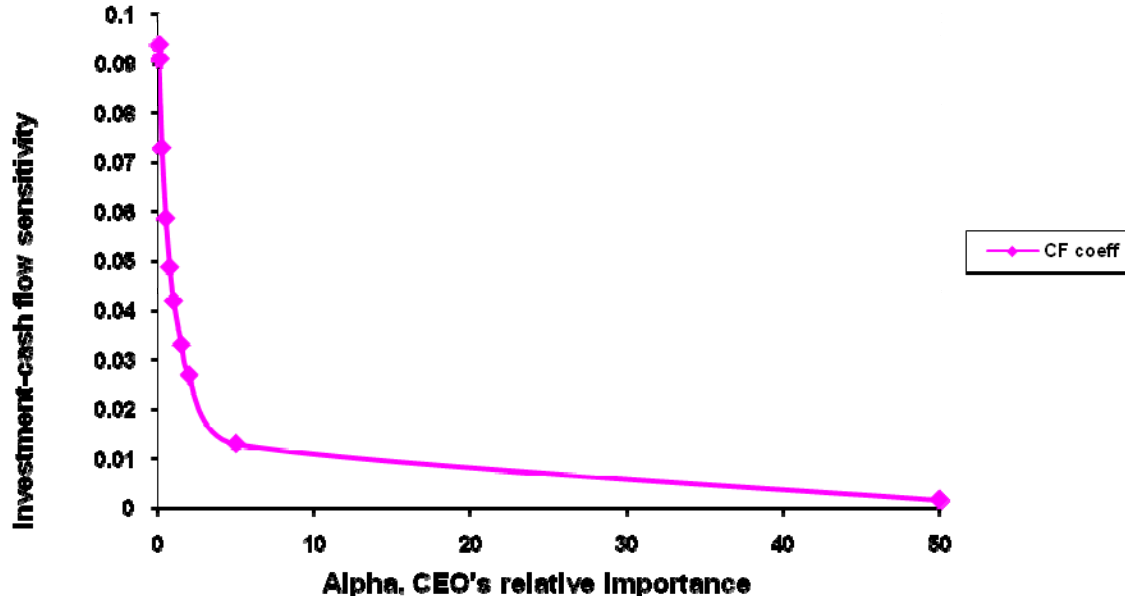**Figure 3b: Sensitivity of investment to cash flow in a regression on cash flow and future conditions**
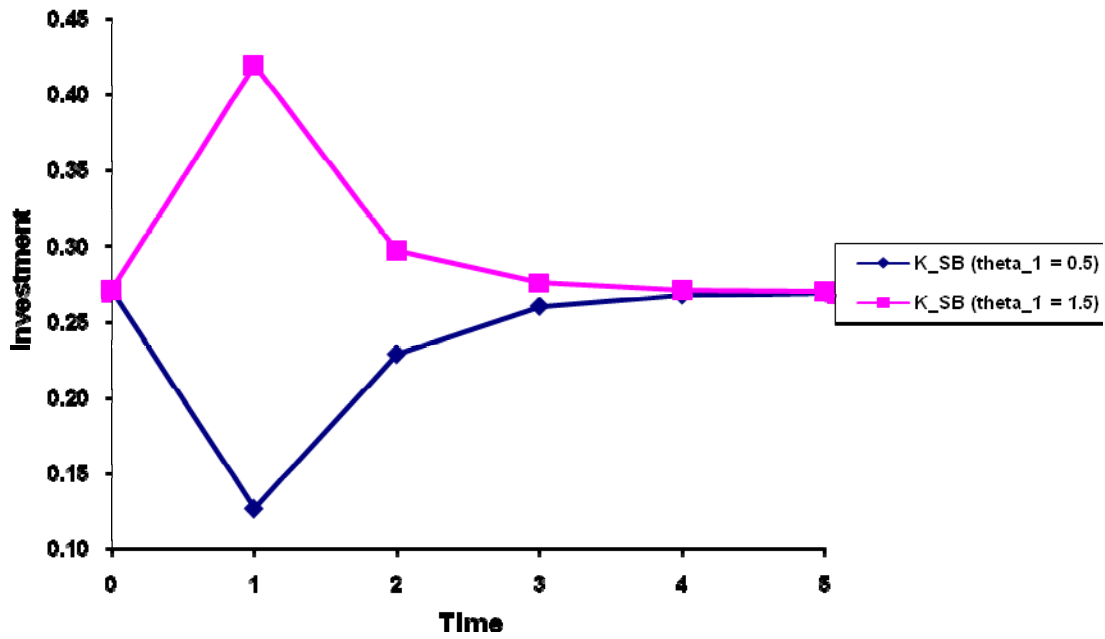
Figure 3c: Convergence of investment after temporary shock at t = 1

Figure 4a: Investment with equity issuance (at t=10)
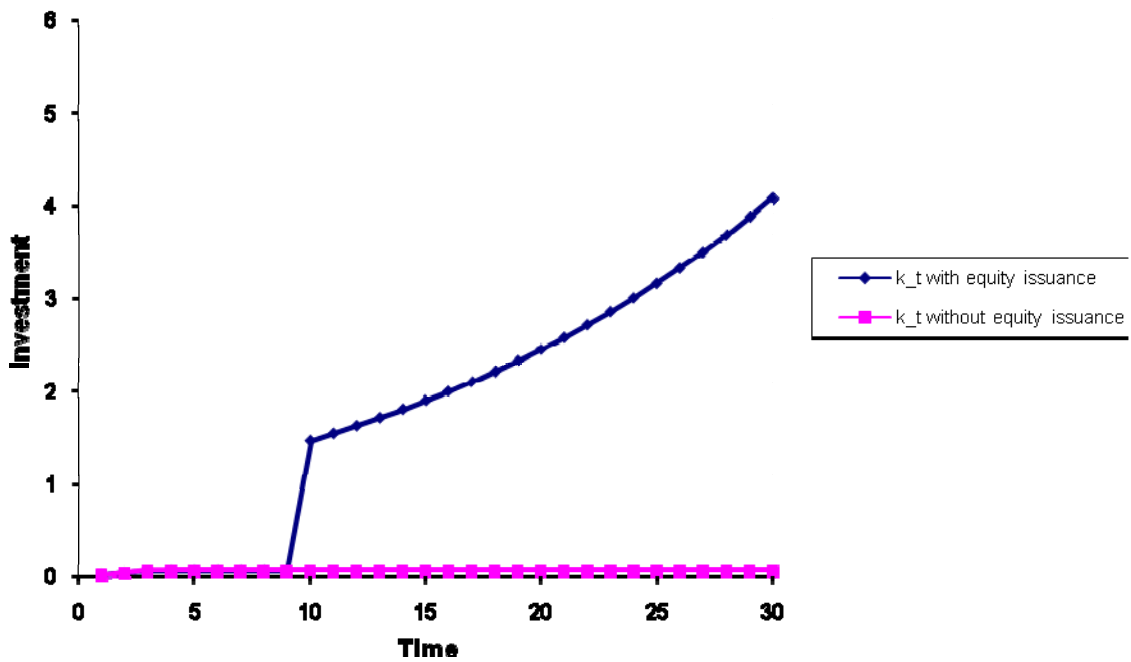
Figure 4b: Managerial learning with IPO (at t=0)
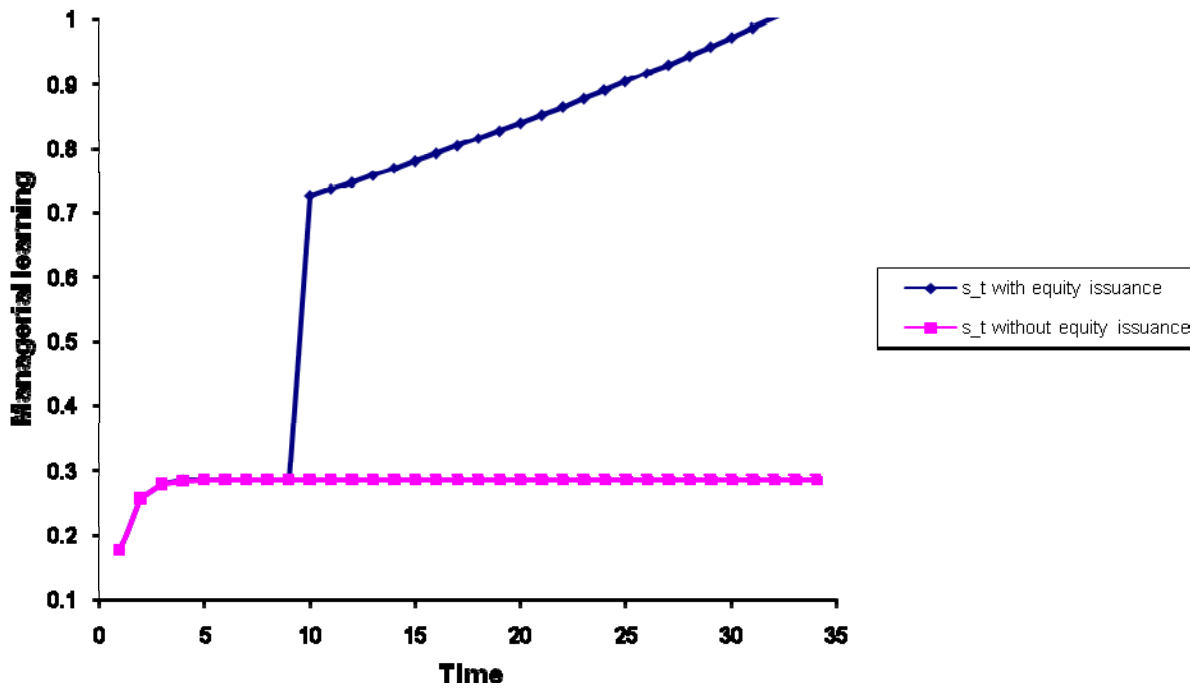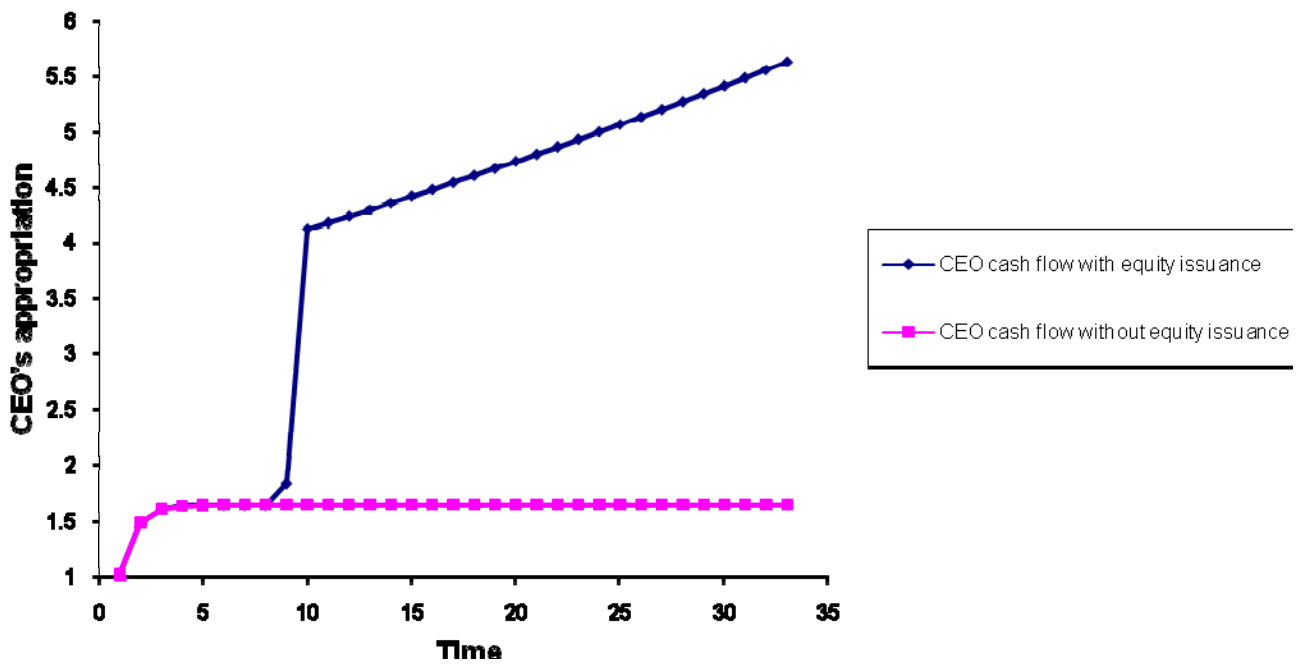

Chart 4c: Cash flow appropriated by the CEO with IPO (at t=10)

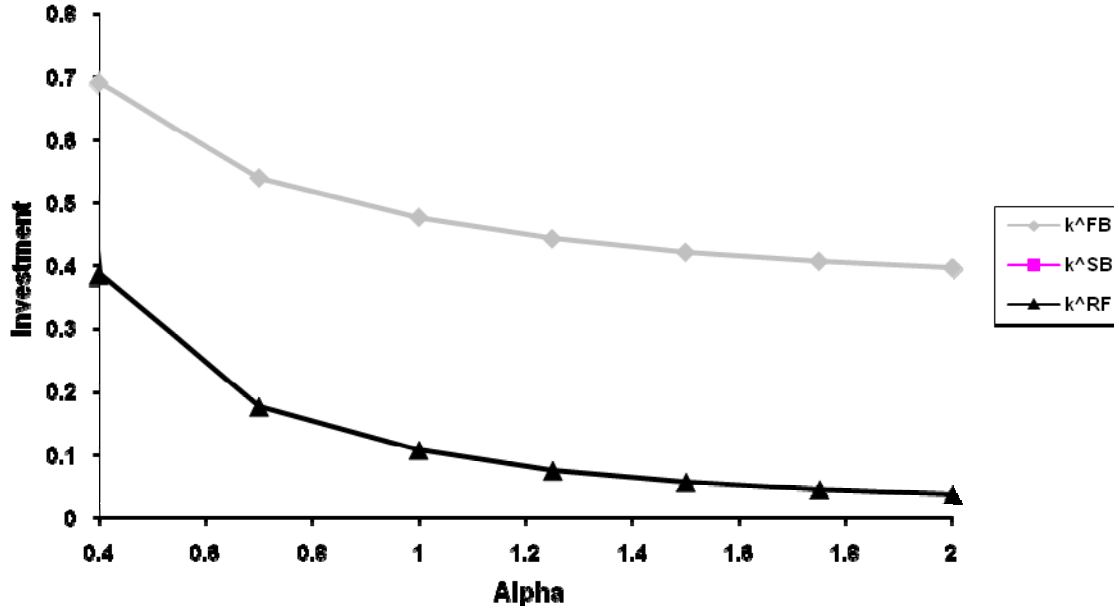**Figure 5a: First-best and second-best investment without risky debt**

Figure 5b: Second-best investment with risky debt
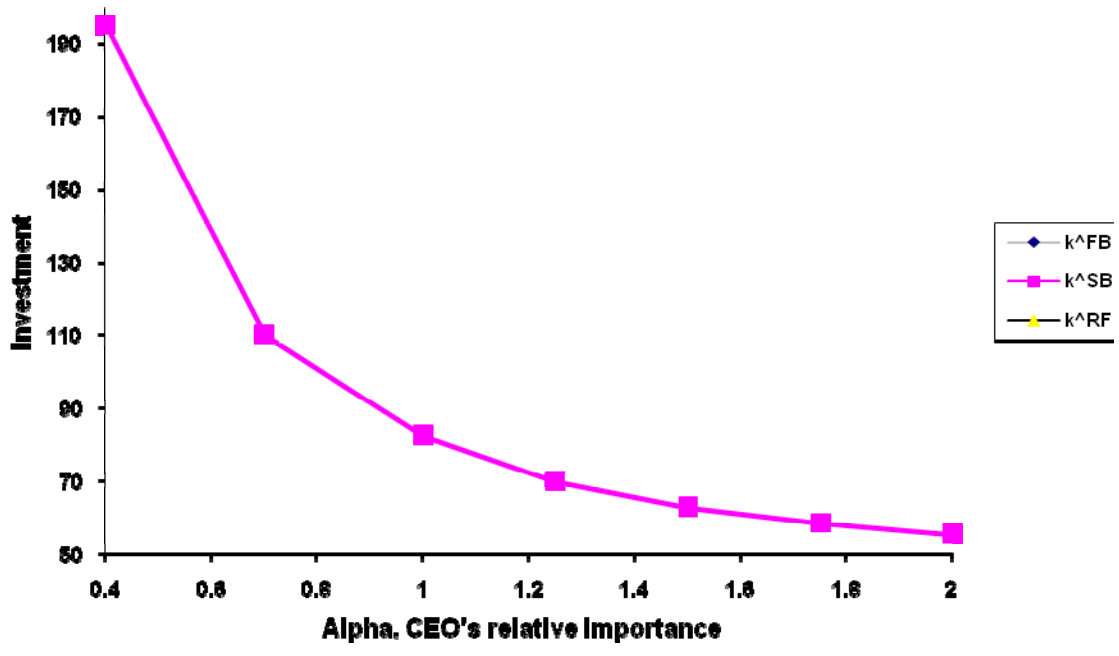
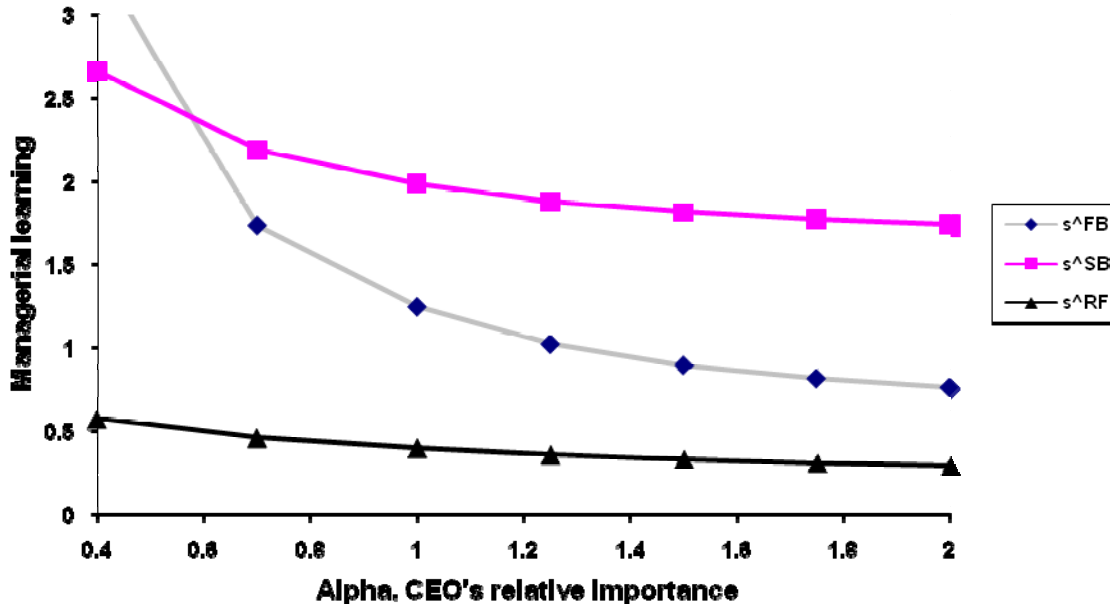# Figure 5c: First-best and second-best managerial learning with and without risky debt
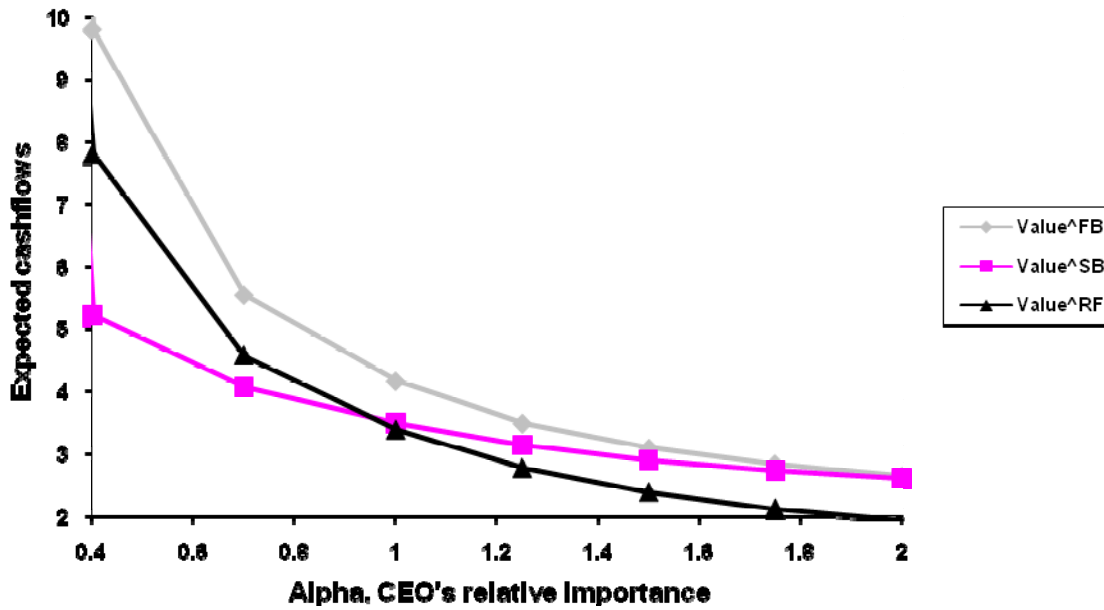

Figure 5d: Expected net cashflows under first-best, second-best (riskfree and risky debt)

Appendix I: Short-term debt

Default point and comparative statics

The no-default condition is given by $FCF(k_{t+1}(\theta_{t+1}),\theta_{t+1}) \geq F$, that is,

$$CF_t(k_{t+1}(\theta_{t+1}),\theta_{t+1}) - (k_{t+1}(\theta_{t+1}) - k_t) + A_{t+1}(k_{t+1}(\theta_{t+1}),\theta_{t+1}) \geq F. \qquad (1.29)$$

Consider the left hand side, which can be expressed more fully as

$$\theta_{t+1}(k_t)^{\gamma}\left[f(s_t^D) + g(s_{t+1}^{SB}(k_{t+1}(\theta_{t+1})))\right] - (k_{t+1}(\theta_{t+1}) - k_t) + A_{t+1}(k_{t+1}(\theta_{t+1}),\theta_{t+1}). \qquad (1.30)$$

Now, note that the CEO at t+1 chooses k_{t+1} to maximize $FCF(k_{t+1}(\theta_{t+1}),\theta_{t+1})$. In case default cannot be avoided even at the so maximized free cash flow, then the firm is in default. Thus, without loss of generality, one can assume that for all θ_{t+1},

$$\frac{\partial FCF(k_{t+1},\theta_{t+1})}{\partial k_{t+1}} = 0. \qquad (1.31)$$

Given this, as long as one assumes that

$$\frac{\partial A_{t+1}(k_{t+1},\theta_{t+1})}{\partial \theta_{t+1}} \geq 0. \qquad (1.32)$$

we obtain that

$$\frac{dFCF(k_{t+1},\theta_{t+1})}{d\theta_{t+1}} = \frac{\partial FCF(k_{t+1},\theta_{t+1})}{\partial \theta_{t+1}} > 0, \qquad (1.33)$$

It follows now that in general there exists a critical threshold value of θ_{t+1} denoted as θ^{Def} such that $FCF(k_{t+1}(\theta^{Def}), \theta^{Def}) = F$, with firm being in default for values below θ^{Def} and firm being able to pay off debt for values above θ^{Def}.

(1) $\dfrac{d\theta^{Def}}{dF} > 0.$

This follows from the observation that $\dfrac{dFCF(k_{t+1}(\theta^{Def}),\theta^{Def})}{dF} = 1$ which, in turn, implies that

$$\frac{\partial FCF(k_{t+1}(\theta^{Def}),\theta^{Def})}{\partial \theta^{Def}}\frac{d\theta^{Def}}{dF} = 1.$$

Since the first term on lhs above is positive, the claim follows.

(2) $\dfrac{d\theta^{Def}}{dk_t} < 0.$

This follows from the observation that $\dfrac{dFCF(k_{t+1}(\theta^{Def}),\theta^{Def})}{dk_t}=0$ which, in turn, implies that

$$\frac{\partial FCF(k_{t+1}(\theta^{Def}),\theta^{Def})}{\partial\theta^{Def}}\frac{d\theta^{Def}}{dk_t}+\frac{\partial FCF(k_{t+1}(\theta^{Def}),\theta^{Def})}{\partial k_t}=0.$$

Since the first and third terms in the lhs above are positive, the claim follows.

(3) $\dfrac{d\theta^{Def}}{ds_t}<0.$

This follows from the observation that $\dfrac{dFCF(k_{t+1}(\theta^{Def}),\theta^{Def})}{ds_t}=0$ which, in turn, implies that

$$\frac{\partial FCF(k_{t+1}(\theta^{Def}),\theta^{Def})}{\partial\theta^{Def}}\frac{d\theta^{Def}}{ds_t}+\frac{\partial FCF(k_{t+1}(\theta^{Def}),\theta^{Def})}{\partial s_t}=0.$$

Since the first and third terms in the lhs above are positive, the claim follows.

Debt value and comparative statics

The debt value is given by the condition $D=\dfrac{1}{(1+r)}\left[F-(F-k_t)^+\Pr(\theta<\theta^{Def})\right]$. Focusing on the relevant case when debt is risky (so that $F>k_t$), we obtain the following results.

(1) $\dfrac{dD}{dF}>0$ as $\theta^{Def}\to\theta_{\min}$ whenever $h(\theta_{\min})=0$ or sufficiently small.

This follows from the fact that $\dfrac{dD}{dF}=\dfrac{1}{(1+r)}\left[1-P(\theta<\theta^{Def})-(F-k_t)h(\theta^{Def})\dfrac{d\theta^{Def}}{dF}\right]$. Note that as $\theta^{Def}\to\theta_{\min}$ then $[1-P(\theta<\theta^{Def})]$ tends to 1 and if we assume $h(\theta_{\min})=0$ then the second term inside [.] in the expression for $\dfrac{dD}{dF}$ goes to zero (since $\dfrac{d\theta^{Def}}{dF}$ can be verified to have a finite value).

(2) $\dfrac{dD}{dk_t}>0.$

This follows from the fact that $\dfrac{dD}{dk_t}=\dfrac{1}{(1+r)}\left[P(\theta<\theta^{Def})-(F-k_t)h(\theta^{Def})\dfrac{d\theta^{Def}}{dk_t}\right]$ and as shown above $\dfrac{d\theta^{Def}}{dk_t}<0.$

(3) $\dfrac{dD}{ds_t}>0.$

This follows from the fact that $\dfrac{dD}{ds_t} = \dfrac{1}{(1+r)}\left[-(F-k_t)h(\theta^{Def})\dfrac{d\theta^{Def}}{ds_t}\right]$ and as shown above

$\dfrac{d\theta^{Def}}{ds_t} < 0.$

Managerial learning and comparative statics

The managerial learning in period t, denoted as s_t^D is given by the manager's first-order condition

$$E(\theta_{t+1}1_{\theta_{t+1}\geq\theta^{Def}})(k_t)^{\gamma}\,f\,'(s_t^D) = 1.$$

Using this characterization, the following results arise.

(1) [Under-investment] $\dfrac{ds_t^D}{dF} < 0.$

Taking the derivative of the manager's foc w.r.t. F, we obtain that

$$\frac{ds_t^D}{dF} = \frac{f\,'(s_t)\theta^{Def}h(\theta^{Def})\dfrac{d\theta^{Def}}{dF}}{f\,''(s_t)E\left(\theta 1_{\{\theta>\theta^{Def}\}}\right)} < 0,\ \text{since}\ f\,' > 0,\ f\,'' < 0,\ \text{and as shown above}\ \frac{d\theta^{Def}}{dF} > 0.$$

(1b) $\dfrac{ds_t^D}{dF} \to 0$ as $\theta^{Def} \to \theta_{\min}$ whenever $h(\theta_{\min}) = 0$ or sufficiently small. This follows easily from the expression above.

(2) $\dfrac{ds_t^D}{dk_t} > 0.$

Taking the derivative of the manager's foc w.r.t. k_t, we obtain that

$$\frac{ds_t^D}{dk_t} = -\frac{\gamma f\,'(s_t)}{k_t f\,''(s_t)}\frac{\left[1 - \dfrac{k_t\theta^{Def}h(\theta^{Def})\dfrac{d\theta^{Def}}{dk_t}}{\gamma E\left(\theta 1_{\{\theta>\theta^{Def}\}}\right)}\right]}{\left[1 - \dfrac{f\,'(s_t)\theta^{Def}h(\theta^{Def})\dfrac{d\theta^{Def}}{ds_t}}{f\,''(s_t)E\left(\theta 1_{\{\theta>\theta^{Def}\}}\right)}\right]} > 0,\ \text{since}\ f\,' > 0,\ f\,'' < 0,\ \text{the term inside [.] in}$$

the numerator is positive since $\dfrac{d\theta^{Def}}{dk_t} < 0$ and the term inside [.] in the denominator is positive

since it is proportional to the negative of the second-order condition for manager's optimization (assumed to be negative in turn for foc to yield the maximum).

(3) $\dfrac{ds_t^D}{dk_t} > \dfrac{ds_t^{SB}}{dk_t}$ where both derivatives are evaluated the same combination of outcomes (k_t, s_t).

Recall that $\dfrac{ds_t^{SB}}{dk_t} = -\dfrac{\gamma f'(s_t)}{k_t f''(s_t)}$. Thus, the result follows from the fact that the term inside [.] in numerator of $\dfrac{ds_t^D}{dk_t}$ is greater than one, whereas the term inside [.] in denominator of $\dfrac{ds_t^D}{dk_t}$ is smaller than one.

CEO's optimization of capital investment and debt level

Recall that the first-order conditions for this optimization are respectively given by

$$\theta_t \left(k_{t-1}\right)^{\gamma} g'(s_t) \frac{ds^D}{dk_t} - 1 + \frac{\partial D}{\partial k_t} + \frac{\partial D}{\partial s_t} \frac{ds^D}{dk_t} = 0, \text{ and}$$

$$\theta_t \left(k_{t-1}\right)^{\gamma} g'(s_t) \frac{ds^D}{dF} + \frac{\partial D}{\partial F} + \frac{\partial D}{\partial s_t} \frac{ds^D}{dF} = 0.$$

Note that when debt is riskless, all derivatives of D are zero except for its derivative w.r.t. F which is positive, and s^D is the same as s^{SB}. Hence, riskless debt has no effect on outcomes in terms of investment and it is optimal for the CEO to keep issuing more debt as long as it remains riskless since it enables him to steal more.

Next, consider debt level F that is risky, but take its limit as F tends to its highest risk-free level F^{RF}. Examine in the limit how the foc with respect to investment behaves at the risk-free outcomes, (k^{SB}, s^{SB}). Then, the foc at these outcomes evaluates to a positive value since as shown above (1) $\dfrac{ds_t^D}{dk_t} > \dfrac{ds_t^{SB}}{dk_t} > 0$ where both derivatives are evaluated the same combination of outcomes (k_t, s_t); (2) $\dfrac{\partial D}{\partial k_t} > 0$, and (3) $\dfrac{\partial D}{\partial s_t} > 0$. Thus, on the margin, the CEO invests more than the risk-free case when debt is increased beyond the risk-free level.

Now, examine in the above limit how foc with respect to debt level behaves at the risk-free outcomes (k^{SB}, s^{SB}). This foc is also positive so that debt will be higher than the risk-free debt in equilibrium since as shown above (1) $\dfrac{ds_t^D}{dF} \to 0$ as $\theta^{Def} \to \theta_{min}$ whenever $h(\theta_{min}) = 0$ or sufficiently small. This follows easily from the expression above; and (2) $\dfrac{dD}{dF} > 0$ as $\theta^{Def} \to \theta_{min}$ whenever $h(\theta_{min}) = 0$ or sufficiently small.

These facts together prove Lemma 3 and Proposition 2. Q.E.D.

Appendix II: Long-term debt

Consider the possibility that the CEO issues long term debt in period t instead of short term debt which we analyzed in Section 3.2. The debt is due in period t+N+1, that is, after N+1 periods, where N is positive and large. Assume no issuance of external finance is possible in the interim until period t+N+1. In period t+N+1, additional financing A_{t+N+1} can be raised, if required, as in the case of short-term debt. Whether debt can be paid or not in period t+N+1 depends upon FCF_{t+N+1} which depends upon the investment and managerial learning in period t+N, denoted as (k_{t+N}, s_{t+N}). Note these are investment and learning essentially in the presence of *short-term* debt when viewed from period t+N. Hence, the debt value that CEO in period t can raise against face value F can be denoted as $D(F, k_{t+N}, s_{t+N})$. The period t CEO's incentives to invest and take on debt are quite different than with short-term debt because debt does not directly affect the current period manager's effort incentives. The CEO's first-order conditions with respect to k_t and F are:

$$\theta_t \left(k_{t-1} \right)^\gamma g'(s_t^{LTD}) \frac{ds_t^{LTD}}{dk_t} - 1 + \frac{\partial D}{\partial k_{t+N}} \frac{dk_{t+N}}{dk_t} + \frac{\partial D}{\partial s_{t+N}} \frac{ds_{t+N}}{dk_t} = 0, \qquad (1.34)$$

and

$$\theta_t \left(k_{t-1} \right)^\gamma g'(s_t^{LTD}) \frac{ds_t^{LTD}}{dF} + \frac{\partial D}{\partial F} + \frac{\partial D}{\partial k_{t+N}} \frac{dk_{t+N}}{dF} + \frac{\partial D}{\partial s_{t+N}} \frac{ds_{t+N}}{dF} = 0. \qquad (1.35)$$

First, given a level of investment k_t, managerial learning in period t with long term debt, s_t^{LTD}, is the same as that in its absence, s_t^{SB} – this is because given the nature of the agency problem and each period being a CEO "tenure", debt maturing in the future has no effect on learning other than in the period immediately before maturity. Second, the CEO now has "long-term" incentives in the sense that he cares about the effect of k_{t+N} and s_{t+N} on debt capacity, but if N is sufficiently large, his investment today has little impact on these long-term outcomes – its effects will decay quickly; in this sense, the incentives to invest today are far weaker with long-term debt than with short-term debt, and in the limiting case of very long-term debt, the

incentives are the same as those without any debt in the first place – the last two terms in (1.34) will be zero.

Similarly, the first term in (1.35) will be zero because the debt repayment is too far away to affect effort today. However, the CEO will recognize the effects of a higher F on the amount raised, D, through its effects on period t+N effort and investment (when the long term debt essentially becomes short term debt). Thus the CEO will choose the face value of debt *F* to maximize *D*, which requires setting the sum of the last three terms in (1.35) to zero.

How does long-term debt compare then to short-term debt in terms of efficiency for the firm? We saw earlier that when CEO is relatively more important to producing cash flows than the manager, short-term debt can ameliorate agency problems and bring outcomes closer to the first-best. In these situations, long-term debt, which provides *weaker* incentives to CEO to invest, would be dominated by short-term debt. When the CEO is relatively less important to cash flows, we saw that short-term debt gives excessive incentives to the CEO to invest. Hence in such situations, long-term debt – which gives the CEO weaker incentives to invest – may be more desirable than short term debt. Put another way, assuming the CEO wants to issue debt and appropriate its proceeds, it is better for debt to be short-term debt when CEO is relatively more important, and long-term otherwise.