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ABSTRACT

We present a real-options model of takeovers and disinvestment in declining industries. As product demand declines, a first-best closure level is reached, where overall value is maximized by shutting down the .rm and releasing its capital to investors. Absent takeovers, managers of unlevered firms always abandon the firm's business too late. We model the managers' payout policy absent takeovers and consider the effects of golden parachutes and leverage on managers' shut-down decisions. We analyze the effects of takeovers of under-leveraged firms. Takeovers by raiders enforce first-best closure. Hostile takeovers by other firms occur either at the first-best closure point or too *early*. We also consider management buyouts and mergers of equals and show that in both cases closure happens inefficiently *late*.

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1 Introduction

There is no single hypothesis which is both plausible and general and which shows promise of explaining the current merger movement. If so, it is correct to say that there is nothing known about mergers; there are no useful generalizations. (Segall (1968))

The literature on mergers and acquisitions has grown by orders of magnitude since Joel Segall wrote in 1968. Most of this research is empirical, testing hypotheses derived from qualitative economic reasoning. The hypotheses relate to possible motives for mergers and acquisitions, their impacts on stock-market values, and the effects of financial-market conditions and legal constraints. But the hypotheses are not consolidating. One can pick and choose from the hypotheses to explain almost every merger or acquisition. We do have useful empirical generalizations, but no theory of the sort that Segall was seeking.

Mergers and acquisitions fall into at least two broad categories. The first type exploits synergies and growth opportunities. The second type seeks greater efficiency through layoffs, consolidation and disinvestment. This paper presents a formal theory of the second type. The theory is a continuous-time, real-options model, in which the managers of the firm can abandon its business if product demand falls to a sufficiently low level. The managers may abandon voluntarily, or be forced to do so by a takeover. (We will use "takeover" to refer to all types of mergers and acquisitions.) We analyze the managers' behavior absent any takeover threats, then consider what happens if a "raider" or another company can bid to take over the firm.

Few takeovers are undertaken solely to force disinvestment. Opportunities for disinvestment and synergy and growth may coexist in the same deal. Takeovers undertaken primarily for disinvestment are common, however. When U.S. defense budgets fell after the end of the Cold War, a round of consolidating takeovers followed. The takeovers in the oil industry in the early 1980s, including Boone Pickens's raids on Cities Service and Phillips Petroleum (Ruback (1982, 1983)) also were classic examples. So were the "diet deals" of the LBO boom of the late 1980s. The banking industry is another good example. The U.S. was "over-banked" in the 1970s, partly as a result of restrictive state banking regulations. As regulation eased, a wave of takeovers started. "Super-regionals" have grown by taking over dozens of relatively small local and regional banks, in each case shedding employees and consolidating operations.

Disinvestment is also used as a defense against takeovers. The UK bank NatWest tried this tactic (unsuccessfully) in response to a hostile takeover bid from the Bank of Scotland:[1]

NatWest has announced a further 1,650 job cuts as it launches details of its vigorous defence against the hostile £21bn ($35bn) Bank of Scotland takeover bid. ... Greenwich NatWest, Ulster Bank, Gartmore and NatWest Equity Partners are to be sold, with surplus capital returned to shareholders. ... NatWest poured scorn on Bank of Scotland's claims regarding cost savings and merger benefits, saying the Edinburgh firm was "attempting to hijack cost savings that belong to NatWest shareholders" and claiming unrealistic merger benefits. (BBC, October 27, 1999)

Why are takeovers necessary to shrink declining industries? The easy answers, such as "Managers don't want to lose their jobs," are not satisfactory. A CEO with a golden parachute might end up richer by closing redundant plants than by keeping them open. A CEO who ended up out of work as a result of a successful shutdown ought to be in demand to run other declining companies.

Of course there are reasons why incumbent managers may not want to disinvest. Their human capital may be specialized to the firm or they may be extracting more rents as incumbents than they could get by starting fresh in another firm. If these reasons apply, we are led to further questions. Can a golden parachute or the threat of a takeover overcome the managers' reluctance to shrink their firm? Does the holdup problem described by Grossman and Hart (1980) prevent efficient takeovers? If another firm leads a successful takeover, why do the new managers act to shrink the firm? Are their incentives any different than the old managers'? Does it make a difference whether the takeover is launched by another company or by a raider with purely financial motives? We consider these and several related questions in this paper.

This paper is not just about takeovers, however. In order to analyze takeovers, we first have to identify and examine the reasons for inefficient disinvestment. Thus we have to derive managers' payout and closure decisions and consider the possible disciplinary role of golden parachutes and debt. Our results about payout, golden parachutes and debt policy are interesting in their own right.

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[1]The Royal Bank of Scotland (RBS) ended up winning the battle for NatWest. RBS has continued to pursue diet deals, including $10.5 billion acquisition of Charter One Financial in May 2004.

1.1 Preview of the model and main results

We consider a public firm with dispersed outside stockholders.[2] We assume that managers maximize the present value of the cash flows they can extract from the firm. But at the same time managers have to pay out enough money to prevent investors from exercising their property rights and taking control of the firm. The equilibrium payout policy is dynamically optimal (for the managers). In good times, payout varies with operating cash flow. As demand falls, a switching point is reached, where payout falls to a fixed, minimum amount that is proportional to the firm's stock of capital.

The first-best closure point is the level of demand where shut-down and redeployment of capital maximizes total firm value, i.e., the sum of the present values of the managers' and investors' claims on the firm. (Efficiency does *not* mean "maximizing shareholder value.") We show that managers always wait too long, as product demand declines, before abandoning and allowing closure. The managers have no property rights to the released capital, and do not consider its full opportunity cost. But if demand keeps falling, the managers are eventually forced to pay from their own pockets in order to keep investors at bay. Sooner or later they give up.[3]

We consider whether a golden parachute – a contract that shares liquidation proceeds with the managers – can provide the right incentives for efficient disinvestment. Golden parachutes can mitigate the late-closure problem but not eliminate it. An "optimal" golden parachute that would generate first best closure always harms outside investors, who would not approve it.

We also consider how financial leverage, and the resulting obligation to pay out cash for debt service, changes the managers' behavior. Debt financing accelerates abandonment and improves efficiency. There is an optimal debt level, which assures efficient abandonment. The optimal level is linked to the liquidation value of the firm's assets, not to its operating cash flow or market value.

Our predictions about debt and payout policy are, as far as we know, new theoretical

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[2]Thus our paper is *not* about optimal financial contracting, optimal compensation or managers' effort. Also, we do not consider private benefits of control.

[3]One can easily find other reasons for late closure, for example empire building motives, private benefits or the benefits of risk-taking and delay for firms in financial distress – See Decamps and Faure-Grimaud (2002). Most of our takeover results would follow.

results. These results can be viewed as formal expressions of the Jensen (1986) free cash flow theory, which says that managers prefer to capture or invest cash flow rather than paying it out. Jensen goes on to suggest that high levels of debt (as in LBOs) help solve the free cash flow problem by forcing payout of cash. But the usual expressions of the free-cash-flow theory are incomplete. There has to be some minimum payout to investors and therefore some restriction on managers' capture or investment of cash flow – otherwise the firm could not raise outside financing in the first place. Our model analyzes this restriction explicitly in a dynamic setting.

If the firm carries sufficient debt, takeovers have no role to play. Therefore we consider takeovers of underlevered firms. The takeovers may be launched by:

1. **Raiders**, that is, purely financial investors. Raiders take over the firm at exactly the right level of product demand and shut the firm down immediately. Thus raiders implement the first-best outcome, where abandonment maximizes the overall value of the firm, not its value to the managers or investors separately.

2. **Another firm**. Managers of another firm can launch a hostile takeover. They act just as a raider would unless they are forced to preempt a competing bid. Preemption means that the takeover occurs too early, i.e., at too high a demand level. Hostile takeovers require some commitment mechanism to assure that the acquiring managers actually follow through and shut down the target. (After the bidding firm takes over, it also acquires the incentives of the target management.) The right amount of debt can force disinvestment. Equity-financed takeovers will not occur unless there is some credible alternative commitment mechanism.

3. **Management buyouts** (MBOs). Allowing managers to buy out their own firm prompts them to disinvest at higher levels of demand. Closure still happens inefficiently late, however, because managers lose the ability to capture cash flow when they take over and shut down. MBOs can occur only if takeovers by raiders or other firms are ruled out.

4. **Mergers of equals**. In some cases a firm that could make a hostile takeover will be better off forcing the target to accept a "merger of equals," in which the merger terms are negotiated by the two firms' managers without putting the target in play. A merger of equals reduces the power of the target shareholders to extract value from the bidder. Since a merger of equals does not change managers' incentives, disinvestment remains inefficiently late. A raider could always contest such a merger and win, however.

At the end of the paper we comment briefly on takeovers for growth or synergy. These

takeovers are more likely to be effected as mergers of equals, because both firms' managements can share the value added without paying a premium to the shareholders of a target firm.

1.2 Literature review

This paper continues a line of research using real-options models to analyze the financing and investment decisions of firms rather than the valuation of individual investment projects. Several papers, including Mello and Parsons (1992), Leland (1994), Mauer and Triantis (1994), Parrino and Weisbach (1999) and Morellec (2001) quantify the possible impacts of taxes, asset liquidity and stockholder-bondholder conflicts on investment decisions and debt policy. Anderson and Sundaresan (1996) and Mella-Barral and Perraudin (1997) consider the role of strategic debt service on firm's closure decisions and the agency costs of debt. Lambrecht (2001) examines the effect of product market competition and debt financing on firm closure in a duopoly.

Many authors, dating back at least to Jensen and Meckling (1976), have proposed that managers will overinvest (for example in empire-building) and disinvest only if forced to do so. Recent papers by Leland (1998), Ericsson (2000) and Décamps and Fauré-Grimaud (2002) examine various aspects of this problem. In particular Décamps and Fauré-Grimaud (2002) show that debt financing can give equity investors an incentive to delay closure in order to gamble for resurrection. In our model, the *managers* decide to delay closure, and debt financing accelerates closure.

Our paper focuses on agency problems between managers and dispersed outside investors. We follow Myers (2000) by assuming that managers maximize the present value of their stake in the firm, subject to constraints imposed by the investors. Papers by Stulz (1990), Zwiebel (1996) and Morellec (2004) tackle much the same problem, but with interesting differences. They assume that the manager derives private, non-pecuniary benefits from retaining control and reinvesting free cash flow. Debt service reduces free cash flow and constrains over-investment. In Zwiebel (1996), managers are also constrained by the threats of takeover and bankruptcy. Bankruptcy plays no role in our model, and we do not invoke private benefits to support an assumption that managers always want to expand or maintain investment. Our managers' benefits are inside our model and are valued endogenously.

Formal models of takeover incentives and decisions are scarce. Lambrecht (2004) presents

a real-options model of mergers motivated by economies of scale and provides a rationale for the pro-cyclicality of merger waves. There are no agency costs in his model, and he focuses on takeovers in rising product markets. We consider takeovers in declining markets. Morellec and Zhdanov (2005) develop a real-options model that examines the role of multiple bidders and imperfect information on takeover activity.

Jovanovic and Rousseau (2001, 2002) model merger waves that are based on technological change and changes in Tobin's Q. We do not propose to explain merger waves, which typically occur in buoyant stock markets, but the release of capital in declining industries. Gorton, Kahl, and Rosen (2000) argue that mergers can be used as a defensive mechanism by managers who do not wish to be taken over. In their model technological and regulatory change that makes acquisitions profitable in some future states of the world can induce a preemptive wave of unprofitable, defensive acquisitions. Preemptive mergers can occur in our theory, but they are offensive and profitable.

A few recent papers model takeover activity as a result of stock market valuations. Shleifer and Vishny (2001) assume that the stock market may misvalue potential acquirers, potential targets and their combinations. Managers understand stock market inefficiencies and take advantage of them, in part through takeovers. Takeover gains and merger waves are driven by market's valuation mistakes. Rhodes-Kropf and Viswanathan (2003) show that potential market value deviations from fundamental values can rationally lead to a correlation between stock merger activity and market valuation.

The empirical implications of our model are mostly in line with the facts about takeovers, as recently reviewed by Andrade, Mitchell, and Stafford (2001). For example, target shareholders gain. The gain to shareholders on the other side of the transaction is relatively small. However, we say that the combined increase in the bidding and target firms' market values (or the combined gain to a raider and target) does *not* measure the economic value added by the takeover, because the gain to the target shareholders includes their capture of the value of the target managers' future cash flows. The target managers' stake in the firm is extinguished by takeover and shutdown. Our model also predicts that the gain to both the target and acquiring shareholders is zero in the case of friendly mergers. This is consistent with the evidence.

We also predict that unlevered or underlevered firms in declining industries are more likely targets for hostile takeover attempts. We explain why an increase in financial leverage (a leveraged restructuring of the target, for example) can be an effective defense. We also note

that debt financing can pre-commit management to follow through with the restructuring of the target after the takeover.

The remainder of this paper splits naturally into two main parts. In Section 2, we set out a formal description of the problem that takeovers can potentially solve. We model managers' payout policies and closure decisions when takeovers are excluded. We consider the effects of golden parachutes and financial leverage. Section 3 shows how closure decisions change when takeovers are allowed. We consider takeovers by raiders, hostile takeovers by other firms, MBOs and mergers of equals, and we note some empirical and policy implications of our takeover results. Section 4 concludes.

2 Disinvestment absent takeovers

Consider a firm that generates a total operating profit of $K x_t - f$ per period, where f is the fixed cost of operating the firm. K denotes the amount of capital in place and x_t is a geometric Brownian motion representing exogenous demand shocks:

$$dx_t = \mu x_t dt + \sigma x_t dB_t, \tag{1}$$

where μ is a drift term, assumed negative in our numerical examples, and σ measures the volatility of demand. As demand (x_t) falls, the firm will at some point close down. We assume that closure is irreversible and that it releases the stock of capital K. For now we assume that the firm is all-equity financed. All capital is returned to shareholders upon closure.

2.1 First best disinvestment policy

We assume that investors are risk neutral (or that all expected payoffs are certainty equivalents). The investors' expected return from dividends and capital gains must equal the risk-free rate of return r. Thus the first-best firm value V_t^o satisfies the following equilibrium condition:

$$rV_t^o = Kx_t - f + \frac{d}{d\Delta}E_t\left[V_{t+\Delta}^o\right]\Big|_{\Delta=0} \tag{2}$$

Applying Ito's lemma inside the expectation operator gives the following differential equation:

$$\frac{1}{2}\sigma^2 x^2\frac{\partial^2 V^o(x)}{\partial x^2} + \mu x\frac{\partial V^o(x)}{\partial x} + Kx - f = rV^o(x) \tag{3}$$

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We solve this differential equation subject to the no-bubble condition (for $x \to +\infty$) and the boundary conditions at the closure point $\underline{x}^o$. The first-best closure policy, the corresponding firm value and payout policy are as follows. (Proofs for all propositions are given in the Appendix.)

Proposition 1 *First-best firm value is:*

$$
\begin{aligned}
V^o(x) &= \frac{Kx}{r-\mu} - \frac{f}{r} + \left[K + \frac{f}{r} - \frac{K\underline{x}^o}{r-\mu} \right] \left(\frac{x}{\underline{x}^o} \right)^\lambda && \text{for } x > \underline{x}^o \\
&= K && \text{for } x \le \underline{x}^o \qquad (4)
\end{aligned}
$$

The first-best closure rule is:

$$
\underline{x}^o = \frac{-\lambda \left(K + \frac{f}{r} \right) (r-\mu)}{(1-\lambda)K} \qquad (5)
$$

where λ is the negative root of the characteristic equation $\frac{1}{2}\sigma^2 p(p-1) + \mu p = r$. The first-best closure rule implies that $V^o(x) \ge K$ for all $x \ge \underline{x}^o$. The dividend payout flow until closure is $Kx - f$.

This expression for firm value has a simple economic interpretation: it is the present value of operating the firm forever plus the value of the option to shut it down. The discount factor $\left(\frac{x}{\underline{x}^o} \right)^\lambda$ can be interpreted as the probability of the firm closing down in future given the current demand level x. Note that the optimal closure point $(\underline{x}^o)$ increases with fixed costs (f) but decreases for higher values of the drift (μ) and volatility (σ) of demand.

2.2 Disinvestment by management

Now we consider the closure policy adopted by managers. The present values of managers' and equity investors' claims are $R(x)$ and $E(x)$. With no debt, the claims add up to total firm value, $V(x) = E(x) + R(x)$. The managers maximize $R(x)$, not $V(x)$, subject to constraints imposed by outside investors. We assume that the outside investors can take control, exercising their property rights to the firm's assets, and either managing the firm privately or closing it down and releasing the stock of capital K. If they manage the firm, they implement the first-best disinvestment policy and generate the first-best firm value $V^o(x)$. Collective action is costly, however. If outside investors have to mobilize to take control, they realize only $\alpha V^o(x) = \alpha \max[V^0(x), K]$, where $0 < \alpha < 1$. Thus the threat

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of collective action constrains the managers, but the cost of collective action creates the space for managerial rents, that is, capture of cash flows by managers. The size of the space is determined by $1 - \alpha$.[4]

The following assumptions summarize our framework.

Assumption 1 *Outside stockholders have put an amount of capital K at the disposal of the managers of a public corporation. The investors' property rights to the capital are protected. Managers can capture operating cash flows, but not the stock of capital.[5] The managers' ability to use and manage this capital can be terminated in two ways:*

a) The outside investors take collective action, force out the management and either close the firm or manage it privately. Collective action generates a net payoff of $\alpha V^o(x)$ for the investors. The managers get nothing.[6]

b) The managers close the firm voluntarily, returning the capital stock to investors. The managers get nothing.

Assumption 2 *Promises made by the management to pay out extra cash or to return the stock of capital at a particular demand level are not binding and cannot be used to obtain concessions from investors.*

Assumption 3 *Managers act as a coalition, maximizing R(x), the present value of the future cash flows (managerial rents) that they can extract from the firm. Both managers and investors are risk-neutral and agree on the value of the firm's future cash flows, regardless of how these cash flows are divided.*

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[4]Wrapping up all the costs of corporate governance in one parameter α is a drastic, but very useful simplification. But 1 - α does not have to be taken literally as only measuring the cost of collective action. Jensen and Meckling (1976) could interpret α as the result of outside investors' optimal outlays on monitoring and control. If monitoring and control face decreasing returns, then investors allow managers to capture some cash flows. The space $1 - \alpha$ could also represent extra bargaining power created for managers by entrenching investments. See Shleifer and Vishny (1989).

[5]It is not necessary to assume that managers can take all operating cash flows but not a penny's worth of the stock of capital. The only essential point is that investors' ability to secure cash flows is weaker, or more difficult to enforce, than their ability to secure capital assets.

[6]"Get nothing" does not mean that the managers are penniless. They can still earn their opportunity wage. We interpret $R(x)$ as the present value of managerial rents above the compensation that managers could earn outside the firm.

Assumption 1(a) establishes the threat of intervention by investors. Intervention does not occur in equilibrium, because managers pay out enough cash to keep investors at bay. Assumption 1(b) reflects investors' unqualified property rights: we assume that they do not have to take collective action to recover their capital when managers decide to close down the firm. In other words, the managers cooperate and do not contest the return of capital. Assumption 1(b) can be supported in three ways. First, if the act of closure is a verifiable and contractible event, it should be possible to provide for an immediate, automatic liquidating dividend. (This does *not* mean that the level of demand is verifiable and contractible. If it were, achieving first-best closure would be easy.) Second, Assumption 1(a) means that the managers cannot just shut down the firm, sell off its assets and keep the cash. Therefore a threat by managers not to return capital is a threat to keep the firm running at demand levels below the *managers'* optimal closure threshold. Third, the managers' payoff is zero if they cooperate and return investors' capital, and also zero if they force collective action. Therefore a tiny payment – a small "golden parachute" – should tip the balance in favor of voluntary return of capital. We return to golden parachutes below, however.

Assumptions 1, 2 and 3 generally follow the "corporation model" in Myers (2000), but we extend that model in several ways. First, we allow investors to take over the firm and manage it as a going concern if the firm is more valuable alive than dead. Thus the investors' net payoff is $\alpha V^o(x) = \alpha \max[V^o, K]$, not just αK as in Myers's paper. Second, we zero in on the case where the firm should shut down because of declining demand. Third, we replace Myers's discrete-time setup with a continuous time, real options model. This allows us to model the downward drift and uncertainty of demand and to analyze payout, closure, debt and several takeover scenarios in a common setting.

The managers set payout policy $p(x)$ to maximize $R(x)$, subject to constraints imposed by investors' property rights and ability to take collective action. As the state variable x falls, the managers have to reach deeper into their own pockets, forgoing managerial rents in order to service the required payout. They give up at the closure threshold $\underline{x}$. At that point, managers depart and investors receive the capital value K.

We can now derive the managers' payout policy, demand threshold for closure, and the values of investors' and managers' claims on the firm.

Proposition 2 *Assume that outside investors face a cost of collective action but, if they absorb that cost and take control of the firm, they can run the firm efficiently or shut it*

down. But if the managers shut down the firm, its capital stock is automatically returned to investors. Then the values of the firm and investors' and managers' claims are:

$$
\begin{aligned}
V(x) &= \frac{Kx}{r-\mu} - \frac{f}{r} + \left[K + \frac{f}{r} - \frac{K\underline{x}}{r-\mu} \right] \left(\frac{x}{\underline{x}} \right)^{\lambda} && \text{for} \quad x > \underline{x} \\
&= K && \text{for} \quad x \leq \underline{x} \\
E(x) &= \alpha V^o(x) + (1-\alpha)K \left(\frac{x}{\underline{x}} \right)^{\lambda} && \text{for} \quad x > \underline{x} \\
&= K && \text{for} \quad x \leq \underline{x} \\
R(x) &= V(x) - E(x)
\end{aligned}
$$

The managerial closure threshold $\underline{x}$ is given by:

$$
\underline{x} = \frac{-\lambda \left[\alpha K + \frac{f}{r} \right] (r - \mu)}{(1 - \lambda)K} \tag{6}
$$

The payout policy $p(x)$ is:

$$
\begin{aligned}
p(x) &= \alpha \left(Kx - f \right) && \text{for} \quad x > \underline{x}^o \\
&= r\alpha K && \text{for} \quad \underline{x} \leq x \leq \underline{x}^o
\end{aligned}
$$

When there are no costs of collective action ($\alpha = 1$), management closes the firm at the efficient point ($\underline{x} = \underline{x}^o$) and outside shareholders realize the first-best firm value (i.e. $E(x) = V^o(x; \underline{x}^o)$). When the cost of collective action is strictly positive ($\alpha < 1$), management closes the firm inefficiently late (i.e. $\underline{x} < \underline{x}^o$).

This proposition requires managers to pay out a minimum cash dividend in each period. If they do this, and investors expect the managers to follow the stated payout policy in future periods, then the investors do not intervene, and the managers' stake $R(x)$ is preserved.

The outside equity value consists of two components. The first ($\alpha V^o(x)$) is the value resulting from the threat of collective action. The second ($(1-\alpha) K \left(\frac{x}{\underline{x}} \right)^{\lambda}$) is the incremental value from investors' property rights to the stock of capital K. Property rights ensure that upon closure outsiders do not get αK (as guaranteed by the threat of collective action) but the full value K.[7]

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[7]This result is not strictly necessary for our analysis of takeovers. Suppose that investors do not cooperate at their shutdown threshold $\underline{x}$, so that investors have to bear costs of collective action to recover the capital stock K. Then equity value at shut-down is not K, but $E(\underline{x}) = \alpha K$. The payoffs to managers are the same as in Proposition 2, however, so payout policy is not affected, and shutdown still occurs too late, at $x = \underline{x}$. The outside equity value would be given by $E(x) = \alpha V^o(x)$. See the proof of proposition 2 for further details on this scenario.

When times are bad, the equity investors' claim resembles a perpetual debt contract that pays a fixed coupon flow till default, and upon default pays out the liquidation value of the firm. The dividends are like coupon payments and the stock of capital released upon closure is like the firm's liquidation value in bankruptcy.[8] By opting for a constant dividend when demand is low, managers smooth dividends and absorb all underlying variation in earnings.

The closure threshold in Proposition 2 shows why the firm is closed inefficiently late. Managers do not internalize the full opportunity cost of the capital stock.[9] Their payouts are based on αK, not K. That is why αK appears in the numerator of the closure threshold.

The ratio $\frac{\underline{x}}{\underline{x}^o}$ measures the relative inefficiency of the closure policy, $\underline{x}$:

$$\frac{\underline{x}}{\underline{x}^o} = \frac{\alpha + \frac{f}{K r}}{1 + \frac{f}{K r}} \tag{7}$$

This ratio varies from $\frac{\frac{f}{K r}}{1 + \frac{f}{K r}}$ to 1, with first-best at $\alpha = 1$. The managers' closure policy becomes less efficient as the ratio $\frac{f}{K r}$ of fixed operating costs, f, to the opportunity cost of capital, $K r$, declines. The cost of collective action allows managers to ignore part of the opportunity cost of the capital stock, but they are forced to absorb the firm's total operating costs f if they continue to operate the firm when $x = \underline{x}^o$.

The results summarized in Proposition 2 are the foundation of the analysis that follows. With these results, we can consider the efficiency of closure forced by takeovers relative to the value lost when managers are left alone to close voluntarily. We can see how the value added by takeovers depends on the costs of collective action, the drift and volatility of demand, fixed operating costs and the value of the capital stock.

Proposition 2's explicit valuation of managerial rents is especially important in understanding takeovers. These rents are extinguished when a takeover forces closure, but we will show how the value of these rents ends up in the pockets of the target firm's stockholders. The value gains to investors overstate the value added by the takeovers. The distinction between rents lost and value added is also a key to understanding the differences between

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[8]The investors' claim specified in Proposition 2 shares some features of convertible debt. Conversion of debt into equity is irreversible, however. In our model the switch between constant and variable dividend payments is reversible.

[9]Thus far we have assumed that disinvestment is an all-or-nothing decision to close down the entire firm. Our results generalize to the case of gradual contraction, where disinvestment occurs in two or more stages. As demand declines, management waits too long to close each stage, although the efficient outcome is restored when there is no cost of collective action.

hostile takeovers and "friendly" mergers – although it turns out that "mergers of equals" are never friendly in our model.

2.3 Example

Figures 1a, 1b and 1c summarize a numerical example.[10] Figure 1a plots first-best firm value, V^o (solid line), firm value under the managers' closure policy V (dashed line), equity value E (dotted line) and the payoff to investors from taking collective action $\alpha \max[V^o, K]$ (double-dashed line). Figure 1b plots $R(x)$, the present value of managerial rents.

First-best closure is at $x = 0.0391$, the demand level where the first-best firm value value-matches and smooth-pastes to the value of the capital stock, $K = 100$. Firm value increases with demand x. For high levels of demand, the value of the closure option goes to zero and firm value converges to $\frac{Kx}{r-\mu} - \frac{f}{r}$.

The managers' closure threshold is at $x = 0.0293$, the demand level where the managers' value $R(x)$ value-matches and smooth-pastes to the zero value line (see Figure 1b). Since management closes the firm inefficiently late, total firm value is below first-best. Value is therefore destroyed at the expense of investors. Late closure also makes equity value and total firm value U-shaped functions of the state variable x. These values *increase* in the run-down to closure – the possibility of receiving the capital stock in the near future is positive news for investors.[11] Equity value equals K at $\underline{x}$ (closure), reaches a minimum (which exceeds αK) as demand increases, and thereafter increases and gradually converges to the asymptote $\alpha \left(\frac{Kx}{r-\mu} - \frac{f}{r} \right)$.

Investors' payoff from taking collective action (shown as a double-dotted line) is αK when the state variable is below the first-best closure point and $\alpha V^o(x)$ otherwise. Note that the outside equity value exceeds $\alpha V^o(x)$ at all times. This follows from the fact that

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[10]The parameters used to generate the figure are: $\mu = -0.02$, $r = 0.05$, $\sigma = 0.2$, $\alpha = 0.7$, $K = 100$ and $f = 1$.

[11]Proposition 2 implies that equity value E(x) is greater than αK when demand falls close to the managers' closure threshold $\underline{x}$. In other words, equity value exceeds what investors could get from collective action. The extra value reflects investors' property rights to the full asset value K if the managers shut down the firm. We have investigated other possible equilibria that would allow managers to extract part of this extra value by cutting payout below $p(x) = r\alpha K$ at low levels of demand. These alternatives have the same qualitative implications for disinvestment and takeovers, but they are fragile and do not have closed-form solutions. For simplicity we build on the equilibrium given in Proposition 2.

property rights force $E = K$ at closure.

Figure 1c plots cash payout $p(x)$ (solid line) and the managers' cash flow (dashed line).[12] When demand exceeds the first-best closure point, payout is a fraction α of the firm's profits $(\alpha (Kx - f))$. For levels of x below the first-best closure point, collective action would shut down the firm, with investors receiving a fixed payoff αK $(0.7 * 100 = 70)$. To discourage investors from closing the firm in bad times, management must pay a constant dividend flow of $r\alpha K$ $(0.05 \times 0.7 \times 100 = 3.5)$ until the firm is closed at $x = 0.0293$. There is therefore a switch in payout policy at the first-best closure point.[13]

2.4 Golden parachutes and efficient closure

Now we investigate whether a "golden parachute" contract could lead the managers to shut down the firm at the first-best closure threshold $\underline{x}^o$. A golden parachute $(1 - \theta)K$ would pay the managers some fraction $1 - \theta$ of the proceeds if and when they shut down the firm and liquidate its capital stock. It turns out that a golden parachute could speed up closure, but that investors will not accept a golden parachute generous enough to assure first-best closure.

The first-best golden parachute would set $\theta = \alpha$, so that the managers capture the same fraction of liquidation value and operating cash flows. Then the managers' and investors' interests would be aligned. Closure would happen at the efficient point $\underline{x}^o$. Payout policy, the values of the investors' and managers' claims would be:

$$\begin{aligned} p(x) &= \alpha(Kx - f) \quad \text{for} \quad x > \underline{x}^o \\ E(x) &= \alpha V^0(x) \\ R(x) &= (1 - \alpha) V^0(x) \end{aligned}$$

Since the constraint $E(x) \geq \alpha V^o(x)$ is binding everywhere and the total firm value is first-best, the managers cannot extract more value, and this first-best solution is also optimal

---

[12]Note how the managers' cash flow turns negative as demand declines and approaches the shutdown point. In this region, the managers contribute money from their own pockets or "sweat equity", and keep the firm going in the hope of recovery. Such "propping" is common, though not universal, in our model. Propping also occurs in Friedman, Johnson, and Mitton (2003).

[13]This switch can sometimes increase payout, depending on the model parameters. For example, high demand volatility pushes optimal closure to low demand levels where $\alpha (Kx - f)$ is relatively small, and possibly smaller than the post-switch payout $r\alpha K$.

from their point of view.

But this solution is not as easy as it looks. First, is closure at the first-best demand level $\underline{x}^o$ a verifiable and contractible event? The answer may depend on the nature of the asset and the closure decision. If the only asset is a specific, tangible asset – a factory, say – and closure means shutting down the factory and selling it, then a golden parachute should work. But if some assets are intangible, and closure is gradual and requires a series of decisions, then contracting becomes more difficult. Presumably the golden parachute has to be set up ahead of time, when the firm is still a healthy going concern. At that point it may be impossible to write a complete contract specifying the actions required for efficient closure. Absent a complete contract, managers will be tempted to look for ways to take their golden parachute and keep the firm operating anyway. (This temptation does not arise at the inefficient threshold $\underline{x}$, where closure optimizes the *managers'* value.) These problems may explain why actual golden parachutes pay off only when there is a takeover or other change in control, not when the firm disinvests.

But assume that closure is contractible. Will investors award a golden parachute equal to $(1 - \alpha)K$? No, because the value of investors' claim in the first-best case where $\theta = \alpha$ is only $E(x) = \alpha V^0(x)$, less than the value when managers close inefficiently late. (Compare the first-best $E(x) = \alpha V^0(x)$ to the value of $E(x)$ in proposition 2).[14]

Assume that managers get $(1 - \theta)K$ on closure. Using a similar derivation as for proposition 2, the values of the investors' and managers' claims are:

$$
\begin{aligned}
E(x) &= \alpha V^o(x) + (\theta - \alpha)K \left(\frac{x}{\underline{x}}\right)^\lambda \quad \text{for} \quad \underline{x} < x \\
&= \theta K \qquad\qquad\qquad\qquad\qquad \text{for} \quad x \le \underline{x} \\
R(x) &= V(x) - E(x)
\end{aligned}
$$

The best golden parachute for investors maximizes equity value $E(x; \theta)$ with respect to θ. This gives the following proposition.

Proposition 3 *Assume that investors face a cost of collective action, but if they absorb that cost and take control of the firm, they can run the firm efficiently or shut it down. Investors have property rights to the stock of capital K, but award a golden parachute equal to $(1-\theta)K$*

---

[14]The first-best golden parachute, with $\theta = \alpha$, is in the joint interest of investors and managers, and could be negotiated if the managers could make a side payment to investors. We assume that the managers' wealth is limited, however. In particular, managers cannot raise money today by pledging not to capture operating cash flow in the future. See Assumption 2.

(with $\theta \leq 1$) payable to managers on closure. Then the values of the firm and investors' and managers' claims are:

$$
\begin{aligned}
V(x) &= \frac{Kx}{r-\mu} - \frac{f}{r} + \left[K + \frac{f}{r} - \frac{K\underline{x}}{r-\mu}\right]\left(\frac{x}{\underline{x}}\right)^{\lambda} & \text{for} \quad x > \underline{x} \\
&= K & \text{for} \quad x \leq \underline{x} \\
E(x) &= \alpha V^o(x) + (\theta - \alpha)K\left(\frac{x}{\underline{x}}\right)^{\lambda} & \text{for} \quad x > \underline{x} \\
&= \theta K & \text{for} \quad x \leq \underline{x} \\
R(x) &= V(x) - E(x)
\end{aligned}
$$

The managers' closure threshold $\underline{x}$ is:

$$
\underline{x} = \frac{-\lambda\left[(1 - \theta + \alpha)K + \frac{f}{r}\right](r - \mu)}{(1 - \lambda)K} \tag{8}
$$

The payout policy $p(x)$ is:

$$
\begin{aligned}
p(x) &= \alpha(Kx - f) & \text{for} \quad x > \underline{x}^o \\
&= r\alpha K & \text{for} \quad \underline{x} \leq x \leq \underline{x}^o
\end{aligned}
$$

The optimal value for θ, which strikes a balance between the benefit of earlier closure and the cost of awarding the golden parachute, is:

$$
\theta^* = \min\left[\alpha + \frac{K + \frac{f}{r}}{K(1 - \lambda)}, 1\right] \tag{9}
$$

If the optimal compensation policy θ^* is implemented, then the managers' optimal closure point is:

$$
\begin{aligned}
\underline{x} &= \left(\frac{-\lambda}{1-\lambda}\right)^2 \frac{\left(K + \frac{f}{r}\right)(r - \mu)}{K} < \underline{x}^o \quad \text{if } \theta^* < 1 \\
\underline{x} &= \left(\frac{-\lambda}{1-\lambda}\right) \frac{\left(\alpha K + \frac{f}{r}\right)(r - \mu)}{K} < \underline{x}^o \quad \text{if } \theta^* = 1
\end{aligned}
$$

Even with an optimal golden parachute, managers' closure decisions remain inefficiently late.

Since θ^* strictly exceeds α, the optimal golden parachute is always less than $(1 - \alpha)K$, and managerial closure remains inefficiently late (i.e. $\underline{x} < \underline{x}^o$). Investors will never offer managers the full amount of the cost of collective action. They may not offer anything: a (non-zero) golden parachute is optimal only if $\theta^* < 1$, or if:

$$
\alpha < \frac{-\lambda}{1 - \lambda} - \frac{f}{rK(1 - \lambda)} \tag{10}
$$

Since $\lambda < 0$, golden parachutes should be more likely for firms with a high cost of collective action (low α), low fixed costs (low f) and a high stock of capital (K). Since $\frac{\partial \lambda}{\partial \sigma} > 0$,

16

$\frac{\partial \lambda}{\partial \mu} < 0$ and $\frac{\partial \lambda}{\partial r} < 0$, golden parachutes are less likely for firms with high demand volatility (σ) and negative growth ($\mu < 0$), and when the interest rate (r) is low.

The intuition for these results is simple. First take the extreme case where $\alpha = 0$ and $f = 0$. Then management would never close the firm without a golden parachute. Investors' would never receive any payout and their equity would be worthless. However, by awarding a golden parachute (and sharing the proceeds from closure), investors could induce managers to close the firm at some low level of demand, giving outside equity some value. On the other hand, if the cost of collective action is zero ($\alpha = 1$), then managerial closure policy is efficient anyway, and golden parachutes are redundant.

Second, high fixed costs and declining demand discipline managers and reduce the need for a golden parachute. Third, if the stock of capital K and the interest rate r are high, then the opportunity cost of the capital stock is also high, which makes accelerated closure through a golden parachute more desirable. Finally, if volatility is low, say $\sigma = 0$, then $\lambda \to -\infty$ and hence the first-best closure point is $\underline{x}^o = \frac{\left(K + \frac{f}{r}\right)}{K}$, and the option value of delaying abandonment beyond this breakeven point is zero. Yet managers will carry on until $\underline{x} = \frac{\left(\alpha K + \frac{f}{r}\right)}{K}$. This delay is particularly costly if the decline in demand is slow. A golden parachute may therefore be desirable to speed up closure for relatively safe firms.

The key point for the rest of this paper is that golden parachute contracts cannot reasonably be expected to solve the problem of late disinvestment by self-interested managers. Perhaps debt will work.

2.5 Debt financing

Now we briefly analyze how debt financing influences firm value and the managers' actions. In the interest of space we do not go into details. A complete analysis of debt policy is beyond the scope of this paper and is developed in Lambrecht and Myers (2004). Our point here is just to show how debt financing can force efficient closure in the model we have set out.

Assume that a perpetual debt contract is issued with principal D. The debt is fully collateralized by the firm's assets ($D \leq K$). Assume also that the cost of collective action is independent of the level of debt D and is therefore, as in the unlevered case, given by

$(1 - \alpha)V^o(x; \underline{x}^o).$[15]

If we rule out equity issues to pay for debt service,[16] managers' cash flows when $x \leq \underline{x}^o$, after dividends and interest repayments, are:

$$
\begin{aligned}
&(Kx - f) - \max[0, r\alpha K - rD] - rD \\
&= Kx - f - r\alpha K && \text{if} \quad D < \alpha K \\
&= Kx - f - rD && \text{if} \quad D > \alpha K
\end{aligned}
$$

If $D < \alpha K$, managers can pay debt interest by cutting payout to equity investors. But if $D > \alpha K$, part of the debt service comes out of managers' pockets. (Payout cannot be negative when equity issues are ruled out.) Increasing debt above αK therefore forces managers to close the firm earlier, because debt service reduces managerial rents. The demand threshold for closure increases monotonically with the debt level D, and there is an optimal debt level D^* that enforces closure at the first-best closure point $\underline{x}^o$. Debt higher than D^* forces inefficiently *early* closure. Lambrecht and Myers (2004) show that the optimal debt level D^* is independent of the level of the state variable and therefore dynamically optimal. Furthermore, the optimal capital structure is linked to the liquidation value K, not to the firm's market value as a going concern. We therefore predict optimal book leverage $\frac{D^*}{K}$ and not optimal market leverage.

It seems clear that debt can play an important role in bonding managers to a particular closure policy. For example, debt can commit the acquiring management to follow through after a takeover and close the target firm. Also, low-debt firms are more likely to be takeover targets – there is no need for takeovers to force efficient disinvestment if debt is set and held at the right level. We should not see takeovers where the only immediate result is more debt but no immediate disinvestment.

---

[15]In other words, the net payoff to investors when they take over the levered firm is $\alpha \max[V^o, K] - D$, not $\alpha \max[V^o - D, K - D]$. Lambrecht and Myers (2004) explore both specifications.

[16]This important assumption is implicit in most prior research that invokes debt service as a device to discipline managers and retard over-investment. See, for example, Jensen and Meckling (1976), Stulz (1990) and Zwiebel (1996). Clearly there is no discipline if managers can just issue shares to service debt. In fact, Lambrecht and Myers (2004) show that debt is irrelevant, at least in the model presented here, if equity issues are allowed. If they are allowed, and debt service exceeds equilibrium payout under all-equity financing, managers can issue equity to make up the difference, thus passing the burden of debt on to investors. Debt would not affect managers' cash flows or closure policy.

3 Disinvestment forced by takeovers

Now we consider whether takeovers can force efficient disinvestment. We adopt the following assumptions:

Assumption 4 *The supply of bidders is limited by entry and setup costs. Once these costs are sunk, the bidder's cost of collective action is zero ($\alpha = 1$).*

Assumption 5 *Since the supply of bidders is limited, outside investors perceive the probability of attack to be negligibly small and are therefore always acquired by surprise.*

Assumption 5 implies that stock valuations prior to the takeover do not incorporate the potential benefit associated with takeovers and that the target's stock price jumps up when the takeover is announced.[17] Shleifer and Vishny (2001) and Morellec and Zhdanov (2005) make a similar assumption, whereas Lambrecht (2004) incorporates potential merger benefits into the valuation.

Next, we specify how the payoffs to a takeover are shared between the target shareholders, the target managers and the bidder. The payoff from closing down the target is K. The value created by the takeover is therefore $K - V(x; \underline{x})$. When the target is shut down, the target managers get nothing, because they have no property rights to the stock of capital. The value of the target firm is split between the target shareholders and the bidder. When the target is in play, its shareholders can hold out (note the Grossman and Hart (1980) free-rider problem) and push their equity value at least to $V(x, \underline{x})$, the full firm value prior to the takeover. In addition they get a fraction $(1 - \gamma)$ of the value added $K - V(x, \underline{x})$.

Assumption 6 *Target shareholders receive $V(x; \underline{x})$, the target's overall value prior to the takeover, plus a fraction $(1 - \gamma)$ of $K - V(x, \underline{x})$, the value that can be created by the takeover and shutdown.*

---

[17]Assumption 5 simplifies exposition but is not strictly necessary for our results. Suppose that managers are forewarned that a raider is lurking. The only actions that the target firm's managers could take are (1) increase debt to D^* or (2) reduce capture of the firm's cash flows. We rule out (1) by focusing on unlevered or underlevered firms. Action (2) is unlikely, because managers have no incentive to reduce capture at demand levels above the point where a takeover occurs, and at that point the firm is shut down anyway. Action (2) would not work anyway, given Assumption 2. Forewarning of a takeover attempt would give the target firm time to shore up its takeover defenses, however.

Assumption 7 *Managers can only acquire the target if the payoff from closing down the target is positive.*

Assumption 7 rules out pre-emptive takeovers motivated purely by self-defense. We require that the payoff from closure is positive (i.e. $K - V(x) \geq 0$) and that only takeovers that are inherently value-increasing (or value-neutral) are possible. Assumption 7 is important, and we believe it is reasonable. Suppose that B's management is threatened with takeover by firm A at demand level x. Takeover means that B's managers lose rents worth $R_B(x)$. If B can preempt and acquire A, the net payoff to B's managers is $R_B(x) + \gamma (K - V_A(x))$. Suppose $K - V_A(x)$ is negative, contrary to assumption 7. Then B's managers must finance the takeover partly out of their own pockets.[18] Unless they are independently wealthy, they would have to try to sell off or borrow against $R_B(x)$. But managers cannot commit *not* to capture future rents, *a fortiori* if rents are the product of "inalienable" human capital and effort (see Hart and Moore (1994)). Therefore B's managers could not finance a value-destroying takeover.[19]

We now consider takeovers by raiders, takeovers by other firms, management buyouts and mergers of equals. We define a *raider* as a financial investor that specializes in takeovers and restructuring. A raider acts on its own behalf, not on behalf of outside investors. Since the target shareholders receive $V + (1 - \gamma) (K - V(x; \underline{x}))$, the raider's payoff from acquiring and closing the firm is: $\gamma (K - V(x; \underline{x}))$.

In a *hostile takeover*, firm A acquires another firm B. The acquisition is decided on and executed by the managers of the acquiring firm A. A's managers maximize their personal gain from the deal, subject to the threat of collective action by A's shareholders. This means that, as long as the deal makes A's outside investors no worse off, A's management can extract all remaining takeover surplus. (We could give some fraction of the takeover gain to the acquirer's investors. As we show later, this would not alter our results.)

In a *one-way* hostile takeover, A can acquire B, but not the other way around. The payoffs

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[18]The managers have already reduced payout to the limit allowed by the threat of collective action. Therefore they have no "slack" to extract from their own shareholders.

[19]In our model, managers do sometimes pay out of their own pockets to help cover required debt service and payouts to investors. For example, managers may be better off keeping the firm going even when operating cash flows are negative ($Kx - f < 0$). But these payments are a flow that can be stopped at any time by closing the firm, not a lump-sum contribution amounting to a significant fraction of the value of the firm. Managers may also be able to cover operating losses by putting in "sweat equity," but this does not help to finance a takeover.

Table 1: A comparative description of the takeover cases

	Acquirer's payoff:	Subject to:	Target is:
Raider	$\gamma\left(K_B - V_B(x;\underline{x}_B)\right)$		In play
Hostile takeover, one-way	$\gamma\left(K_B - V_B(x;\underline{x}_B)\right)$	Commitment device	In play
Hostile takeover, two-way	$\gamma\left(K_B - V_B(x;\underline{x}_B)\right)$	Commitment device, preemptive threat	In play
MBO	$\gamma\left(K_B - V_B(x;\underline{x}_B)\right) - R_B(x)$		In play
Merger	$R_B(x)$		Not in play

to A's and B's managers from acquisition and closure of firm B are $\gamma_B\left(K_B - V_B(x;\underline{x}_B)\right)$ and zero. The payoffs to A's and B's shareholders are zero and $V_B + (1-\gamma_B)\left(K_B - V_B(x;\underline{x}_B)\right)$. The objective of A's managers is the same as the raider's ex ante, but not necessarily ex-post. After the takeover has been paid for and is a done deal, A's managers may be better off if they do not close the target, but instead take the place of B's managers and continue to capture part of the cashflows generated by B's assets. This is the case if $\gamma_B\left(K_B - V_B(x)\right) < R_B(x)$. Therefore, to get the deal approved by its shareholders A's managers may need a device that credibly forces them to commit to restructuring. We return to this point later.

In a *two-way* hostile takeover, A can acquire B or vice versa. Incentives and payoffs are similar to a one-way takeover, except that one firm may act preemptively to acquire its opponent in order to safeguard its own managers' rents. We will show that this sort of competition can lead to early takeover and inefficient closure.

A *management buyout* (MBO) is a takeover of the firm by its own managers. The managers act like a raider, except that they give up future rents after a buyout, while a raider has nothing to lose.

Finally, in a *merger of equals*, two firms' managers act cooperatively and strike an agreement without putting either firm in play. No bid premium is paid to shareholders. Both firms' managers act in their own interest, constrained as usual by the threat of collective action by investors.

Thus we have four takeover and restructuring mechanisms (raiders, hostile takeovers, MBOs and mergers of equals) that differ across three key dimensions: (1) Whether the

target is in play and a premium needs to be paid to the target's shareholders; (2) whether a mechanism is needed to commit acquiring managers to follow through and shut down the target, and (3) whether the target can threaten to preempt and acquire the bidder. Table 1 sets out the various cases.

We now analyze each takeover mechanism.

3.1   Raiders

When the raider takes over and closes the target, the payoff is $\gamma\left(K - V(x, \underline{x})\right)$, where γ was defined in assumption 6. This payoff is the raider's compensation for acquiring and restructuring the firm. The raider has a zero cost of collective action ($\alpha = 1$) and therefore realizes the full stock of capital K, not αK. Since $V(x; \underline{x})$ is a convex function in x it follows that the raider's payoff is a concave function. It is zero at $x = \underline{x}$, thereafter increases with x, reaches a maximum and subsequently monotonically decreases and becomes negative.

A positive NPV (i.e. $K - V(x) \geq 0$) is a necessary condition for takeover by a raider. But positive NPV is not sufficient, because demand uncertainty and irreversible disinvestment create an option to wait. Using standard real option techniques, we show in the Appendix that the raider's optimal takeover policy is a trigger strategy: the raider acquires the target as soon as the state variable drops below some threshold $\underline{x}_r$. The raider's optimal threshold is given in the following proposition:

Proposition 4 *If the initial level of demand is above the first-best closure threshold $\underline{x}^o$, then the raider waits, and takes over and closes down the firm as soon as demand falls below the first-best closure point $\underline{x}^o$.*

Proposition 4 says that in a declining market the raider acquires and restructures the firm at the efficient time. The first-best closure policy maximizes the present value of the raider's takeover surplus $\gamma\left(K - V(x, \underline{x})\right)$. The efficient outcome is achieved because the raider's objective function (unlike the target management's) takes into account the full stock of capital K.

Why does the raider, who is only interested in the financial payoff, end up maximizing the *sum* of the value to investors and the value to managers? The reason is that $R(x, \underline{x}^o) = 0$

at the optimal shutdown point $x = \underline{x}^o$, so $V^o = E^o = K$. But note that the raider does have to "buy out" $R(x, \underline{x})$, the value of the rents that the target managers would have received absent the takeover. Unfortunately for the managers, the buyout proceeds do not go to the managers but to the target shareholders, who can hold up the bidder for at least the full value of the target firm under existing management. That is, the bidder pays $V(x, \underline{x}) = R(x, \underline{x}) + E(x, \underline{x})$ plus the fraction $1 - \gamma$ of the value added.

The target managers may regard the loss of $R(x, \underline{x})$ as a "breach of trust" of the sort described by Shleifer and Summers (1988). The breach is efficient, however. If the breach is regarded as unfair, then the unfairness can be traced back to the difficulty of writing and enforcing the value-maximizing employment contract, which would require managers to close down at the optimal demand level $\underline{x}^o$.

Shleifer and Summers (1988) say that a raider could take over a firm not in order to shrink its assets, but simply to capture the rents going to incumbent managers. This cannot happen in our model, because the rents are shifted to target shareholders and not captured by the raider. (The Grossman-Hart (1980) holdup problem prevents hostile takeovers motivated solely by rent-seeking.) But we agree with Shleifer and Summers that a large part of the stock-market gains to merger announcements represent transfers from other stakeholders. Our comments about breach of trust also apply to takeovers by other firms, which we turn to now.

3.2 Hostile Takeovers

3.2.1 One-way Hostile Takeovers

Assume that firm A can acquire firm B, but not the other way around. We ignore possible synergies from combining the firms' operations, and assume that the only opportunity to add value is by forcing the target firm to shut down. The price that A must pay to B's shareholders is $V_B(x; \underline{x}_B) + (1 - \gamma)(K - V_B(x, \underline{x}_B))$. A's managers receive the fraction γ of the value created. If firm A acts like a raider and acquires and closes down the firm at the first-best closure point, then its shareholders are not harmed:

Proceeds to acquiring shareholders

$= \text{Acquisition proceeds} - \text{payment to target shareholders} - \text{payment to acquiring managers}$

$= K - [V_B(\underline{x}_B^o, \underline{x}_B) + (1 - \gamma)(K - V_B(\underline{x}_B^o, \underline{x}_B))] - \gamma(K - V_B(\underline{x}_B^o, \underline{x}_B)) = 0 \quad (11)$

In other words, the takeover is zero-NPV for the acquiring shareholders, because all value created is shared between the target shareholders and the acquiring management. The payoff $\gamma \left(K - V_B(x; \underline{x}_B) \right)$ to A's managers is exactly the same as to a raider. Therefore the takeover occurs at the same first-best demand level. Notice that firm A's stockholders are not harmed by the takeover and shutdown of firm B, and have no reason to intervene to prevent it. However, their wealth gain from the takeover is zero. This outcome seems to be roughly true empirically; see Andrade, Mitchell, and Stafford (2001). The lion's share of merger gains seems to go to the target firm's shareholders – and in our model, to the acquiring firm's management.

If we take assumption 1(b) strictly and literally, perhaps A's shareholders should get the lion's share of profits. Takeover and shutdown of firm B releases its capital stock K. If shareholders have complete, automatic property rights to released capital, then A's shareholders should get a "free gift" of K from shutdown of B. This would leave A's managers with no gain and no incentive to go ahead with the takeover. This is not a cul de sac, however, because we can easily extend our model to assume that A's stockholders and managers could split the merger gains.[20] Our main results do not change.

There is another important difference between the raider and hostile takeover cases. The raider always closes the target immediately after takeover. The management of an acquiring company may not follow through. Once the takeover is a done deal, A's managers may be better off if they take the place of B's managers and continue to capture some of the cash flows generated by B's assets. This is the case if $\gamma \left(K_B - V_B(x; \underline{x}_B) \right) < R_B(x)$. How then can hostile takeovers lead to efficient disinvestment?

The first, partial answer is that A's stockholders will prevent a takeover unless A's management makes a credible commitment to shut down B. Suppose that A acquires B at a demand level $x \geq \underline{x}^o$, and suppose that investors anticipate that B will be shut down too late, at a demand level $\underline{x}_B < \underline{x}^o$. The payoff to the acquiring shareholders is:

Proceeds to acquiring shareholders

$=$ acquisition proceeds $-$ payment to target shareholders $-$ payment to acquiring managers

$= V_B(x, \underline{x}_B) - [V_B(x, \underline{x}_B) + (1 - \gamma)(K - V_B(x, \underline{x}_B))] - [R_B(x, \underline{x}_B)]$

$= E_B(x, \underline{x}_B) - [V_B(x, \underline{x}_B) + (1 - \gamma)(K - V_B(x, \underline{x}_B))] < 0$

---

[20]From our model in Section 2, one could argue that a fraction α of the acquiring firm's gain goes to its investors. Then the payoff to A's managers would be scaled down by a factor of $(1 - \alpha)$ to $(1 - \alpha)\gamma \left(K - V_B(x; \underline{x}_B) \right)$. The takeover threshold would not change, however.

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In other words, the acquiring shareholders would receive the target's existing equity value, $E_B(x, \underline{x}_B)$, but pay the total firm value $V_B(x, \underline{x}_B)$ plus $(1 - \gamma)(K - V_B(x, \underline{x}_B))$. This would reduce their equity value and trigger collective action against A's managers. Therefore the takeover could not take place.

The second answer is that debt financing can provide a bonding mechanism to force shutdown. Managers could finance the takeover by the amount of debt that pre-commits them to shut down the firm immediately after the takeover. We know from Section 2 that such a debt level always exists, because the closure threshold is monotonically increasing in the level of debt when equity issues are restricted. This may be one explanation for leveraged buyouts, for example.

Our results can be summarized in the following proposition.

Proposition 5 *If firm A can acquire firm B, but not vice versa, then the timing of the takeover is the same as in the raider case; acquisition happens at the first-best closure point. But the takeover may have to be financed by the debt level that forces the target to be closed immediately after the takeover.*

3.2.2 Two-way Takeovers

Consider next the case where A can acquire B or B can acquire A. The normal form of the game is given by:

	Payoff to $A's$ managers	Payoff to $B's$ managers
A acquires B	$\gamma_B(K_B - V_B(x; \underline{x}_B))$	$-R_B(x; \underline{x}_B)$
B acquires A	$-R_A(x; \underline{x}_A)$	$\gamma_A(K_A - V_A(x; \underline{x}_A))$

Assumption 7 rules out value-reducing takeovers, so each firm can act only if takeover is positive-NPV project, i.e. $K_i - V_i(x; \underline{x}_i) \geq 0, i = A, B$. Each firm has a breakeven point, x_i^* such that $V_i(x_i^*, \underline{x}_i) = K_i$ (with $\underline{x}_i < x_i^*$) and

$$K_i - V_i(x, \underline{x}_i) \geq 0 \quad \text{for all } x \in [\underline{x}_i, x_i^*] \ (i = A, B) \tag{12}$$

When demand falls in the interval $[\underline{x}_i, x_i^*]$, acquiring firm i and closing it down is positive NPV. Assume, without loss of generality, that $x_B^* > x_A^*$ and that the initial level of

demand exceeds $x_B{}^*$. Which firm will then be the acquirer, and at what demand level does the takeover happen? The answer to the first question is that the firm with the lowest breakeven threshold, $x_i{}^*$ (in our case, firm A) will be the acquirer. As demand declines, acquiring firm B becomes a positive-NPV action for firm A at $x_B{}^*$ before B can acquire A at $x_A{}^*$. The firm with the lowest breakeven threshold can therefore always preempt its opponent, if necessary.

At what level of demand will firm A acquire firm B? Ideally, A would acquire B at B's first-best disinvestment threshold, $\underline{x}_B{}^o$, as in Proposition 5. However, the threat of a preemptive takeover by B could speed up a takeover by A. If A's breakeven point exceeds B's optimal disinvestment threshold $(x_A{}^* > \underline{x}_B{}^o)$ then B has an incentive to "epsilon preempt" firm A at $\underline{x}_B{}^o + \epsilon$. This in turn would encourage A to preempt B at $\underline{x}_B{}^o + 2\epsilon$, and so on. Therefore, if $x_A{}^* > \underline{x}_B{}^o$, in equilibrium firm A acquires B when x equals $x_A{}^*$, which is the point where preemption by B is no longer profitable or feasible (see assumption 7). If, however, $x_A{}^* < \underline{x}_B{}^o$, then there is no danger that B may preempt A, and A acquires B at $\underline{x}_B{}^o$. These results can be summarized in the following proposition:

Proposition 6 *If $x_i{}^*$ is defined as the breakeven point at which firm i's value equals its capital stock $(V_i(x_i{}^*, \underline{x}_i) = K_i, \ i = A, B)$, then the acquirer is the firm with the lower breakeven point, and the target is the firm with the higher breakeven point. The firm whose asset value drops first below the value of its stock of capital is taken over by its opponent and immediately closed down. The takeover threshold is:*

$$\max[\underline{x}_B{}^o, \ x_A{}^*] \quad \text{if} \quad x_A{}^* \le x_B{}^* \quad \text{(with A being the acquirer)}$$
$$\max[\underline{x}_A{}^o, \ x_B{}^*] \quad \text{if} \quad x_B{}^* < x_A{}^* \quad \text{(with B being the acquirer)} \tag{13}$$

Therefore corporate restructurings induced by hostile takeovers either happen at the efficient time or inefficiently early.

Note that, as in the one-way takeover, the acquiring firm's managers must supply a credible commitment to follow through and shut down the acquired firm. Debt can again act as a bonding device and enforce immediate closure.[21]

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[21]If the takeover happens at a demand level that exceeds the first-best closure point then ideally closure should be delayed. In principle managers could adopt a debt level that forces them to close the target when demand falls to the first-best closure point. In practice this may not be as simple as it appears since there is no guarantee that managers will maintain the right debt level. In particular managers may over time

All else equal, the firm with the highest cost of collective action (i.e., the lowest α) is the takeover target, and the firm with the lowest cost of collective action (highest α) is the acquirer. The reason is that a higher cost of collective action causes the firm to be closed more inefficiently late by its managers, which decreases the firm's value $V(x, \underline{x})$ from its first-best value, $V^o(x, \underline{x})$.

3.3 Management Buyouts

Instead of collecting as many rents as possible and closing down the firm inefficiently late (at $\underline{x}$), managers could organize a management buyout (MBO). They will do so at a given demand level x if and only if the net proceeds from a buyout exceed the present value of all remaining rents:

$$\gamma\left(K - V(x; \underline{x})\right) \; > \; R(x; \underline{x}) \tag{14}$$

We know from the raider and takeover cases that there is a breakeven threshold, x^*, such that $\gamma\left(K - V(x; \underline{x})\right) \; \geq \; 0$ for all $x \in [\underline{x}, x^*](x > x^*)$. The difference between takeover by a raider (or another firm) and a MBO is that the managers in a MBO forgo future rents after a buyout, while a raider has nothing to lose. It follows that managers in an MBO have an incentive to acquire the firm at a later point than a raider would. There is a MBO breakeven threshold x^{**} (with $x^{**} \; < \; x^*$) such that:[22]

$$\gamma\left(K - V(x; \underline{x})\right) \; - \; R(x; \underline{x}) \; \geq \; 0 \; \; \text{for} \; \; x \in [\underline{x}, x^{**}] \tag{15}$$

Buying out the firm and closing it down pays off for managers only if demand falls sufficiently close to the shut down point $\underline{x}$. However, the managers will not usually exercise their MBO shutdown option immediately when x falls to x^{**}. They still have the option to delay, and their optimal exercise point depends on the drift and uncertainty in demand. In the Appendix we derive the optimal trigger $\underline{x}_{mb}$ at which the MBO takes place:

Proposition 7 *If the initial level of demand is above $\underline{x}_{mb}$ then managers prefer to carry on collecting rents until demand falls to $\underline{x}_{mb}$. The threshold $\underline{x}_{mb}$ at which the managers buy out the firm and close it down is, however, inefficiently late ($\underline{x} \; < \; \underline{x}_{mb} \; < \; \underline{x}^o$).*

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cross-subsidize the target with cash from the acquiring firm. Since these issues are beyond the scope of this paper we assume that investors require managers to adopt a debt level that enforces immediate closure after the takeover.

[22]This result follows from the fact that $R(\underline{x}; \underline{x}) = 0$, and $R'(x; \underline{x}) > 0$ for all $x > \underline{x}$.

An MBO allows management to capture part of the value created by shutting down the firm and releasing its stock of capital. But managers close the firm later than an outside acquirer, because the managers give up their ability to capture cash flows from the going concern. An outside acquirer does not sacrifice any such rents.

MBOs undertaken to shrink or shut down the firm should not occur if takeovers by raiders or other firms are allowed. The raiders or other firms would act first as demand declines. However, MBOs often involve partial buyouts, which may be difficult to achieve through takeovers. For example, a raider might have to take over the whole firm to shut down one piece of it.

3.4 Mergers

Suppose A and B join in a "merger of equals." We assume that the merger does not create any synergies. In a merger of equals, the target firm B is not in play, and the target shareholders do not receive a bid premium. Since R_A and R_B are already the maximum rents that insiders can extract from each firm, $R_A(x) + R_B(x)$ is the most that the managers of A and B can achieve jointly. By merging, the managers simply combine and redistribute the existing rents. Managers do not have an incentive to close down either firm, because closure would require payout of the stock of capital.

The managers of firm A will consider a merger, instead of a hostile takeover, only if the present value of the joint rents is larger than the payoff from a takeover:

$$R_A(x) + R_B(x) > R_A(x) + \gamma\left(K - V_B(x; \underline{x}_B)\right) \tag{16}$$

$$R_B(x) > \gamma\left(K - V_B(x; \underline{x}_B)\right) \tag{17}$$

In other words, the rent value $R_B(x)$, which would captured by target shareholders in a takeover, but is retained by managers in a merger, has to exceed the acquiring firm's gain in a hostile takeover.

The decision whether to merge or acquire is similar to the managers' decision whether to keep collecting rents or to buy out the firm in a MBO. It follows from the analysis of the MBO case that there exists a threshold x^{**} such that for all x below (above) x^{**} firm A prefers to acquire (merge with) firm B.

If A can undertake a hostile takeover, then firm B's rents have to be redistributed in a

merger. A's managers will demand at least $\gamma\left(K - V_B(x; \underline{x}_B)\right)$. Only the remaining value $\left(R_B(x) - \gamma\left(K - V_B(x; \underline{x}_B)\right)\right)$ could be shared with the target management. Therefore the target management always loses out in a merger, and resists a merger as long as possible. The managers of the target firm B refuse to merge until A's threat to acquire B is credible. We know from proposition 6 that A would acquire B at $\max[\underline{x}_B{}^o, x_A{}^*]$ (prior to this point A's threat to acquire B is not credible), and only at this point will B accept the merger. Whether A prefers a merger to a takeover at this point is determined by the inequality (17). If A decides to merge, it can make a take-it-or-leave-it offer to the management of B, in which B gets a small consolation prize. (Note that A has all the bargaining power.) We summarize these results in the following proposition:

Proposition 8 *There is a breakeven demand threshold x^{**}, such that for all levels of demand below (above) x^{**} the acquiring management prefers a hostile takeover (merger), where x^{**} is the solution to the equation $R_B(x^{**}) = \gamma\left(K - V_B(x^{**}; \underline{x}_B)\right)$. The takeover or merger happens at the point where A would acquire B (as given in Proposition 6). A takeover (merger) occurs if the restructuring takes place at a state variable level below (above) x^{**}. In a hostile takeover, the target is closed down immediately. In a non-synergistic merger the managers' closure policies are maintained, and firm B therefore closed inefficiently late.*

3.5 A comparison of takeover mechanisms

We are now in a position to compare takeover mechanisms and to draw implications. We start by comparing the takeover timing and closure policies across the four takeover mechanisms studied. The takeover thresholds for a raider, hostile takeover, management buyout and merger are $\underline{x}_r$, $\underline{x}_{ht}$, $\underline{x}_{mb}$ and $\underline{x}_{ht}$, respectively. (Mergers occur at the time when a hostile takeover becomes credible. Thus the threshold for a merger is $\underline{x}_{ht}$.) Recall also that the first-best and the managers' closure policies are given by the demand thresholds $\underline{x}^o$ and $\underline{x}$, respectively.

Table 2 summarizes the main results: Raiders are first-best. Hostile takeovers are second-best: closure (and takeover) happen either at the efficient time, or inefficiently early if there is an incentive to preempt. Management buyouts come third: closure happens inefficiently late, but still at a higher level of demand than the level that forces managers to shut down. Closure is least efficient in mergers, since the managers' policies remain in place, and the managers collect rents for as long as possible. Unlike the other takeover mechanisms

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Table 2: Takeover and closure thresholds: a comparison across takeover mechanisms

	takeover threshold	closure threshold
raider	$\underline{x}_r = \underline{x}^o$	first-best (at $\underline{x}^o$)
hostile takeover	$\underline{x}^o \leq \underline{x}_{ht}$	first-best (at $\underline{x}^o$) or too early (at $\underline{x}_{ht}$)
management buyout	$\underline{x} < \underline{x}_{mb} < \underline{x}^o$	inefficiently late (at $\underline{x}_{mb}$)
merger	$\underline{x}^o \leq \underline{x}_{ht}$	inefficiently late (at $\underline{x}$)

the merger threshold and the closure threshold do not coincide. The merger happens at $\underline{x}_{ht}$ ($\geq \underline{x}^o$) but closure only occurs at $\underline{x}$ ($\leq \underline{x}^o$). Mergers may therefore happen when demand is still relatively high, yet closure occurs inefficiently late, when demand is lower and below the first-best demand threshold.

Several empirical or policy implications can be drawn from our analysis.

1. Raiders and hostile takeovers can improve efficiency by forcing closure of the target firm at the correct level of demand. Acquiring managers and target shareholders are the main beneficiaries. The total gains to target and acquiring shareholders overstate the value added by hostile takeovers, however, because the target shareholders gain at the target managers' expense.

2. Mergers are a management-friendly alternative to hostile takeovers. These mergers redistribute rents between the acquiring and the target managements, but do not lead to more efficient closure. Mergers also have a hostile side, however, because the target management only agrees to a merger when a hostile takeover by the other firm becomes credible.

3. Hostile takeovers are more likely to occur when few managerial rents remain to be collected in the target and when the acquiring managers are capable of capturing a relatively large fraction (γ) of the value created. Mergers are more likely to occur in situations where there are still significant rents to be collected and/or in situations where the acquiring firm would have to pay too high a bid premium (γ is small). We expect target firms in hostile takeovers to be closer to voluntary shutdown than target firms in mergers.

4. We expect mergers between firms that are equal or similar (particularly in terms of how efficiently they are run). Hostile takeovers are more likely to involve firms that are different. When firms are similar, say identical, then preemptive motives become important and can speed up the takeover. Managers will prefer merging to a hostile takeover when

ample rents remain to be collected, and when demand is still relatively high.

5. MBOs should not occur in the presence of raiders, hostile takeovers or mergers, since these takeover types are triggered at higher levels of demand.

6. Firms with significant debt are less likely to be takeover targets.

7. Hostile takeovers may be financed by debt to ensure that the acquiring management does not merely replace the target management, but closes the target after the restructuring.

8. Hostile takeovers, especially by raiders, generate significant positive returns for target shareholders. MBOs generate smaller, but positive, returns to the target shareholders. Non-synergistic mergers generate zero returns for the acquiring and target shareholders. A raider or hostile acquirer (if present) could therefore "win" in a competition with a MBO or merger.

Our conclusions about the relative efficiency of the various takeover mechanisms should be interpreted with at least two caveats. First, we defined efficiency in terms of the total value to both managers and outside shareholders. There may be other stakeholders, including customers, suppliers or employees left out of the coalition of managers that makes the decisions in our model. Second, we have passed by takeover tactics. Our model would not justify coercive two-part tender offers, for example.

We have not considered merger synergies, where firms A and B are worth more operating together than apart, but our model does predict that combinations motivated by synergies will be mergers rather than hostile takeovers. If combining firms A and B adds value, then their managers will agree to a friendly combination. A hostile takeover would allow one firm's stockholders to capture the value of its managers' rents.

4   Conclusions

This paper starts with the observation that disinvestment in declining industries is usually accompanied by – and apparently forced by – takeovers. We decided to explore such takeovers theoretically. To do so we made several modeling choices.

1. We assumed that the firm's managers act as a coalition in their own self interest. They maximize the present value of future managerial rents, that is, the value of their capture of the firm's future operating cash flows. Their rents are constrained by outside investors'

ability to take control of the firm and its assets if the investors do not receive an adequate rate of return. We assume that their rate of return comes from payout of cash to investors. Managers close the firm when the burden of paying out cash to investors overcomes their reluctance to leave the firm and give up the chance of future managerial rents.

2. Investors can exercise their property rights only after absorbing a cost of collective action. This cost creates a gap between the overall value of the firm and its value to investors. The gap allows the managers to capture part of the firm's operating cash flows. That capture is not necessarily inefficient, because managers may contribute human capital that is specialized to the firm. Managerial rents can provide a return on that capital. Nevertheless, the managers' reluctance to give up their rents leads them to shrink or shut down the firm too late, at a demand threshold lower than the first-best threshold. Closure at the first-best threshold maximizes the sum of the values of the managers' and investors' claims. Just maximizing shareholder value is not efficient when the firm's cash flows and value are shared between managers and investors.

3. We built a dynamic, infinite-horizon model incorporating the option to abandon the firm and release its assets to investors. The model is similar to real-options analyses of abandonment, except that the *managers* decide when to exercise. The infinite (or indefinite) horizon is necessary to support outside equity financing.[23] The demand for the firm's products is treated as a continuous stochastic state variable. The continuity of demand is important, because it allows us to distinguish several cases in a common setting and it leads to closed-form solutions. For example, we can compare managers' demand thresholds for closure to the thresholds for takeover and closure by raiders or by other firms in hostile takeovers or mergers. We can easily see how these thresholds depend on investors' costs of collective action, the drift and variance of demand and the fixed costs of continuing to operate the firm. We could not have done all these analyses in a matchstick model with two or three dates and two or three discrete demand levels.

Our model generates the predictions about takeovers that are summarized at the end of the last section. The model also generates new predictions about payout policy, the role of golden parachutes and the links between debt and disinvestment.

As far as we know, our characterization of optimal payout policy (optimal for the managers) is a new theoretical result. The firm's payout policy has two regimes. When times are good and demand is high, managers pay out a constant fraction of operating cash flow. The

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[23]See Fluck (1998) and Myers (2000).

payout fraction is decreasing in the outsiders' cost of collective action. When times are bad and demand is low, payout is cut to a constant level equal to $\alpha r K$, the firm's opportunity cost of capital adjusted for the cost of collective action. Payout is constant until the firm is either closed or recovers to the point where payout is again linked to operating cash flow.

Since managers closes the firm too late – they allow demand to fall too far before giving up – we analyzed alternatives to takeovers as mechanisms for improving efficiency. We show that a contract that pays managers a fraction of the capital stock – a "golden parachute" – can speed up closure and increase equity value. However, the optimal golden parachute for investors is not generous enough to assure first-best closure. Golden parachutes are most effective for firms with a high cost of collective action, a low fixed cost of operation and a highly valued stock of capital. Golden parachutes should be more prevalent in slowly declining industries with low product demand volatility, and also when interest rates are high.

Of course these results about golden parachutes assume that closure and release of capital are contractible. In real life such contracts may not be possible. Actual golden parachutes pay off when there is a change in control, as in a takeover, which evidently is contractible. Our model has something to say about real-life golden parchutes, however. Suppose, for example, that managers of firm B could set up an impregnable takeover defense, and that only a golden parachute could make them accept a takeover and shut-down of their firm. Would B's shareholders agree to a golden parachute generous enough to allow the takeover and shut-down at the first-best demand level? Our proposition 3 says no.

We also briefly explored the role of debt. Debt service reduces managerial rents and forces managers to close the firm earlier. There exists an optimal debt level D^* that maximizes overall firm value by forcing managers to implement the first-best closure policy. This debt level D^* is dynamically optimal, but independent of the level of demand. We argued that debt financing may play an important role in hostile takeovers. Since there is a danger that the acquiring management may inherit the incentives of the target management, debt financing may ensure that managers close the target after the takeover, and that managers not merely replace the target management. Further research intends to analyze debt policy in more detail.

5 Appendix: Proofs

Proof of proposition 1

One can verify that the general solution to differential equation 3 is given by:

$$V^o(x) = \frac{Kx}{r-\mu} - \frac{f}{r} + A_v{}^o x^\lambda + B_v{}^o x^\beta \tag{18}$$

where $A_v{}^o$ and $B_v{}^o$ are constants that need to be determined by the boundary conditions, and where λ and β are respectively the negative and positive root of the characteristic equation:

$$\frac{1}{2}\sigma^2 p(p-1) + \mu p = r \tag{19}$$

As $x_t \to \infty$ the abandonment option becomes worthless and the firm value converges to the expected present value of all future cashflows of the firm's operations, given by:
$\mathrm{E}\left[\int_t^\infty (Kx_\tau - f)\exp(-r\tau)\,d\tau\right] = \frac{Kx_t}{r-\mu} - \frac{f}{r}$. Hence,

$$\lim_{x\to\infty} V^o(x) = \frac{Kx}{r-\mu} - \frac{f}{r} \tag{20}$$

which implies that $B_v{}^o = 0$. The term $A_v{}^o x^\lambda$ represents the value of the abandonment option and is determined by the boundary condition at closure. The value-matching condition requires that at the closure threshold, $\underline{x}^o$, the firm value equals the stock of capital, i.e.:

$$V^o(\underline{x}^o) = \frac{K\underline{x}^o}{r-\mu} - \frac{f}{r} + A_v{}^o \underline{x}^{o\lambda} = K \tag{21}$$

Finally, the optimal closure point, $\underline{x}^o$, satisfies the following smooth-pasting condition:

$$\left.\frac{\partial V^o(x)}{\partial x}\right|_{x=\underline{x}^o} = \frac{K}{r-\mu} + \lambda A_v{}^o \underline{x}^{o\lambda-1} = 0 \tag{22}$$

Solving the above system of equations gives proposition 1. Since $\lambda < 0$ it follows that the second order condition for $\underline{x}^o$ is always satisfied.

Proof of proposition 2

Managers maximize $R(x)$ with respect to the payout policy $p(x)$ and a closure policy $\underline{x}$ at which they stop servicing the payout. Assume for now that at $\underline{x}$ managers act non-cooperatively and have to be forced out, which means that outside investors have to take collective action and receive αK at $\underline{x}$. We return afterwards to the case of cooperation and its implications for the solution.

We first prove that there exists a payout policy such that for any closure policy $\underline{x}\ (\le \underline{x}^o)$ the cost of collective action constraint is always binding, i.e. $E(x) = \alpha V^o(x)$. This policy is given by:

$$\begin{aligned}
p(x) &= \alpha(Kx-f) \quad \text{for} \quad x > \underline{x}^o \\
&= \alpha rK \qquad\quad\; \text{for} \quad \underline{x}^0 \ge x \ge \underline{x}
\end{aligned}$$

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Indeed, define $H(x)$ as the value of a claim on the above payout policy plus a payment αK at $\underline{x}$. Then $H(x)$ must satisfy the following differential equations:

$$r\,H(x) = \alpha\,(Kx - f) + \mu x H'(x) + \tfrac{1}{2}\sigma^2 x^2 H''(x) \quad \text{for} \quad x > \underline{x}^o$$
$$r\,H(x) = r\alpha K + \mu x H'(x) + \tfrac{1}{2}\sigma^2 x^2 H''(x) \quad\quad \text{for} \quad x \le \underline{x}^o$$

Let us define $\overline{H}(x) \equiv H(x)$ when $x > \underline{x}^o$ and $\underline{H}(x) \equiv H(x)$ when $x \le \underline{x}^o$. Then the general solution for $\overline{H}(x)$ and $\underline{H}(x)$ is given by:

$$\overline{H}(x) = \alpha\left(\frac{Kx}{r-\mu} - \frac{f}{r}\right) + \overline{A}_h\,x^\lambda + \overline{B}_h\,x^\beta$$
$$\underline{H}(x) = \alpha K + \underline{A}_h\,x^\lambda + \underline{B}_h\,x^\beta$$

The constants $\overline{A}_h$, $\overline{B}_h$, $\underline{A}_h$ and $\underline{B}_h$ are the solutions to the following boundary conditions. First, the no-bubble condition requires that $\lim_{x\to\infty} \overline{H}(x) = \alpha\left(\frac{Kx}{r-\mu} - \frac{f}{r}\right)$, which implies that $\overline{B}_h = 0$. Second, at $\underline{x}$ the insiders stop paying out dividends and have to be forced out. Outsiders receive αK and hence $\underline{H}(\underline{x}) = \alpha K$, or equivalently:

$$\underline{H}(\underline{x}) = \alpha K + \underline{A}_h\underline{x}^\lambda + \underline{B}_h\underline{x}^\beta = \alpha K \tag{23}$$

Third, in order to rule out arbitrage opportunities $H(x)$ must be continuous and differentiable at the payout switch $\underline{x}^o$, so $\underline{H}(\underline{x}^o) = \overline{H}(\underline{x}^o)$ and $\underline{H}'(\underline{x}^o) = \overline{H}'(\underline{x}^o)$.[24] Or equivalently,

$$\alpha K + \underline{A}_h\underline{x}^{o\lambda} + \underline{B}_h\underline{x}^{o\beta} = \alpha\left(\frac{K\underline{x}^{o\lambda}}{r-\mu} - \frac{f}{r}\right) + \overline{A}_h\underline{x}^{o\lambda}$$

$$\lambda\underline{A}_h\underline{x}^{o\lambda} + \beta\underline{B}_h\underline{x}^{o\beta} = \lambda\alpha\left(\frac{K\underline{x}^{o\lambda}}{r-\mu}\right) + \lambda\overline{A}_h\underline{x}^{o\lambda} \tag{24}$$

Combining the above two equations allows us to substitute out $\overline{A}_h$. Simplifying, and substituting for $\underline{x}^o$ gives:

$$(\beta - \lambda)\,\underline{B}_h\underline{x}^{o\beta} = \frac{\alpha K\underline{x}^o(1-\lambda)}{r-\mu} + \alpha\lambda K + \frac{\lambda f}{r} \quad \text{or equivalently :}$$

$$(\beta - \lambda)\,\underline{B}_h\underline{x}^{o\beta} = 0 \tag{25}$$

Consequently, $\underline{B}_h = 0$; substituting into (23) gives $\underline{A}_h = 0$, and hence $\underline{H}(x) = \alpha K$. Substituting this into the value-matching condition at $\underline{x}^o$ allows us to solve for $\overline{A}_h$, and gives us $\overline{H}(x)$. Combining our results for $\underline{H}(x)$ and $\overline{H}(x)$ gives: $H(x) = \alpha V^o(x)$, and hence the collective action constraint is always binding, irrespective of the closure threshold $\underline{x}$. Consequently, the payout policy is optimal for the insiders, as any reduction in the payout would cause the constraint to be violated.

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[24]Since the Brownian motion can diffuse freely across the dividend switch, $\underline{x}^o$, the functions $H(x)$, $E(x)$ and $R(x)$ cannot change abruptly across this point. Dixit (1993) shows that at reversible switching points the functions must be continuous and differentiable. Continuity is ensured by a value-matching condition. Differentiability is achieved by the smooth-pasting condition (see also Karatzas and Shreve (1991), Theorem 4.9 p271).

Given the payout policy $p(x)$ that is imposed on the insiders, we can now derive the outsiders' claim value $R(x)$ and their optimal closure policy. Under the payout policy $p(x)$ the claim $R(x)$ must satisfy the following differential equations:

$$r\,R(x) = (1-\alpha)\,(Kx - f) + \mu x R'(x) + \tfrac{1}{2}\sigma^2 x^2 R''(x) \quad \text{for} \quad x > \underline{x}^o$$
$$r\,R(x) = (Kx - f) - r\alpha K + \mu x R'(x) + \tfrac{1}{2}\sigma^2 x^2 R''(x) \quad \text{for} \quad x \leq \underline{x}^o$$

Let us define $\overline{R}(x) \equiv R(x)$ when $x > \underline{x}^o$ and $\underline{R}(x) \equiv R(x)$ when $x \leq \underline{x}^o$. Then the general solution for $\overline{R}(x)$ and $\underline{R}(x)$ is given by:

$$\overline{R}(x) = (1-\alpha)\left(\tfrac{Kx}{r-\mu} - \tfrac{f}{r}\right) + \overline{A}_r\, x^\lambda + \overline{B}_r\, x^\beta$$
$$\underline{R}(x) = \left(\tfrac{Kx}{r-\mu} - \tfrac{f}{r}\right) - \alpha K + \underline{A}_r\, x^\lambda + \underline{B}_r\, x^\beta$$

The constants $\overline{A}_r$, $\overline{B}_r$, $\underline{A}_r$, $\underline{B}_r$ and the managerial abandonment threshold $\underline{x}$ are the solutions to the following boundary conditions. First, the no-bubble condition requires that $\lim_{x\to\infty}\overline{R}(x) = (1-\alpha)\left(\tfrac{Kx}{r-\mu} - \tfrac{f}{r}\right)$, which implies that $\overline{B}_r = 0$. Second, at $\underline{x}$ the insiders stop paying out dividends and are forced out. This means that their claim value is zero at $\underline{x}$, i.e. $\underline{R}(\underline{x}) = 0$. Third, in order to rule out arbitrage opportunities inside equity value must be continuous and differentiable at the payout switch $\underline{x}^o$, so $\underline{R}(\underline{x}^o) = \overline{R}(\underline{x}^o)$ and $\underline{R}'(\underline{x}^o) = \overline{R}'(\underline{x}^o)$. Finally, since the management optimally chooses the closure threshold, $\underline{x}$, it satisfies the following smooth-pasting condition: $\underline{R}'(\underline{x}) = 0$.

In summary, we have five equations (two value-matching and two smooth-pasting conditions, and one no-bubble condition) and five unknowns ($\overline{A}_r$, $\overline{B}_r$, $\underline{A}_r$, $\underline{B}_r$ and $\underline{x}$). The solution method is exactly as before. Combining the two boundary conditions at $\underline{x}^o$ gives $\underline{B}_r = 0$. Substituting into $\underline{R}(\underline{x}) = 0$ we find that:

$$\underline{A}_r = \left[\alpha K + \frac{f}{r} - \frac{K\underline{x}}{r-\mu}\right]\underline{x}^{-\lambda} \tag{26}$$

Substituting into the condition $\underline{R}(\underline{x}^o) = \overline{R}(\underline{x}^o)$ allows us to solve for $\overline{A}_r$. Finally, solving $\underline{R}'(\underline{x}) = 0$ for $\underline{x}$ gives the expression for $\underline{x}$ in proposition 2. The second order condition for a maximum is given by:

$$\left(\frac{x}{\underline{x}}\right)^\lambda \frac{1}{\underline{x}}\left[\frac{-K(1-\lambda)}{r-\mu}\right] < 0 \tag{27}$$

which is always satisfied.

Finally, we solve for the outside equity value $E(x)$. If insiders do not cooperate then the outside equity value is given by $E(x) = H(x) = \alpha V^o(x)$. However, by offering insiders an infinitesimal bribe it should be possible to avoid the deadweight cost of collective action and we therefore consider it to be the natural equilibrium. Cooperation would not alter the insiders' closure or payout policy as from assumption 2 it follows that the stock of capital is protected by property rights and that promises to return this capital in the future cannot be used to obtain concessions on payout.[25]

---

[25]In section 2.4 we consider the case where the bribe is not arbitrarily small, but takes the form of a golden parachute. In this case the management's closure policy is affected.

However, it would mean that at $\underline{x}$ outsiders receive K instead of αK. Going through the same derivation as for $H(x)$, but replacing the condition $E(\underline{x}) = \alpha K$ by $E(\underline{x}) = K$, gives:

$$
\begin{aligned}
E(x) &= \alpha V^o(x) + K(1-\alpha)\left(\tfrac{x}{\underline{x}}\right)^\lambda && \text{for} \quad x > \underline{x} \\
E(x) &= K && \text{for} \quad x \leq \underline{x}
\end{aligned}
$$

Substituting our expressions for $V(x)$, $R(x)$ and $E(x)$ one can easily verify that $V(x) = R(x) + E(x)$, i.e. in the absence of any dead weight cost or other frictions the managers' and shareholders' claim values sum up to the total firm value.

Proof of proposition 3

The derivation of the claim values for the shareholders and managers is exactly the same as in the proof of proposition 2, except that the boundary conditions $R(\underline{x}) = 0$ and $E(\underline{x}) = K$ are replaced respectively by $R(\underline{x}) = (1-\theta)K$ and $E(\underline{x}) = \theta K$. Solving $R'(\underline{x}) = 0$ for $\underline{x}$ gives:

$$
\underline{x} = \frac{-\lambda\left[(1-\theta+\alpha)K + \tfrac{f}{r}\right](r-\mu)}{(1-\lambda)K} \tag{28}
$$

The second order condition is the same as before and always satisfied.

Optimizing $E(x)$ with respect to θ gives as first order condition:

$$
\left(\frac{x}{\underline{x}}\right)^\lambda \frac{-\lambda K(r-\mu)}{\underline{x}(1-\lambda)}\left[\theta(\lambda-1) + \alpha(1-\lambda) + 1 + \frac{f}{rK}\right] = 0 \tag{29}
$$

Solving for θ, and taking into account that $\theta \leq 1$ gives the expression for θ^* given in the proposition. The second order condition for a maximum is always satisfied since:

$$
\left(\frac{x}{\underline{x}}\right)^\lambda \frac{-\lambda K(r-\mu)}{\underline{x}(1-\lambda)}(\lambda-1) < 0 \tag{30}
$$

Substituting θ^* into the expression for $\underline{x}$ gives the solution for $\underline{x}$ under the optimal golden parachute.

Proof of proposition 4

The raider's payoff from restructuring is given by $S(x) \equiv \gamma\left(K - V(x;\underline{x})\right)$. We first prove that the raider's optimal takeover strategy is a trigger strategy. Dixit and Pindyck (1994) and Huang and Li (1990) show that when the underlying state variable follows a geometric Brownian motion then a trigger strategy is adopted if the difference between the payoff from investing ('stopping') right away and the value of waiting for one more instant is monotonic in the state variable. If $S(x)$ denotes the payoff from investing at x then in our model the condition for a trigger strategy to be adopted requires that (see Dixit and Pindyck (2nd print) p130):

$$
D(x) \equiv rS(x) - \mu x S'(x) - 0.5\sigma^2 x^2 S''(x) \tag{31}
$$

37

be monotonic in x. Substituting $S(x)$ into $D(x)$, and simplifying gives:

$$D(x) \; = \; -\gamma \left(K\,x \, - \, f \right) + \gamma r K \tag{32}$$

Since $D(x)$ is monotonically decreasing in x it follows that the raider acquires the target as soon as x falls below some threshold $\underline{x}_r$.

The raider's option to acquire has the following general solution $OS_r(x) \; = \; B_1\,x^\lambda \, + \, B_2 x^\beta$. The condition $\lim_{x \to +\infty} OS_r(x) \; = \; 0$ implies that $B_2 \; = \; 0$. The constant B_1 is determined by the following value matching condition:

$$OS_r(\underline{x}_r) \; = \; S(\underline{x}_r) \; \equiv \; \gamma \left(\left[K + \frac{f}{r} - \frac{K\underline{x}_r}{r-\mu} \right] - A(\underline{x})\,\underline{x}_r{}^\lambda \right) \; = \; B_1\,\underline{x}_r{}^\lambda \tag{33}$$

Solving for B_1 gives:

$$OS_r(x) \; = \; \gamma \left[K + \frac{f}{r} - \frac{K\underline{x}_r}{r-\mu} \right] \left(\frac{x}{\underline{x}_r} \right)^\lambda - \gamma\,A(\underline{x})\,x^\lambda \tag{34}$$

Optimizing with respect to $\underline{x}_r$ we find that $\underline{x}_r \; = \; \underline{x}^o$ where $\underline{x}^o$ is the first best closure threshold as defined in proposition 1. The second order condition is always satisfied.

Proof of proposition 5

The proof of the takeover threshold is the same as for proposition 4. The derivation why debt financing may be required is given in the text prior to the proposition.

Proof of proposition 6 (proof in text)

Proof of proposition 7

The derivation of the management buyout option $OMB(x; \underline{x}_{mb})$ is analogous to the raider case, but with the management's payoff given by $S(x) \; \equiv \; \gamma \left(K - V(x; \underline{x}) \right) \, - \, R(x; \underline{x})$.

We first prove that also for a MBO a trigger strategy is optimal. The condition for a trigger strategy to be adopted requires that:

$$D(x) \; \equiv \; r S(x) - \mu x S'(x) - 0.5\sigma^2 x^2 S''(x) \tag{35}$$

be monotonic in x. Substituting $S(x)$ into $D(x)$, and simplifying gives:

$$\begin{aligned} D(x) \; &= \; \left(f \, - \, K\,x \right) \left(1 + \gamma - \alpha \right) + \gamma r K \qquad \text{for } \; x > \underline{x}^o \\ &= \; \left(f \, - \, K\,x \right) \left(1 + \gamma \right) + \left(\gamma + \alpha \right) r K \quad \text{for } \; x \le \underline{x}^o \end{aligned} \tag{36}$$

Since $D(x)$ is always monotonically decreasing in x it follows that the MBO happens as soon as x falls below some threshold $\underline{x}_{mb}$.

Analogous as before the management's option to buy out the firm at $\underline{x}_{mb}$ can be written as:

$$
\begin{aligned}
OMB(x; \underline{x}_{mb}) &= S(\underline{x}_{mb}) \left(\frac{x}{\underline{x}_{mb}}\right)^\lambda \equiv \left[\gamma\left(K - V(\underline{x}_{mb}; \underline{x})\right) - R(\underline{x}_{mb}; \underline{x})\right]\left(\frac{x}{\underline{x}_{mb}}\right)^\lambda \\
&= \left[\gamma\left(K + \frac{f}{r} - \frac{K\underline{x}_{mb}}{r-\mu}\right) - R(\underline{x}_{mb}; \underline{x})\right]\left(\frac{x}{\underline{x}_{mb}}\right)^\lambda - \gamma A(\underline{x})x^\lambda
\end{aligned}
\tag{37}
$$

The optimal management buyout threshold $\underline{x}_{mb}$ is the solution to the first order condition $\underline{x}_{mb}S'(\underline{x}_{mb}) - \lambda S(\underline{x}_{mb}) = 0$. To verify the second order condition we differentiate $OMB(x; \underline{x}_{mb})$ twice with respect to $\underline{x}_{mb}$. We substitute $R(x)$ by $(V(x) - E(x))$ and use the solutions for $V(x)$ and $E(x)$ as given in proposition 2. Simplifying gives:

$$
\frac{\partial^2 OMB(x; \underline{x}_{mb})}{\partial \underline{x}_{mb}^2} < 0 \iff -(1-\lambda)(1+\gamma)\frac{K}{r-\mu} + \alpha(1-\lambda)V^{o'}(\underline{x}_{mb}) + \alpha\underline{x}_{mb}V^{o''}(\underline{x}_{mb}) < 0 \tag{38}
$$

For $\underline{x}_{mb} < \underline{x}^o$ the second order condition reduces to $-(1-\lambda)(1+\gamma)\frac{K}{r-\mu} < 0$, which is always satisfied. For $\underline{x}_{mb} \geq \underline{x}^o$ the second order condition simplifies to $-(1-\lambda)(1+\gamma-\alpha)\frac{K}{r-\mu} < 0$, which is also always satisfied.

Finally, we prove that $\underline{x}_{mb} < \underline{x}^o$. Differentiating $OMB(x; \underline{x}_{mb})$ with respect to $\underline{x}_{mb}$ and evaluating the first order condition at $\underline{x}^o$ gives:

$$
\left[\frac{\partial\left[\gamma\left(K + \frac{f}{r} - \frac{K\underline{x}_{mb}}{r-\mu}\right)\left(\frac{x}{\underline{x}_{mb}}\right)^\lambda\right]}{\partial \underline{x}_{mb}} - \frac{\partial R(\underline{x}_{mb}; \underline{x})}{\partial \underline{x}_{mb}}\left(\frac{x}{\underline{x}_{mb}}\right)^\lambda - R(\underline{x}_{mb}; \underline{x})\left(\frac{-\lambda}{\underline{x}_{mb}}\right)\left(\frac{x}{\underline{x}_{mb}}\right)^\lambda\right]\Bigg|_{\underline{x}_{mb}=\underline{x}^o} < 0 \tag{39}
$$

The inequality follows from the fact that the first term is zero and the second and third term are negative. Consequently, $\underline{x}^o$ cannot be a maximum. The presence of the second and third term differentiate the MBO from the raider case. Since both those terms are negative for all values of $\underline{x}_{mb}$, it follows that the optimal trigger value for $\underline{x}_{mb}$ is situated to the left of $\underline{x}^o$ (i.e. $\underline{x}_{mb} < \underline{x}^o$).

Proof of proposition 8

Define $S(x) \equiv \gamma\left(K - V(x; \underline{x})\right) - R(x; \underline{x}) = \gamma K - (1+\gamma)V(x; \underline{x}) + E(x; \underline{x})$ for $x \geq \underline{x}$. We want to prove that there exists a $x^{**}(> \underline{x})$ such that $S(x) > (<)0 \iff x < (>)x^{**}$.

It follows immediately that $S(\underline{x}) = 0$ and $S(+\infty) = -\infty$. Substituting first $R(x)$ by $V(x) - E(x)$, and substituting next for the managerial closure threshold $\underline{x}$ it follows that:

$$
\begin{aligned}
S'(\underline{x}) > 0 &\iff -(1+\gamma)\frac{K}{r-\mu} - (1+\gamma)\frac{\lambda}{\underline{x}}\left[K + \frac{f}{r} - \frac{K\underline{x}}{r-\mu}\right] + \lambda(1-\alpha)\frac{K}{\underline{x}} > 0 \\
&\iff -\lambda K \gamma(1-\alpha) > 0
\end{aligned}
\tag{40}
$$

Furthermore, $S(x)$ is strictly concave over $[\underline{x}, \underline{x}^o]$ since:

$$
\begin{aligned}
S''(x) &= -(1+\gamma)\frac{\lambda(\lambda-1)}{x^2}\left[K + \frac{f}{r} - \frac{K\underline{x}}{r-\mu}\right]\left(\frac{x}{\underline{x}}\right)^\lambda + \lambda(\lambda-1)(1-\alpha)\frac{K}{x^2}\left(\frac{x}{\underline{x}}\right)^\lambda \\
&= \frac{-\lambda(\lambda-1)}{x^2}\left(\frac{x}{\underline{x}}\right)^\lambda\left[K\left(\gamma + \alpha - \lambda\gamma(1-\alpha)\right) + \frac{f}{r}(\gamma-\lambda)\right] < 0 \qquad (41)
\end{aligned}
$$

Define $S_r(x) \equiv \gamma\left(K - V(x;\underline{x})\right)$, then we know from the analysis of the raider case that $\underline{x}^o\, S_r{}'(\underline{x}^o) = \lambda S_r(\underline{x}^o) < 0$, and hence the function $S_r(x)$ reaches its maximum at some $x^{max} < \underline{x}^o$. Since $R(x)$ is positive and monotonically increasing, it follows that $S(x)$ reaches its maximum even earlier. It follows from the above that $S(x)$ is a (concave) inverted U-shaped function over $[\underline{x}, \underline{x}^o]$ (with $S(\underline{x}) = 0$).

Consider next the behavior of $S(x)$ for $x \geq \underline{x}^o$. Since both $\gamma(K - V(x))$ and $(-R(x))$ are decreasing functions, it follows that their sum is also decreasing, and hence $S(x)$ is monotonically decreasing over $x \geq \underline{x}^o$. Combining the results for $x < \underline{x}^o$ and $x \geq \underline{x}^o$, it follows from the continuity of $S(x)$ that there exists a x^{**} such that $S(x) > (<)0 \iff x < (>)x^{**}$.

The remainder of the proof is described in the main text preceding proposition 8.

References

ANDERSON, R., AND S. SUNDARESAN (1996): "Design and Valuation of Debt Contracts," *Review of Financial Studies*, 9(1), 37–68.

ANDRADE, G., M. MITCHELL, AND E. STAFFORD (2001): "New Evidence and Perspectives on Mergers," *Journal of Economic Perspectives*, 15(2), 103–120.

DIXIT, A. (1993): "The Art of Smooth Pasting," in *Fundamentals of Pure and Applied Economics*, ed. by J. Lesourne, and H. Sonnenschein, vol. 55. Harwood Academic Publishers, Chur, Switzerland.

DIXIT, A., AND R. PINDYCK (1994): *Investment Under Uncertainty*. Princeton University Press, Princeton, New Jersey.

DÉCAMPS, J.-P., AND A. FAURÉ-GRIMAUD (2002): "Excessive Continuation and Dynamic Agency Costs of Debt," *European Economic Review*, 46, 1623–1644.

ERICSSON, J. (2000): "Asset Substitution, Debt Pricing, Optimal Leverage and Maturity," *Finance*, 21(2), 39–70.

FLUCK, Z. (1998): "Optimal Financial Contracting: Debt versus Outside Equity," *Review of Financial Studies*, 11(2), 383–419.

FRIEDMAN, E., S. JOHNSON, AND T. MITTON (2003): "Propping and Tunneling," *Journal of Comparative Economics*, 31(4), 732–750.

GORTON, G., M. KAHL, AND R. ROSEN (2000): "Eat or Be Eaten: A Theory of Mergers and Merger Waves," Working paper, Wharton School.

GROSSMAN, S., AND O. HART (1980): "Takeover Bids, the Free-Rider Problem and the Theory of the Corporation," *Bell Journal of Economics and Management Science*, 11, 42–64.

HART, O., AND J. MOORE (1994): "A Theory of Debt Based on the Inalienability of Human Capital," *Quarterly Journal of Economics*, 439, 841–879.

HUANG, C. F., AND L. LI (1990): "Continuous Time Stopping Games with Monotone Reward Structures," *Mathematics of Operations Research*, 15, 496–507.

JENSEN, M. (1986): "Agency Costs of Free Cash Flow, Corporate Finance and Takeovers," *American Economic Review*, 76, 323–329.

JENSEN, M., AND W. MECKLING (1976): "Theory of the Firm: Managerial Behavior, Agency Costs and Capital Structure," *Journal of Financial Economics*, 3, 305–360.

JOVANOVIC, B., AND P. ROUSSEAU (2001): "Mergers and Technological Change: 1885-2001," Working paper, New York University.

——— (2002): "The Q-Theory of Mergers," *American Economic Review*, 92(2), 198–204.

KARATZAS, I., AND S. E. SHREVE (1991): *Brownian Motion and Stochastic Calculus*. Springer-Verlag, New York.

LAMBRECHT, B. M. (2001): "The Impact of Debt Financing on Entry and Exit in a Duopoly," *Review of Financial Studies*, 14(3), 765–804.

——— (2004): "The Timing and Terms of Mergers Motivated by Economies of Scale," *Journal of Financial Economics*, 72(1), 41–62.

LAMBRECHT, B. M., AND S. C. MYERS (2004): "Debt and Agency in an Infinite-Horizon Model of the Firm," mimeo, University of Lancaster, Lancaster.

LELAND, H. E. (1994): "Corporate Debt Value, Bond Covenants, and Optimal Capital Structure," *Journal of Finance*, 49(4), 1213–1252.

——— (1998): "Agency Costs, Risk Management, and Capital Structure," *Journal of Finance*, 53(4), 1213–1243.

MAUER, D. C., AND A. TRIANTIS (1994): "Interactions of Corporate Financing and Investment Decisions: a Dynamic Framework," *Journal of Finance*, 49, 1253–1277.

MELLA-BARRAL, P., AND W. R. PERRAUDIN (1997): "Strategic Debt Service," *Journal of Finance*, 52, 531–556.

MELLO, A., AND J. PARSONS (1992): "Measuring the Agency Cost of Debt," *Journal of Finance*, 47(5), 1887–1904.

MORELLEC, E. (2001): "Asset Liquidity, Capital Structure, and Secured Debt," *Journal of Financial Economics*, 61(2), 173–206.

——— (2004): "Can Managerial Discretion Explain Observed Leverage Ratios?," *Review of Financial Studies*, 17, 257–294.

MORELLEC, E., AND A. ZHDANOV (2005): "The Dynamics of Mergers and Acquisitions," *Journal of Financial Economics*, forthcoming.

MYERS, S. C. (2000): "Outside Equity," *Journal of Finance*, 55(3), 1005–1037.

PARRINO, R., AND M. S. WEISBACH (1999): "Measuring Investment Distortions Arising from Stockholder-bondholder Conflicts," *Journal of Financial Economics*, 53(1), 3–42.

RHODES-KROPF, M., AND S. VISWANATHAN (2003): "Market Valuation and Merger Waves," *Journal of Finance*, forthcoming.

RUBACK, R. (1982): "The Conoco Takeover and Shareholder Returns," *Sloan Management Review*, 23, 13–33.

——— (1983): "The Cities Service Takeover: A Case Study," *Journal of Finance*, 38, 319–330.

SEGALL, J. (1968): "Merging for Fun and Profit," *Industrial Management Review*, 9, 17–30.

SHLEIFER, A., AND L. SUMMERS (1988): "Breach of Trust in Hostile Takeovers," in *Corporate Takeovers: Causes and Consequences*, ed. by A. J. Auerbach. University of Chicago Press, Chicago.

SHLEIFER, A., AND R. W. VISHNY (1989): "Management Entrenchment: The Case of Manager-specific Investments," *Journal of Financial Economics*, 25(1), 123–139.

——— (2001): "Stock Market Driven Acquisitions," WP 8439, National Bureau of Economic Research, forthcoming Journal of Financial Economics.

STULZ, R. (1990): "Managerial Discretion and Optimal Financing Policies," *Journal of Financial Economics*, 26, 3–27.

ZWIEBEL, J. (1996): "Dynamic Capital Structure under Managerial Entrenchment," *American Economic Review*, 86(5), 1197–1215.

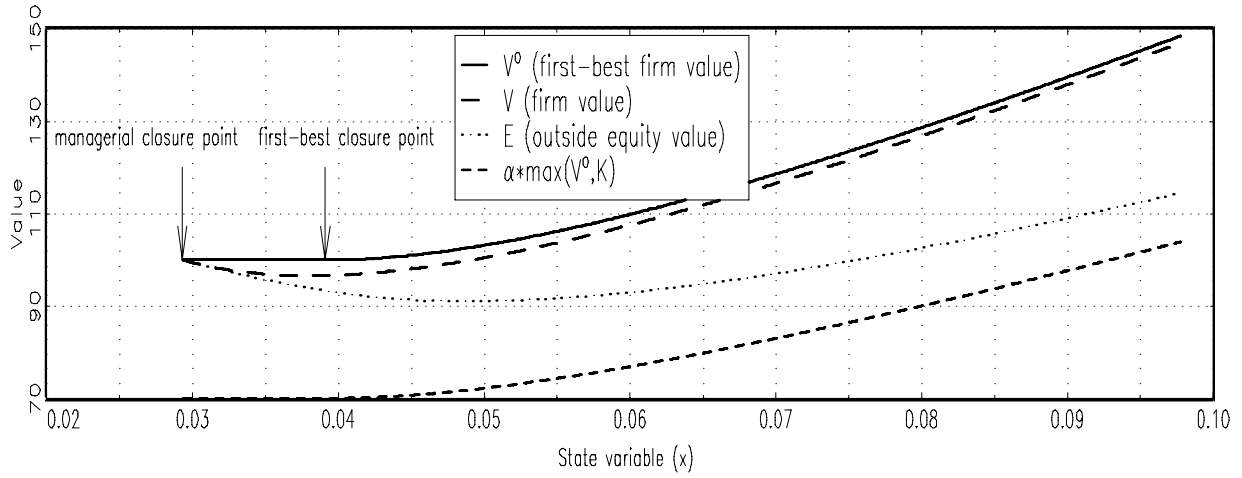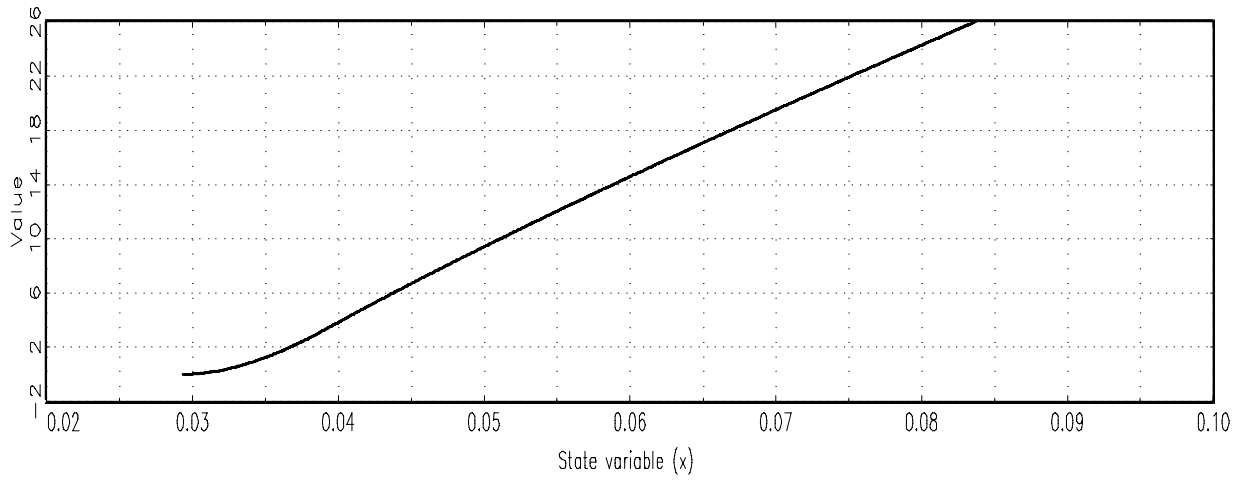Figure 1a: Total firm value (V) and outside equity value (E)

Figure 1b: Value to managers (R)

Figure 1c: Dividends and cash flow to managers