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A Theory of Takeovers and Disinvestment

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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 closing the firm and releasing its capital to investors. Absent takeovers, managers of underleveraged firms always close too late, although golden parachutes may accelerate closure. We analyze the effects of takeovers of underleveraged firms. Takeovers by raiders enforce first-best closure. Hostile takeovers by other firms occur either at the first-best closure point or too *early*. Closure in management buyouts and mergers of equals happens inefficiently *late*.

> *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, p. 19)*

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. The hypotheses are not consolidating, however. One can pick and choose 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

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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.

Takeovers undertaken primarily for disinvestment are common. When U.S. defense budgets fell after the end of the Cold War, a round of consolidating takeovers followed. The takeover battles in the oil industry in the late 1970s and early 1980s, including Boone Pickens's raids on Cities Service and Phillips Petroleum (Ruback (1982, 1983)) are other classic examples, as are the "diet deals" of the LBO boom of the late 1980s. The banking industry is another good example. The United States was "overbanked" in the 1970s, partly as a result of restrictive state banking regulations. As regulation eased, a wave of takeovers started. "Superregionals" have grown by taking over dozens of banks, in each case shedding employees and consolidating operations.

Disinvestment is also used as a defense against takeovers. The U.K. 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 and they may be extracting more rents as incumbents than they could get by starting fresh in another firm. If such 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 shrink the firm? Are their incentives any different from 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.

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

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

A. 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. 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, at which 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 at which shutdown and redeployment of capital maximizes total firm value, that is, the sum of the present values of the managers' and investors' claims on the firm. (Efficiency does *not* mean just maximizing shareholder value.) We show that managers always wait too long, as product demand declines, before shutting down. The managers have no property rights to the released capital and do not consider its full opportunity cost. If demand keeps falling, however, the managers are eventually forced to pay from their own pockets in order to keep investors at bay. Sooner or later they give up and close the firm.

We consider whether a golden parachute—a contract that shares liquidation proceeds with the managers—can provide the right incentives for efficient disinvestment. We show that golden parachutes may 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 note that financial leverage accelerates shutdown by managers and thus improves efficiency.

Our conclusions about payout policy and golden parachutes are, as far as we know, new theoretical 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 to pay it out. Jensen suggests that high levels of debt (as in LBOs) help solve the free cash flow problem. The usual expressions of the free cash flow theory are incomplete, however. 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.

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

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. Raiders implement the first-best outcome, where abandonment maximizes the overall value of the firm, not its value to 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, at a demand level higher than the level at first-best closure. Hostile takeovers also require some commitment mechanism to assure that the acquiring managers actually follow through and shut the target down. The right amount of debt can force disinvestment. Equity-financed takeovers will not occur unless there is some other way of committing to disinvest.
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 is inefficiently late. A raider could always contest such a merger and win, however.

At the end of the paper we comment briefly on takeovers that are partly motivated by synergies. Such takeovers are more likely to be effected as mergers of equals, because managers can share the value added without paying a premium to the shareholders of a target firm.

B. 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 firms' 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 (e.g., in empire-building) and disinvest only if forced to do so. Leland (1998) and Décamps and Fauré-Grimaud (2002) examine this problem. 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.

We focus 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. These papers assume that the manager derives private, nonpecuniary benefits from retaining control and reinvesting free cash flow. Debt service reduces free cash flow and constrains overinvestment. 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 model values managers' benefits 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 procyclicality 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 broad merger waves, which typically occur in buoyant stock markets. We focus instead on 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 receive private benefits of control and 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 also 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 (2003) assume that the stock market may misvalue potential acquirers, potential targets, and their combinations. In their model, managers understand stock market inefficiencies and take advantage of them, in part through takeovers. Thus takeover gains and merger waves are driven by the market's valuation mistakes. Rhodes-Kropf and Viswanathan (2004) show that deviations of market from fundamental values can 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 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 argue 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 mergers of equals. 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 I, we first set out a formal description of the problem that takeovers can potentially solve. Then we model managers' payout policies and closure decisions when takeovers are excluded. We also consider golden parachutes and financial leverage. Section II 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 implications of our takeover results. Section III concludes.

I. Disinvestment Absent Takeovers

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

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

where μ is a drift term, assumed negative in our setting, 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 on closure.

A. 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. The first-best firm value ${V_t}^o$ satisfies the equilibrium condition:

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

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

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

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 the payout policy are as follows:[3]

PROPOSITION 1: *First-best firm value is*

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

The first-best closure rule is

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

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 $x \ge \underline{x}^o$. Payout before closure is $Kx - f$.

This expression for firm value has a simple economic interpretation. The value is the present value of operating the firm forever plus the value of the option to shut it down. The discount factor $(\frac{x}{\underline{x}^o})^{\lambda}$ can be interpreted as the probability of the firm closing down in the 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.

B. Disinvestment by Managers

Now we consider the closure policy adopted by managers. The present values of managers' and equity investors' claims are $R(x)$ and $E(x)$, respectively. With no debt, the claims add up to total firm value, $V(x) = R(x) + E(x)$. 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 manage the firm privately or close it down, releasing the stock of capital K. If they manage the firm, they

[3] The proof of Proposition 1 is standard and can be found, for example, in Mella-Barral and Perraudin (1997) and Lambrecht (2001).

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 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 $1 - \alpha$. 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.*[4] *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.*[5]
(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 future 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.*

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 proceeds. Therefore, a threat by managers not to return capital is a threat to keep the firm running at demand levels below

[4] 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.

[5] "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.

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.

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 in which 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, the demand threshold for closure, and the values of investors' and managers' claims on the firm. (Proofs for this and later propositions are in the Appendix.)

PROPOSITION 2: *Assume that outside investors face a cost of collective action. If they absorb that cost and take control of the firm, they can run it efficiently or shut it down. If the managers shut down the firm, its capital stock is automatically returned to investors. Under these assumptions the values of the firm and investors' and managers' claims are, respectively,*

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

the managers' closure threshold $\underline{x}$ is

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

the payout policy $p(x)$ *is*

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

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* $E(x) = V^o(x; \underline{x}^o)$. *When the cost of collective action is strictly positive* ($\alpha < 1$), *management closes the firm inefficiently late at* $\underline{x} < \underline{x}^o$.

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 payout policy exactly replicates the investors' payoff from collective action. It is therefore the lowest payout that managers can get away with.[6]

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 ($(1 - \alpha) K (x/\underline{x})^{\lambda}$) 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]

When times are bad, the equity investors' claim resembles a perpetual debt contract that pays a fixed coupon flow until default, and on default pays out the liquidation value of the firm. The dividends are like coupon payments and the stock of capital released on 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. Their payouts are based on αK, not K. That is why αK appears in the numerator of the closure threshold.

[6] Repeated games with an infinite horizon can have multiple equilibria. Here there are potential equilibria with higher payouts if investors can punish managers for paying out less. Our equilibrium implicitly assumes that managers have all bargaining power and can make take-it-or-leave-it offers to investors. We believe that our equilibrium is natural when shareholders are dispersed.

[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 shutdown 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.

[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.

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

$$\frac{\underline{x}}{\underline{x}^o} = \frac{\alpha + \dfrac{f}{Kr}}{1 + \dfrac{f}{Kr}}. \tag{7}$$

This ratio varies from $(f/Kr)/(1+(f/Kr))$ to 1, with first-best at $\alpha = 1$. The managers' closure policy becomes less efficient as the ratio f/Kr of fixed operating costs, f, to the opportunity cost of capital, Kr, 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 $x = \underline{x}^o$.

Propositions 1 and 2 assume that disinvestment is an all-or-nothing decision to close down the entire firm. Our results generalize to the case of gradual contraction, in which disinvestment occurs in two or more stages (see Lambrecht and Myers (2006)). 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. For simplicity, we will stick to the case of all-or-nothing disinvestment.

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

C. Example

Figure 1 summarizes a numerical example.[9] Panel A 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). Panel B plots $R(x)$, the present value of managerial rents.

First-best closure is at $x = 0.0391$, the demand level at which the first-best firm value value-matches and smooth pastes to the value of the capital stock,

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

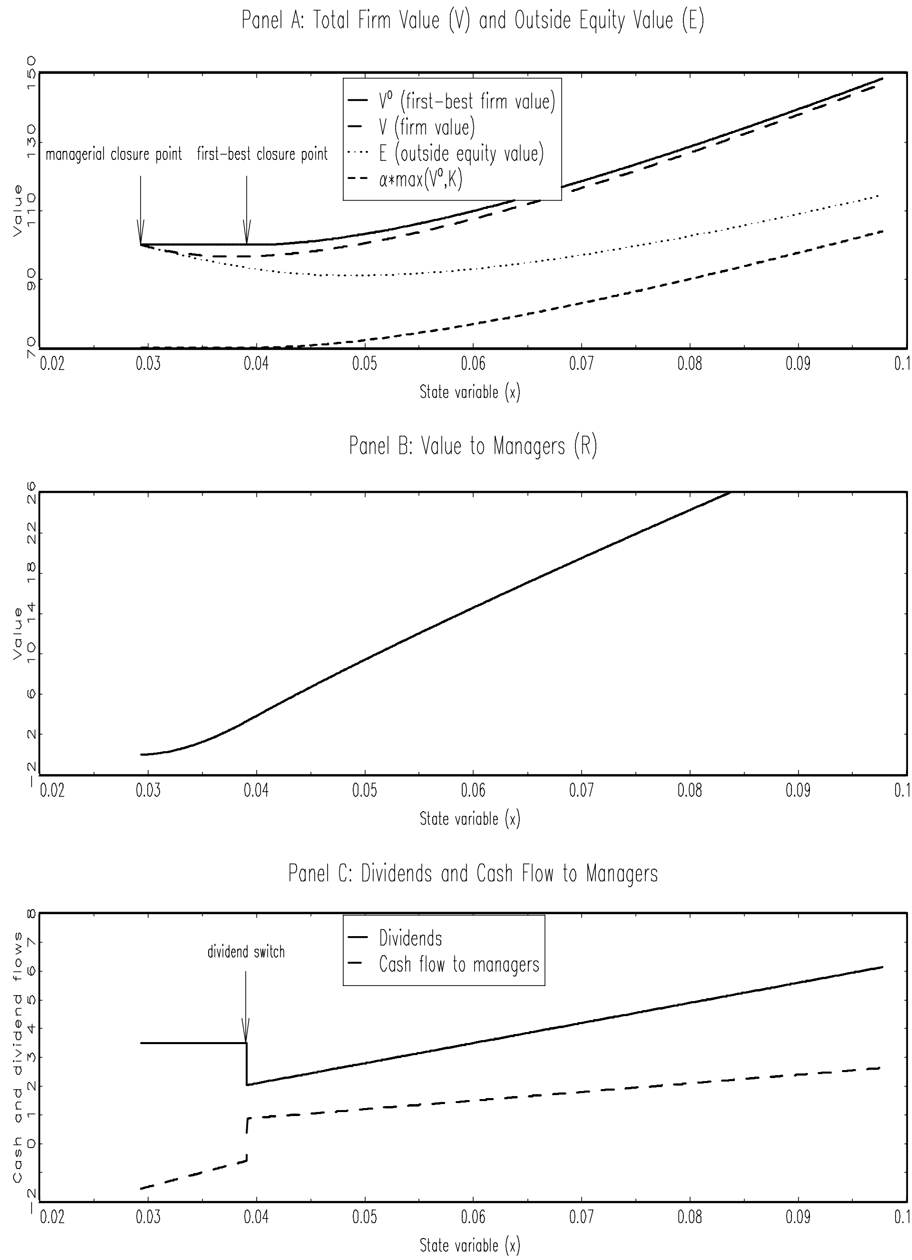

Figure 1. Values and payout as a function of the level of demand. Panel A plots the total firm value under the efficient closure policy (V^o) and under the inefficiently late managerial closure policy (V). The first-best and the managers' closure points are at $x = 0.039$ and $x = 0.029$, respectively. The dotted curve shows the outside equity value. The lowest curve is the payoff to investors from taking collective action (α max $[V^o, K]$). Panel B plots the present value of the managers' rents (R). Panel C plots the payout to outside investors (solid line) and the cash flow to managers (dashed line). There is a switch in the payout policy at the first-best closure point.

$K = 100$. 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 at which the managers' value $R(x)$ value matches and smooth pastes to the zero value line (see Panel B). 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 because the possibility of receiving the capital stock in the near future is positive news for investors.[10] 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 $\alpha(\frac{Kx}{r-\mu} - \frac{f}{r})$.

The payoff to investors from taking collective action (the double-dashed 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 always exceeds $\alpha V^o(x)$, because property rights force $E = K$ at closure.

Panel C plots cash payout $p(x)$ (solid line) and the managers' cash flow (dashed line). 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 $(0.7 \times 100 = 70)$. 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.[11]

Note in Panel C how the managers' cash flow turns negative as demand declines and approaches the shutdown point. In this region, the managers contribute "sweat equity" or money from their own pockets 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).

D. 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.

[10] Proposition 2 implies that equity value $E(x)$ is greater than αK when demand falls close to the managers' closure threshold $\underline{x}$. 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.

[11] This switch does not always increase payout. It depends on the model parameters.

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 $\underline{x}^o$. The payout policy and the values of the investors' and managers' claims would be

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

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 from their point of view.

Closure at the first-best demand level $\underline{x}^o$ may not be a verifiable and contractible event, however. 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.

Assume, however, that closure is contractible. Will investors award a golden parachute equal to $(1 - \alpha)K$? No, because the value of the investors' claim in the first-best case, where $\theta = \alpha$, is only $E(x) = \alpha V^0(x)$, which is 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).[12]

Assume that managers get $(1 - \theta)K$ at closure. Using a derivation similar to the proof of Proposition 2, the values of the investors' and managers' claims are

$$E(x) = \alpha V^o(x) + (\theta - \alpha)K \left(\frac{x}{\underline{x}}\right)^{\lambda} \quad \text{for } \underline{x} < x$$
$$= \theta K \quad \text{for } x \leq \underline{x}$$
$$R(x) = V(x) - E(x).$$

[12] 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.

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

PROPOSITION 3: *If investors have property rights to the stock of capital K, but award a golden parachute equal to* $(1-\theta)K$ *(with* $\theta \leq 1$*) payable to managers at closure, then the managers' closure threshold* $\underline{x}$ *is*

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

The payout policy $p(x)$ *remains the same as without a golden parachute (see Proposition 2). Define* θ^* *as the value of* θ *that maximizes value to investors, which is given by*

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

If θ^* *is implemented, then the managers' closure point is*

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

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

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, at $\underline{x} < \underline{x}^o$. Investors will never offer managers the full amount of the cost of collective action. They may not offer anything: A (nonzero) 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 $\frac{\partial\lambda}{\partial\sigma} > 0$, $\frac{\partial\lambda}{\partial\mu} < 0$, 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.

High fixed costs and declining demand discipline managers and reduce the need for a golden parachute. But 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. If volatility is low, say $\sigma = 0$, then $\lambda \to -\infty$ and hence the first-best closure point is $\underline{x}^o = (K + \frac{f}{r})/K$, and the option value of delaying abandonment beyond this breakeven point is zero. Yet managers will carry on until $\underline{x} = (\alpha K + \frac{f}{r})/K$. 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.

E. 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 (2006). 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 net payoff to investors when they take over the levered firm is $\alpha\,(V^o(x;\underline{x}^o) - D)$. Using a derivation similar to the all-equity case, one can show that managers' cash flows after dividends and interest repayments are

$$
\begin{aligned}
&= (1-\alpha)(Kx - f - rD) && \text{for} \quad x \geq \underline{x}^o \\
&= Kx - f - \alpha r K - (1-\alpha) r D && \textit{for} \quad \underline{x}^o \geq x > \underline{x}.
\end{aligned}
$$

Increasing debt therefore forces managers to close the firm earlier because debt service reduces managers' rents. The 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 $\underline{x}^o$ (see Lambrecht and Myers (2006)).

We conclude that debt can help managers to commit to disinvest and that the right level of debt can protect the firm from takeovers that would force disinvestment. However, this conclusion does not imply that managers will simply adopt a last-minute debt defense to thwart takeovers. Suppose that the managers have some reason to operate at a debt level less than D^*. Would the threat of a takeover prod them to increase debt to D^*? Not necessarily: We show in the next section that in many cases hostile takeovers are launched at the first-best demand level $\underline{x}^o$, the same level at which closure would be forced by debt at D^*. When the end comes in these cases, the managers are no better off with debt at D^* than with lower debt, and they may as well stick to the low-debt policy and hope that demand does not fall to $\underline{x}^o$. (If it does fall to $\underline{x}^o$, the target managers may still escape if the supply of potential acquirors is limited and none attacks.)

II. Disinvestment Forced by Takeovers

Now we consider whether takeovers can force efficient disinvestment. Since there is no role for takeovers if debt is held at the right level, we focus in this section on unlevered firms. We consider takeovers in an industry in which all firms are subject to an exogenous industry demand shock x. We assume for simplicity that the demand shock is the only source of uncertainty, although revenues and costs vary across firms.[13] We focus on nonsynergistic takeovers and therefore rule out value added by operating cost savings or increased market power.

ASSUMPTION 4: *If firms A and B combine then the operating profits are equal to the sum of the firms' premerger operating profits,* $(K_A x - f_A) + (K_B x - f_B)$*. If firm A acquires firm B and closes B down, then A's posttakeover operating profits remain at* $(K_A x - f_A)$.

In our model, takeovers can discipline managers only if acquirers have a lower cost of intervention than the target's outside shareholders. This is evidently the case for public companies with dispersed shareholders. A raider or the management of an another firm face no problems of collective action and may specialize in takeovers and restructuring. Therefore, we assume that the acquirer's cost of collective action is low, for simplicity zero.

ASSUMPTION 5: *The acquirer's cost of collective action is zero* ($\alpha = 1$).

Next we specify how the payoffs to a takeover are shared between the target shareholders, the target managers, and the acquirer. Since we focus on public firms with dispersed ownership, an acquirer faces the Grossman and Hart (1980) free-rider problem, which may allow target shareholders to hold out and capture K_B, the full value of firm B on closure. That result would leave the acquirer with nothing and no incentive to undertake the acquisition in the first place. But takeovers do happen. The free-rider problem can be mitigated by several mechanisms, including toeholds, two-tiered offers, and opportunities to dilute the value of the target's shares. An acquirer can also regain some bargaining power versus the dispersed shareholders if the acquirer has alternative investments with positive NPVs. We therefore assume that the acquirer can capture at least some value, specifically the fraction γ_B of the value $K_B - V_B(x; \underline{x}_B)$ that is created by closing the target firm B. When the target is acquired and shut down the target shareholders receive all remaining proceeds. The target managers get nothing because they have no property rights to the stock of capital K_B. The value of the target firm is therefore split between the target shareholders and the acquirer.[14]

ASSUMPTION 6: *The acquirer receives* $\gamma_B\,[K_B - V_B(x; \underline{x}_B)]$*, that is, a fraction* γ_B *of the value that can be created by the takeover and shutdown of the target firm B. The target shareholders receive all remaining value, that is,* $K_B - \gamma_B(K_B - V_B(x; \underline{x}_B))$.

[13] The assumption of a common demand shock means that we are concentrating on horizontal takeovers, although our model could also apply to some vertical takeovers. For example, a supplier of auto parts could face the same demand shocks as an auto manufacturer.

[14] For simplicity we ignore investment bankers' fees and other transaction costs. That is, we assume these costs are small relative to the overall cost of the takeover.

If firm B is a potential target, then an acquirer has a takeover option with payoff $\gamma_B(K_B - V_B(x;\underline{x}_B))$. This option resembles a put that is exercised when demand falls below a threshold, which we define for now as $\underline{x}_t$. Thus, takeovers are triggered by declining industry demand. As demand declines, more and more firms approach the point at which they should shrink and release capital to investors. Firms that do not shrink run the risk of a takeover.

ASSUMPTION 7: *Managers of a bidding firm A cannot take over a target firm B if the payoff from acquiring and closing down B is negative* ($K_B - V_B(x) < 0$).

Assumption 7 requires that takeover and closure of a target firm be at least breakeven, which rules out preemptive takeovers motivated purely by self-defense. 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 $R_B(x) + \gamma_A(K_A - V_A(x))$. Suppose $K_A - V_A(x)$ is negative, contrary to Assumption 7. Where could B's managers find the money to cover the takeover losses? They 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. Could they finance the takeover partly out of their own pockets? Unless they are independently wealthy, they would have to try to sell off some of $R_B(x)$, their stock of future rents. 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.[15]

We generally assume complete information and efficient financial markets. If investors know that a rational bidder is ready to acquire firm B, then as demand declines and the takeover threshold $\underline{x}_t$ approaches, B's share price gradually incorporates the takeover payoff $K_B - \gamma_B(K_B - V_B(x;\underline{x}_B))$. The takeover itself, if and when it happens, is no surprise and does not cause any share price reaction.[16]

In practice, investors may not know that B is a takeover target until the last minute. Suppose that the supply of potential bidders is limited, perhaps by fixed setup costs or the need for special skills or experience in restructuring. Then the number of potential acquirers may be less than the number of potential targets. A potential target will not automatically be in play as demand declines, and the target's share price will jump suddenly when a takeover is announced.[17]

[15] In our model, managers do sometimes pay out of their own pockets to help cover debt service and payouts to investors. See Figure 1 (Panel C) for an example. But these payments are a flow that can be stopped at any time by closing the firm, not a lump-sum contribution that could amount to a significant fraction of the value of the firm.

[16] The target's share price prior to the takeover is $E_B(x) + [K_B - \gamma_B(K_B - V_B(\underline{x}_t;\underline{x}_B)) - E_B(\underline{x}_t)](\frac{x}{\underline{x}_t})^\lambda$, where $E_B(x)$ is the target's share price in the absence of a takeover and the second term is the amount of the takeover premium incorporated in market value at the demand level $x > \underline{x}_t$. The fraction of the premium incorporated in the stock price depends on the level of demand in the stochastic discount factor $(\frac{x}{\underline{x}_t})^\lambda$.

[17] In this case the acquirer's managers could engage in insider trading and make arbitrage gains by buying the target's stock. We do not pursue the possible implications of insider trading in this paper.

In practice it seems that the likelihood of an individual firm being acquired is small: Maksimovic and Phillips (2001) find that the probability that a firm will be involved in a takeover or merger in a given year is only about 3%.

Our model requires no assumption about when information is released, however, because the target's ultimate share price at the takeover threshold does not depend on whether investors receive takeover news early or late. If the news arrives late, then the acquirer still has to pay the full takeover premium $K_B - \gamma_B(K_B - V_B(x; \underline{x}_B))$. (Any gain to the acquirer from purchasing B's shares before the takeover is announced is captured in the parameter γ_B.) Therefore, the acquirer's and the target's payoffs do not depend on when investors learn that a takeover is on the way, and the takeover threshold $\underline{x}_t$ does not depend on whether the takeover is a surprise to the market. Early news of a takeover threat might give target managers time to shore up their takeover defenses, however. Better defenses could reduce a bidder's payoff. This would show up in our model as a lower value for γ_B.

So far we have taken B as the target firm and A as the bidder. What if B can acquire A ? Since B's managers lose their future rents when B is acquired, they have an incentive to acquire firm A preemptively. Although we start by assuming that B is the target, we will also derive each firm's acquisition strategy when it faces the threat of a preemptive strike by its opponent. We will then derive takeover strategies in equilibrium and determine the acquirer and the target endogenously.

A. Takeover Mechanisms

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. From Assumption 6, the raider's payoff from acquiring and closing the target firm is $\gamma_B(K_B - V_B(x; \underline{x}_B))$.

In a *hostile takeover*, firm A acquires another firm B. The takeover 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. As long as the deal makes A's outside investors no worse off, A's management can extract all remaining takeover surplus. The payoffs to A's and B's managers from acquisition and closure of firm B are $\gamma_B(K_B - V_B(x; \underline{x}_B))$ and zero, respectively. The payoffs to A's and B's shareholders are zero and $K_B - \gamma_B(K_B - V_B(x; \underline{x}_B))$, respectively. (We could give some fraction of the takeover gain to A's investors, however. As we show later, this would not alter our results.)

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 the managerial rents generated by B's assets. Therefore, to get the deal approved by its shareholders, A's managers may need a credible bonding mechanism that commits them to follow through with closure.

Table I
Comparison of the Takeover Cases

	Acquirer's Payoff	Subject To	Target Is
Raider	$\gamma_B(K_B - V_B(x;\underline{x}_B))$		In play
Hostile takeover	$\gamma_B(K_B - V_B(x;\underline{x}_B))$	- Commitment device - Threat of preemption	In play
MBO	$\gamma_B(K_B - V_B(x;\underline{x}_B)) - R_B(x)$		In play
Merger	$R_B(x)$		Not in play

A *management buyout* (MBO) is a takeover of the firm by its own managers. The managers operate on their own behalf and therefore act like a raider, except that they give up future rents after a buyout. A raider has no rents 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. We determine the timing of the merger and also show that mergers in declining industries are inherently hostile, not cooperative.

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 commitment 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 I sets out the various cases. We now analyze each takeover mechanism.

B. Raiders

When the raider takes over and closes the target B, the payoff is $\gamma_B(K_B - V_B(x, \underline{x}_B))$. The raider has a zero cost of collective action ($\alpha = 1$) and therefore realizes the full stock of capital K_B, not αK_B. Since $V_B(x;\underline{x}_B)$ is a convex function in x, the raider's payoff is a concave function. It is zero at $x = \underline{x}_B$, then increases with x, reaches a maximum, and finally declines monotonically.

A positive net present value (NPV = $K_B - V_B(x;\underline{x}_B) \geq 0$) 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 a threshold $\underline{x}_r$, which equals the first-best threshold $\underline{x}_B^o$.[18]

[18] If the raider arrives late, when $\underline{x}_B < x < \underline{x}_B^o$, then takeover and shutdown occur immediately. The takeover option resembles a perpetual American put that is exercised when the price of the underlying asset is below some critical level. The same late-arrival strategy applies to hostile takeovers by other firms.

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

Proposition 4 says that the raider acquires and closes down the target at the efficient time. The first-best closure policy maximizes the present value of the raider's takeover payoff $\gamma_B(K_B - V_B(x, \underline{x}_B))$. 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_B.

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 $R_B(x, \underline{x}_B^o) = 0$ at the optimal shutdown point $x = \underline{x}_B^o$, so ${V_B}^o = {E_B}^o = K_B$. But note that the raider must "buy out" $R_B(\underline{x}_B^o, \underline{x}_B)$, 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 the total stock of capital minus a fraction γ_B of the value created.

The target managers may regard the loss of $R_B({\underline{x}_B}^o, \underline{x}_B)$ 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 (or golden parachute) contract, which would force managers to close down at the optimal demand level $\underline{x}_B^o$.

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 target shareholders represent transfers from target managers and employees. Our comments about breach of trust also apply to takeovers by other firms, which we turn to now.

C. Hostile Takeover

In a hostile takeover a firm A acquires another firm B. We first derive the optimal takeover strategy when the identities of the acquirer and the target are preassigned. Then we derive acquisition strategies when each firm is constrained by the threat of a preemptive takeover by its opponent. This gives equilibrium strategies and determines the acquirer and the target endogenously.

C.1. Hostile Takeover of a Predetermined Target

Assume to start 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 $K_B - \gamma_B(K_B - V_B(x, \underline{x}_B))$. A's managers receive the fraction γ_B 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 the payoff to A's shareholders is

$$\begin{aligned} &\text{Proceeds to acquiring shareholders} \\ &\quad = \text{Acquisition proceeds} - \text{payment to target shareholders} \\ &\qquad - \text{payment to acquiring managers} \\ &\quad = K_B - \left[K_B - \gamma_B\left(K_B - V_B\left(\underline{x}_B^o, \underline{x}_B\right)\right)\right] - \gamma_B\left(K_B - V_B\left(\underline{x}_B^o, \underline{x}_B\right)\right) = 0. \end{aligned} \tag{11}$$

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 managers. Firm A's stockholders are not harmed by the takeover and shutdown of firm B, and have no reason to intervene to prevent it.

If we take Assumption 1(b) strictly and literally, perhaps A's shareholders also should get a share of the profits. Takeover and shutdown of firm B releases its capital stock K_B. If shareholders have complete, automatic property rights to released capital, then A's shareholders should get a "free gift" of K_B 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 split the merger gains.[19] In practice, the lion's share of merger gains goes to the target firm's shareholders, and the bidding firm's shareholders roughly break even. See Andrade et al. (2001). Their empirical results are consistent with our assumption about the division of takeover gains.

The payoff $\gamma_B(K_B - V_B(x; \underline{x}_B))$ to A's managers is exactly the same as to a raider. Therefore the takeover occurs at the same first-best demand level $\underline{x}_B{}^o$. There is an important difference between the raider and hostile takeover cases, however. 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. How then can hostile takeovers lead to efficient disinvestment? There is a three-part answer.

First, the acquiring managers will shut down the target voluntarily if $\gamma_B(K_B - V_B(x; \underline{x}_B)) > R_B(x)$. Note our assumption that the acquiring managers get all the takeover gains accruing to firm A and that A's stockholders merely break even. This division of gains is efficient if it assures that A's managers follow through and shut down the target.

Second, A's stockholders will prevent a takeover unless A's managers make a credible commitment to shut down B. Suppose that the stockholders anticipate

[19] Suppose that a fraction α_A of the acquiring firm's gain goes to its investors. Then the payoff to A's managers is scaled down by a factor of $(1 - \alpha_A)$ to $(1 - \alpha_A)\gamma_B(K_B - V_B(x; \underline{x}_B))$. The takeover threshold and our main results do not change, because adding the factor $(1 - \alpha_A)$ has exactly the same effect as a lower value for γ_B.

that B will be shut down too late, at a demand level $\underline{x}_B < \underline{x}_B^o$, with A's managers extracting rents worth $R_B(x, \underline{x}_B)$ in the meantime. The stockholders' payoff is

$$\begin{aligned}
&\text{Proceeds to acquiring shareholders}\\
&\quad = \text{acquisition proceeds} - \text{payment to acquiring managers}\\
&\qquad - \text{payment to target shareholders}\\
&\quad = V_B(x, \underline{x}_B) - \left[R_B(x, \underline{x}_B)\right] - \left[K_B - \gamma_B(K_B - V_B(x, \underline{x}_B))\right]\\
&\quad = E_B(x, \underline{x}_B) - \left[V_B(x, \underline{x}_B) + (1 - \gamma_B)(K_B - V_B(x, \underline{x}_B))\right] < 0.
\end{aligned}$$

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 $(1 - \gamma_B)(K_B - V_B(x, \underline{x}_B))$. This would reduce their equity value and trigger collective action against A's managers. Therefore the takeover could not take place.

Third, debt financing can provide a bonding mechanism to force shutdown. Managers could finance the takeover by the amount of debt that precommits them to shut down the firm immediately after the takeover. We know from Section I that such a debt level always exists. Moreover, A's managers have a clear incentive to take on debt if necessary to satisfy their shareholders and get the deal done.[20] They get $\gamma_B(K_B - V_B(x, \underline{x}_B))$ from taking over and shutting down B and nothing otherwise.

Of course there may be other bonding mechanisms. For example, a management team that makes serial takeovers in a declining industry will value its reputation for efficient disinvestment.

Our results can be summarized in the following proposition.[21]

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. However, the takeover may have to be financed by the debt level that forces the target to be closed immediately after the takeover.*

C.2. Which Firm Is the Acquirer and Which Is the Target?

Consider next the case in which A can acquire B or B can acquire A. The normal form of the game is given in Table II.

Assumption 7 rules out value-reducing takeovers, so each firm can act only if takeover and shutdown is positive- or zero-NPV, that is, $K_i - V_i(x; \underline{x}_i) \geq 0$, $i = A, B$. 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

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

[20] Contrast this incentive to the incentives of the target managers. They can commit to efficient closure by adopting the optimal debt level D^*, but doing so makes them no better off at the closure point than they would be in a takeover.

[21] The proof of the takeover threshold is the same as for Proposition 4.

Table II
Normal Form of the Takeover Game

	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	$-R_A(x;\underline{x}_A)$	$\gamma_A(K_A - V_A(x;\underline{x}_A))$

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^*. Then 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 demand level at which preemption by B becomes a credible threat. If, however, $x_A^* < x_B^o$, 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, which determines the acquirer and the target, as well as the timing of the hostile takeover:

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*

$$\max\left[\underline{x}_B^o\,,\, x_A^*\right] \text{ (with A the acquirer) if } x_A^* < x_B^*$$
$$\max\left[\underline{x}_A^o\,,\, x_B^*\right] \text{ (with B the acquirer) if } x_B^* < x_A^*. \qquad (13)$$

Therefore, disinvestment induced by hostile takeovers happens either at the efficient time or inefficiently early.

Note again that the acquiring firm's managers may have to 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.

All else equal, the firm with the highest cost of collective action (the lowest α) is the takeover target, and the firm with the lowest cost of collective action (highest α) is the acquirer. The higher the cost of collective action, the longer managers will delay closure, and the greater the shortfall of the firm's value $V(x, \underline{x})$ from its first-best value $V^o(x, \underline{x})$.

More generally, one could express the condition $x_A^* < (>) x_B^*$ for firm A (B) being the acquirer as a function of the underlying model parameters $K_A, K_B, f_A, f_B, \alpha_A, \alpha_B, \mu, r$, and σ. However, since no closed-form solution exists for x_A^* and x_B^*, the condition would have to be evaluated numerically.[22]

If a preemptive takeover threat is sufficiently strong, then the takeover and closure may take place inefficiently early at $\underline{x}_{ht} = x_A^* (> \underline{x}_B^o)$. This is of course inefficient. If the takeover happens early, then ideally closure should be delayed. This would require some bonding mechanism strong enough to overcome the acquiring managers' incentive to continue to collect rents from firm B 's assets until the managers' closure point at $\underline{x}_B < \underline{x}_B^o$. 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 easy, since there is no guarantee that managers will maintain this debt level. A sustained "optimal debt policy" is probably not verifiable and contractible, but we cannot rule out the possibility that the optimal policy will be followed. We note this as a topic for further research and assume in the rest of this paper that investors require bidding managers to commit in some fashion to immediate closure after the takeover. In practice it appears that restructuring starts promptly after takeovers motivated by opportunities for disinvestment.

Our model predicts preemptive takeovers, but it is not clear how common preemptive takeovers are. Perhaps most bidders are not threatened by preemptive bids. Suppose, for example, that A specializes in takeovers and restructuring but B does not and that B is considerably smaller than A. (For example, some superregionals have taken over many smaller banks and presumably have learned how to consolidate operations efficiently.) Then B may not be a threat to A, so that A can wait and take over at the first-best shutdown point $\underline{x}_B^o$.

D. Management Buyouts

Instead of collecting as many rents as possible and closing down the firm inefficiently late (at $\underline{x}$), managers could organize an 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:

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

We know from the raider and takeover cases that there is a breakeven threshold, x^*, such that $\gamma(K - V(x; \underline{x})) \geq 0$ for all $x \in [\underline{x}, x^*]$. The difference between takeover by a raider or another firm and an MBO is that the managers in an MBO forgo future rents after a buyout. A raider has no rents to lose and the managers of an acquiring firm do not put their own rents at risk. Therefore,

[22] Remember that x_A^* and x_B^* are the solutions to the nonlinear equations $V_A(x_A^*; \underline{x}_A) = K_A$ and $V_B(x_B^*; \underline{x}_B) = K_B$.

managers will launch an MBO at a lower demand level than an outside acquirer would. There is an MBO breakeven threshold x^{**} (with $x^{**} < x^*$) such that[23]

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

The MBO is self-financing, because K exceeds the payment to shareholders, so that managers' wealth constraints are not binding. The managers could finance the MBO with a short-term loan against the collateral K.

Buying out the firm and closing it down pays off for managers only if demand falls sufficiently close to the shutdown 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 inefficiently late ($\underline{x} < \underline{x}_{mb} < \underline{x}^o$).*

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 would, 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, for example, the buyout of one of several divisions, which may be difficult to achieve through a takeover. For example, a raider could be reluctant to take over the whole firm just to shut down one piece of it.

E. Mergers

Suppose A and B join in a "merger of equals." We assume for now 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. Mergers do not harm shareholders, however, since aggregate capture of cash flow by managers does not increase, and the shareholders of either firm could veto a merger that decreased the value of their stake.

[23] This result follows because $R(\underline{x};\underline{x}) = 0$ and $R'(x;\underline{x}) > 0$ for all $x > \underline{x}$.

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:

$$R_A(x) + R_B(x) > R_A(x) + \gamma_B(K_B - V_B(x; \underline{x}_B)) \tag{16}$$

$$R_B(x) > \gamma_B(K_B - V_B(x; \underline{x}_B)). \tag{17}$$

In other words, the rent value $R_B(x)$, which would be 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.[24]

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 $\gamma_B(K_B - V_B(x; \underline{x}_B))$. Only the remaining value $R_B(x) - \gamma_B(K_B - V_B(x; \underline{x}_B))$ 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 $\max[\underline{x}_B^o, x_A^*]$, the demand level at which A could decide to launch a hostile takeover of B, and only at this point will B accept a merger. Whether A prefers a merger to a takeover at this point is determined by the inequality (17). If A decides to merge, it has all the bargaining power and can make a take-it-or-leave-it offer to B's managers, who end up with a small consolation prize. The following proposition states the condition under which firms prefer a merger to a hostile takeover and the demand level at which closure takes place.

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

F. Comparing the Takeover Mechanisms

We can now summarize the takeover timing and closure policies for the four takeover mechanisms. Recall that the first-best and the managers' closure thresholds are at the demand levels $\underline{x}^o$ and $\underline{x}$. 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, so the threshold for a merger is the same as for a hostile takeover, i.e., $\underline{x}_{ht}$.)

[24] Note again our assumption that the managers of firm A would get all of the acquirer's gains in a takeover. This reduces the frequency of mergers, which are inefficient when the target firm B should be closed.

Table III
Takeover and Closure Thresholds

	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 $\underline{x}$)

Table III summarizes the main results. Raiders are first-best. Hostile takeovers are in second place: They can generate efficient disinvestment if managers can commit to close down the target firm immediately after takeover, but hostile takeovers and closure can happen at demand levels above the first-best threshold 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. The merger and closure thresholds do not coincide. The merger happens at $\underline{x}_{ht} \geq \underline{x}^o$ but closure is deferred until $\underline{x} \leq \underline{x}^o$. 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.

Our conclusions about the relative efficiency of the various takeover mechanisms carry at least two caveats. First, we defined efficiency in terms of the total value to both managers and outside shareholders. Our model excludes other stakeholders (such as customers, suppliers, or employees), so no welfare implications can be drawn. Second, we have passed by takeover tactics and takeover defenses. Our model would not justify coercive two-part tender offers, for example.

G. Some Empirical Implications

Several empirical 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 acquiring and target managers, 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 synergies are not important, when few managerial rents remain to be collected in the target, and when the acquiring managers can capture a relatively large fraction (γ)

of the value created by takeover and closure. Mergers are more likely to occur when synergies are important, when there are still significant rents to be collected, and when the acquiring firm would have to pay too high a bid premium (i.e., when 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 therefore 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 mechanisms are triggered at higher levels of demand.
6. Firms with debt are less-attractive takeover targets, and firms with sufficient debt are not targets.
7. Golden parachutes, defined as bonuses paid contingent on closure and release of capital, will not assure efficient investment or forestall takeovers. Shareholders will not approve golden parachutes generous enough to generate efficient closure by managers.
8. Hostile takeovers may have to be financed by debt to ensure that the acquiring managers follow through and restructure the target.
9. Hostile takeovers, especially by raiders, generate significant positive returns for target shareholders. MBOs generate smaller, but positive, returns to the target shareholders. Mergers generate zero returns for the acquiring and target shareholders. A raider or hostile acquirer (if present) could therefore "win" in a competition with an MBO or merger. Returns to stockholders of aquiring firms should be zero.

H. Synergies

Now we can briefly discuss the effect of synergies on takeover and closure decisions and on managers' choice between a hostile takeover and a merger of equals. Suppose that acquisition and closure of firm B not only releases the stock of capital K_B but also increases the acquirer's operating profits from $K_A x - f_A$ to $K_{AB} x - f_{AB}$, where $K_{AB} \geq K_A$ and $f_{AB} \leq f_A$. The increase in the revenues $(K_{AB} - K_A)x$ could result from increased market power and the decrease in operating costs $(f_A - f_{AB})$ could result from costs savings or increased efficiency. Assume for simplicity that the acquirer's stock of capital at closure remains equal to K_A (no synergies in liquidation) and also that $(K_{AB} - K_A)x$, A's incremental revenue from takeover, is not large enough to trigger takeovers in response to increased demand.

How would these synergies affect our previous results? A complete analysis is beyond the scope of this paper,[25] but some results should be intuitive. First,

[25] For example, synergies will in general depend on whether A takes over and shuts down B or vice versa. Also, synergies can generate takeovers in rising product markets, which we have not modeled. See Lambrecht (2004), however.

synergies favor takeovers by operating firms. Raiders cannot capture synergies, since raiders are purely financial investors, and MBOs cannot generate synergies, since there is no combination with another firm. Second, synergies speed up hostile takeovers, so that the target is acquired and closed before the target's (stand-alone) first-best closure threshold $\underline{x}_B^o$. The extra operating profits generated by the takeover are partly captured by the acquiring managers, who move the takeover threshold up to a higher demand level. Third, synergies increase the frequency of mergers versus hostile takeovers. The higher takeover threshold means a higher flow of rents at that threshold to the target firm's managers. The greater the rents, the less attractive a hostile takeover (see Proposition 8).

Synergies create increased cash flow once the target firm B is closed, and Proposition 2 says that firm A's payout then increases. This could mean positive gains for shareholders in a takeover or merger. If we take our model strictly, however, the value of these extra payouts would loosen the collective-action constraint at the takeover or merger date, allowing managers to cut payout and recapture the present value gain to stockholders. Thus gains to acquiring-firm stockholders may remain close to zero. Synergies should benefit target shareholders in hostile takeovers, however, because these shareholders can hold up the acquirer and extract part of the extra value added.

III. Conclusions

This paper starts with the observation that disinvestment in declining industries is often accompanied by—and apparently forced by—takeovers. We explore such takeovers theoretically. To do so, we make several modeling choices.

1. We assume 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 build 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.[26] 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 completed all these analyses in a matchstick model with two or three dates and a few discrete demand levels.

Our model clarifies when and why takeovers are efficient and generates the empirical predictions summarized at the end of Section II. The model also generates new predictions about payout policy, the role of golden parachutes, and the links between debt and takeovers.

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 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 αrK, 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 close the firm too late—they allow demand to fall too far before giving up—we analyze alternatives to takeovers as mechanisms for improving efficiency. We show that a golden parachute contract that pays managers a fraction of the capital stock 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 high costs of collective action, low fixed operating costs, and capital with high value in alternative uses. 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

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

a takeover, which evidently is contractible. Our model does have something to say about real-life golden parachutes, however. For example, suppose that managers of the target firm B could set up an impregnable takeover defense, and that only a golden parachute could make them accept a takeover and shutdown of their firm. Would B's shareholders agree to a golden parachute generous enough to allow the takeover and shutdown at the first-best demand level? Our Proposition 3 says no.

We also briefly explore the role of debt. Debt service reduces managerial rents and forces managers to close the firm earlier. We argue 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 can help ensure that managers resist the temptation to keep the target running and collect firm B's rents. Further research intends to analyze debt policy in more detail.

Appendix

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 payout. Assume for now that managers act noncooperatively at $\underline{x}$ and have to be forced out, which means that outside investors have to take collective action and receive αK at $\underline{x}$. We will return to the cooperative case.

We first prove that for any closure policy $\underline{x}(\leq \underline{x}^o)$, there is a payout policy $p(x)$ such that the cost of collective action constraint is always binding ($E(x) = \alpha V^o(x)$):

$$\begin{aligned} p(x) &= \alpha(Kx - f) && \text{for } x > \underline{x}^o \\ &= \alpha r K && \text{for } \underline{x}^0 \geq x \geq \underline{x}. \end{aligned}$$

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

$$\begin{aligned} r\,H(x) &= \alpha(Kx - f) + \mu x H'(x) + \tfrac{1}{2}\sigma^2 x^2 H''(x) && \text{for } x > \underline{x}^o \\ r\,H(x) &= r\alpha K + \mu x H'(x) + \tfrac{1}{2}\sigma^2 x^2 H''(x) && \text{for } x \leq \underline{x}^o. \end{aligned}$$

Define $\bar{H}(x) \equiv H(x)$ when $x > \underline{x}^o$ and $\underline{H}(x) \equiv H(x)$ when $x \leq \underline{x}^o$. Then the general solution for $\bar{H}(x)$ and $\underline{H}(x)$ is given by

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

The constants $\bar{A}_h, \bar{B}_h, \underline{A}_h$, and $\underline{B}_h$ are the solutions to the following boundary conditions. First, the no-bubble condition requires that $\lim_{x\to\infty} \bar{H}(x) = \alpha(\frac{Kx}{r-\mu} - \frac{f}{r})$. Second, at $\underline{x}$ the managers stop paying out dividends and have to be forced out. Outsiders receive αK and hence $\underline{H}(\underline{x}) = \alpha K$. Third, in order to rule out arbitrage opportunities, $H(x)$ must be continuous and differentiable at the payout switch $\underline{x}^o$, so $\underline{H}(\underline{x}^o) = \bar{H}(\underline{x}^o)$ and $\underline{H}'(\underline{x}^o) = \bar{H}'(\underline{x}^o)$. Solving these four equations for the four unknowns gives $H(x) = \alpha V^o(x)$. The collective action constraint is always binding, regardless of the closure threshold $\underline{x}$. The payout policy is therefore optimal for the managers.

Next, we derive $R(x)$ and the managers' optimal closure policy. Under the payout policy $p(x)$, the claim $R(x)$ must satisfy the same differential equations as $H(x)$, with the same general solution. This leaves us again with four constants to be determined. We also need to determine the managers' closure threshold $\underline{x}$. Define $\bar{R}(x) \equiv R(x)$ when $x > \underline{x}^o$ and $\underline{R}(x) \equiv R(x)$ when $x \leq \underline{x}^o$. The unknowns are pinned down by the following boundary conditions. First, $\lim_{x\to\infty} \bar{R}(x) = (1-\alpha)(\frac{Kx}{r-\mu} - \frac{f}{r})$. Second, at $\underline{x}$ the insiders stop paying out dividends and are forced out, with $\underline{R}(\underline{x}) = 0$. Third, $R(x)$ must be continuous and differentiable at the payout switch $\underline{x}^o$, so $\underline{R}(\underline{x}^o) = \bar{R}(\underline{x}^o)$ and $\underline{R}'(\underline{x}^o) = \bar{R}'(\underline{x}^o)$. Finally, since the managers optimize the closure threshold $\underline{x}$, it satisfies the smooth-pasting condition $\underline{R}'(\underline{x}) = 0$. Solving the five equations (two value-matching and two smooth-pasting conditions, plus one no-bubble condition) for the five unknowns gives the solution for $R(x)$. The following second-order condition for a maximum is always satisfied

$$\left(\frac{x}{\underline{x}}\right)^{\lambda} \frac{1}{\underline{x}} \left[\frac{-K(1-\lambda)}{r-\mu}\right] < 0. \tag{A1}$$

Finally, we solve for the 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 a tiny bribe it should be possible to avoid the deadweight cost of collective action. (Here we consider infinitesimal bribes, not golden parachutes.) Given Assumption 2, cooperation would not alter the insiders' closure or payout policy. However, cooperation does 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

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

Q.E.D.

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

$$\underline{x} = \frac{-\lambda\left[(1-\theta+\alpha)K + \dfrac{f}{r}\right](r-\mu)}{(1-\lambda)K}. \tag{A2}$$

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

Optimizing $E(x)$ with respect to θ gives the first-order condition

$$\left(\frac{x}{\underline{x}}\right)^{\lambda} \frac{-\lambda K(r-\mu)}{\underline{x}(1-\lambda)} \left[\theta(\lambda-1) + \alpha(1-\lambda) + 1 + \frac{f}{rK}\right] = 0. \tag{A3}$$

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

$$\left(\frac{x}{\underline{x}}\right)^{\lambda} \frac{-\lambda K(r-\mu)}{\underline{x}(1-\lambda)}(\lambda - 1) < 0. \tag{A4}$$

Substituting θ^* into the expression for $\underline{x}$ gives the solution for $\underline{x}$ under the golden parachute that is best for investors. Q.E.D.

Proof of Proposition 4: The raider's payoff from restructuring is given by $S(x) \equiv \gamma(K - V(x;\underline{x}))$. We first prove that the raider's optimal takeover strategy is a trigger strategy. 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

$$G(x) \equiv rS(x) - \mu x S'(x) - 0.5\sigma^2 x^2 S''(x) \tag{A5}$$

be monotonic in x. See Dixit and Pindyck (1994, p. 130). Substituting $S(x)$ into $G(x)$ and simplifying gives

$$G(x) = -\gamma(K\,x - f) + \gamma r K. \tag{A6}$$

Since $G(x)$ 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 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 value matching condition

$$OS_r(\underline{x}_r) = S(\underline{x}_r) \equiv \gamma\left(\left[K + \frac{f}{r} - \frac{K\underline{x}_r}{r-\mu}\right] - A(\underline{x})\ \underline{x}_r^{\lambda}\right) = B_1 \underline{x}_r^{\lambda}. \tag{A7}$$

Solving for B_1 gives

$$OS_r(x) = \gamma\left[K + \frac{f}{r} - \frac{K\underline{x}_r}{r-\mu}\right]\left(\frac{x}{\underline{x}_r}\right)^{\lambda} - \gamma\, A(\underline{x})\, x^{\lambda}. \tag{A8}$$

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. Q.E.D.

Proof of Proposition 6: Proof in text. Q.E.D.

Proof of Proposition 7: The derivation of the management buyout option $OMB(x;\underline{x}_{mb})$ is similar to the raider case, but with the management's payoff given by $S(x) \equiv \gamma(K - V(x;\underline{x})) - R(x;\underline{x})$. A trigger strategy is also optimal for MBOs. The managers' option to buy out the firm at $\underline{x}_{mb}$ can be written as

$$\begin{aligned} OMB(x;\underline{x}_{mb}) &= S(\underline{x}_{mb})\left(\frac{x}{\underline{x}_{mb}}\right)^{\lambda} \equiv \left[\gamma(K - V(\underline{x}_{mb};\underline{x})) - R(\underline{x}_{mb};\underline{x})\right]\left(\frac{x}{\underline{x}_{mb}}\right)^{\lambda} \\ &= \left[\gamma\left(K + \frac{f}{r} - \frac{K\underline{x}_{mb}}{r-\mu}\right) - R(\underline{x}_{mb};\underline{x})\right]\left(\frac{x}{\underline{x}_{mb}}\right)^{\lambda} - \gamma A(\underline{x}) x^{\lambda}. \end{aligned} \tag{A9}$$

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, differentiate $OMB(x;\underline{x}_{mb})$ twice with respect to $\underline{x}_{mb}$. 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

$$\frac{\partial^2 OMB(x;\underline{x}_{mb})}{\partial \underline{x}_{mb}{}^2} < 0 \iff -(1-\lambda)(1+\gamma)\frac{K}{r-\mu} + \alpha(1-\lambda)V^{o'}(\underline{x}_{mb}) + \alpha \underline{x}_{mb} V^{o''}(\underline{x}_{mb}) < 0. \tag{A10}$$

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

$$\left[\frac{\partial\left[\gamma\left(K + \frac{f}{r} - \frac{K\underline{x}_{mb}}{r-\mu}\right)\left(\frac{x}{\underline{x}_{mb}}\right)^{\lambda}\right]}{\partial \underline{x}_{mb}} - \frac{\partial R\left(\underline{x}_{mb};\underline{x}\right)}{\partial \underline{x}_{mb}}\left(\frac{x}{\underline{x}_{mb}}\right)^{\lambda} - R\left(\underline{x}_{mb};\underline{x}\right)\left(\frac{-\lambda}{\underline{x}_{mb}}\right)\left(\frac{x}{\underline{x}_{mb}}\right)^{\lambda}\right]\Bigg|_{\underline{x}_{mb}=\underline{x}^o} < 0. \tag{A11}$$

The inequality follows because the first term is zero and the second and third terms are negative. Consequently, $\underline{x}^o$ cannot be a maximum. The second and third terms differentiate the MBO from the raider case. Since both terms are negative for all values of $\underline{x}_{mb}$, the optimal trigger value for $\underline{x}_{mb}$ must be to the left of $\underline{x}^o(\underline{x}_{mb} < \underline{x}^o)$. Q.E.D.

Proof of Proposition 8: Define $S(x) \equiv \gamma(K - V(x;\underline{x})) - R(x;\underline{x}) = \gamma K - (1+\gamma)V(x;\underline{x}) + E(x;\underline{x})$ 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 $V(x) - E(x)$ for $R(x)$, and substituting next for the managers' closure threshold $\underline{x}$,

$$S'(\underline{x}) > 0 \iff -(1+\gamma)\frac{K}{r-\mu} - (1+\gamma)\frac{\lambda}{\underline{x}}\left[K + \frac{f}{r} - \frac{K\underline{x}}{r-\mu}\right] + \lambda(1-\alpha)\frac{K}{\underline{x}} > 0$$
$$\iff -\lambda K\gamma(1-\alpha) > 0. \quad \text{(A12)}$$

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

$$S''(x) = -(1+\gamma)\frac{\lambda(\lambda-1)}{x^2}\left[K + \frac{f}{r} - \frac{K\underline{x}}{r-\mu}\right]\left(\frac{x}{\underline{x}}\right)^{\lambda} + \lambda(\lambda-1)(1-\alpha)\frac{K}{x^2}\left(\frac{x}{\underline{x}}\right)^{\lambda}$$
$$= \frac{-\lambda(\lambda-1)}{x^2}\left(\frac{x}{\underline{x}}\right)^{\lambda}\left[K(\gamma+\alpha-\lambda\gamma(1-\alpha)) + \frac{f}{r}(\gamma-\lambda)\right] < 0. \quad \text{(A13)}$$

Define $S_r(x) \equiv \gamma(K - V(x;\underline{x}))$. We know from 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, $S(x)$ reaches its maximum even earlier. Therefore, $S(x)$ 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 text preceding Proposition 8.

Q.E.D.

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