Disciplinary Takeovers and Industry Effects

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This paper presents a disciplinary explanation for some seemingly paradoxical stylized facts from the takeover literature. Most notable among these are: (1) hostile takeovers are predicted better by industry-wide than by firm-specific performance failures; and (2) gains from a successful bid for a specific firm extend to other firms in the same industry. Our explanation is based on the idea that managerial incentives based on relative performance evaluation may induce an inefficient industry-wide equilibrium in which all firms underperform with respect to a value-maximizing firm, but no firm underperforms with respect to the industry average. A takeover can serve as a means to destroy such an inefficient industry-wide incentive equilibrium.

1. Introduction

The takeover literature usually distinguishes between two broad classes of takeovers: hostile takeovers and friendly ones. A takeover is called *hostile* if it hasn't been approved by the target company's management or its board of directors. Takeovers that are not classified as hostile are called *friendly* takeovers. The present paper focuses exclusively on hostile takeovers.

The debate over motives for, and effects of, hostile takeovers has taken on a polarized character. On one side of the issue stand those who view hostile bids as an effective *means for disciplining*

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non-value-maximizing managers. The argument, which dates back to Marris (1963) and Manne (1965), runs roughly as follows:

> As an existing company is poorly managed . . . the market price of the shares declines relative to the shares of other companies in the same industry or relative to the market as a whole. . . . The lower the stock price, relative to what it could be with more efficient management, the more attractive the take-over becomes to those who believe that they can manage the company more efficiently. (Manne, 1965, pp. 112–113)

Adherents of this view usually strongly favor unfettered hostile activity. They argue that a hostile bid is often the only effective mechanism for removing corporate control from entrenched, inefficient management.[1] And—so the argument extends—actual hostile activity may not even be necessary to produce positive effects: If the probability of a bid increases with managerial misconduct, and if deviating managers are punished sufficiently in the event of a change in control, then the mere threat of a hostile bid makes managers less prone to slack.[2]

This line of reasoning (henceforth called the *disciplinary thesis*) has been questioned by a number of critics. They argue that companies can become targets not only because their managers depart from value-maximizing behavior, but also for a lot of other reasons: stock-market valuation errors (Caves, 1989), unresolved agency conflicts on the bidder's side (Jensen, 1988; Shleifer and Vishny, 1989), bidder hubris (Roll 1986), and redistribution of wealth from current shareholders (Bebchuk, 1989), from taxpayers (Gibson et al., 1988), from workers or managers (Shleifer and Summers, 1988), and from bondholders (Lehn and Paulson, 1988). Also critics deny that the most important *ex ante* impact of hostile activity is a positive incentive effect. Common complaints are that the takeover pressure biases managers' attitudes toward risky projects (Coffee, 1988), destroys their incentives to invest in firm-specific human capital (Laffont and Tirole, 1988), causes them to put too much emphasis on activities that boost short-term performance (Stein, 1988), and induces them to waste time and corporate resources on defensive tactics (Jarrell and Poulsen, 1987).

1. See, for example, Hart (1988a), Harris and Raviv (1988), and Grossman and Hart (1988). These papers analyze the implications of different security voting structures for the corporate-control argument.

2. Formal models along these lines are analyzed in Grossman and Hart (1980) and Scharfstein (1988).

The sharp conflict in hypotheses and the accompanying opposing views over the appropriate policy response have inspired considerable quantitative research. This research has brought out several striking empirical regularities. The present paper tackles some stylized facts from the takeover literature that can be summarized under the heading *industry effects associated with hostile takeovers*:

- The first set of stylized facts stems from quantitative research on the relation between frequency of takeovers and characteristics of targets. If the purpose of takeovers is to correct the non-value-maximizing practices of managers, one would expect that firms that perform particularly poorly would tend to be typical targets. This seems in fact to be the case. Several authors have found that relatively low profits or low ratios of market value to replacement costs increase the likelihood of a takeover.[3] The reported relationships are, however, statistically fairly weak. A statistically more significant relationship has been discovered by Mørck et al. (1988a). These authors find that *hostile takeovers are more reliably predicted by poor performance of a whole industry than by company-specific mismanagement in an otherwise healthy industry*. In discussing Mørck et al.'s paper, Hart (1988b) describes this result as a "major paradox" (p. 132). He writes:

  > This find is quite surprising, since one would naturally suppose that a good indicator of managerial competence (or slack)—and hence of whether the firm is a likely candidate for a disciplinary takeover—is the firm's q relative to that of its industry. Note that I am not suggesting that the industrywide q should not affect the likelihood of a hostile bid. As the authors note, one can imagine general shocks that lead to slack in a whole industry. . . . To the extent that this problem arises because the incumbent managers as a whole find it difficult to adapt to a new environment (to learn new tricks), disciplinary takeovers may be called for to replace them. . . . Nevertheless, it is still very surprising that *only* industrywide q should be important. (Hart, 1988b, pp. 132–133)

- Another set of stylized facts has emerged from empirical work on the behavior of normalized stock prices around the date of a

3. See, for example, Palepu (1986). A brief discussion of some of the older evidence is given in Scherer and Ross (1990, pp. 47 f.).

takeover. Such *event studies* lend some support to the disciplinary thesis by showing that (1) market evaluations of targets decline for a longer period prior to the date of a takeover, and (2) these market evaluations increase strongly around the time of the first public announcement of a bid.[4] More interesting for my work is a stylized fact reported by Eckbo (1983). Eckbo investigates the stock prices of firms involved in a takeover and those of other firms operating in the same branch and finds that *not only the market evaluations of targets, but also those of other firms in the same industry, increase strongly around the time of the first public announcement of a bid*.[5] Abnormal returns do not appear to follow the pattern predicted by the hypothesis that takeover gains emanate from collusion. In their review of the empirical evidence on shareholder wealth effects of takeovers, Jensen and Ruback (1983) point out:

> Eckbo's results . . . are inconsistent with the target inefficiency hypothesis. His evidence indicates that the gains are more general, extending to rivals in the industry as well as to the specific target firm, and removal of inefficient target management is unlikely to be an industry-wide phenomenon. (Jensen and Ruback, 1983, p. 25)

The evidence on industry effects is grist for the critics' mills. They argue that these facts do not conform to the disciplinary thesis but are easily explainable within a *stock-market-valuation-error interpretation of takeovers*. Those who make the case for efficiency-enhancing properties of hostile bids admit that, according to the existing literature, the disciplinary thesis cannot account for industry effects. They theorize that these results might be caused by either data problems or model misspecification. Or they resort to ''learning effects'' (Eckbo, 1983; Mørck et al., 1988a)—a not entirely convincing argument (see Hart's discussion in the preceding paragraph).

This paper investigates the joint working of incentive schemes and hostile takeovers as corporate control mechanisms and shows that the mentioned seemingly paradoxical ''aggregate effects'' are explainable within the disciplinary thesis. In accordance with the rest of the literature, I call takeovers *disciplinary* if they aim at correcting the non-value-maximizing practices of managers of the target firm.

4. See Jensen and Ruback (1983) for a survey on event studies regarding takeovers before 1980, and Jarrell et al. (1988) for an updated review.

5. Other papers documenting significantly positive valuation effects for industry rivals to a takeover bid for a target are Eckbo and Wier (1985), Chatterjee (1986), and Chatterjee (1992).

My disciplinary explanation for the first stylized fact—that hostile takeovers are likely to happen in industries with overall poor performance—is based on the following four elements:

1. A takeover is only one among several means suited to induce the management of a public corporation to work towards shareholders' goals.
2. The takeover mechanism is utilized only if other, less expensive tools (as, e.g., the compensation and dismissal policy of the board, the managerial labor market, etc.) are not effective in deterring self-serving managerial behavior.
3. Other tools are effective in providing incentives in situations where rival firms in the industry are performing well, but they sometimes fail if the whole industry is performing poorly.
4. This is due to the fact that those alternative tools are based on weak relative performance incentives that induce an inefficient equilibrium if no reliable standard of comparison is provided—an inefficient equilibrium in which all firms underperform with respect to a value-maximizing firm, but no firm underperforms with respect to the industry average.

My explanation for the second stylized fact—that hostile takeovers positively affect the performance of other companies in the same industry—is based on the idea that an inefficient equilibrium in which all managements use suboptimal strategies does not survive a takeover that optimally resets the incentive scheme of one of the firms in the industry: post-raid performance of the target management acts as a reliable standard of comparison; given this standard, the weak relative performance incentives in rival firms provide adequate incentives for managers in those firms.

To explore these ideas more formally I need a framework with the following main ingredients: First, a formal representation of an industry. I'll work with the simplest framework in which industry effects can sensibly be represented: a scenario in which two identical firms operate in correlated environments. The second key element in my model is the existence of an agency conflict in each firm. Again I have settled on a very simple frame: I investigate a setting in which at the outset each firm consists of two persons: an owner and a manager. Each manager acquires private information on the realization of some payoff-relevant random variable and can use this information to pursue his own interests. A key element in my argument is that firms are public corporations (in privately held firms takeovers are not needed to change managerial incentives) and that there exist alternative motivating devices for managers. The third ingredient of my modeling approach, therefore, is the assumption that owners devise incentive structures to ensure good management (''contracts'') at the outset and that they sell their firms to the public later on. Finally an important ingredient in my model is the existence of a potential acquirer, the raider. The raider is assumed to arrive after the going-public date. He may acquire control of one of the firms by buying the shares and also paying a deadweight takeover cost.

The assumed sequence of events is as follows: At stage 0 owners simultaneously and independently choose contracts and then sell their firms to the public. At this date all the players have identical beliefs about all payoff-relevant data. The risk-neutral raider arrives at the beginning of stage 1 and investigates one of the firms (determined randomly). In the course of his investigation the raider acquires private information on the amount of the (deadweight) takeover cost. Then he decides whether or not to make a bid. If he makes a bid and gets control of the firm, he can redesign the contract in the target firm. Otherwise, initial contracts remain in force. Now managers acquire their private information and then (at stage 2) simultaneously make publicly observed decisions.

With these ingredients in place it is possible to sketch the broad features of my model. The correlation in environments leads owners to design contracts based on relative-performance evaluation. The least expensive relative-performance scheme penalizes the manager for underperforming relative to other firms in the industry. It does not, however, adequately reward him for outperforming his rivals. If all managers in the industry are compensated in accordance with such schemes, then there is no incorruptible monitoring distribution in the sector to rely on: managers can escape a meaningful comparison by jointly adopting suboptimal strategies. In order to prevent such behavior, at least one management in the sector has to be remunerated in conformity with a more powerful contract. However, high-powered incentive schemes are (*ex ante*) more expensive to shareholders than low-powered ones. This gives rise to a sort of public-good phenomenon in the game among contract designers: While each owner stands prepared to use the performance information revealed by other firms, each would prefer the other to incur the additional costs of the high-powered contract. The presence of this public-good problem leads to the existence of multiple noncooperative equilibria in the contracting game among owners.

The only symmetric equilibrium requires randomizing between high-powered and low-powered incentive schemes. One realization of this equilibrium is a situation in which all firms in the industry employ low-powered incentive schemes. Under such an incentive structure all firms underperform with respect to a value-maximizing firm, but no firm underperforms with respect to the industry average. In my model this is the only situation where disciplinary takeovers (i.e., takeovers that aim at changing the target's operational performance) may occur. Hence, industry averages are better predictors of disciplinary takeovers than firm-specific financial indicators. Furthermore, a disciplinary takeover that provides new incentives for the management of a single firm induces the whole industry to move from an inefficient contracting equilibrium to an efficient one. Thus, disciplinary takeovers are accompanied by an industry-wide increase in stock prices.

These results are introduced in two steps. First (in Section 2) I investigate a model in which the contract-design decisions of initial owners are irreversible, that is, a setting without takeovers. Then (in Section 3) I introduce takeovers as a means to update initial contracts.

My research relates to several strands of previous work. For example, disciplinary takeovers have been previously considered by Grossman and Hart (1980) and Scharfstein (1988). These papers focus on the disciplinary value of the takeover *threat* (i.e., on the *ex ante* effect of takeovers) and not on actual disciplinary takeovers.[6] By contrast, the present paper is on *actual disciplinary takeovers*, and the *ex ante* effect of takeovers is neglected.[7] My research is also related to earlier work on multiple equilibria problems in the subgame defined by a pair of optimal revelation schemes as presented, for example, by Mookherjee (1984), Demski and Sappington (1984), Ma et al. (1988) and Kerschbamer (1994). These papers consider settings where a single principal deals with two agents. In such settings the contracts used in equilibrium are always efficient relative to incentive constraints. By contrast, in the present paper there are two principals as well as two agents. Here suboptimal contract combinations may arise, for example, because of coordination failure. Finally, my research is related to earlier work on the effects of managerial incentives on the

6. Scharfstein, for example, explores a model in which firm value depends on managerial effort and the environment, both unobservable to shareholders. An important feature of his model is: when shareholders observe low firm value, they believe that the environment is unfavorable; they are therefore prepared to sell their shares at a low price. This guarantees that the probability of takeover is high if the firm value is low because the manager shirked. The equilibria characterized by Scharfstein are separating, i.e., in equilibrium the manager doesn't shirk (that is, he reports the environment truthfully), so that shareholders' beliefs are right.

7. The relevant assumption in this respect is that takeovers occur before any information about types is revealed.

industry-wide equilibrium as presented, for example, by Fershtman and Judd (1987), Sklivas (1987), and Caillaud et al. (1995). The focus of these papers is on commitment effects achieved by letting a delegate (the agent) represent the main player (the principal) on some market. On an analytical level a main difference to the present work is that in these papers an interdependence between different principal-agent structures arises because the profit in one firm depends also on the decision made by the second firm, that is, in these papers there is *market interdependence*. In contrast to this, in the present paper the assumed correlation in environments (i.e., an *informational interdependence*) leads to the use of relative performance schemes.

The rest of the paper is organized as follows: The next section presents the basic model and studies equilibria with irreversible contract design decisions. In Section 3 I consider the alternative case in which updating of initial contracts through a takeover bid is possible. Section 4 presents a reinterpretation of the theoretical results in more realistic terms. Section 5 discusses empirical, and Section 6 policy implications. Section 7 finally concludes.[8]

2. Irreversible Contract Design Decisions

2.1 The The Basic Model

2.1.1 Technologies I consider a simple model of an industry consisting of two firms. Each firm i $(= A, B)$ is run by a single risk-averse manager (m^i). Each manager's task is to make an investment decision $(e^i \in E^i)$. Investment, together with the realization of a random variable $(\theta^i \in \Theta^i)$, determines profit $(y^i \in \mathbb{R}^+)$ produced according to the known relationship $y^i = y^i(\theta^i, e^i)$, where $y^i(\theta^i, e^i) \geq 0$ for each e^i and each θ^i. Each random variable θ^i is assumed to have only two possible realizations: $\Theta^i = \{\theta_1^i, \theta_2^i\}$ for $i = A, B$, where $\theta_1^i < \theta_2^i$. The higher realization is assumed to imply higher profits for each level of investment and is therefore referred to as the *favorable firm environment*:

$$y^i(\theta_2^i, e^i) > y^i(\theta_1^i, e^i) \qquad \forall\, e^i \in E^i. \tag{1}$$

Each manager can choose only among two possible investment levels: $E^i = \{e_1^i, e_2^i\}$. For each realization of the random variable θ^i a different

8. Section 2 makes considerable use of results and insights derived in an accompanying paper that focuses on the design aspect of the multiple-principal multiple-agent relationship (Kerschbamer, 1996).

investment level is the better choice:

$$y^i(\theta_k^i, e_k^i) > y^i(\theta_k^i, e_l^i) \qquad \forall k, l \in \{1, 2\},\, k \neq l. \tag{2}$$

The random variables θ^A and θ^B are drawn from a joint distribution $p(\cdot)$ on $\Theta^A \times \Theta^B$. This distribution exhibits positive but imperfect correlation. That is, defining $q_k^i \equiv \text{Prob}(\theta_1^j \mid \theta_k^i)$ for $i, j = A, B, i \neq j$, and $k = 1, 2$, it is assumed that

$$1 > q_1^i > q_2^i > 0 \qquad \forall i \in \{A, B\}. \tag{3}$$

For expositional purposes (to suppress superscripts whenever possible), it is finally assumed that the two firms are *ex ante* (i.e., before θ^A and θ^B are realized) identical. Formally, we have

$$\begin{aligned} \Theta^A &= \Theta^B, \\ E^A &= E^B, \\ y^A(\cdot) &= y^B(\cdot), \\ p_{lk} \equiv p(\theta_l, \theta_k) &= p(\theta_k, \theta_l) \equiv p_{kl} \qquad \text{for} \quad k, l = 1, 2. \end{aligned} \tag{4}$$

2.1.2 Time and Information Structure I assume that firms have a life cycle of the Grossman and Hart (1980) sort: Initially, at stage 0, each firm i belongs to a small group of perfectly colluding shareholders. These shareholders are treated as a single entity, which is called the *owner*, o^i. Owner o^i hires manager m^i and then decides to go public. Since each o^i desires to sell his firm at the highest possible price, he has an incentive to organize his firm so as to maximize expected future earnings. Owners realize that the shares of their firms will be widely held after the going-public date, so that manager control will be poor thereafter because of the familiar free-rider problems associated with dispersed shareholdings. Hence, before going public, owners try to devise incentive structures (*contracts*) to ensure good management.[9] I assume the following sequence

9. Later (in Section 4) I will argue that the term *contract* should be interpreted very broadly as including not only explicit agreements but the whole reward-and-punishment system a typical manager faces. Of course, in the real world owners do not have the power to design every element of the overall incentive mix under which their manager(s) work(s). Parts of the incentive mix are predetermined in the (labor) market, other parts by other outsiders, still others by the working of internal control mechanisms, which are not necessarily under the direct control of initial owners. One can, however, imagine that initial owners can influence or correct the terms of existing contracts through their choice of residual compensating schemes or through the design of internal control mechanisms via provisions in the corporate charter.

of events: At stage 0 the two owners propose contracts to their respective managers. In proposing their contracts (denoted δ^A and δ^B), the owners act simultaneously and in a noncooperative fashion. Contract choices are supposed to be binding in the basic setting of this section, i.e., the rules designed *ex ante* are carried out *ex post*, no matter what the actual configuration of contracts and environments in the industry turns out to be. At the end of stage 0 the owners sell their firms to the public. Up to this date all players have identical beliefs $p(\cdot)$ about the realization of both random variables. Later, in stage 1, each manager alone learns the realization of the random variable that characterizes the technology under which he is employed. After having learned their θ^i's, managers can quite without penalty if they wish. Otherwise they have to make their investment decisions (in stage 2). Managers make their investment decisions simultaneously and in full knowledge of the contract profile (one contract for each firm), but without cooperation or sharing of information. Some time elapses; then investments in both firms become publicly observable and verifiable. Profits in each firm are privately observed by its manager.[10] This provides managers opportunities to divert these resources for private consumption.

2.1.3 Contracts Each o^i chooses his contract from a finite set of feasible contracts Λ^i. Each contract consists of an informal investment recommendation $f^i(\cdot): \Theta^i \to E^i$ and a binding payoff schedule $g^i(\cdot)$. The investment recommendation specifies for any $\theta_h^i \in \Theta^i$ a desired investment level $f^i(\theta_h^i) \in E^i$. The payoff schedule $g^i(\cdot)$ specifies a contingent payment from the manager to the owner. In order to be enforceable the payoff schedule must be conditioned on verifiable variables. The only verifiable variables in my model are the managers' investment decisions.[11] So each enforceable payoff schedule

10. The assumption that investment is contractable while total cash flow is not is made to simplify the analysis. Assuming instead that managers' actions are unobservable and profits observable would require one to let action be a continuous variable and to introduce a disutility for action. The associated additional notation would complicate the analysis without producing results that differed markedly from those presented here.

11. To be more precise: they are the managers' stage-0 contract-acceptance and stage-1 quitting decisions, and their stage-2 investment decisions. However, since situations in which one of the firms is closed down are of limited interest for my work, I deal with the managers' stage-0 and stage-1 decisions in a fairly rudimentary way (see, for example, the next footnote).

can be represented by a function $g^i(\cdot): E^i \times E^j \to \mathbb{R}$.[12] If we denote $f_h^i \equiv f^i(\theta_h^i)$ and $g_{kl}^i \equiv g^i(e_k, e_l)$, we can represent each contract by a vector

$$\delta^i = (f_1^i, f_2^i, g_{11}^i, g_{12}^i, g_{21}^i, g_{22}^i).$$

That is, a contract specifies a desired investment level for each realization of θ^i and a contingent payment from m^i to o^i for each combination of investments. Suppose a given contract contains the investment recommendation $f_1 = e_1$, $f_2 = e_2$. Then we can define the "implicit wage of the manager for correct behavior" by subtracting the payout obligation from the arising profit: $\omega_{kl} = y(\theta_k, e_k) - g_{kl}$. If the manager doesn't obey the investment recommendation, then a difference emerges between ω and his actual monetary payoff. This difference is measured by $\Delta_k \equiv y(\theta_k, e_h) - y(\theta_h, e_h)$, where $k \neq h$. That is, Δ_k denotes the amount of profits the θ_k-manager can appropriate if he behaves as if he had observed θ_h.

2.1.4 Individual Behavior Productivity variables are assumed to be correlated within industries but uncorrelated among them, so that investors are able to obtain complete income insurance. They are therefore prepared to buy shares in each firm from original owners at the expected value. So we can treat original owners as risk neutral. Managers, having no access to the capital market, are identical. Their (twice continuously differentiable, concave, strictly increasing, von Neumann–Morgenstern) utility functions for money, $U(\cdot)$, are assumed to exhibit nonincreasing absolute risk aversion (NIARA).[13] Managers' utility functions are common knowledge, as is the magnitude of their reservation utility $\overline{U}$. Both the reservation utility and the amount of money required to guarantee the reservation utility are normalized to equal zero: $U(0) = \overline{U} = 0$.

2.1.5 Collective Behavior The joint-behavior rules imputed in this paper are in the spirit of perfect equilibrium. Perfect equilibrium requires one to begin by analyzing the last stage of the

12. A payoff schedule of this form is not wholly comprehensive: $g^i(\cdot)$ does not specify any profit transfer from m^i to o^i for the case where corporation j is closed down. To avoid ambiguities I assume that each contract contains a clause specifying that the amount of resources m^i has to disburse to o^i if firm $j \neq i$ is closed down is $g^i(e_1, -) = y(\theta_1, e_1)$, $g^i(e_2, -) = y(\theta_1, e_1) + y(\theta_2, e_2) - y(\theta_2, e_1)$. A justification for this assumption is given below.

13. This assumption ensures that stochastic payoff schedules are never optimal.

game—the managers' choice of investment levels, given contract-proposal, -acceptance, and -quitting decisions. I call this final game the *agents' game*.

To begin with, suppose that both types of both managers are active players in this game, i.e., both managers have accepted their contracts at stage 0, and no type of any manager has quit at stage 1. In this case each manager's pure strategy set at this stage consists of functions $h^i(\cdot)$ from Θ^i to E^i. The equilibrium concept used to predict the behavior in this game is that of a Bayesian equilibrium (BE). I use $\Phi(\delta)$ to denote the set of BEs induced by an accepted $\delta \in \Lambda = \Lambda^A \times \Lambda^B$. Since the agents' game is finite, there exists at least one BE for each δ, so that $\#\Phi(\delta) \geq 1$. If $\#\Phi(\delta) > 1$ for a given δ in Λ, then I use a semiorder R (defined below) to select a single element $\bar{h}(\cdot) = (\bar{h}^A(\cdot), \bar{h}^B(\cdot))$ in $\Phi(\delta)$. I then proceed as though $\bar{h}(\cdot)$ were the unique element in $\Phi(\delta)$. If $\Phi(\delta)$ is a singleton for a given δ, I calculate the interim expected utility for each manager for each realization of his private information [denoted $\text{eu}^i(\delta \mid \theta_h^i)$] under this δ in the obvious way.

If for every $i \in \{A, B\}$ and for every $\theta_h^i \in \Theta^i$ one has $\text{eu}^i(\delta \mid \theta_h^i) \geq 0$, then each o^i's *ex ante* valuation of δ [denoted $\text{ev}^i(\delta^i, \delta^j)$] is computed by using the equilibrium strategies $\bar{h}(\cdot)$ and the prior probabilities $p(\cdot)$. If $\text{eu}^i(\delta \mid \theta_h^i) < 0$ for at least one $\theta_h^i \in \Theta^i$ of at least one $i \in \{A, B\}$, then the individual-rationality constraint for this type is violated and the $\text{ev}^i(\delta^i, \delta^j)$'s are determined differently.[14] When we have derived the $\text{ev}^i(\delta^i, \delta^j)$'s for each δ in Λ, we can use these reduced-form payoffs to calculate the set of Nash equilibria (NEs) in the contract-writing game among owners. I use Γ to denote the set of NEs in this game.

If $\#\Phi(\delta) > 1$ and/or $\#\Gamma > 1$, one has to ask which of the elements, if any, is a reasonable prediction. I deal with this question by imposing two different choice criteria in each of these sets:

14. To keep things simple I use the following conventions: If $\text{eu}^i(\delta \mid \theta^i) < 0$ for both realizations of θ^i of one $i \in \{A, B\}$ and $\text{eu}^j(\delta \mid \theta^j) > 0$ for at least one realization of θ^j ($j \in \{A, B\}$; $i \neq j$), then I assume that firm i is closed down and m^j plays $h^j(\theta_1^j) = e_1$, $h^j(\theta_2^j) = e_2$ as a best response to the payoff schedule specified in footnote 8; o^i gets a payoff of zero and o^j gets $\text{ev}^j(\delta^j, \delta^i) = \lambda \equiv y(\theta_1, e_1) + p_2[y(\theta_2, e_2) - y(\theta_2, e_1)]$, where p_2 is defined by $p_2 \equiv p_{21} + p_{22}$. All other contract constellations under which the individual rationality constraint for at least one type of at least one manager is violated are treated similarly, with one exception: the firm that is closed down is assumed to be determined by a flip of a fair coin, so that $\text{ev}^i(\delta^i, \delta^j) = \text{ev}^j(\delta^j, \delta^i) = \lambda/2$ under these contract constellations.

symmetry and *payoff dominance*.[15] Throughout I give symmetry the first priority, and payoff dominance the second. For a discussion on the philosophical and logical underpinnings behind this precedence relation see Harsanyi and Selten (1988).

To avoid a trivial openness problem in the design of optimal contracts I employ *weak firm loyalty* (WFL) as defined in Kerschbamer (1996) as an additional selection criterion in the agents' game. This criterion eliminates undesired equilibria in the agents' game that could also be eliminated by one of the owners at an arbitrary low cost. As a purely technical device, WFL is applied before symmetry and payoff dominance. Together symmetry, payoff dominance and—in the agents' game—WFL define an order relation R on $\Phi(\delta)$ and on Γ. Although this relation is only reflexive and transitive but not complete, it suffices—in our present context—to select a single maximal element in the relevant $\Phi(\delta)$'s and in Γ.

2.2 Preliminary Results

The main result of this section (Proposition 1) is presented in Subsection 2.3. The proof of this result, as well as the intuition behind it, relies on a number of observations that are reported as Lemmas 1–6. Lemmas 4 and 6 follow directly from the arguments in the text. The other lemmas are proved in Appendix A. Lemma 1 discusses a benchmark solution in which there is a single active firm in the market. In this lemma reference is made to ω_1 and ω_2. These variables are defined as $\omega_1 \equiv y(\theta_1, e_1) - g_1$ and $\omega_2 \equiv y(\theta_2, e_2) - g_2$, where g_k is the active manager's payout obligation if his decision is e_k.[16]

Lemma 1: *Suppose there is a single active firm in the industry. Then the optimal contract in this firm has* $f_1 = e_1,\ f_2 = e_2,\ \omega_1 = 0,\ \omega_2 = \Delta_2$.

I term the contract characterized in Lemma 1 the *optimal independent contract* and denote it by δ^I. Note that if the owner offers δ^I, the respective manager will accept the offer and obey the investment recommendation. The manager gets his reservation utility in the low-productive environment and earns a rent if $\theta^i = \theta_2^i$. The exis-

15. In the agents' game, the BE $r \in \Phi(\delta)$ is payoff-dominated if there exists another BE $\hat{r} \in \Phi(\delta)$ that weakly increases each manager's interim expected utility in each environment with at least one strict increase for each manager. Similarly, the CE $\hat{\delta} \in \Gamma$ payoff-dominates the CE $\delta \in \Gamma$ if each owner's *ex ante* valuation of $\hat{\delta}$ is strictly higher than that of δ.

16. In the statement of Lemma 1 and in the rest of the paper the relation $y(\theta_1, e_1) > p_{2y}(\theta_2, e_1)$ is supposed to hold. This assumption guarantees that it is not optimal to concentrate exclusively on the favorable firm environment while shutting down the operation when $\theta^i = \theta_1^i$.

tence of this rent can easily be understood: If the owner attempted to reach the first best solution by instructing the manager to make efficient investments ($f_1 = e_1$, $f_2 = e_2$) and by collecting the resulting surplus ($\omega_1 = \omega_2 = 0$), the manager in the favorable firm environment would always have an incentive to misrepresent his private information: by choosing e_1 he could divert corporate resources in the magnitude of Δ_2 for private consumption. To counteract this tendency ω_2 must be higher than ω_1 by at least this amount. Since ω_1 cannot be negative, a rent for the θ_2-manager results. An immediate implication is that the owner's *ex ante* payoff under δ^I [denoted by[17] $\mathrm{ev}(\delta^I, -)$] is lower than that in the first best solution.

Having identified δ^I as the optimal contract for an owner who deals with his manager in isolation, a first question of interest is whether the strategy profile (δ^I, δ^I) constitutes a NE in the contractual game among owners. The answer turns out to be no. This result is recorded as:

Lemma 2: *A vector of independent contracts (one for each owner-manager pairing) doesn't constitute a NE in the contractual game among owners.*

The intuition underlying this result is as follows: We know that an optimal independent contract is necessarily only second best: because m^i has privileged information about θ^i, he is able to command a share of the surplus in the form of a rent. This implies that the owner would be strictly better off if he could observe his firm's environment along with his manager. Perfect observation is impossible. But even imperfect information is of value. If one owner commits to δ^I, the investment behavior of the respective manager provides such imperfect information. The second manager is, for example, more likely to work in the favorable firm environment if the manager under the independent contract makes investment e_2, rather than if he chooses e_1. The presence of this information enables the owner of the second firm to offer a contract that reduces the informational rent of the respective manager. The form of this contract is characterized in Lemma 3.

Lemma 3: *Suppose o^i and m^i sign δ^I. Then the best response of o^j is to offer a contract characterized by (I drop the j superscript)*

$$f_1 = e_1, \qquad f_2 = e_2, \tag{5}$$

17. Throughout I use the symbol $\mathrm{ev}^i(\delta^i, -)$ if δ^i has a form that makes o^i's *ex ante* valuation of (δ^i, δ^j) independent of δ^j.

$$\omega_{11} > \omega_{12}, \qquad \omega_{21} = \omega_{22} = \omega_2, \tag{6}$$

$$q_1 U(\omega_{11}) + (1 - q_1)U(\omega_{12}) > q_1 U(\omega_{21} + \Delta_1) + (1 - q_1)U(\omega_{22} + \Delta_1), \tag{7}$$

$$q_2 U(\omega_{21}) + (1 - q_2)U(\omega_{22}) = q_2 U(\omega_{11} + \Delta_2) + (1 - q_2)U(\omega_{12} + \Delta_2), \tag{8}$$

$$q_2 U(\omega_{21}) + (1 - q_2)U(\omega_{22}) \geq q_1 U(\omega_{11}) + (1 - q_1)U(\omega_{12}) = 0. \tag{9}$$

I term the contract characterized in Lemma 3 the *optimal weak comparative contract* and denote it by δ^W. If o^i and m^i commit to δ^I and o^j offers δ^W, then m^j will accept the offer and obey the investment recommendation. This follows from relations (7), (8), and (9) and from WFL. Relations (7) and (8) reflect the requirement that, conditional on his private information and the belief that the second manager obeys the investment recommendation of δ^I, the manager under consideration does not prefer to adopt a strategy other than that designated for him. Equation (8) tells us that the binding incentive problem is again to prevent the manager in the favorable firm environment from behaving as if he had observed θ_1.

From condition (6) we can see how this incentive problem is mitigated under δ^W. This contract offers the manager who makes the investment decision e_1 a relatively low implicit wage if the second manager chooses e_2 and a higher wage if he chooses $e_1 : \omega_{11} > \omega_{12}$ helps with incentives because if the manager observes θ_1 and chooses e_1, then he knows that the other firm is relatively unlikely to be in the favorable environment (and thus, the respective manager is relatively unlikely to make the investment e_2), and so he is unlikely to suffer the penalty w_{12}; but if he observes θ_2 and mimics θ_1, he assesses the penalty ω_{12} to be more likely. This ''screening by expectations'' eases the binding incentive problem and thereby reduces the rent the manager can command from his private information. As a result, given that the players in the second firm commit to δ^I, an owner's *ex ante* payoff under δ^W is higher than that under $c^I : \text{ev}(\delta^W, \delta^I) > \text{ev}(\delta^I, -)$.

In the situation just considered the investment behavior in one firm produces an *informational externality* that enables the owner of the second firm to take advantage of the correlation between environments. Clearly, both owners would prefer to sign δ^W provided that the players in the second firm commit to δ^I. A natural question therefore is whether the constellation (δ^I, δ^W) constitutes a NE in the contractual game among owners. Again, the answer is no. The intuition seems clear: In the situation under consideration δ^W induces the respective manager to play the perfectly revealing investment strategy "choose the investment level e_1 in the unfavorable firm environment and the level e_2 in the favorable one" as a Bayes Nash response to the same investment strategy chosen by the manager under δ^I. Since δ^W is a best response to c^I and since c^I and c^W induce the same investment behavior in the game among managers, δ^W should be a best response to c^W, too.

However, the matter is somewhat more complicated:

Lemma 4: *A vector of weak comparative contracts doesn't constitute a NE in the contractual game among owners.*

The explanation for this result is that the contract combination (δ^W, δ^W) produces not only a BE in which managers obey their investment recommendations, but also another solution. In this solution both managers behave as if they had observed the unfavorable firm environment at all times.

To see that these strategies form a BE, first remember that under δ^W we have $\omega_{11} > \omega_{12}$. Hence, using (7), $U(\omega_{11}) > q_1 U(\omega_{11}) + (1 - q_1)U(\omega_{12}) > U(\omega_2 + \Delta_1)$. Similarly, using (8), $U(\omega_{11} + \Delta_2) > q_2 U(\omega_{11} + \Delta_2) + (1 - q_2)U(\omega_{12} + \Delta_2) = U(\omega_2)$.

From these relations we can also see that the interim expected utility of each manager in each environment goes strictly up on moving from the first to the second BE. Thus, given the assumption of payoff dominance, the managers will focus on the latter; i.e., they misrepresent their private information in order to divert corporate resources for private consumption. Since the owners could improve their position by reducing ω_{11} without causing any quittings, (δ^W, δ^W) cannot form a NE in the contractual game among owners.

The question therefore remains: What is an owner's best response to δ^W signed in the rival firm? Lemma 5 deals with this question:

Lemma 5: *Suppose o^j and m^j sign δ^W. Then the best response of o^i is to offer a contract characterized by conditions (5), (7), (8), and (9) of Lemma 3 and by*

$$\omega_{21} = \omega_{11} + \Delta_2 > \omega_{12} + \Delta_2 = \omega_{22}. \tag{10}$$

I term the contract characterized in Lemma 5 the *optimal strong comparative contract* and denote it by δ^S. If o^j and m^j commit to δ^W and o^i offers δ^S, then m^i will obey the investment recommendation at stage 2. This follows from the fact that conditions (7), (8), and (10) together imply that choosing the efficient investment levels in each environment is a dominant strategy for the manager under consideration (and from WFL). Notice that the implicit wage of the manager under δ^S depends on the investment behavior of the second manager, whatever his own investment behavior is ($\omega_{11} \neq \omega_{12}$, $\omega_{21} \neq \omega_{22}$). Roughly speaking, the payoff structure under δ^S works in such a way that the manager is not only penalized for underperforming relative to the other firm in the industry ($\omega_{12} < \omega_{11}$), but is also rewarded for outperforming his rival ($\omega_{21} > \omega_{22}$). The reward for outperforming the rival is chosen in such a way that a manager in the favorable firm environment who expects that his rival will always behave as if he had observed θ_1 has no incentives for not obeying his investment recommendation ($\omega_{21} = \omega_{11} + \Delta_2$). This eliminates the attraction to the managers of jointly adopting strategies other than those intended for them.

Before proceeding, it will be useful to record a relation between the owner valuations of different constellations of the contracts treated so far:

Lemma 6: *Let* $\text{ev}(\delta^*, \delta^*) = \text{ev}^i(\delta^i, \delta^j)$ *denote* o^i*'s* ex ante *valuation of* (δ^i, δ^j). *Then the following sequence holds*:

$$\text{ev}(\delta^W, \delta^I) = \text{ev}(\delta^W, \delta^S) > \text{ev}(\delta^S, \delta^I) = \text{ev}(\delta^S, \delta^S) = \text{ev}(\delta^S, \delta^W)$$

$$> \text{ev}(\delta^I, -) > \text{ev}(\delta^W, \delta^W).$$

The equality signs in this sequence result from the facts that (1) each o^i's payoff under a given contract combination doesn't depend upon δ^j directly, but only indirectly via the investment behavior the contract combination generates, and that (2) all of the listed contract constellations, except (δ^W, δ^W), induce the same BE in the agents' game. The strictly greater signs between δ^W and δ^S on the one hand, and between δ^S and δ^I on the other, follow from the fact that the program leading to δ^W is less restrictive than that yielding δ^S while the latter is less restrictive than that generating δ^I. The last sign $>$ in the chain results from the facts that (1) (δ^W, δ^W) leads to a pooling investment behavior in the agents' game under which each owner's payoff is a constant for each realization of θ, that (2) this constant (by definition) cannot exceed an owner's payoff under an optimal independent pooling contract and that (3) by the optimality of δ^I an owner's payoff under an optimal independent pooling contract cannot exceed that under δ^I.

2.3 Inefficient Industry-wide Incentive Structures as an Equilibrium Phenomenon

In the situations considered in the last subsection the owners act in different ways and have different *ex ante* payoffs. Since the considered game is perfectly symmetric, it seems natural to look for symmetric equilibria in which the players in both firms act in the same way. This leads us to my first main result, recorded as Proposition 1. Proposition 1 first claims that there exists no symmetric equilibrium in pure strategies and then characterizes a symmetric equilibrium in mixed strategies.

To facilitate the understanding of this proposition it is constructive to start with a simple example in which each owner's pure-strategy set is restricted to $\hat{\Lambda}^i = \{\delta^I, \delta^W, \delta^S\}$. From Lemmas 3 and 5 we know that if o^i chooses δ^I, then o^j moves to δ^W, which induces o^i to play δ^S. But then o^j sticks to δ^W, which exhausts all the possibilities for a symmetric pure-strategy NE in this game. There is, however, such an equilibrium in mixed strategies: Imagine that o^j plays δ^S with probability α and δ^W with probability $1 - \alpha$. Then o^i, by choosing δ^S, gets $\mathrm{ev}(\delta^S, \delta^S) = \mathrm{ev}(\delta^S, \delta^W)$ $[= \mathrm{ev}(\delta^S, -)$, say$]$ for sure. By playing δ^W he induces a probability distribution with two possible outcomes: There is a chance α of (δ^W, δ^S), where the associated BE in the agents' game produces the desired investment-behavior, and there is a chance $1 - \alpha$ of (δ^W, δ^W), where both managers always behave as if they had observed the unfavorable firm environment. Since $\mathrm{ev}(\delta^W, \delta^S) > \mathrm{ev}(\delta^S, -)$ and $\mathrm{ev}(\delta^S, -) > \mathrm{ev}(\delta^W, \delta^W)$ and since the payoff for δ^W is a linear combination between the higher value in the former inequality and the lower in the latter, there is a number α from the interval $(0, 1)$ such that $\mathrm{ev}(\delta^S, -) = \alpha\,\mathrm{ev}(\delta^W, \delta^S) + (1 - \alpha)\,\mathrm{ev}(\delta^W, \delta^W)$. Denote this α by $\hat{\alpha}$.

Now consider the following pair of strategies: both owners commit to δ^S with probability $\hat{\alpha}$ and to δ^W with probability $1 - \hat{\alpha}$. Then, since the game is perfectly symmetric, and since each o^i's payoff for δ^S is the same as that for δ^W and these two are strictly higher than that for δ^I, the range of best responses for any owner (to the opponent's proposed move) is any mixed strategy that puts zero probability on δ^I. Hence, each owner is prepared to play what the predicted selection specifies.

The argument remains much the same if we consider the whole set of possible stage-0 contracts. The main difference is that δ^W is not optimal in an environment in which the combination of δ^W with the distribution over contracts induced by the strategy played by the second owner yields the desired separating investment behavior only with probability $\alpha \in (0, 1)$, and the BE in which both managers always behave as if they had observed the unfavorable environment with probability $1 - \alpha$. Thus, a new contract, denoted by δ^{α^*}, is introduced. This contract is a member of a range of *modified weak comparative contracts*, each indexed by α, where $\alpha \in (0, 1)$. Each δ^{α} is a close relative of δ^{W}. Both contain the same investment recommendation. They differ, however, in the payout function: The original weak comparative contract chooses the payout function so as to maximize $M \equiv \sum_{k=1}^{2} \sum_{l=1}^{2} p_{kl} g_{kl}$, subject to the usual individual-rationality and Bayesian-incentive constraints; δ^{W} is therefore optimal for a setting in which managerial behavior is fully revealing with probability one. The program leading to δ^{α} has the same set of relevant constraints but a different objective—namely, to maximize $\alpha M + (1 - \alpha) g_{11}$; thus, δ^{α} is the best weak comparative contract for a situation in which there is a chance α that managerial behavior is fully revealing and a chance $1 - \alpha$ that both managers choose the strategy $h(\theta_1) = h(\theta_2) = e_1$. In the proof of Proposition 1 (in Appendix B) I show that in the relevant range of values of α, δ^{α} has the same qualitative characteristics as δ^{W} has.

Proposition 1: *There is no symmetric pure-strategy equilibrium in the perfectly symmetric contractual game among owners. In a symmetric equilibrium in mixed strategies each owner plays δ^{S} with probability $0 < \alpha^* < 1$ and δ^{α^*} with probability $1 - \alpha^*$. In this equilibrium the two firms end up with $(\delta^{\alpha^*}, \delta^{\alpha^*})$ with probability $(1 - \alpha^*)^2$. If this contract constellation is realized, both managers "cheat" their owners by jointly adopting suboptimal strategies.*

In the proposed equilibrium the lack of coordination among owners generates various inefficiencies. First, there is an $\alpha^* \times \alpha^*$ chance of the contract combination (δ^{S}, δ^{S}). In this realization there is *excess control*: Both owners employ a contract with a high-powered payout schedule although a single high-powered incentive scheme (when combined with a weak comparative contract) would suffice to induce both managers to tailor their investments to the environment. In this realization one of the two owners could obtain strict gains by switching to δ^{W}. Second, there is a chance $\alpha^*(1 - \alpha^*)$ of each of the two mirror-image pairs $(\delta^{\alpha^*}, \delta^{S})$ and $(\delta^{S}, \delta^{\alpha^*})$. These institutional structures are also not efficient relative to incentive constraints: Although δ^{α^*} is (*ex ante*) optimal for probabilistic beliefs about the incentives prevailing in the rival firm, it is not (*ex post*) optimal once uncertainty about contracts has been resolved. In each of these mirror-image pairs the owner choosing δ^{α^*} could obtain strict gains by redesigning his contract to δ^W. Finally there is a chance $(1 - \alpha^*)^2$ of $(\delta^{\alpha^*}, \delta^{\alpha^*})$. Under this contract combination there is no incorruptible monitoring distribution in the sector to rely on: managers can escape a meaningful performance comparison by jointly mimicking unfavorable environments; the whole industry seems to be troubled by an adverse shock. In this realization both owners would be strictly better off with a more powerful incentive scheme in one of the firms.

The explanation for the inefficiencies in the design of institutions implied by Proposition 1 is basically the same as that for other coordination-failure results in the economic literature: The key observation is that the presence of externalities can lead to the existence of multiple noncooperative equilibria. The multiplicity of equilibria creates a demand for coordination. With uncoordinated maximization an industry or economy can get stuck at an inefficient equilibrium even though a superior noncooperative solution exists. In the inefficient equilibrium profitable opportunities from an overall change in strategies (from a coordinated change in institutional design) remain unrealized.

3. Contract Renegotiation and Industry Effects

3.1. The Extended Basic Model

Up to now we have examined a scenario in which initial owners choose their contracts irrevocably at date 0. The institutional idea behind this assumption was that each firm has a continuum of owners after this date. In this case, the incentives for any individual shareholder to collect information about possible improvements in the governance structure are likely to be weak; and even if information about inefficiencies in contract design is cheaply available, arranging renegotiations with the management (for example by initiating a proxy contest) may not be worthwhile for a small stockholder if there are nontrivial costs associated with this activity.

None of these arguments holds for a potential large shareholder. In this section I introduce such a potential large shareholder, the *raider*. Again the game is described as consisting of three stages. In stage 0 we have again the contract-writing game among owners. To keep matters simple, I assume that owners play the mixed-strategy equilibrium of Proposition 1 in this game, ignoring the possibility of future takeovers.[18] At the end of the contract-writing game the owners sell their firms to the public.

The risk-neutral raider arrives at the beginning of stage 1 and investigates one of the firms. Which firm he investigates is determined by an *a priori* move by nature: μ is the objective probability, known by all players, that firm A is the target of the investigation; $1 - \mu$ is the corresponding probability for firm B. In the course of his investigation the raider gets to know the contract of the firm under consideration and that of its rival. In addition he acquires private information on the amount of a (deadweight) takeover cost c that he has to incur if he makes a bid. I assume that c is a nonnegative random variable drawn from a known cumulative distribution $Z(\cdot)$ on $[\underline{c}, \bar{c}]$, with strictly positive density $z(\cdot)$. On the basis of the information acquired in the course of his investigation the raider has to decide whether or not to make a bid. To abstract from Grossman and Hart's (1980) free-rider problem, I assume that the raider can get the firm in the bid at a price that equals the expected value of the target in the absence of a takeover as assessed by shareholders given the bid.[19]

I distinguish two different cases with respect to the observability of contracts to the shareholders at the time of the bid. In case 1, shareholders observe neither which incentive structure prevails in the industry, nor which contract is in force in a particular firm. They must use the *ex ante* probabilities of the mixed-strategy equilibrium at the contract-writing stage of the game in valuing firms. I call this the *unobservable-contracts* case. In case 2, information about contracts in the industry is shared by all parties at the time of the bid. I call this the *observable-contracts* case.

If the raider makes the bid and gets control of the firm, he is assumed to be able to implement the first best contract. If he doesn't make a bid or if the bid is rejected by shareholders, initial contracts remain in force. The rest of stage 1 and the whole stage 2 are as in the basic model.

18. In a supplement to this paper (available upon request) I show that the qualitative results remain unchanged if owners are aware at the contract-writing stage of the game that takeovers become a possibility between the going-public and the investment date.

19. In an unconditional-offer scenario this amounts to assuming that the successful raider is able to dilute the posttakeover value of not tendered shares by a rather large amount.

3.2 Determinants of Takeovers and Characteristics of Targets

A first question of interest is which characteristics make a firm especially vulnerable to a takeover. Proposition 2 deals with this question. In this proposition δ^T denotes the contract in effect in the target firm and δ^R that effective in the rival firm.

Proposition 2: *In the unobservable-contracts case the equilibrium probability of takeover, ρ^*, is unaffected by the incentive structure prevailing in the industry prior to the date of the bid. In the observable-contracts case, however, it depends on (δ^T, δ^R). In this case a takeover bid may be triggered by the threat that a bad industry-wide incentive equilibrium would prevail if none of the initial contracts were to be replaced. That is, if $\rho^*(t \mid \delta^T, \delta^R)$ denotes the probability of takeover given the incentive structure (δ^T, δ^R), then $\rho^*(t \mid \delta^{\alpha^*}, \delta^{\alpha^*}) \geq \rho^*(t \mid \delta^T, \delta^R)$ for all $(\delta^T, \delta^T) \neq (\delta^{\alpha^*}, \delta^{\alpha^*})$. This inequality is strict if—for each (δ^T, δ^R)—takeover is a probabilistic event from a prior-to-the-date-of-the-bid perspective.*

The explanation for this result (formally verified in Appendix C) is readily provided: Because of shareholders' poor information, the equilibrium acquisition price in the unobservable-contract case is the same under each contract constellation; since the posttakeover value of the target is unaffected by (δ^T, δ^R) too, the first statement follows. Since (1) the equilibrium acquisition price is equal to shareholders' assessment of $\mathrm{ev}^T(\delta^T, \delta^R)$, since (2) in the observable-contracts case this assessment is unequivocally lowest under $(\delta^{\alpha^*}, \delta^{\alpha^*})$, and since (3) the value of the firm under the raider's control is independent of existing contractual arrangements, it follows that the payoff for the raider from making a bid is nonnegative for a wider range of takeover costs if $(\delta^T, \delta^R) = (\delta^{\alpha^*}, \delta^{\alpha^*})$ than if $(\delta^T, \delta^R) \neq (\delta^{\alpha^*}, \delta^{\alpha^*})$. This proves the second part of the statement.

Proposition 2 establishes a relationship between frequency of takeovers and incentive structures in the industry. To compare this result with the findings of the empirical investigations quoted in the introduction we need (1) a relation between incentive structures in the industry and performance characteristics of targets, and (2) a workable definition of "disciplinary takeovers." Ad (1): The first task is easily carried out: If $(\delta^T, \delta^R) = (\delta^{\alpha^*}, \delta^{\alpha^*})$, then managers choose, in the absence of a takeover, the equilibrium strategies of always behaving as if the unfavorable firm environment were realized. Thus, if $(\delta^T, \delta^R) = (\delta^{\alpha^*}, \delta^{\alpha^*})$, then $(e^T, e^R) = (e_1, e_1)$ with probability one. If $(\delta^T, \delta^R) \neq (\delta^{\alpha^*}, \delta^{\alpha^*})$ the incentive structure implements the owners' desired investment behavior. Thus, if $(\delta^T, \delta^R) \neq (\delta^{\alpha^*}, \delta^{\alpha^*})$, then

$[(\theta^T, \theta^R) = (\theta_k^T, \theta_l^R) \Leftrightarrow (e^T, e^R) = (e_k, e_l)]$. Ad (2): Mørck et al.—the authors of one of the empirical investigations discussed in the introduction—call takeovers ''the purpose of which seems to be to correct the non-value-maximizing . . . practices of managers of the target firm'' (p. 101) *disciplinary takeovers*. Leaning upon this definition, I define a takeover to be disciplinary if at least a part of the takeover gain is due to a change in the (expected) operating strategy of the target firm's management. Since a change in the operating strategy is only sensible if $(\delta^T, \delta^R) = (\delta^{\alpha^*}, \delta^{\alpha^*})$, we have:

Proposition 3: *In the unobservable-contracts case there is no difference between the performance characteristics of targets of disciplinary takeovers and other targets. In the observable-contracts case disciplinary takeovers are entirely explained by poor industry performance. Poor performance of the target relative to other firms in the industry does not predict disciplinary takeovers.*

The first part of Proposition 3 is a peculiarity of the static model considered here. Since this result would not survive the introduction of a signal for the performance of the corporation under the current management, it is of limited interest. The second part is more interesting. This finding is identical to the ''major paradox'' (Hart, 1988b, p. 132) that hostile takeovers are reliably predicted by poor performance of a whole industry but not by company-specific mismanagement in an otherwise healthy industry. The explanation suggested by the present work has four main elements: (1) a takeover is only one of several means suited to induce the management in a public corporation to work towards shareholders' goals; (2) the takeover mechanism is operated only if other, less expensive tools (''contracts'') are not effective in deterring self-serving managerial behavior; (3) other tools are effective in providing incentives in situations where rival firms in the industry are performing well, but they sometimes fail if the whole industry is performing poorly; (4) this is due to the fact that these tools are based on relative performance evaluation, which collapses if no reliable monitoring distribution is provided.

Remark: The referee points out that there is room in my model for a second kind of hostile takeover besides those aimed at changing the target's operational performance (i.e., besides disciplinary ones)—namely, for takeovers motivated by a desire to reduce managerial rents. The probability of these takeovers will, in general, depend on firm-specific profitability. Hence, the likelihood of hostile bids as a whole will also depend on firm performance even if disciplinary takeovers alone are entirely explained by (poor) industry performance. The referee is indeed right. However, as the coeditor observes, it is unlikely that in practice many takeovers are motivated by a desire to expropriate managers, since managerial compensation is usually a small fraction of total firm value. In my model such takeovers can be deterred by assuming that fixed costs of takeover are sufficiently high. This is the case if $\underline{c} > \mathrm{ev}(\delta^f, -) - \mathrm{ev}(\delta^S, \delta^S)$, where δ^f denotes the first best contract.

3.3 Consequences of Takeovers for Other Firms in the Same Industry

We have defined a takeover to be disciplinary if at least a part of the takeover gain results from a change in the (expected) operating strategy of the incumbent management. A change in the target's operating strategy is profitable if and only if the management's planned decision is not optimally tailored to the environment. In my model this is solely the case if $(\delta^R, \delta^T) = (\delta^{\alpha^*}, \delta^{\alpha^*})$. Under this contract constellation both managements, in the absence of a takeover, always behave as if the unfavorable firm environment were realized; and a successful takeover for one firm leads to a change in operating strategy not only in the target but also in the rival firm:

Proposition 4: *A disciplinary takeover of the target firm has allocative consequences for the rival firm.*

The driving force behind this result is easily located: After a takeover the manager of the target firm is confronted with completely new incentives. As a well-motivated agent, he generates the monitoring distribution that is necessary for a meaningful relative comparison. Given this monitoring distribution, the weak comparative contract in the rival firm provides adequate incentives for the management in that firm.

The *allocational externality* of Proposition 4 has obvious consequences for the value of the rival firm as assessed by shareholders:

Implication 4.1: *In the observable-contracts case a disciplinary takeover raises the market price of shares in the target's rival. In the unobservable-contracts case every takeover has such an external share-price effect.*

In the observable-contracts case, the revaluation effect is clear: A disciplinary takeover raises investors' assessment of the value of the rival firm from $\mathrm{ev}(\delta^{\alpha^*}, \delta^{\alpha^*})$ to $\mathrm{ev}(\delta^{\alpha^*}, \delta^{f}) = \mathrm{ev}(\delta^{\alpha^*}, \delta^{S})$, where δ^f denotes the first best contract. In the unobservable-contracts case shareholders don't know whether a successful takeover is disciplinary or not. They do not care about this, however. For them each takeover resolves uncertainty: An undesired event—the pretending equilibrium in the agents' game—which is a probabilistic event in the absence of takeover, becomes impossible if a takeover is successfully carried out. This inevitably leads to an upward revaluation of the market price of shares in the rival firm.

Remark: The referee points out that Scharfstein (1988) provides an alternative explanation for the fact that takeovers are accompanied by an industry-wide increase in stock prices if we allow (1) for some renegotiation of incentive contracts and (2) for updating (downwards) of takeover costs after a firm in the industry is taken over. As Scharfstein showed, increased takeover pressure decreases managerial rents in the optimal incentive scheme. As a result, we should see (possibly after renegotiation) incentive schemes with lower managerial rents after a downward revision in expected takeover costs called forth by a successful bid. A third explanation for the value revision in share prices of industry rivals after a takeover bid is provided by Kerschbamer (1997). There that effect emerges as a normal share-price reaction in a situation of positively correlated environments and uncertainty about whether the raider possesses inside information about the target or not.

4. A Reinterpretation of the Theoretical Results in More Realistic Terms

Although my formal model narrowly focuses on contracts, I believe that the intuition behind my results extends quite well to more realistic incentive systems:

4.1 The Board of Directors

An important real-world institution by which shareholders control their management is the *board of directors*. The board's nominal power of control is in many respects similar to that of the residual claimant in a closely held business organization. Similar rights are, however, not enough. We also have to ask for the incentives. Why should a board without a significant stake in the firm act on behalf of shareholders?

Several papers have attempted to assess the effectiveness of boards in disciplining top managers by an active compensation policy. The typical finding has been that the empirical relation between the pay of top-level executives and firm performance is positive but very small in terms of the implied incentives [see Mørck et al. (1988b) and Jensen and Murphy (1990)]. Similarly the findings on incentives through the threat of performance-related dismissal: Coughlan and Schmidt (1985), Warner et al. (1988), and Jensen and Murphy (1990) all find that the relation between the probability of a change in top management (replacement of current managers, addition of new managers from inside or outside the firm) and firm performance is negative but very small and that only very poor performance for a long time brings about a turnover.

A study of Mørck et al. (1989) adds to our understanding of the functioning of corporate boards by contrasting industry-wide and firm-specific performance failures. The authors find that boards without significant stakes in their firms tend to respond to particularly poor performance by their own relative to other firms in the same industry by precipitating turnover. When the whole industry is suffering, the board is more reluctant to make changes.[20]

These findings suggest that the real-world decision problem of whether and how to motivate the board of directors[21] is isomorphic to the decision problem of our initial owners in the contract-writing

20. One explanation for this finding is that boards have fairly good information regarding managerial activity but that they *collude* with managers (and other insiders) if they are poorly motivated; collusion is upheld until clear evidence of mismanagement is observable by parties that do not belong to the coalition. This seems to be the view taken by the authors when they argue: "...even when board members know how to raise value, they may refuse to do so because the required changes...harm employees who are considered more important to the organization than shareholders who are only 'out for speculative profit'" (Mørck et al., 1989, p. 843). A second explanation is that strong incentives are required to induce board members to invest time, effort, and resources to acquire information that allows them to control management's activities effectively; inadequately motivated directors *limit their information costs* by looking at other firms in evaluating their own firm's performance.

21. Initial owners could, for example, require a minimum number of nonexecutive directors as board members when designing the corporate charter. The charter could provide that directors' compensation is closely tied to firm value, it could force directors into short-term relationships with the corporation, etc.

game: The performance incentives for top-level executives generated by the activities of poorly motivated directors are similar to those created by weak comparative contracts. Managers are penalized for underperforming in comparison to other firms in the industry. They are, however, not adequately rewarded for outperforming their rivals. Relying on poorly motivated directors to solve the interest conflict between shareholders and managers can therefore be regarded as an attempt to free-ride on the performance information released by other firms in the same branch: If at least one management team in the sector is well motivated, then this free-riding strategy is successful. However, if the whole sector relies on poorly motivated directors in disciplining managers, then managers' incentives to act in the interest of shareholders are fairly weak.[22]

4.2 The Managerial Labor Market

The labor market is another important disciplinary device for managers in which relative evaluations play a dominant rule. Relying on the power of the market to police managerial misconduct rather than motivating the executives by direct monetary incentives may therefore be seen as another decision for a weak comparative contract.

5. Some Empirical Implications

In addition to providing a possible explanation for the existence of the industry effects referred to in the introduction, my model also generates some other testable implications. My model predicts, for example, that:

1. *Hostile targets are typically ''old-fashioned'' public corporations with widely dispersed share ownership containing managers and directors without substantial equity holdings and without other strong pay-for-*

22. The coeditor points out that managerial incentives are not the only way to develop the story. It could be a matter of managerial types and the willingness of boards to fire poor managers. The representation of a manager-selection scenario would, of course, require a different kind of model. I think, however, that a coordination-failure story similar to that presented in this paper is needed to explain why a situation in which a whole industry is populated by boards that are too poorly motivated to replace incompetent managers may arise in equilibrium. Also, an assumption that even poorly motivated directors are prepared to fire unqualified managers when the performance of rival firms makes their incompetence observable to outsiders is required to explain why a single disciplinary takeover increases efficiency in other firms.

performance compensation systems.[23] In such corporations we would expect managements' incentives for taking care of good absolute performance to be fairly weak; and we would expect *weak* relative-performance rewards and punishments—as brought about, for instance, by the compensation and dismissal decisions of poorly motivated directors—to play a dominant role. My model also predicts that:

2. *Hostile targets are clustered in industries characterized by the absence of owner-controlled corporations*. In such industries we would expect there to be no incorruptible monitoring distribution to rely on. Finally, my model predicts that:
3. *Takeover-related changes in the target's operating strategy often trigger similar changes in other firms in the same industry*. There is strong evidence that new incentive compensation systems, augmented management equity ownership, higher board stakes, increased leverage, and more concentrated residual claims create a new, more efficient organizational structure that improves the post-raid performance of targets. If in reality managements are judged and compensated relative to their peers in other corporations in the industry, this improved performance should produce similar general equilibrium effects to those of contract-renegotiation-induced changes in the target's operating strategy, in the stylized setting considered in this paper.

There is both direct and indirect evidence that supports these predictions:

Ad (1): Empirical research by Jensen and Murphy (1990) has documented that stock ownership by top-level management in large public corporations is small and declining, and that incentives gener-

23. The referee points out that the existence of dispersed shareholdings is actually assumed by the model. Thus, it cannot be an implication of the model. He is, of course, right. I think, however, that the real-world interpretation of my explanation for disciplinary takeovers (see Section 4) is restricted to corporations with widely dispersed shareownership. In firms in which ownership is highly concentrated, major shareholders usually take an active role in the board of directors. As partial owners, they are better motivated to carry out their mandate then a director without a significant stake in the firm. And even without a seat on the firm's board, major blockholders are able to influence monitoring activities, for example, by imposing their will on the director selection process. The performance incentives for managers in such corporations should therefore be different from those created by weak comparative contracts and contain a strong element of absolute performance evaluation. If I am right, owner-dominated firms (i.e., enterprises in which active investors hold large equity positions) should not only be less vulnerable to hostile takeovers but also generate positive externalities for publicly held corporations in which each individual investor has neither the ability nor the incentive to monitor managerial activity (see prediction 2).

ated by performance-based compensation schemes are an order of magnitude still smaller than those coming from managerial equity stakes. Another study by Mørck et al. (1988a) considers the impact of insider shareownership on the probability of being acquired in a hostile raid. They find that hostile targets have, on average, both lower board ownership and lower officer ownership than the rest of their sample. On the other hand, Gibbons and Murphy (1990) find that there is an inverse relation between the probability of change in the group of people constituting top management and performance relative to the industry. Likewise, it is plausible that the labor market itself functions as an incentive scheme in which relative evaluation and compensation plays an important role. Together these results can be interpreted as evidence for the prediction that managers of hostile targets are—on average—more likely to work under what we have called a weak comparative contract.

Ad (2): There is some evidence that takeover targets are clustered in particular industries and not spread evenly throughout the corporate sector. Jensen (1988), for example, presents data indicating that takeover activity is especially high in oil and gas, banking and finance, insurance, food processing, and mining and minerals. Jensen argues that the main common feature of these diverse industries is that they are ''rich in cash but low in growth.'' In such industries—so he claims—there is a special conflict of interest between managers and owners, concerning the payout of ''free cash flow.'' My interpretation can be viewed as complementary to Jensen's thesis: In it, the *nature* of the interest conflict is of secondary importance. My main focus is on the question of why alternative monitoring and control systems (contracts) fail to mitigate conflicts of interest between managers and shareholders in these industries. In my view an important distinguishing feature of the listed industries is the dominance of large public corporations, and the complete absence of owner-dominated firms and resulting lack of a reliable monitoring distribution.

Ad (3): Several authors have observed that takeover-related restructurings in one firm are often followed by similar changes in other firms in the same branch [see, for example, Jensen (1988, p. 34) or Coffee (1988, pp. 96–100)]. The standard interpretation of this phenomenon is that these adjustments are brought about by the threat of a takeover. However, the more difficult question of why a takeover in one publicly traded company augments the probability that another company in the same industry will also be acquired in a hostile bid has remained unanswered. In my interpretation, the motive behind these restructurings is not (only) managers' fear that, in the absence of such transitions, their own companies are likely to become future targets of hostile takeovers. It is (also) their knowledge that the post-raid performance of the takeover target acts as a public signal about the profit potential of a typical firm in the respective industry, and their fear of being punished under existing relative performance systems (board of directors, labor market) if their own performance is sufficiently below that of the target.

6. Policy Implications

Apart from its empirical predictions, my model also generated some policy implications. For example, my model suggests that owner-dominated firms produce positive externalities for publicly held corporations in which each individual investor has neither the ability nor the incentive to monitor and control management activities. The reason is easily seen: The performance of an owner-dominated firm provides an incorruptible indicator for the profit potential of a typical firm in the respective branch; given this yardstick, incentives based on weak relative comparisons—as present, for example, in the managerial labor market, or in the compensation and dismissal decisions of poorly motivated directors—perform well in inducing managers of rival firms to work toward their shareholders' goals. This positive externality may provide a possible argument for preferential treatment of concentrated equity ownership, of lead debt positions, and/or of employee stock-ownership programs in income- or property-tax affairs.

My model also has some policy implications concerning the legal regulation of takeover activity. Critics of hostile bids typically explain the mentioned industry effects as due to stock-market evaluation errors: Random disturbances to market values (so they claim) allow professional investors with inside information to acquire a firm at below its true worth. The fact that firms are—on average—more likely to become targets if the whole industry is low-valued, and not if a firm is low-valued relative to the industry, is attributed to ''fashions'' or ''fads'' in the stock market: investors (so the argument goes) sometimes simply ''overlook'' an entire branch. The tendency of market prices of rivals to rise with the appearance of an offer for a single firm is explained by the fact that a hostile bid is a drastic event that directs the attention of investors to the whole industry. This increased attention (so the argument continues) is the cause of these positive price reactions. Since takeovers motivated by mispricings in the stock market do not lead to a better allocation of resources, but simply involve redistributions of wealth, adherents of this view use the evidence on industry effects to propose governmental restrictions of hostile activity. In my model hostile takeovers generate efficiency gains. Governmental provisions to restrict hostile activity are therefore not justified.

7. Concluding Remarks

This paper has presented an explanation for some stylized facts from the takeover literature—namely, that (1) industry averages are better predictors for hostile takeovers than individual company data, that (2) not only the stock prices of targets, but also those of other firms in the same industry, increase strongly around the date of a takeover bid, and that (3) takeover-related changes in the operating strategy of the target often lead to similar changes in rival firms in the same branch. The explanation presented here is based on a model of coordination failure in contracting between management and owners: Effective motivation of managers by compensation based on relative performance evaluation requires coordination among owners. Uncoordinated maximization may lead to an inefficient industry-wide institutional network under which managers can escape meaningful comparison by jointly adopting suboptimal strategies. If an industry settles in an inefficient incentive equilibrium, then a hostile takeover that provides new incentives for the management of a single company in the industry induces the whole industry to move from an inefficient contracting equilibrium to an efficient one.

The model presented here provides a disciplinary explanation for each of the listed industry effects: Since in my model disciplinary takeovers are aimed at destroying an inefficient industry-wide contractual network, industry-wide and not firm-specific performance is relevant for these takeovers. Furthermore, since a single disciplinary takeover changes the incentives for all managers in the industry, it also changes their behavior. The change in behavior in turn finds its expression in share-price changes.

Appendix A

Proof of Lemma 1. I first show that an optimal independent contract must induce the play $h(\theta_1) = e_1$, $h(\theta_2) = e_2$ at stage 2. Then I argue that the payout schedule characterized in Lemma 1 is the best payout schedule from the owner's point of view that triggers this behavior. First note that Assumption 1 implies that if the θ_1-manager prefers to remain at stage 1 rather than quit, then the θ_2-manager cannot prefer to quit rather than remain. Next note that it cannot be optimal to let the manager quit if he has observed θ_1: if the θ_2-manager quits too, the owner's *ex ante* payoff is 0, which is strictly less than $\mathrm{ev}(\delta^I, -)$; if the θ_2-manager remains, the owner's *ex ante* payoff cannot exceed $p_2 y(\theta_2, e_2)$; but (by the assumption in footnote 11) $p_2 y(\theta_2, e_2) < p_2 y(\theta_2, e_2) + y(\theta_1, e_1) - p_2 y(\theta_2, e_1) = \mathrm{ev}(\delta^I, -)$. These observations reveal that an optimal independent contract must respect the participation constraints for both realizations of θ^i. Next observe that an optimal independent contract cannot induce a pooling strategy, i.e., a strategy of the form $h(\theta_1) = e_k$, $h(\theta_2) = e_k$: the owner's *ex ante* valuation of a contract that triggers such a behavior cannot exceed $\max\{\min[y(\theta_1, e_1), y(\theta_2, e_1)], \min[y(\theta_1, e_2), y(\theta_2, e_2)]\} = y(\theta_1, e_1)$, which is strictly less than $\mathrm{ev}(\delta^I, -)$. We are left with two possible strategies for the manager: $[h(\theta_1) = e_1, h(\theta_2) = e_2]$ and $[h(\theta_1) = e_2, h(\theta_2) = e_1]$. Since the second of these strategies cannot be induced by any independent contract, the optimal independent contract must contain the recommendation $f_1 = e_1$, $f_2 = e_2$. The manager will obey this recommendation if and only if the associated payout schedule satisfies

$$y(\theta_k, e_k) - g_k \geq y(\theta_k, e_l) - g_l \qquad \forall k, l \in \{1, 2\},$$

$$y(\theta_k, e_k) - g_k \geq 0 \qquad \forall k \in \{1, 2\}.$$

It is straightforward to verify that the payout schedule characterized in Lemma 1 is the best payout schedule from the owner's point of view that respects these relations. □

Proofs of Lemma 2 and Lemma 3. It will be useful to deal first with Lemma 3 and then to show that δ^W, taking δ^I in the second firm as given, offers strictly more surplus to the owner than δ^I does. Using arguments similar to those presented in the proof of Lemma 1, it can be shown that a best response to δ^I must contain the investment recommendation $f_1 = e_1$, $f_2 = e_2$. For both types of the manager to stay at stage 1 and to obey this recommendation at stage 2, the accompanying payout function must satisfy

$$\begin{aligned} \mathrm{SS}_k: \quad & q_k[U(w_{k1}) - U(w_{l1} + \Delta_k)] \\ & + (1 - q_k)[U(w_{k2}) - U(w_{l2} + \Delta_k)] \geq 0 \qquad \forall k, l \in \{1, 2\}, k \neq l, \end{aligned}$$

$$\mathrm{IR}_k: \quad q_k U(w_{k1}) + (1 - q_k) U(w_{k2}) \geq 0 \qquad \forall k \in \{1, 2\}.$$

Among the payout schedules which satisfy these constraints, the one that is optimal from the owner's point of view chooses $\{g_{11}, g_{12}, g_{21}, g_{22}\}$ so as to maximize $\sum_{g=1}^{2}\sum_{h=1}^{2} p_{gh} g_{gh}$ so that SS_1, SS_2, IR_1, and IR_2 hold. I denote this program by W. In the search for a solution to W I first consider a relaxed program (RP) in which SS_1 is not included. Later I'll verify that SS_1 is in fact satisfied in the solution to RP.

First, observe that at the solution to RP, the constraints IR_1 and SS_2 are both binding: if IR_1 were slack, it would be possible to raise g_{11} slightly, which doesn't violate IR_1, relaxes SS_2, and increases the object; if SS_2 were slack, we could implement the first best solution $g_{11} = g_{12} = y(\theta_1, e_1)$, $g_{21} = g_{22} = y(\theta_2, e_2)$; but this solution violates SS_2, contrary to the hypothesis. Next, observe that $g_{21} = g_{22}$: if $g_{21} \neq g_{22}$ then $w_{21} \neq w_{22}$ and we could obtain an improvement by replacing w_{21} and w_{22} by $\overline{w}_2$ such that $U(\overline{w}_2) = q_2 U(w_{21}) + (1 - q_2)U(w_{22})$; all the constraints would continue to be met, and since $U(\cdot)$ is strictly concave, $\bar{g}_2 \equiv y(\theta_2, e_2) - \overline{w}_2 > q_2 g_{21} + (1 - q_2) g_{22}$.

It remains to be shown that $g_{12} > g_{11}$. To prove this, I analyze the FOCs associated with RP. Let $\mu_2 > 0$ denote the multiplier for SS_2, and $\lambda_1 > 0$ that for IR_1. The FOCs for g_{11} and g_{12} are $-p_{11} - \mu_2 q_2 U'(w_{11} + \Delta_2) + \lambda_1 q_1 U'(w_{11}) = 0$ and $-p_{12} - \mu_2(1 - q_2)U'(w_{12} + \Delta_2) + \lambda_1(1 - q_1)U'(w_{12}) = 0$. Solving for λ_1 and subtracting the second equation from the first yields

$$
\begin{aligned}
(p_{11} + p_{12})&\left(\frac{1}{U'(w_{11})} - \frac{1}{U'(w_{12})}\right) \\
&= \mu_2\left(\frac{(1 - q_2)}{(1 - q_1)}\frac{U'(w_{12} + \Delta_2)}{U'(w_{12})} - \frac{q_2}{q_1}\frac{U'(w_{11} + \Delta_2)}{U'(w_{11})}\right). \qquad (\epsilon)
\end{aligned}
$$

Consider first the RHS of equation (ϵ). Suppose $w_{12} \geq w_{11}$. Assumption 1 implies $\Delta_2 > 0$. Therefore, by NIARA, $a \equiv U'(w_{12} + \Delta_2)/U'(w_{12}) \geq U'(w_{11} + \Delta_2)/U'(w_{11}) \equiv b > 0$. Moreover, by the definition of the conditional probabilities and Assumption 3, $c \equiv (1 - q_2)/(1 - q_1) > 1 > q_2/q_1 \equiv d > 0$, so that $ac > bd$. Thus, the RHS of equation (ϵ) is strictly positive. Now consider the LHS. From $w_{12} \geq w_{11}$ and the concavity of $U(\cdot)$, $U'(w_{12}) \leq U'(w_{11})$. But then the LHS of (ϵ) is nonpositive. This contradiction proves that $w_{11} > w_{12}$ and therefore $g_{12} > g_{11}$.

It remains only to verify that at a solution to RP the missing SS_1 constraint is satisfied. This is easily shown. Let δ^{RP} denote the contract $\{f_1 = e_1; f_2 = e_2; g_{11}, g_{12}, g_{21}, g_{22}\}$, where $(g_{11}, g_{12}, g_{21}, g_{22})$

is the solution to RP. Also let $\dot{\delta} = (\dot{g}_{11}, \dot{g}_{12}, \dot{g}_{21}, \dot{g}_{22})$ be a vector in which $\dot{g}_{11} = \dot{g}_{12} = g_1$ and $\dot{g}_{21} = \dot{g}_{22} = g_2$, where g_1 and g_2 are as implicitly defined in Lemma 1. First note that since $\dot{\delta}$ is feasible as a solution to RP but not optimal it must be that $\mathrm{ev}(\delta^{\mathrm{RP}}, \delta^I) > \mathrm{ev}(\delta^I, -)$. Furthermore, from the arguments in the proof of Lemma 1, $\mathrm{ev}(\delta^I, -) > \mathrm{ev}(\bar{\delta}, -)$ for all $\bar{\delta}$, where $\bar{\delta}$ denotes an independent pooling contract in which the manager is instructed to play e_2 for all realizations of θ^i and in which $\bar{g}_1$ and $\bar{g}_2$ (the transfers from m to o for e_1 and e_2) satisfy $\bar{g}_1 \geq \bar{g}_2 + y(\theta_1, e_1) - y(\theta_1, e_2)$. Our aim is to show that each solution to RP in which SS_1 is violated has $\mathrm{ev}(\delta^{\mathrm{RP}}, \delta^I) < \mathrm{ev}(\bar{\delta}, -)$ for some $\bar{\delta}$. To see this, replace δ^{RP} by a $\bar{\delta}$ in which $\bar{g}_2 = g_{21}$ and $\bar{g}_1 = \bar{g}_2 + y(\theta_1, e_1) - y(\theta_1, e_2) + \epsilon$, for some $\epsilon > 0$. Admissibility of δ^{RP} as a solution to RP, together with the hypothesis that SS_1 is violated, guarantees that each type of manager gets his reservation utility under $\bar{\delta}$, so that the replacement is feasible. From SS_2 binding, from $g_{11} \neq g_{12}$, from $g_{21} = g_{22}$, and from the strict concavity of $U(\cdot)$ we have $y(\theta_2, e_2) - g_{21} < q_2[y(\theta_2, e_1) - g_{11}] + (1 - q_2)[y(\theta_2, e_1) - g_{12}]$. Therefore, $g_{21} + y(\theta_2, e_1) - y(\theta_2, e_2) > q_2 g_{11} + (1 - q_2)g_{12} > q_1 g_{11} - (1 - q_1)g_{12}$, where the last inequality follows from $q_1 > q_2$ and $g_{12} > g_{11}$. By Assumption 2, $y(\theta_2, e_1) - y(\theta_2, e_2) < 0$. Combined with the definition of $\bar{g}_2$, this gives $\bar{g}_2 = g_{21} > q_1 g_{11} + (1 - q_1)g_{12}$, so that the change in the objective obtained by the replacement is strictly positive. This contradicts the optimality of the SS_1-violating solution to RP. It follows that $\mathrm{ev}(\delta^W, \delta^I) = \mathrm{ev}(\delta^{\mathrm{RP}}, \delta^I)$, which by the arguments presented earlier is strictly greater than $\mathrm{ev}(\delta^I, -)$. □

Proof of Lemma 5. Using arguments similar to those presented in the proof of Lemma 1, it can be shown that a best response to δ^W must contain the investment recommendation $f_1 = e_1$, $f_2 = e_2$. For both types of the manager to stay at stage 1 and to obey this recommendation at stage 2, the associated payout schedule must satisfy SS_1, SS_2, IR_1, and IR_2 as defined in the proof of Lemma 3.

This is, however, not enough. According to our assumption of payoff dominance, m^i and m^j will play these strategies only if there is no other BE that leaves both of them better off. From the discussion in the text we know that the strategy pair of always choosing e_1 is a potentially jeopardizing candidate. To ensure that the incentive structure resulting from the combination of a given contract with δ^W is proof against this kind of behavior, we must impose one of the following two constraints in addition to SS_k and IR_k in the design of the given contract: (a) this behavior doesn't form an equilibrium in the agents' game; (b) this behavior forms an equilibrium that doesn't dominate the recommended one. Imposing requirement (b) as an additional constraint in the program W (defined in the proof of Lemma 3) yields δ^I as solution. Requirement (a) might be less demanding. There are two candidate restrictions to meet this requirement: (a_1) $w_{21} + \Delta_1 \geq w_{11}$, and ($a_2$) $w_{21} \geq w_{11} + \Delta_2$; Assumption 2 implies that condition (a_1) is strictly more demanding than condition (a_2). Imposing (a_2) as an additional constraint in the program W yields program S. To find a solution to S I first consider a relaxed version (RV) of this program in which SS_1 is not included. Later I'll verify that SS_1 is satisfied in the solution to RV.

Using the same arguments as in the Proof of Lemma 3 plus the fact that (a_2) is violated if it isn't explicitly imposed, it can be shown that IR_1, SS_2 and (a_2) are binding. From SS_2 and (a_2) binding we get $w_{21} = w_{11} + \Delta_2$ and $w_{22} = w_{12} + \Delta_2$. To prove that $w_{21} > w_{22}$ I use the FOCs associated with RV. Denoting the multiplier for (a_2) by a, for SS_2 by μ_2 for IR_2 by λ_2, we get $-p_{21} + (\mu_2 q_2 + a)U'(w_{21}) + \lambda_2 q_2 U'(w_{21}) = 0$ and $-p_{22} + \mu_2(1 - q_2)U'(w_{22}) + \lambda_2(1 - q_2)U'(w_{22}) = 0$. Solving for λ_2 and subtracting the second equation from the first yields $1/U'(w_{21}) - 1/U'(w_{22}) = a/p_{21}$. The RHS of this equation is strictly positive. For the LHS to be strictly positive we must have $w_{21} > w_{22}$.

It remains to be shown that the missing SS_1 constraint is satisfied. Using Assumption 2 and the fact that $w_{2k} = w_{1k} + \Delta_2$ for $k \in \{1, 2\}$ we get $w_{1k} = w_{2k} + \Delta_1$ for $k \in \{1, 2\}$. Therefore, $q_1 U(w_{11}) + (1 - q_1)U(w_{12}) > q_1 U(w_{21} + \Delta_1) + (1 - q_1)U(w_{22} + \Delta_1)$. This completes the argument.

To show that δ^S is a best response to δ^W it remains to verify (1) that the recommended equilibrium in the agents' game will arise under (δ^S, δ^W) and (2) that $\mathrm{ev}(\delta^S, \delta^W) \geq \mathrm{ev}(\delta^I, -)$. Ad (1): Under δ^S the recommended investment behavior is a dominant strategy for the respective manager. By WFL he will use this strategy. Knowing this, the manager under δ^W has no incentive to deviate from $h(\theta_1) = e_1$, $h(\theta_2) = e_2$. By WFL he will use this strategy. Ad (2): Since the payout schedule characterized in Lemma 1 is feasible as a solution to the program S, but not optimal, this condition holds as a strict inequality. □

Appendix B

B.1 Nonexistence of a Symmetric Pure Strategy NE

Throughout I begin by supposing that there is a symmetric NE in pure strategies. Then—by analyzing the associated agents' game—I show that this leads to a contradiction. Before beginning, it is useful to note that we cannot have a NE in which one of the owners gets an *ex ante* payoff that is lower than $\text{ev}(\delta^I, -)$. Why? Because in any equilibrium a player's strategy must be a best response, and because each owner has always the option to choose δ^I. I consider three distinct cases:

Case 1. The equilibrium strategies in the agents' game are fully pooling $(h^A(\cdot) = h^B(\cdot) = [h(\theta_1) = e_k,\ h(\theta_2) = e_k])$. In this case the owners' beliefs at date 2 about $\theta = (\theta^\alpha, \theta^\beta)$ are just the prior probabilities and each owner's *ex ante* payoff cannot exceed $y(\theta_1, d_1)$ (see the arguments in the proof of Lemma 1). Since $\text{ev}(\delta^I, -) > y(\theta_1, d_1)$, we conclude that a contract combination that induces full pooling in the agents' game is not sustainable as a NE in the contract-writing game.

Case 2. The equilibrium strategies in the agents' game are fully revealing $(h^A(\cdot) = h^B(\cdot) = [h(\theta_1) = e_k,\ h(\theta_2) = e_l]$, where $e_k \neq e_l)$. A necessary condition for the existence of a separating BE in the agents' game is that both payout schedules in the contract combination under consideration satisfy the usual self-selection and individual-rationality constraints. But this condition is not sufficient. At least one of the contracts must have a specially structured payout schedule in order to guarantee that the separating BE is not payoff-dominated. I name such a contract an S-contract. From the arguments in the proof of Lemma 5 we know that the least restricted S-contract for the separating equilibrium $h^A(\cdot) = h^B(\cdot) = [h(\theta_1) = e_1,\ h(\theta_2) = e_2]$ is δ^S.[24] Under δ^S, $[h(\theta_1) = e_1,\ h(\theta_2) = e_2]$ is a dominant strategy for the manager under consideration. Together with WFL, this implies that if we remove one contract from a contract combination that induces the above-mentioned separating BE in the agents' game and replace it by δ^S, then the new contract combination produces the same separating BE as well. Hence, any further restricted S-contract can be replaced by δ^S without affecting the managers' equilibrium behavior. It follows that δ^S is the only S-contract ever observed in a pure strategy NE in the contract-writing game that induces the above-mentioned separating BE in the agents' game. Since at least one S-contract is needed to induce this behavior, we conclude that δ^S must be part of the NE. The rest of the argument is obvious: If one owner plays δ^S (with probability one), then the second owner chooses δ^W (with probability one). This contradicts symmetry.

24. The perverse separating strategy profile $h^A(\cdot) = h^B(\cdot) = [e(\theta_1) = d_2,\ e(\theta_2) = d_1]$ cannot be induced as a payoff-undominated Bayesian equilibrium in the agents' game by any contract combination.

Case 3. The equilibrium investments in the agents' game are semiseparating. Then, because a player chooses a strategy only if it is in his best interest, and because in an equilibrium a player only randomizes over strategies he is indifferent among, the payout schedules must satisfy (I drop the superscript)

$$\hat{q}_1 U(w_{11}) + (1 - \hat{q}_1) U(w_{12}) \\ = \hat{q}_1 U(w_{21} + \Delta_1) + (1 - \hat{q}_1) U(w_{22} + \Delta_1) \qquad (\alpha_1)$$

or

$$\hat{q}_2 U(w_{21}) + (1 - \hat{q}_2) U(w_{22}) \\ = \hat{q}_2 U(w_{11} + \Delta_2) + (1 - \hat{q}_2) U(w_{12} + \Delta_2), \qquad (\alpha_2)$$

where $\hat{q}_k^i$ denotes the conditional probability that the second manager chooses e_1 given that the manager under consideration is of type θ_k. Also, for both types of each manager to remain at stage 1, each payout schedule must respect the usual individual rationality constraints. In addition each contract must maximize the *ex ante* payoff of the owner given the contract chosen by the second owner. In the proof (available from the author upon request) I show that this leads to a contradiction. The basic idea of the proof is as follows: Hybrid strategy profiles in which the θ_1-manager randomizes between e_1 and e_2 cannot be induced as a payoff-undominated BE in the agents' game by any contract combination. Hybrid strategy profiles in which the θ_2-manager randomizes are more critical. Here the contradiction runs similar to that in case 2: If both θ_2-managers randomize in the agents' game, then (α_2) must hold as an equality in both payout schedules. In addition one of the payout schedules must have a special structure; if not, randomizing would be payoff-dominated. The structure requirement is similar to that discussed in case 2. In a symmetric NE contracts are identical. The trick is again to show that given the structured payout function in one firm, it is always possible to construct a less restricted schedule for the second firm that gives the respective owner a higher *ex ante* payoff, leaves each type of the manager the same expected utility, and produces the same hybrid BE in the agents' game.

B.2 Existence of a Symmetric NE in Mixed Strategies

The proof is divided into four steps.

Step 1. In a first step I introduce a range of modified weak comparative contracts, each indexed by $\alpha \in [0, 1]$. Each contract in this family recommends the strategy $h(\theta_1) = e_1$, $h(\theta_2) = e_2$; the payout schedule $(g_{11}, g_{12}, g_{21}, g_{22})$ in δ^{α} is chosen in order to maximize $\alpha\sum_{g=1}^{2}\sum_{h=1}^{2} p_{gh}g_{gh} + (1-\alpha)g_{11}$ subject to SS_1, SS_2, IR_1, and IR_2 (as defined in Appendix A) and to IR_x, defined as the constraint $U(w_{11}) \geq 0$. I denote this program by $W(\alpha)$ and the maximal value of the objective function for a given α by $M(\alpha)$.

Step 2. Next we search for a number $\alpha \in (0,1)$ such that $M(\alpha) = \mathrm{ev}(\delta^S, \delta^W)$. First we have to show that such an α exists. This is easily verified: If $\alpha = 1$, the objective in the program $W(\alpha)$ is the same as that in the program S. Since the optimal solution to S is feasible as a solution to $W(\alpha)$, but not optimal, we have $M(1) > \mathrm{ev}(\delta^S, \delta^W)$.[25] If $\alpha = 0$, the program $W(\alpha)$ boils down to the problem of designing a payout schedule for an optimal independent pooling contract in which $f(\cdot) = e_1$ for each θ. From the arguments in Appendix A we know that the *ex ante* payoff of an owner under such a contract is $y(\theta_1, d_1)$. Since $\mathrm{ev}(\delta^S, \delta^W) > \mathrm{ev}(\delta^I, -) > y(\theta_1, d_1)$, we have $\mathrm{ev}(\delta^S, \delta^W) > M(0)$. To complete the proof for the existence it remains to be demonstrated that $M(\alpha)$ is continuous. This follows from the theorem of the maximum in Berge (1963). To guarantee uniqueness we must also show that $M(\alpha)$ is strictly increasing in the relevant range. To see this, first note that the component of the objective function that relates to $1-\alpha$ can never exceed $y(\theta_1, d_1) < \mathrm{ev}(\delta^I, -)$. Thus, in that range of α where $M(\alpha) \geq \mathrm{ev}(\delta^I, -)$, the component of the objective function that relates to α must strictly exceed the component that relates to $1-\alpha$. Since the α-component obtains more and the $(1-\alpha)$-component less weight if α increases, and since it is always possible not to adapt the α- and $(1-\alpha)$-parts, $M(\alpha)$ must increase in α in this range. We therefore conclude: The condition $M(\alpha) = \mathrm{ev}(\delta^S, \delta^W)$ defines a unique α in $(0,1)$. I denote this α by α^* and the accompanying modified weak comparative contract by δ^{α^*}.

Step 3. Now I claim that the payout schedule in δ^{α^*} has the properties listed in Lemma 3. To show this, I examine a relaxed version of $W(\alpha)$ in which SS_1 and IR_x are not included and go step by step the same way as in the proof of Lemma 3. All the arguments continue to hold, except one: $g_{12} > g_{11}$ can't be proved by analyzing

25. To see this, observe that the programs W, $W(1)$, and S differ only in the constraints. The least restricted program is W. Since the optimal solution to W has $g_{12} > g_{11}$, it is also a solution to $W(1)$. Since it violates (α_2)—as defined in Appendix A—it is not a solution to S.

the FOCs. Here the proof is by contradiction: Suppose that $g_{21} = g_{22}$ but $g_{11} \geq g_{12}$, so that $w_{21} = w_{22}$ and $w_{12} \geq w_{11}$. Then we could define a new payout schedule in which w_{11} and w_{12} are replaced by $\overline{w}_1$, where $\overline{w}_1$ is such that $U(\overline{w}_1) = q_1 U(w_{11}) + (1 - q_1)U(w_{12})$. The definition of $\overline{w}_1$ guarantees that IR_1 is maintained. That SS_2 is satisfied can be seen from the sequence $q_2 U(w_{21}) - (1 - q_2)U(w_{22}) \geq q_2 U(w_{11} + \Delta_2) + (1 - q_2)U(w_{12} + \Delta_2) \geq q_1 U(w_{11} + \Delta_2) + (1 - q_1)U(w_{12} + \Delta_2) \geq U(\overline{w}_1 + \Delta_2)$, where the first inequality follows from the original payout schedule being feasible, the second from $w_{12} \geq w_{11}$ and $q_1 > q_2$, and the last from the definition of $\overline{w}_1$ and NIARA. Moreover, since $U(\cdot)$ is strictly increasing and concave, $\overline{g}_1 \equiv y(\theta_1, e_1) - \overline{w}_1 \geq q_1 g_{11} + (1 - q_1)g_{12}$, so that that component of the objective function that relates to α is improved. The new payout schedule is a feasible solution to the program defined in the proof of Lemma 1. The maximal value of the objective function in this program is $\mathrm{ev}(\delta^I, -)$. So under the original payout schedule the value of the α-part of the objective function in $W(\alpha)$ must have been (weakly) less than $\mathrm{ev}(\delta^I, -)$. By the arguments in step 2 the value of the $(1 - \alpha)$-part of the objective function in $W(\alpha)$ can never exceed $\mathrm{ev}(\delta^I, -)$. But then the sum of the two parts couldn't have been $M(\alpha^*) = \mathrm{ev}(\delta^S, \delta^W) > \mathrm{ev}(\delta^I, -)$. It remains only to be verified that at the solution to the relaxed program SS_1 and IR_x are satisfied. The argument for SS_1 is the same as that in the proof of Lemma 3. And from $w_{11} > w_{12}$ and IR_1 it follows that $U(w_{11}) > 0$, so that IR_x holds as a strict inequality.

Step 4. Now we finish the argument by claiming that the strategy profile "each owner plays δ^S with probability α^* and δ^{α^*} with probability $1 - \alpha^*$" forms a symmetric NE. To verify this, imagine that o^i fulfills his part of the equilibrium. Then o^j, by playing δ^S, nets an *ex ante* payoff of $\mathrm{ev}(\delta^S, \delta^W)$. This follows from the facts that (1) each owner's payoff under a given contract combination doesn't directly depend on the contract chosen by the second owner, but only indirectly through the equilibrium behavior of the managers, and that (2) the contract profiles (δ^S, δ^W), (δ^S, δ^S), and $(\delta^S, \delta^\alpha)$ all induce the same BE in the agents' game. By playing δ^{α^*}, o^j induces a probability distribution with two possible outcomes: There is a chance α^* of $(\delta^{\alpha^*}, \delta^S)$. Under this contract combination the managers play the separating BE $h^A(\cdot) = h^B(\cdot) = [h(\theta_1) = e_1, h(\theta_2) = e_2]$; this follows from the fact that δ^{α^*} and δ^W share the characteristics recorded in Lemma 3 and from the arguments in Appendix A. And there is a chance $1 - \alpha$ of $(\delta^{\alpha^*}, \delta^{\alpha^*})$. Under this contract combination the managers play the pooling BE $h^A(\cdot) = h^B(\cdot) = [h(\theta_1) = e_1; h(\theta_2) = e_1]$; this follows again from the fact that δ^{α^*} and δ^W have the same qualitative features and from the discussion that follows Lemma 4. Hence, if $(g_{11}, g_{12}, g_{21}, g_{22})$ denotes the payout schedule in δ^{α^*}, then o^j's *ex ante* payoff under δ^{α^*} (given o^i's equilibrium strategy) is $\alpha^* \sum_{g=1}^{2} \sum_{h=1}^{2} p_{gh} g_{gh} + (1 - \alpha^*) g_{11} = M(\alpha^*)$. From the discussion in Appendix A we know that there is a single way to raise the *ex ante* payoff of an owner beyond $\mathrm{ev}(\delta^S, \delta^W)$, namely, to give up the restriction that ensures that the strategy profile in which both managers always choose e_1 doesn't form a BE in the agents' game. Abandoning this restriction leads inevitably to the class of modified weak comparative contracts defined in step 1 above. Since—by definition—δ^{α^*} is the best contract in this class for a given α^*, and since—by construction—$M(\alpha^*) = \mathrm{ev}(\delta^S, \delta^W)$, we conclude that no player has positive incentives to deviate from what the predicted selection specifies. Thus, the proposed strategy profile forms a NE, and it is symmetric.

Appendix C

Proof of Proposition 2. If we denote the value of the firm under the raider's control by w^R and the acquisition price by x, the raider will make a bid if and only if $w^R - x - c \geq 0$. Since the raider is able to implement the first best contract, w^R is independent of the contractual arrangements existing in the industry prior to the date of the bid. In the unobservable-contracts case x is unaffected by (δ^T, δ^R) too. Thus, the first statement follows. In the observable-contracts case all players are symmetrically informed on the firm's current worth and $x(\delta^T, \delta^R)$ is equal to this worth. Since, by the arguments in Section 2.2, $\mathrm{ev}(\delta^{\alpha^*}, \delta^S) > \mathrm{ev}(\delta^S, \delta^{\alpha^*}) = \mathrm{ev}(\delta^S, \delta^S) > \mathrm{ev}(\delta^{\alpha^*}, \delta^{\alpha^*})$, the raider's payoff for a successful bid is nonnegative for a wider range of takeover costs under $(\delta^{\alpha^*}, \delta^{\alpha^*})$ than under any other contract constellation. The probability of takeover is therefore highest in this case. That the inequality is strict if takeover is a probabilistic event for each (δ^T, δ^R) from a prior-to-the-date-of-the-bid perspective is also easily seen: Define $\hat{c}(x)$ as that level of c for which the profitability condition $w^R - x - c \geq 0$ is met with equality for a given x. Take the convention that $\hat{c}(x) = \bar{c}$ if $w^R - x > \bar{c}$ and $\hat{c}(x) = \underline{c}$ if $w^R - x < \underline{c}$. Obviously, the higher $\hat{c}(x)$, the greater the probability of takeover. From the arguments above, $\hat{c}(x(\delta^{\alpha^*}, \delta^{\alpha^*})) \geq \hat{c}(x(\delta^T, \delta^R))$ for all $(\delta^T, \delta^R) \neq (\delta^{\alpha^*}, \delta^{\alpha^*})$. The inequality is strict if $\hat{c}(x(\delta^T, \delta^R)) < \bar{c}$ for $(\delta^T, \delta^R) = (\delta^{\alpha^*}, \delta^{\alpha^*})$ and $\hat{c}(x(\delta^T, \delta^R)) > \underline{c}$ for all $(\delta^T, \delta^R) \neq (\delta^{\alpha^*}, \delta^{\alpha^*})$. □

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