# 7

# Topics: Product Markets and Earnings Manipulations

This chapter studies two underexplored but important topics in corporate finance. Section 7.1 puts the firm in its industrial context by adding the interactions with its competitors, suppliers, or clients. Needless to say, the interest is not in these interactions per se, which have been the focus of an enormous amount of literature in industrial organization, but rather in how corporate financing is affected by these interactions, and vice versa.

Section 7.2 looks at the topical issue of earnings manipulation.[1] The management's ability to garble signals received through creative accounting, timing of income recognition, and risk taking adds an extra degree of moral hazard into the managerial incentive problem. Incentive schemes, such as stock options or high-powered career concerns, that are meant to align managerial incentives with investors' interests and thus induce high performance also tend to invite management to game the incentive system.

## 7.1 Corporate Finance and Product Markets

We examine the interaction between corporate financing and industrial organization. A firm designing its funding level and structure (collateral, liquidity, diversification, control rights, and corporate governance, say) does so in the context of horizontal (competitors) and vertical (suppliers and customers) interactions.

Two broad questions then emerge.

(i) How do market characteristics affect corporate financing choices?

(ii) How do other firms react to a firm's financial structure? And does a firm want to alter its financial structure so as to affect the behavior of other firms? That is, can a firm use its financial structure so as to reduce product-market competition or to extract more favorable conditions from other parties in the vertical chain? For example, does leverage make a firm weak or strong against its competitors in the product market? Or can leverage be used to extract lower wages from a labor union or better terms from a supplier?[2]

We analyze these questions in sequence.

### 7.1.1 Impact of Competition on Financial Choices

#### 7.1.1.1 Basics: Profit Destruction and Benchmarking Effects

Let us begin with two basic and opposite effects of competition on a firm's ability to obtain funding. First, competitive pressure reduces market power and profit, and thereby makes it more difficult for firms to receive financing. This profit-destruction effect is not specific to markets with credit rationing; that is, firms tend to be less keen on investing in the presence of rivals whether they have easy access to outside financing or not. At most, the profit-destruction effect exacerbates the lack of pledgeable income and the concomitant difficulty for the borrowers to raise funds. Second, the presence of competitors subject to similar demand and cost conditions facilitates the investors' control of the agency problem. In a nutshell, the competitors' performance brings about information that helps investors assess the circumstances under which their firm operated. This reduces the agency cost and thereby facilitates financing.

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1. As discussed in Chapter 1 (see also the papers by Healy and Palepu, Lev, and Demski in the 2003 *Journal of Economic Perspectives* symposium on "Enron and conflicts of interests"), recent corporate scandals in the United States and in Europe have highlighted the pervasiveness and the scope of earnings manipulations.

2. See also Cestone (2000) for a survey of corporate financing and product-market competition.

(a) *Profit destruction.* Consider the profit-destruction effect first. A market is (potentially) served by a duopoly (the analysis generalizes straightforwardly to an arbitrary number of firms): firms $i = 1, 2$. Each of these firms must develop a new technology (or acquire know-how) in order to enter and serve the market. Thus, one can think of the market as being primarily an innovation market.

The model is the basic, fixed-investment model of Section 3.2 except for the twist that a firm's profit depends on how successful the other firm is. Namely, while a firm makes no profit if it fails to develop the new technology, its profit when its succeeds in developing it depends on whether it faces a competitor, that is, whether the other firm also succeeds. Thus the firm's profit is as follows:

$$\text{profit} = \begin{cases} M & \text{if it is the only firm to succeed,} \\ D & \text{if both firms succeed,} \\ 0 & \text{if it fails,} \end{cases}$$

where

$$M \geqslant D \geqslant 0 \quad \text{and} \quad p_H M > I.$$

Here, $M$ stands for "monopoly profit" and $D$ for "duopoly profit."[3] The condition $M \geqslant D$ means that competition reduces individual profit. The condition $p_H M > I$, where $p_H$ is the probability of success in the case of good behavior, says that the NPV under monopoly is positive.[4]

The familiar agency cost affects the development process. Each entrepreneur succeeds with probability $p_H$ if she behaves (in which case she receives no private benefit) and with probability $p_L = p_H - \Delta p$ if she misbehaves (and thereby receives private benefit $B$), where $\Delta p > 0$.

Each entrepreneur needs to raise $I - A$ in order to finance her project, where $I$ is the investment cost and $A$ her initial net worth.

To isolate the profit-destruction effect, we first rule out any possibility of benchmarking (that is, of rewards that are based not only on the firm's performance but also on that of its rival) by assuming that *the two research processes are independent*, and so investors in one firm cannot infer anything about

the entrepreneur's behavior by looking at whether the other firm succeeds or fails.

Assuming, as usual, that investors can break even only if incentives are in place for the entrepreneur to behave, we look at conditions under which the two firms receive financing, or only one firm receives it.

*Equilibrium in which both firms receive funding.* When one's potential competitor is funded (and is induced to behave), the expected income is

$$p_H[(1 - p_H)M + p_H D] + (1 - p_H)[0],$$

since the firm succeeds in developing the technology with probability $p_H$ and is then a monopolist with probability $1 - p_H$ and a duopolist with probability $p_H$.

The pledgeable income is smaller, though. The entrepreneur must receive a reward $R_b$ in the case of success in developing the technology[5] (and 0 in the case of failure), which ensures incentive compatibility:

$$(\Delta p) R_b \geqslant B.$$

Thus the pledgeable income is equal to the expected income described above minus the probability of success, $p_H$, times the minimum reward, $B/\Delta p$, to be given to the entrepreneur in order to provide adequate incentives.

It is an equilibrium for both firms to receive funding if, for each firm, the pledgeable income exceeds the investors' initial outlay, or

$$p_H\left[(1 - p_H)\left(M - \frac{B}{\Delta p}\right) + p_H\left(D - \frac{B}{\Delta p}\right)\right] \geqslant I - A. \quad (7.1)$$

*Equilibria in which only one firm receives funding.* When inequality (7.1) is not satisfied, investors are unwilling to fund a firm if its rival receives funding. Let us therefore look at the possibility that only one firm receives financing. This firm is a monopolist if it succeeds; therefore the pledgeable income is

$$p_H\left[M - \frac{B}{\Delta p}\right].$$

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3. The case of an R&D race (see Schroth and Szalay (2004) for an R&D race with financial constraints) is somewhat akin, in reduced form, to $D = \frac{1}{2}M$: each receives a patent with probability $\frac{1}{2}$.

4. Otherwise, no firm in the industry would ever invest.

5. Under risk neutrality, it does not matter whether the entrepreneur receives a uniform $R_b$ regardless of the performance of the competitor, or, say, gets a share $\theta$ of the firm's profit (with $\theta[(1 - p_H)M + p_H D] = R_b$).

Under entrepreneurial risk aversion, though, it would become strictly optimal *not* to make the reward contingent on the other firm's performance: there is no point imposing a risk on the entrepreneur that she has no control over. (This is an application of the sufficient statistic result: see Section 3.2.6.)

**Figure 7.1**



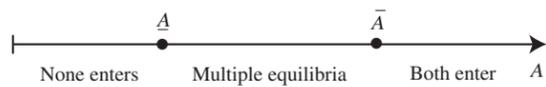**Figure 7.2**

A necessary and sufficient condition for the funding of a single firm is therefore

$$p_H\left(M - \frac{B}{\Delta p}\right) \geqslant I - A$$

$$\geqslant p_H\left[(1 - p_H)M + p_HD - \frac{B}{\Delta p}\right]. \tag{7.2}$$

Note that in this case the equilibrium is indeterminate. It may be firm 1 or firm 2 that gets funded.[6] The entrepreneurs are not indifferent as to which equilibrium prevails, though. Their net utility from receiving monopoly funding is $p_HM - I > 0$; it is equal to 0 when denied funding. This suggests that, in this case, the entrepreneurs have an incentive to preempt each other and invest "too early," spending investment $I$ before the technology is ripe. (This preemption game is analyzed in Exercise 7.4.)[7]

Summing up and letting $\bar{A}$ and $\underline{A}$ be defined by

$$p_H\left(M - \frac{B}{\Delta p}\right) = I - \underline{A}$$

and

$$p_H\left[(1 - p_H)M + p_HD - \frac{B}{\Delta p}\right] = I - \bar{A},$$

the outcome(s) are described in Figure 7.1.

   (b) *Benchmarking.* Competition generally allows some benchmarking (also called relative performance evaluation) because the performance of rival firms is partly governed by common shocks to industry cost and demand. To illustrate this point in a somewhat contrived, but straightforward, manner, consider the previous model, but assume that the exogenous events that determine the firms' outcomes

(success/failure) are the same, i.e., perfectly correlated across firms, rather than independent random variables. This "perfect correlation conditional on effort" is represented in Figure 7.2.

   Here $\omega$ is a random variable distributed uniformly on $[0, 1]$. A project always succeeds if $\omega < p_L$, always fails if $\omega > p_H$, and succeeds only in the case of good behavior if $p_L < \omega < p_H$. Because $\omega$ is uniformly distributed, the probability of success is therefore equal to $p_H$ if the entrepreneur behaves and $p_L$ if she misbehaves. Perfect correlation means that the realization of random variable $\omega$ is the same for both firms.

   Let us further, and for the sake of this argument only, replace the assumption that the entrepreneurs are risk neutral and protected by limited liability by the assumption that the entrepreneurs are risk neutral for positive incomes and infinitely risk averse for negative incomes: their utility from income $w$ is $w$ for $w \geqslant 0$, and $-\infty$ for $w < 0$. The two assumptions are very similar and often lead to the same conclusions. Not so in this somewhat rigged example, as we will see.

   It is easy to see that an equilibrium exists in which the agency cost is eliminated by benchmarking, that is, in which the pledgeable income is the entire NPV. Define the following incentive scheme for entrepreneur $i$:

$$w_i = \begin{cases} a_i & \text{with } a_i \geqslant 0 \text{ if firm } i \text{ does} \\ & \quad \text{at least as well as firm } j, \\ -b_i & \text{with } b_i > 0 \text{ if firm } i \text{ is} \\ & \quad \text{outperformed by firm } j. \end{cases}$$

   Suppose that firm $j$'s entrepreneur is subject to such an incentive scheme and behaves in equilibrium. Then, if firm $i$'s entrepreneur and investors agree on such an incentive scheme as well, entrepreneur $i$ will behave. Indeed good behavior ensures that she will never be outperformed and allows her to secure $a_i$. Misbehavior implies that she is

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   6. Actually, in this game in which the entrepreneurs simultaneously look for funding sources, there also exists a mixed-strategy equilibrium, in which each entrepreneur receives funding with probability $\kappa$, such that

$$\kappa p_H\left[[1 - \kappa + \kappa(1 - p_H)]M + \kappa p_HD - \frac{B}{\Delta p}\right] = \kappa I - A.$$

   7. The industrial organization literature has repeatedly stressed the incentive for preemption in such "natural monopoly" environments even in the absence of credit rationing.
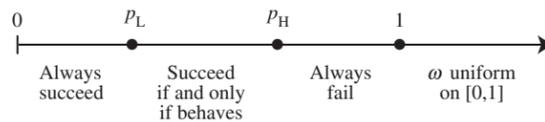
outperformed, and therefore receives a very low utility ($-\infty$ here!) with probability $\Delta p$ (i.e., when $\omega$ falls in the interval $(p_L, p_H)$).

Therefore the full expected income, $p_H D$,[8] is pledgeable and so funding is both feasible and desirable if and only if

$$p_H D \geqslant I.$$

It may even be that funding is easier under competition than under monopoly: this occurs whenever $p_H D \geqslant I$ and $p_H(M - B/\Delta p) < I - A$, that is, when the agency cost under monopoly is high (say, because $B$ is high) and firms do not compete much ($D$ close to $M$, as is the case, for example, when the two firms serve markets that are either only partly overlapping or similar).

Note, lastly, that benchmarking would be useless in this highly stylized example if we instead assumed that entrepreneurs were protected by limited liability. If entrepreneur $i$ misbehaves, then she will be found out whenever $\omega$ takes value in the interval $(p_L, p_H)$, because firm $i$ fails while firm $j$ succeeds, but then the punishment ($w_i = 0$) is no worse than it would have been in the absence of benchmarking. The conclusion that there is "no benefit from benchmarking" here is as extreme and nonrobust as the conclusion that "benchmarking fully eliminates the agency cost" under the alternative assumption of "infinite-risk-aversion-below-zero," that is, of a utility function that is equal to $-\infty$ for negative incomes. The general conclusion in less stylized models is that benchmarking reduces, but does not eliminate, the agency cost (see, for example, Exercise 7.5).

### 7.1.1.2 Impact of Competition on Financial Structure and Corporate Governance

So far, we have considered only the impact of competition on a firm's *ability to secure funding.* Following Aghion et al. (2000), let us extend the analysis to the impact of competition on the *terms of financing.* We make two basic points.

• Financial structure or corporate governance choices are interdependent: one firm's choice is affected by its rivals' choice in the matter.

• The quest for pledgeable income may make these choices "strategic complements" when they otherwise (i.e., in terms of NPV) would be "strategic substitutes": more discipline (in the sense of more profit-oriented behavior) in the rival firms lowers the firm's pledgeable income and calls for more discipline in order to satisfy the firm's investors.

These general statements are deliberately vague with regards to the nature of the financing "choices" made by the firms. These choices may be, for example,

• a choice of "financial muscle," which determines the firm's ability to withstand liquidity shocks,

• a refocusing on a line of business increasing one's efficiency in this line of business,

• the choice of high-powered monitoring or of vertical integration, resulting in improved corporate governance,

• relatedly, the act of granting more extensive control to investors, resulting in an enhanced concern for efficiency and profitability.

In fact, the choice may refer to any provision that (a) raises pledgeable income while (b) making the firm more competitive in the product market.

Anticipating Chapter 10, we illustrate these points in the context of the allocation of a control right. (Exercise 7.2 applies similar ideas to the firms' choice of financial muscle. More on this later.)

Let us return to the model without benchmarking (the two research processes are independent, and benchmarking is therefore useless). We assume that both firms have enough cash or pledgeable income to be attractive to investors. Therefore the issue is what kind of funding they receive rather than whether they are funded.

Let us introduce in each firm the possibility of taking an interim action that

(i) raises the probability of success uniformly by $\tau > 0$ (so the probability of success becomes $p_H + \tau$ or $p_L + \tau$, depending on the entrepreneur's behavior, if the action is taken, and remains $p_H$ or $p_L$ if the status quo action is selected); and

(ii) engenders a private cost $\gamma > 0$ for the entrepreneur (or more generally the insiders).

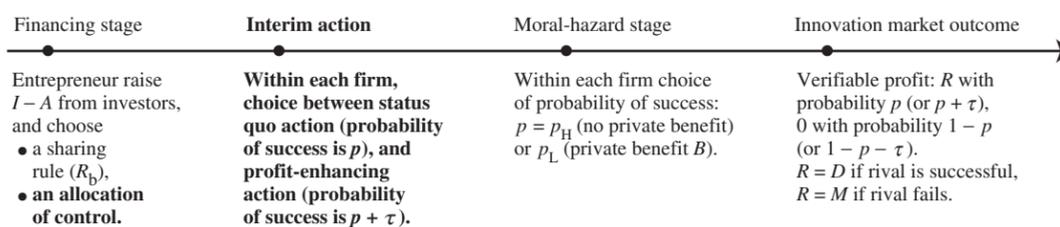For example, the interim action could consist in firing workers or divesting a division that manage-

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8. The profit in the case of success is $D$ rather than $p_H D + (1 - p_H)M$ because the technologies are perfectly correlated and so the two firms succeed or fail at the same time.

| Financing stage | **Interim action** | Moral-hazard stage | Innovation market outcome |
|---|---|---|---|
| Entrepreneur raise $I - A$ from investors, and choose <br> • a sharing rule ($R_b$), <br> • **an allocation of control.** | **Within each firm, choice between status quo action (probability of success is $p$), and profit-enhancing action (probability of success is $p + \tau$).** | Within each firm choice of probability of success: $p = p_H$ (no private benefit) or $p_L$ (private benefit $B$). | Verifiable profit: $R$ with probability $p$ (or $p + \tau$), 0 with probability $1 - p$ (or $1 - p - \tau$). $R = D$ if rival is successful, $R = M$ if rival fails. |

**Figure 7.3**

ment is eager to run. The action (like the "status quo action") is *ex ante* indescribable, so its implementation is achieved through the allocation of the control right to a party with specific incentives to take or not take the profit-enhancing action.

We assume that

$$\gamma > \tau M, \qquad (7.3)$$

which implies that the action always (i.e., even in a monopoly situation) decreases value.

The timing is described in Figure 7.3 (the new elements relative to the basic model are indicated in bold).

Two key preliminary points. First, if the control right over the interim action is granted to investors, they will choose the profit-enhancing action, since it raises the probability of success (and they receive no money in the case of failure) and they bear none of the cost $\gamma$. By contrast, and from (7.3), when in control, the entrepreneur does not choose the profit-enhancing action, since she bears the entire cost and receives only part of the benefit. Thus, the allocation of the control right matters for the actual decision making.

Second, the separability of the impacts of the exercise of the control right and of the moral-hazard choice of the entrepreneur implies that the entrepreneur's incentive constraint is not affected by the allocation of the control right: letting $R_b$ denote the entrepreneur's reward if her firm succeeds ($R_b$ can be chosen independently of the other firm's performance since benchmarking is useless) and 0 her reward in the case of failure, this incentive constraint is

$$(p_H - p_L)R_b \geqslant B$$

if the entrepreneur retains the control right, and

$$[(p_H + \tau) - (p_L + \tau)]R_b \geqslant B$$

if investors receive control. The invariance of the incentive constraint to the allocation of the control right obviously shortens the analysis.[9]

Because investor control reduces the NPV and therefore the entrepreneur's utility, each entrepreneur would rather not surrender control. Let us therefore find the ranges of parameters over which the entrepreneurs can secure financing with and without surrendering control to investors.

*Equilibrium in which both entrepreneurs retain control.* When entrepreneurs retain control, a firm's probability of success is $p_H$ and so the expected income is

$$p_H[(1 - p_H)M + p_H D].$$

Because $R_b \geqslant B/\Delta p$, the pledgeable income is equal to the expected income minus $p_H B/\Delta p$. Hence, financing is possible if the pledgeable income exceeds the investors' initial outlay; this condition takes the same form as in the previous subsection:[10]

$$p_H \left[ (1 - p_H)M + p_H D - \frac{B}{\Delta p} \right] \geqslant I - A. \qquad (7.4)$$

Firms that start with a substantial amount of cash on hand (that is, condition (7.4) is satisfied) create a form of corporate governance that is unfriendly to investors (who, because of the breakeven condition, must be compensated through a higher share of profit in the case of success).

*Equilibrium in which both entrepreneurs surrender control.* Suppose now that

$$p_H \left[ [1 - (p_H + \tau)]M + (p_H + \tau)D - \frac{B}{\Delta p} \right] < I - A \qquad (7.5)$$

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9. It also implies that, in Figure 7.3, whether the interim action comes before or after the moral-hazard stage is irrelevant.

10. Aghion et al. call this the "shirking region." I avoid this terminology so as not to create confusion with the moral-hazard part of the model.

and

$$(p_H + \tau)\left[[1 - (p_H + \tau)]M + (p_H + \tau)D - \frac{B}{\Delta p}\right]$$
$$\geqslant I - A. \quad (7.6)$$

Inequalities (7.4) and (7.5) state that, when the rival surrenders control to her investors (and therefore succeeds with probability $p_H + \tau$), there is enough pledgeable income to attract investors only if the entrepreneur surrenders control herself. In this case, and provided that the cost $y$ of the profit-enhancing action is not so high as to make the NPV negative,[11] then it is an equilibrium for the two entrepreneurs to surrender control. Aghion et al. call this the "bonding region."

Let us push this analysis a bit further by asking ourselves whether the corporate governance decisions (here, the allocations of control) are strategic complements or strategic substitutes. They are strategic complements (substitutes) if your retaining control makes me more (less) willing to retain control. Let $x_i = 0$ if entrepreneur $i$ retains control and $x_i = 1$ otherwise.

As it turns out, corporate governance decisions are either (a) strategic substitutes from an NPV perspective or (b) strategic complements from a pledgeable income perspective.

(a) *Strategic substitutability from an NPV perspective.* Entrepreneur $i$'s utility (also equal to her firm's NPV under a competitive capital market) is[12]

$$U_b^i = \mathcal{V}^i(x_i, x_j)$$
$$= (p_H + x_i\tau)$$
$$\times [[1 - (p_H + x_j\tau)]M + [p_H + x_j\tau]D]$$
$$- I - x_i y,$$

where
$$x_i, x_j \in \{0, 1\}.$$
And so
$$\frac{\partial^2 \mathcal{V}^i}{\partial x_i \partial x_j} = -\tau^2(M - D) < 0.$$

Intuitively, the cost of surrendering control, $y$, is independent from competitive pressure. By contrast,

raising the probability of success by $\tau$ is more advantageous if the other firm is less likely to succeed, since the monopoly profit exceeds the duopoly one. In a nutshell, the cost of surrendering control looms smaller when the payoff from good performance increases (this property holds whether or not condition (7.3) is satisfied).

(b) *Strategic complementarity from a pledgeable income perspective.* The condition that pledgeable income must exceed the investors' initial outlay is

$$\mathcal{P}^i(x_i, x_j)$$
$$= (p_H + x_i\tau)$$
$$\times \left[[1 - (p_H + x_j\tau)]M + [p_H + x_j\tau]D - \frac{B}{\Delta p}\right]$$
$$\geqslant I - A;$$

and so
$$\frac{\partial \mathcal{P}^i}{\partial x_i} > 0 \quad \text{and} \quad \frac{\partial \mathcal{P}^i}{\partial x_j} < 0.$$

Thus, if entrepreneur $i$ can secure financing without relinquishing control when the other entrepreneur surrenders control, she *a fortiori* can secure financing and keep control when her rival keeps control. Or, put differently, an entrepreneur who faces a tight financing constraint is more likely to surrender control if her rival also does so.[13]

This strategic complementarity may give rise to multiple equilibria. Condition (7.4) is consistent with conditions (7.5) and (7.6) holding simultaneously, and so the two equilibria studied above coexist over a range of parameters. Note further that if both equilibria coexist, then the one in which the two entrepreneurs retain control is better for both entrepreneurs ("Pareto-dominates") than the one in which they both surrender control.

### 7.1.1.3 Committing to Be Tough: Brander and Lewis (1986)

The analysis in Section 7.1.1.2, with a minor modification, also illustrates a well-known idea, due to Brander and Lewis (1986): *a firm may want to choose its financial structure or corporate governance so as to commit to being very competitive (aggressive) in*

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11. That is,

$U_b = \text{NPV} = (p_H + \tau)[(1 - (p_H + \tau))M + (p_H + \tau)D] - I - y > 0.$

12. Due to the symmetric structure of the model, $\mathcal{V}^i$, like the pledgeable income $\mathcal{P}^i$ defined below, is independent of $i$. Nonetheless, we keep the index $i$ so as to make it clear which firm is being discussed.

13. Technically, the set of parameters for which $x_i = 1$ is needed to deliver a pledgeable income in excess of $I - A$ when $x_j = 0$ is a subset of the set of parameters for which $x_i = 1$ is needed when $x_j = 1$.

*the product market, thereby deterring or limiting entry by a rival.* (This section offers a good transition from the literature on the impact of competition on the ability to raise funds to the next section on commitment effects.)

Return to the timing described in Figure 7.3 and decompose the "financing stage" into two substages. Namely, firm 1 chooses its financing structure (including the allocation of control) *before*, rather than simultaneously with, firm 2.

It is easy to find parameters such that

  (i) firm 2 cannot secure financing even by giving control to its investors when firm 1 gives control to its own investors,

 (ii) under a simultaneous choice of financial structure, there would have been an equilibrium (actually a Pareto-dominating one, as we have just seen), in which both entrepreneurs keep the control right and receive financing, and

(iii) firm 1 selects to deter firm 2's entry by giving control to its investors.

Indeed suppose that[14]

$$\mathcal{P}^2(1,1) < I - A < \mathcal{P}^2(0,0). \tag{7.7}$$

The left-hand inequality in (7.7) implies that tough corporate governance deters entry, yielding (i). The right inequality means that both firms could have been funded under simultaneous choices of financial structure and so (ii) obtains. For the "Brander–Lewis equilibrium" to arise, we also need to ensure (iii), that is, firm 1's willingness to sacrifice control to the purpose of deterring entry:

$$(p_H + \tau)M - \gamma - I > p_H[(1 - p_H)M + p_H D] - I$$

or

$$p_H^2(M - D) > \gamma - \tau M. \tag{7.8}$$

That is, the cost of relinquishing control is $\gamma - \tau M > 0$. But, with probability $p_H^2$, the probability that both

firms are successful when they both invest, firm 1 earns a monopoly profit rather than a duopoly one.

This analysis only conveys the spirit of the Brander–Lewis contribution. The latter actually studied the incentive to deter entry through a choice of overindebtedness in the context of Cournot competition.[15] Namely, firms 1 and 2 know that they will compete *à la* Cournot in the product market. The supplementary section covers the original Brander–Lewis model.

### 7.1.2 Committing through the Financial Structure

The choice of financial structure alters the incentives of those who run firms, and thereby indirectly modifies the behavior of product market rivals. The principle according to which financial and corporate governance choices can be used to affect other firms' behavior is obviously quite general, and has been developed in a variety of contexts. Let us discuss two of these.

#### 7.1.2.1 Financial Muscle and Predation

An old theme in industrial organization and antitrust policy is that cash-rich firms can prey upon cash-poor rivals. The standard definition of predation is that the predator voluntarily loses money in the short run (relative to the short-term profit that could have been achieved with an alternative strategy) so as to kick a rival out of the market, at which point the reduction in competition will allow it to more than recoup the short-term loss in earnings (see, for example, Joskow and Klevorick 1979). The instrument of predation is usually a low price, but it could be any strategic choice that hurts the rival's bottom line and prospects: intense advertising, selective price cuts, close positioning, clever versioning, etc. In the long-purse theory of predation, the cash-poor rival exits because it can no longer secure financing for its operating or investment costs. By contrast, the predator is assumed to have "deep pockets" (a "long purse") and its existence and investments are not jeopardized by short-term losses.

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14. To see that $\mathcal{P}^2(x,x)$ may be decreasing in $x$, note that

$$\frac{\partial}{\partial \tau}\left[(p_H + \tau)\left[[1 - (p_H + \tau)]M + (p_H + \tau)D - \frac{B}{\Delta p}\right]\right]$$
$$= \frac{\mathcal{P}^2 - (p_H + \tau)^2(M - D)}{p_H + \tau}.$$

So, if, for example, $\mathcal{P}^2$ is small (corresponding, in equilibrium, to $A$ close to $I$), $\mathcal{P}^2(x,x)$ decreases with $x$. Or, more directly, condition (7.7) can be satisfied for some choice of $I - A$ if and only if $M - (B/\Delta p) < (2p_H + \tau)(M - D)$.

15. Substantial extensions of the Brander–Lewis analysis can be found in Maksimovic (1988) and Poitevin (1989). Other papers studying financial contracting in an imperfectly competitive product market include Fulghieri and Nagarajan (1992) and Glazer (1994).

This long-purse story (articulated, for instance, by McGee (1958)), at least in its basic form in which the predator charges rock-bottom prices so as to make the prey lose money, was challenged by Telser (1966) and the Chicago School on the grounds that the prey can always receive financing after a predatory period as long as its prospects are good. That is, the prey's former losses from being preyed upon are "water under the bridge," and are therefore irrelevant. Financiers will look at the prey's prospects, not its past.

In a nutshell, Telser's critique takes an Arrow–Debreu view, under which the capital market is not marred by agency costs and so investment is driven by investment opportunities and not by forgone earnings. And, indeed, this sunk-loss argument is well-taken if firms can always obtain financing for continuation projects that have a positive NPV. In that case, money lost in the past, because it has no effect on future prospects, also has no impact on future investments and decisions. Unsurprisingly, the subsequent literature reintroduced the credit constraints that were not formalized but were implicit in the pre-Telser antitrust literature.

As a warm-up exercise, we begin with the "simple-minded long-purse story" in which the prey may in the future face credit rationing, but obtains no long-term commitment from its lenders, that is, financing occurs through a sequence of short-term borrowing (Fudenberg and Tirole 1986). The possibility that the prey be credit rationed tomorrow may induce the predator to take actions today that reduce both profits today and, in particular, lessen the prey's net worth tomorrow. We then move on to the more interesting case in which the prey, anticipating this, can (as was studied in Chapter 5) secure long-term financing and thereby attempt to discourage predation: this case has been analyzed in the strategic security design literature pioneered by Bolton and Scharfstein (1990).

*Simple-minded long-purse story: short-term financing arrangements.* There are two dates, $t = 0, 1$. There is no discounting between the two periods. Consider a duopoly. Firms $i = 1, 2$ are identical in all respects except the amount of wealth they have access to in order to finance investments. Firm 1 (the predator, the financially strong firm) has a large amount of wealth and never needs to go to the capital market to finance investment. Firm 2 (the prey, the financially weak firm) has just enough wealth to finance the date-0 investment.[16]

While the financially weak firm is self-financed at date 0, it will need to borrow in order to finance the date-1 investment cost. Its date-0 profit is its date-1 net worth or cash on hand.

Without loss of generality we describe date 0 in reduced form: firm 1 can take a costly action (prey) that reduces both firms' date-0 profits. In particular, firm 2's profit falls from $A > 0$ to $a$ (we take the profit to be deterministic in order to simplify the exposition; again, there is no loss of generality here).

The second period, date 1, is described exactly as in Section 7.1.1: for each firm, the investment cost is $I$. Entrepreneurs then engage in moral hazard. The probability of success of the date-1 project is $p_H$ if the entrepreneur behaves and $p_L = p_H - \Delta p$ if she misbehaves (in which case she obtains private benefit $B$). A firm's date-1 profit is $M$ if it alone succeeded, $D$ if both firms succeeded, and 0 otherwise. Let

$$C \equiv p_H D + (1 - p_H) M$$

denote the expected date-1 "competitive" profit per firm when both invest (assuming as always that incentive schemes induce good behavior). The timing is summarized in Figure 7.4.

Assume that

$$I - A < p_H \left( C - \frac{B}{\Delta p} \right) < I - a.$$

This condition says that the pledgeable income—equal to the probability of success, $p_H$, times the amount of revenue in the case of success, $C - B/\Delta p$, that can be promised to investors without compromising incentives—exceeds the investors' date-1 outlay in the financially weak firm if the latter has retained earnings $A$, but not if it only retained earnings $a$. Thus, assuming that the NPV is positive even under competition ($p_H C > I$), predation by firm 1 triggers firm 2's exit.

Does firm 1 find it profitable to induce exit? Firm 1 compares its date-0 cost of predation with its date-1

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16. Alternatively, one could assume that it is able to secure financing for the date-0 investment, where the loan is to be repaid from date-0 profits: that is, there is no long-term financing arrangement.
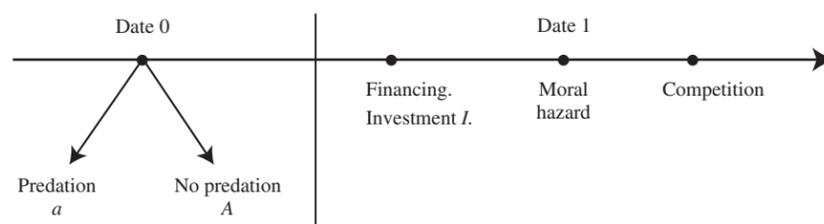
**Figure 7.4**

gain from monopolization. The gain from monopolization, $M - D$, is reaped only when, in the absence of exit, both firms would have been successful, that is with probability $p_H^2$.

Let $k$ denote the predator's cost of predation (for example, $k = A - a$ if the cost of predation is the same for both firms, but obviously, it need not be). In the absence of discounting between dates 0 and 1, firm 1 chooses to prey if and only if

$$k < p_H^2(M - D).$$

More generally, if the prey's investment decreases with its cash on hand (as it does in corporate finance models), the predator is willing to incur losses as long as she can recoup these later on thanks to her rival's reduced scale.

Note also that the prey's potential date-1 funding contract is designed at date 1. In particular, the firm cannot contract with date-0 investors to secure a credit line that will allow it to continue even if earnings are low. Such a credit line might salvage a valuable investment at date 1 (as in Chapter 5), and crucially it might also deter date-0 predation in the first place. This brings us to the strategic security design literature.

*Strategic security design (Bolton and Scharfstein): reducing the sensitivity of investment to cash flow.* The simple-minded version brings credit constraints to the forefront of the analysis of predation, but has two serious shortcomings. First, as we noted, it does not allow for long-term contracting such as credit lines or long-term debt. Second, it does not make the date-0 agency costs explicit (since the prey's date-0 investment is self-financed, the two shortcomings are, as we will see, related; it becomes important to explicitly model date-0 agency costs when the firm secures long-term financing). The crucial work

of Bolton and Scharfstein (1990) (see also the very careful analysis of renegotiation in Snyder (1996)) addresses these shortcomings.

The literature makes three basic points.

1. *A financially weak firm can reduce the occurrence of predation through long-term contracting with its financiers.* Intuitively, the predator feels less inclined to prey (and thereby lose money) if the prey has secured a financial cushion and therefore will probably be able to finance its reinvestment.[17] Conversely, the predator is deterred from predation if the prey has contracted a large amount of short-term debt and does not receive financing even for high earnings (this will later be called the "shallow-pocket strategy"). Either way, a reduction in the prey's sensitivity of investment to cash flow reduces the predator's incentive to prey.

2. *Financial cushions that insure the potential prey against fluctuations in revenue (and thereby deter predation) exacerbate the incentive problem within the firm.* In general, financial contracts may not be able to distinguish between losses that are due to predation and those stemming from other causes (effort, competitive environment). And so, because a shortfall in revenue may be due to managerial moral hazard and not only to the rival's predatory actions, insurance against predation also exacerbates moral hazard. In other words, there is a tension between the minimization of the rival's incentive to prey and the minimization of agency costs within the firm when investors cannot disentangle whether a low profit is due to aggressive competition or low managerial effort.

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17. An alternative to a credit line to build financial muscle is to become a division of a conglomerate, as in Cestone and Fumagalli (2005). For a modeling of financial muscle in a conglomerate, see Exercise 3.20.

3. *Long-term contracts that protect against preda-tion are credible.* That is, investors and the entre-preneur do not find it advantageous to renegotiate their agreement to their mutual advantage later on.[18] As in Chapter 5, when continuation maximizes to-tal (entrepreneur and investor) value but reduces in-vestors' payoff, the continuation policy is not rene-gotiated: either it dictates continuation, in which case there are no gains from renegotiation; or it leads to liquidation, and then the entrepreneur has no cash to compensate investors for the loss they incur if they agree to finance continuation.

Let us now investigate these points in more detail. To do so, we need to build upon the simple-minded model by explicitly describing the date-0 actions and by allowing for long-term financing. To simplify the analysis, let us assume that

- $p_H = 1$;
- furthermore, date 0 is identical to date 1 except for the private benefit from misbehaving—the latter is equal to $B_0$ at date 0 and $B$ at date 1;[19]
- the financially strong firm's act of predation in a given period[20] results in 0 profits (failure) for both firms in that period;
- investors in the financially weak firm observe only that firm's profit at date 0.[21]

As earlier, the financially strong firm is self-fi-nanced. The financially weak firm signs a long-term agreement with its investors that specifies:[22]

- the probabilities $z^S$ and $z^F$ of refinancing (date-1 investment) in the case of date-0 success (i.e., profit $D$) or failure (i.e., profit 0), respectively;
- a reward $R_b^i$ in the case of date-1 success (which assumes a date-1 reinvestment in the first place), where $i \in \{S, F\}$ indexes the date-0 outcome—for all $i$, $R_b^i$ must satisfy the date-1 incentive con-straint $(\Delta p)R_b^i \geqslant B$.[23]

The timing is summarized in Figure 7.5.

Let us make the following assumptions.

**Assumption 7.1.** *Positive-NPV investment even un-der duopoly in the absence of predation:*

$$D - I > 0.$$

(Recall: the probability of success in the case of good behavior is here equal to 1.)

**Assumption 7.2.** *Dearth of pledgeable income in the case of continuation:*[24]

$$\left(D - \frac{B}{\Delta p}\right) - I < 0.$$

Preventing predation by firm 1 at date 0 bene-fits firm 2 in two ways. First, its date-0 income is

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18. A large literature has investigated the use of contracts with third parties as a way to commit to certain types of behavior in strategic interactions (e.g., Katz 1991). A subset of these contributions raises the question of whether such commitments are credible, i.e., whether the parties to the contract would not undo its provisions once the latter have served their objective of altering the others' behavior in the strategic interaction. Once must then assume that the parties to the contract are unable for some reason to renegotiate, or else show that renegotiation is at best inefficient, as in Caillaud et al. (1995), where renegotiation is plagued by informational asymmetries.

19. We will later assume that $B_0 < B$. This distinction between $B_0$ and $B$ allows us to shorten the analysis by ensuring that date-0 incen-tives can be provided through the continuation policy. See below.

20. Predation can, of course, occur at date 0 only. The predator can only lose by preying at date 1 because there is no future at that date.

21. The important assumption is that a court cannot ascertain whether the absence of date-0 profit for firm 2 is due to a predatory act or to moral hazard (lack of luck is not a possible third explanation because we assumed that $p_H = 1$).

Indeed, historically, courts have had difficulties in ascertaining the occurrence of predation. Legal scholars, such as Areeda and Turner (1975), have suggested comparing the price charged by the alleged predator to its marginal cost, approximated by the average variable cost. There are several difficulties with this, leaving aside the fact that predation may be implemented through nonprice instruments. Mea-surability is not easy. Prices may be multidimensional and have whole-sale components; marginal costs are often difficult to measure. Second,

marginal cost is not necessarily the correct theoretical benchmark. On the one hand, a price above marginal cost may be predatory since the short-term profit-maximizing price may be well above marginal cost. On the other hand, prices below marginal cost may arise as part of strategies that are not meant to induce the rival's exit. They are com-mon in markets where (a) quality is unknown, so introductory offers encourage consumers to try the product, or (b) the firms want to bene-fit from learning by doing and so price aggressively initially, or (c) con-sumers are locked into their initial consumption, so that the prospect of future profits from these "installed-base consumers" induces firms to lose money to "acquire" them, or else (d) there are network external-ities and networks/firms are willing to lose money to enlist the initial group or marquee players who will attract other consumers. Bolton et al. (2000, 2001) offer a standard for financial predation. See also Tirole (1988, in particular Chapter 9) for some of the theoretical principles.

Note also that even if courts were able to measure predation cheaply and accurately, the time involved in the process might still make it impossible to base the refinancing decision on the existence or nonex-istence of predation.

22. Exercise 7.7 shows that there is only a slight loss of general-ity in considering this class of contracts, and that the results are not qualitatively affected by our focus on this class.

23. Note that if $(\Delta p)R_b^i < B$, then there is always renegotiation to an $R_b^i \geqslant B/\Delta p$ as long as $p_H(R - B/\Delta p) > p_L R$. But even in the absence of renegotiation, the analysis generalizes.

24. Given that rent $p_H(B/\Delta p) = B/\Delta p$ must be given to the entre-preneurs, investors would not finance firm 2 at date 1 in the absence of retained earnings and long-term contracting obligations.
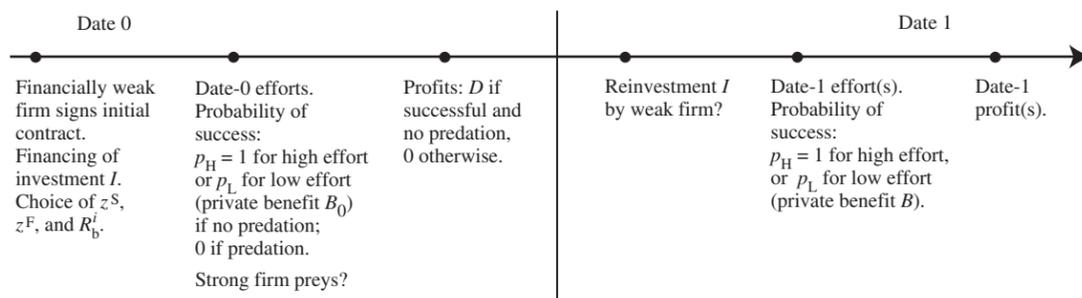
| Date 0 | | | Date 1 | | |
|---|---|---|---|---|---|
| Financially weak firm signs initial contract. Financing of investment $I$. Choice of $z^S$, $z^F$, and $R_b^i$. | Date-0 efforts. Probability of success: $p_H = 1$ for high effort or $p_L$ for low effort (private benefit $B_0$) if no predation; 0 if predation. Strong firm preys? | Profits: $D$ if successful and no predation, 0 otherwise. | Reinvestment $I$ by weak firm? | Date-1 effort(s). Probability of success: $p_H = 1$ for high effort, or $p_L$ for low effort (private benefit $B$). | Date-1 profit(s). |

**Figure 7.5**

increased by $D$, the duopoly profit. Second, it may avoid credit rationing, which from Assumption 7.2 is a threat, and from Assumption 7.1 undesirable.

*Predation deterrence constraint.* To avoid predation firm 2 must choose its financial contract so that firm 1's date-0 cost of predation, $D$, exceed its date-1 gain from monopolization. To compute the latter, note that it is not in firm 1's interest to prey in the last period. Hence, preventing refinancing by firm 2 raises firm 1's profit from $D$ to $M$. And the probability that firm 2 receives refinancing falls from $z^S$ in the absence of predation to $z^F$ under predation (recall that the probability of refinancing is $z^S$ if firm 2's date-0 profit is $D$ and $z^F$ if it is equal to 0). The predation deterrence constraint is therefore

$$D \geqslant (z^S - z^F)(M - D). \qquad \text{(PD)}$$

To deter predation, the weak firm's contract must make the continuation decision relatively insensitive to that firm's date-0 profit performance. Note that (PD) can be rewritten as

$$\frac{D}{M - D} \geqslant z^S - z^F. \qquad \text{(PD′)}$$

Suppose that competition between the two firms reduces industry profit:

$$M \geqslant 2D.$$

The left-hand side of (PD′) can then take any value between 0 (extreme, Bertrand competition) and 1 (perfect tacit collusion or noncompeting goods). In the latter case, (PD′) really does not constrain the financial contract and there is little incentive to prey. By contrast, with Bertrand competition, predation can only be deterred by a performance-insensitive

continuation rule (on the other hand, remaining in the market is also unattractive for firm 2).

*Weak firm's date-0 incentive constraint.* The weak firm's contract must also induce its entrepreneur to behave. Here, the entrepreneur's compensation is delayed. She receives $R_b^i$ if there is reinvestment and firm 2 has profit $D$ in the last period. Let

$$\mathcal{R}_b^S \equiv z^S R_b^S \quad \text{and} \quad \mathcal{R}_b^F \equiv z^F R_b^F$$

denote the expected continuation payoffs for the entrepreneur in the cases of date-0 success and failure, respectively. By misbehaving at date 0, the entrepreneur receives private benefit $B_0$, but reduces the probability of date-0 success by $\Delta p$ (provided that the rival does not prey, i.e., if constraint (PD) is satisfied).

Hence, the incentive constraint is

$$\mathcal{R}_b^S - \mathcal{R}_b^F \geqslant \frac{B_0}{\Delta p}. \qquad \text{(IC)}$$

(a) *The no-predation benchmark.* Suppose, first, that the predator is unable to prey and so constraint (PD) is irrelevant. Let $U_b(z^S)$ denote the NPV:

$$U_b(z^S) \equiv D - I + z^S(D - I).$$

From Assumption 7.1, it increases in $z^S$.

The investors' breakeven constraint can be written as

$$U_b(z^S) - \mathcal{R}_b^S + A \geqslant 0. \qquad \text{(IR_l)}$$

Finally, the entrepreneur's incentive compatibility constraint is

$$\mathcal{R}_b^S - \mathcal{R}_b^F \geqslant \frac{B_0}{\Delta p}. \qquad \text{(IC)}$$

We are led to consider two cases.

*Strong balance sheet.* We will say that the firm has a strong balance sheet if constraints (IR$_l$) and (IC) do not rule out the efficient continuation policy:

$$z^S = 1.$$

Because $\mathcal{R}_b^S = z^S R_b^S$ and $R_b^S \geqslant B/\Delta p$, a necessary condition for this is

$$U_b(1) - \frac{B}{\Delta p} + A \geqslant 0,$$

that is, that $A$ be "sufficiently large." Then $\mathcal{R}_b^S$ is given by the breakeven constraint:

$$\mathcal{R}_b^S = U_b(1) + A.$$

For this condition to also be sufficient, constraint (IC) must be satisfied, or, using the investors' breakeven condition,

$$\mathcal{R}_b^F + \frac{B_0}{\Delta p} \leqslant U_b(1) + A.$$

Because the right-hand side of the latter inequality is greater than $B/\Delta p$ and $\mathcal{R}_b^F \geqslant z^F B/\Delta p$, if $B \geqslant B_0$, which we will assume, there exists $\bar{z}^F$ such that the solution is incentive compatible for $R_b^F = B/\Delta p$ and

$$0 \leqslant z^F \leqslant \bar{z}^F.$$

*Weak balance sheet.* If

$$U_b(1) - \frac{B}{\Delta p} + A < 0,$$

then continuation cannot be guaranteed without violating the investors' breakeven constraint. And so

$$z^S = \bar{z}^S < 1.$$

It is then optimal to set $R_b^S = B/\Delta p$ so as to harness as much pledgeable income and generate as much continuation as possible. The probability of continuation in the case of success is given by

$$U_b(\bar{z}^S) - \mathcal{R}_b^S + A = 0,$$

or, using $\mathcal{R}_b^S = \bar{z}^S(B/\Delta p)$,

$$D - I + \bar{z}^S\left[D - I - \frac{B}{\Delta p}\right] + A = 0.$$

From Assumption 7.2, the left-hand side of this equation is decreasing in the probability of continuation. From Assumption 7.1, the equation has a unique solution in $(0,1)$. Again, if $\bar{z}^S B \geqslant B_0$, which we will assume, there exists $\bar{z}^F \in (0,1)$ such that the incentive constraint is satisfied as long as $0 \leqslant z^F \leqslant \bar{z}^F$.

(b) *Reintroducing the predation-deterrence constraint.* The best, predation-deterring financial contract is now obtained by maximizing firm 2's NPV subject to the predation-deterrence constraint (PD), the breakeven constraint (IR$_l$), and the incentive-compatibility (IC) constraint.

If the solution in the no-predation benchmark case satisfied (PD), then it is also the solution when predation if feasible. So, we will assume that (PD) is not satisfied by the benchmark solution. Let us begin with the case of a weak balance sheet.

*Weak balance sheet.* A benchmark solution $(\bar{z}^S, z^F)$ satisfies (IC) if and only if

$$(\bar{z}^S - z^F)\frac{B}{\Delta p} \geqslant \frac{B_0}{\Delta p}$$

and (PD) if and only if

$$(\bar{z}^S - z^F)(M - D) \leqslant D.$$

These two constraints are inconsistent if

$$\frac{B_0}{B} > \frac{D}{M - D}.$$

which we will assume.

Relative to the benchmark, the weak firm's entrepreneur must reduce the sensitivity of investment to cash flow, which is proportional to $z^S - z^F$. She cannot increase $z^S$ without violating the investors' breakeven constraint. She must thus reduce $z^S$ below $\bar{z}^S$. Furthermore, using (IC) and (PD) satisfied with equality yields

$$\mathcal{R}_b^S - z^S\frac{B}{\Delta p} = \frac{B_0}{\Delta p} - \frac{B}{\Delta p}\left(\frac{D}{M - D}\right) > 0,$$

and so $R_b^S > B/\Delta p$. Note that continuation in the case of success is no longer an efficient currency because it induces the predator to prey; this explains why $R_b^S$ is greater than $B/\Delta p$.

Finally, the probability of continuation in the case of success must satisfy the investors' breakeven constraint:

$$U_b(z^S) - \mathcal{R}_b^S + A = 0$$

or

$$D - I + z^S\left(D - I - \frac{B}{\Delta p}\right)$$
$$- \left[\frac{B_0}{\Delta p} - \frac{B}{\Delta p}\left(\frac{D}{M - D}\right)\right] + A = 0.$$

Hence,

$$z^S < \bar{z}^S.$$

Everything is as if the balance sheet (as measured by $A$) had further deteriorated. The entrepreneur is forced to adopt a *shallow-pocket* (low probability of continuation) policy.

*Strong balance sheet.* We only sketch the case of a strong balance sheet. Under a strong balance sheet, $\bar{z}^S = 1$ in the absence of predation threat. Reducing $z^S$ (here below 1) is, as in the case of a weak balance sheet, a feasible response to deter predation.[25]

Let us use this case to illustrate another feasible response, namely, the *deep-pocket* policy. Here, a deep-pocket policy consists in raising $z^F$ while keeping $z^S = \bar{z}^S = 1$. Maintaining incentive compatibility, however, requires raising $R_b^S$ and thereby violating the investors' breakeven constraint.[26] Thus, the deep-pocket policy requires finding new forms of pledgeable income and/or cash on hand. This book emphasizes the various concessions that can be made to boost pledgeable income (costly collateral, control rights, etc.).

To simplify the exposition, let us enrich the model by assuming that the entrepreneur can increase cash on hand from $A$ to any $A' \geqslant A$ at deadweight cost $\varepsilon(A' - A) > 0$.[27] Because the entrepreneur reaches the first-best allocation when predation is not feasible, then $A' = A$ in the no-predation-threat benchmark. Because reducing $z^S$ is costly, if $\varepsilon$ is small, the entrepreneur is better off raising cash on hand so as to reduce the amount borrowed. She can then set $z^F$ so as to satisfy constraint (PD),

$$(1 - z^F)(M - D) = D,$$

and set $R_b^S$ so as to satisfy the incentive constraint:[28]

$$R_b^S - z^F \frac{B}{\Delta p} = \frac{B_0}{\Delta p}.$$

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25. Constraint (PD) is violated by the benchmark solution if

$$U_b(1) - \frac{B}{\Delta p} + \left[ \frac{B_0}{\Delta p} - \frac{B}{\Delta p}\left(\frac{D}{M - D}\right) \right] + A < 0.$$

26. The assumption that $p_H = 1$ implies that on the equilibrium path there is no date-0 failure. And so the cost of a high $z^F$ in terms of pledgeable income does not correspond to a loss by investors in the case of continuation after a failure. Rather, a high $z^F$ makes it harder to satisfy the (*IC*) constraint, which requires giving extra rents to the entrepreneur in the case of success and thereby reducing the pledgeable income.

27. One can think of a nonmonetary, *ex ante* effort that costs the entrepreneur $(1 + \varepsilon)$ per unit of cash collected.

28. $A'$ is then given by

$$U_b(1) - \frac{B}{\Delta p} + \left[ \frac{B_0}{\Delta p} - \frac{B}{\Delta p}\left(\frac{D}{M - D}\right) \right] + A' = 0.$$

We thus conclude that it may be optimal for the entrepreneur to waste resources to find new sources of cash (or to make concessions to investors) so as to be able to increase the probability of continuation in the case of failure.

Let us conclude with Bolton and Scharfstein's third point: the financing contract between entrepreneur 2 and her lenders is *renegotiation proof.* To appreciate the relevance of this remark, note that, when $z^F > 0$, firm 1 would not be deterred from preying if it anticipated that in the case of date-0 failure of firm 2, firm 2's entrepreneur and her investors would renegotiate and decide not to refinance continuation. To see that the entrepreneur and the investors cannot renegotiate to their mutual advantage, note that continuation is *ex post* optimal from Assumption 7.1. This is indeed the essence of predation in this model: a lack of continuation is not due to a lack of investment opportunities, but rather to a lack of internal funds. So reducing $z^F$ would reduce total value or NPV (entrepreneur plus investor), and at least one of the two parties would necessarily lose—and therefore prefer the implementation of the initial contract. Thus renegotiation toward less frequent continuation will not occur.

Similarly, when $z^S < 1$, firm 1 would be incentivized to prey if it anticipated that the probability of continuation would be renegotiated upwards in the case of success. Again, this renegotiation will not occur, but this time for a different reason. Increasing the probability of continuation would increase total value. However, investors necessarily lose when refinancing from Assumption 7.2 and the fact that the entrepreneur no longer has wealth at date 1.

*Empirical work.* A series of empirical papers (Phillips 1995; Chevalier 1995a,b) argue that debt weakens the competitive position of firms.[29] Chevalier (1995a,b) and Chevalier and Scharfstein (1996) study the link between balance-sheet strength and product market behavior in the U.S. supermarket industry. They measure the strength (or rather the weakness) of the balance sheet by the firm's leverage; for example, an LBO firm (a firm that results from a leveraged buyout, and therefore is highly

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29. See, for example, MacKay and Phillips (2005) for a recent survey of the evidence.

indebted) has a weak balance sheet. Such LBOs in their sample were frequently motivated by the deterrence of takeovers rather than by product market expansion. Two notable results are as follows:

(a) Entry and expansion of non-LBO firms is more likely in markets with LBO firms. This suggests that either LBO firms are unable to expand sufficiently rapidly and thus leave more elbowroom for other firms, or these other firms attempt to prey on the weaker LBO firms. Either way the financial structure of firms seems to affect product market behavior.[30]

(b) Supermarket prices are procyclical. One possible interpretation is that financially weak firms are more fragile during recessions, which may encourage some predation.

### 7.1.2.2  Committing vis-à-vis Suppliers or Customers

Until now we have focused on the interaction between financial structure and product-market competition. The design of the financial structure may also be used to alter the behavior of complementors in the vertical chain, rather than that of the producers of substitutes. A series of papers (Bronars and Deere 1991; Perotti and Spier 1993; Spiegel 1996; Spiegel and Spulber 1994) has argued in various settings that leverage can be used as a commitment to be tough in bargaining over conditions of trade. This insight is usually based on the following premises:[31]

(a) the firm will in the future negotiate with a third party over, say, a transfer price;

(b) the negotiation will be conducted by the entrepreneur (or more generally by the entrepreneur and a class of investors such as shareholders, as long as other interested claimholders are not part of the renegotiation);

(c) this third party has some bargaining power in the renegotiation, perhaps because of an existing relationship or because of institutional (regulatory) constraints on bargaining processes (the one case that is excluded by this assumption is

the case in which the entrepreneur has full bargaining power, i.e., is able to make a take-it-or-leave-it offer to the third party).

In the same way that a firm can use leverage or give the control right over output determination to the entrepreneur to commit to behaving aggressively in the product market (see the discussion of the Brander–Lewis model above), the firm is able to commit to being an aggressive bargainer in future negotiations by giving control to the entrepreneur in those negotiations and by designing her compensation scheme in such a way that her eagerness to reach agreement or her ability to pay is reduced. Third parties are then induced to make concessions.

The third party may be a union, from which the firm tries to extract low wages (Bronars and Deere 1991; Dasgupta and Sengupta 1993), a regulator, from whom the firm (a utility) tries to extract high regulated retail prices (Spiegel 1996; Spiegel and Spulber 1994), a government, from whom the defense contractor tries to obtain high procurement prices, a raider, whose takeover offer the incumbent management tries to raise, or, conversely shareholders, whose free-riding behavior the raider tries to limit (see Chapter 11 and Müller and Panunzi (2004)). For example, in the context of labor relations, Bronars and Deere (1991) find a positive correlation at the industry level between leverage and unionization. Matsa (2005) develops a model of optimal maturity structure similar to that in Chapter 5, but in the presence of wage bargaining at the intermediate stage. He shows that short-term debt indeed rises with the union's bargaining power. Empirically, he uses U.S. state-specific changes in labor law, namely, the enactment of right-to-work leaves, which outlaw employment contract provisions that require employees to join or financially support the union, and thereby weaken unions. Such laws are indeed associated with an increase in the maturity structure of debt.

Note the role of (b) and (c) in the reasoning: if the entrepreneur acted on behalf of herself and all investors in the renegotiation process (say, because they act in concert or realign their interests just before the negotiation), then the initial financial structure would be irrelevant. Hence, the role of assumption (b). As for (c), there would be no point changing

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30. Interestingly, Zingales (1998) finds that, in the U.S. trucking industry, a firm's leverage reduces the probability that it survives an increase in competition.

31. See, however, the discussion of Chemla and Faure-Grimaud (2001) below.
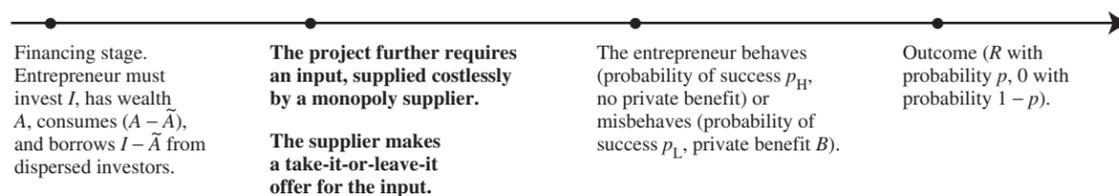
Financing stage. Entrepreneur must invest $I$, has wealth $A$, consumes $(A - \tilde{A})$, and borrows $I - \tilde{A}$ from dispersed investors.

**The project further requires an input, supplied costlessly by a monopoly supplier.**

**The supplier makes a take-it-or-leave-it offer for the input.**

The entrepreneur behaves (probability of success $p_H$, no private benefit) or misbehaves (probability of success $p_L$, private benefit $B$).

Outcome ($R$ with probability $p$, 0 with probability $1 - p$).

**Figure 7.6**

the entrepreneur's objective function by altering the financial structure if the third party had no bargaining power. For example, a competitive supplier accepts the lowest price (its cost) that makes it break even, and this lowest price obtains regardless of the buyer's financial structure.

As we will see, the analysis here is closely related to those of the debt overhang (see Section 3.3) and of the soft budget constraint (see Section 5.5).

To illustrate the commitment effect, consider the situation depicted in Figure 7.6.

This is the standard fixed-investment model except for one twist: the initial investment financed by the lenders is not a sufficient enabler of the technology. A supplier will later bring, at no incremental cost to him, a key complementary input (say, a patent license) to make it possible to continue the project; in the absence of this input, the probability of success is nil. As usual, we assume that

$$p_H R > I > p_L R + B$$

(the NPV is positive if the entrepreneur behaves) and

$$p_H \left( R - \frac{B}{\Delta p} \right) \geqslant I - A$$

(there is enough pledgeable income).

To make the point in the most striking way, we assume that the supplier has full bargaining power: he will set the price for the input. This situation is most conducive to a holdup problem (see, for example, Williamson 1975). Once the investment $I$ has been sunk, the supplier can ask for an extravagant price and basically expropriate the specific investment made by the entrepreneur and her lenders. Indeed, suppose that the entrepreneur and the initial investors acted in concert when deciding whether to accept the supplier's offer. Then the investors would be willing at date 1 to bring an amount of money

equal to the pledgeable income, $p_H[R - B/\Delta p]$, that they can rescue by accepting the supplier's offer. Thus, the supplier fully expropriates the initial investors' claims in the firm, implying that the investors should at date 0 expect their initial outlay to yield no return. Hence, no investment takes place at date 0.

By contrast, assume now, as in Section 3.3, that the initial investors are dispersed and cannot take part in a renegotiation process. The supplier at date 1 offers a price for the input to the entrepreneur, who can at this point invest any of her wealth ($A - \tilde{A}$) not yet invested in the firm and/or turn to new investors.

The entrepreneur can now "trick" the supplier in the following way: she issues *senior* debt

$$D = R - \frac{B}{\Delta p}$$

to the initial investors, takes the minimum incentive-compatible stake $R_b = B/\Delta p$ in the firm, which she commits not to resell (i.e., writes a vesting provision and commits not to short-sell her stake), and, finally, keeps none of her noninvested wealth (i.e., consumes $A - \tilde{A}$). She thereby creates a debt overhang problem. New investors are unwilling to finance the firm at date 1 since the firm's income in the case of success, $R$, is already committed in part to the senior debtholders, $R - B/\Delta p$, with the rest, $B/\Delta p$, being needed as an incentive payment to induce the entrepreneur to behave. So, no new income can be raised by the entrepreneur in the absence of renegotiation with the initial investor. This debt overhang problem, which is usually a handicap for entrepreneurs needing to get refinancing, is an asset here because the cost of "refinancing" is fully endogenous: the supplier has no choice but to lower the price of its input to its marginal cost, here normalized at 0. At the initial stage, the entrepreneur

borrows $I - \tilde{A}$ with

$$p_H \left( R - \frac{B}{\Delta p} \right) = I - \tilde{A},$$

and consumes $A - \tilde{A} \geqslant 0$. She thereby fully extracts not only the investors' rent (as is usual in a competitive capital market), but also that of the monopoly supplier.

Note also that, were the entrepreneur to retain her noninvested wealth, $A - \tilde{A}$, until date 1, the supplier would be able to appropriate part of or all of this retained wealth. Indeed the entrepreneur has a stake, $p_H B/\Delta p$, equal to her rent in the case of continuation. The supplier can then ask the entrepreneur to pay[32]

$$\min \left( A - \tilde{A}, p_H \frac{B}{\Delta p} \right).$$

We thus uncover one exception to the general rule that the entrepreneur cannot lose by investing all her wealth in the firm at the initial stage as long as the contract with investors is structured properly.[33] Here, there is also a contract with a supplier, and, crucially, this contract is not yet entered into at the initial financing stage. The benefit from "committing not to be able to pay the supplier for his input" vindicates this partial consumption of the entrepreneur's equity.

Exercise 7.8 considers a very similar situation in which the third party is a customer rather than a supplier. The final payoff $R$ in the case of success of the project is then endogenous, since it is the amount that the customer will pay for the intermediate input produced by the entrepreneur. As in the model above, the negotiation with the third party over the transfer price takes place after the initial financing stage, and so the financial structure can be used in order to extract more favorable conditions from the third party.

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32. Equivalently, if the entrepreneur borrowed less than $p_H(R - B/\Delta p)$ from initial investors and took a larger stake than is needed to satisfy the incentive compatibility constraint, then the supplier would be able to charge a positive price.

33. See also the discussion of the Brander–Lewis model in the supplementary section.

Another and related reason why the entrepreneur may not want to invest her whole wealth in the firm arises when a raider wants to take over the firm (a raider's bid is similar to the input supplier's price). As we will see in Chapter 11, dispersed ownership may be a way of extracting the raider's rent. By contrast, if the entrepreneur keeps a large stake in the firm, this may lead to smaller takeover premia.

The exercise shows that *short-term debt is more efficient than long-term debt at capturing the customer's surplus.* To see this, suppose that the entrepreneur issues long-term debt (to be repaid after the outcome is realized) to dispersed investors, and, for simplicity, that this customer has full bargaining power in the negotiations. The customer can always wait until the outcome is realized to sign a contract, and (if the project is successful) propose to buy the good at a negligible price (0). Of course, this implies that the entrepreneur has no monetary stake in the case of success, and, anticipating this, chooses to misbehave if no contract has been signed before she chooses the effort decision. But as long as the probability of success, $p_L$, in the case of misbehavior is positive, the customer can guarantee himself a rent.

Not so under short-term debt. If this short-term debt is not repaid, the entrepreneur's firm is liquidated. The customer then cannot play the previous waiting game, and must disburse if he is to keep his rent associated with the production of the intermediate input. Short-term debt therefore puts more pressure directly on the firm, and indirectly on the customer, than long-term debt. The reader will here note the analogy with the analysis of the *soft budget constraint* (the difference with Section 5.5 is that the customer, rather than the investors, is the victim of the soft budget constraint; but in both cases, a party with a stake in continuation is led to disburse in order to rescue the firm and prevent liquidation).

Chemla and Faure-Grimaud (2001) show that leverage may help a firm extract a high price from a customer even when the firm has price-setting power (so condition (c) above is violated) and when it can renegotiate with its investors (condition (b) is violated). Their insight is derived in the context of dynamic pricing to a consumer. As in Coase (1972), the firm does not know whether the consumer has a high or low valuation. Its optimal policy, if it could commit to a pricing policy over time and provided that the probability that the customer's valuation is high, is then to commit to a high price equal to the high valuation; unfortunately, the consumer's expectation that the monopolist will have an incentive to lower its price to the low-valuation level if the first offer is refused induces the high-valuation consumer to wait for a "price concession." That is,

the monopolist's ability to lower its price tomorrow reduces its bargaining power today. Coase's durable-good monopolist model shows that a monopolist's bargaining power may be limited even if it has price-setting power.

Chemla and Faure-Grimaud introduce corporate finance into the Coase model. Leverage implies that the firm may be liquidated if it does not generate enough cash flow. Interestingly, leverage enables the monopolist to credibly charge a high price; for, if the high-valuation buyer does not purchase, no cash flow is generated and short-term debt is not repaid. The possibility of liquidation (and of a concomitant lack of price concessions in the future) induces the high-valuation buyer to accept higher offers early on. Also important is that Chemla and Faure-Grimaud allow for the possibility of renegotiation between entrepreneur and investors after the former's failure to repay her short-term debt. Because the entrepreneur values continuation more than the investors (who in Chemla and Faure-Grimaud receive a liquidation value when the firm is shut down early), the investors may well prefer not to renegotiate and to shut down the firm.[34] Finally, the strategic use of debt reduces social welfare because it exerts a negative externality on the high-valuation buyer, who is given the choice between paying a higher price or not consuming at all.

## 7.2 Creative Accounting and Other Earnings Manipulations

Much of the analysis in the previous chapters has looked at the provision of managerial incentives to reach higher levels of performance. For example, managerial incentives can be aligned with investors' objectives by rewarding management for superior performance, that is by linking a high compensation to a realization in the upper tail of the

performance spectrum. Unfortunately, such "high-powered incentive schemes" usually imply that managerial and investor interests are no longer aligned along other dimensions of managerial activity. In particular, schemes that induce high effort create additional forms of moral hazard, in two ways:

(i) timing of income recognition, to the extent that management has leeway in moving income forward and backward in time;

(ii) risk management, as management can take actions that increase or decrease the firm's income risk.

These additional forms of moral hazard are costly for two reasons: they garble performance measurement and investors' assessment of managerial or project quality; and, as we will shortly see, they generally entail direct costs.

The leitmotiv of this section is thus that high-powered incentive schemes face a multitasking problem (they change effort, but also other behaviors), and that any move toward high-powered incentives must be accompanied with a direct control of these side effects. We start with the case of earnings manipulations and then address risk taking.

### 7.2.1 Earnings Manipulations

The accounting literature (see, for example, Merchant 1989; Ronen and Sadan 1981) has, over a long period, documented the many ways in which management can alter the external assessments of its firm's performance. To simplify, there are basically two categories of earnings management techniques.

*Accounting methods* ("cooking the books"). Even without resorting to fraud, managers have substantial discretion in their income and balance-sheet statements. That is, they enjoy flexibility even within the confines of the Generally Accepted Accounting Principles.

For example, the choice of reserves or provisions for loan losses is always subjective. When a customer does not reimburse his trade credit or when, more generally, a borrower fails to pay interest or principal on a loan, there is usually some probability that the borrower will nevertheless be able to partly or fully repay the loan in the future. Alternative hypotheses as to whether the borrower's situation will

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34. The literature on Coase's durable-good model has often suggested that the monopolist's commitment power can be restored by committing to transfer a large amount of money to a third party if the monopolist lowers its price over time. The standard criticism of this argument is that such a contract with a third party is not renegotiation proof, since, once a high price has been charged, the firm and the third party are better off renegotiating away the lack of price flexibility. Chemla and Faure-Grimaud make such side-contracts (with investors as the "third party") credible by letting the entrepreneur be cash constrained and by introducing an agency problem that creates an *ex post* divergence of interests between entrepreneur and investors.

improve so that he will be in a position to reimburse have a substantial impact on the provisions to be made by the firm. More generally, estimating the value of investments that are not marked-to-market[35] involves some discretion. This discretion can be used in particular to make the firm look more profitable than it really is.[36] Of course, an underprovision only shifts loss recognition in time. Later provisions will need to be made when losses are actually realized or become impossible to hide and deny.

Another common way of shifting income across time is the choice of when a sale or expense is recorded. For example, a sale can be recorded only in January when it actually took place in December, or the reverse. This manipulation affects the assessment of the firm's performance during the year.

In the same spirit, the choice between capitalizing or expensing maintenance and investment costs shifts accounting income across time. Relatedly, a recent debate has focused on whether corporations should expense the stock options (a contingent liability) that they grant to their managers (see Chapter 1).

Lastly, there are various ways of practicing balance-sheet window dressing. For example, the firm may transfer poor investments and associated debts to nonconsolidated subsidiaries.

Such manipulations have the potential to fool the firm's investors and to distort their assessment as to whether they should interfere to change the course of action or replace the manager. And they involve direct costs. First, managerial attention may be devoted to practicing "creative accounting" and fooling investors. Second, corporate resources may be engaged in the process. For example, the firm may reduce the external accountants' investigative ardors by dangling the prospect of termination of lucrative consulting contracts.

*Operating methods.* Alternatively, the firm may distort its strategy in order to alter the external perception of the firm's condition. This form of posturing has direct (real) effects, and not only the indirect ones associated with the garbling of investors' information. For example, to inflate current profits, the firm may delay maintenance and reduce its inventory levels. Or it may run end-of-period sales. Instead of slashing its prices in January just after the holiday season, it can boost the previous year's profit by running a December sale at the cost of reducing overall profit. It can grant advantageous terms to its customers in exchange for their accepting to take early delivery (conversely, to delay income recognition, it may convince them to accept late shipments or to pay late).

The direct costs of such strategies are obvious: bad timing, overtime pay, production disturbances, and the like.

### 7.2.1.1 Managerial Myopia: The Incentive for Posturing

A common theme in corporate finance is that there are benefits to keeping management "on a tight leash" by giving investors an option to fire management, downsize the firm or more generally interfere when they perceive that performance is not adequate. We have seen several reasons why such interference may raise efficiency or at least increase pledgeable income. First, interference *ex post* sanctions past mismanagement and thus *ex ante* may act as a deterrent against such moral hazard. Second, interference may be more forward looking: inadequate past performance may well signal poor prospects. Third, interference may also help solve the adverse-selection problem studied in the previous chapter: a low-quality borrower is more reluctant to seek financing if she knows it is likely that her project or employment will be terminated before completion.

Now, the modes of intervention are diverse: a strong board (or a venture capitalist) may exercise its control rights to fire the manager[37] or restrict her

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35. Some assets, such as stocks in publicly traded companies, have market values that can be and are used to estimate the gains and losses on these assets. This objectivity brought about by the existence of a market is a major argument in favor of using market values in accounting (there are drawbacks, though, as market values may make the firm's balance sheet highly volatile (see, for example, Dewatripont and Tirole (1994) on this)). The absence of marked-to-market accounting generates behaviors such as the use of lease-backs: when commercial real estate appreciates, the company may be tempted to sell its buildings and immediately lease them back, so as to allow the capital gain to show up in the accounts.

36. Or, conversely, to understate the value of its assets: see Section 7.2.2 for why managers sometimes try to play a low-key role.

37. There is substantial evidence that nonroutine management changes are associated with poor financial performance (see, for example, Weisbach 1988; Murphy and Zimmerman 1993).
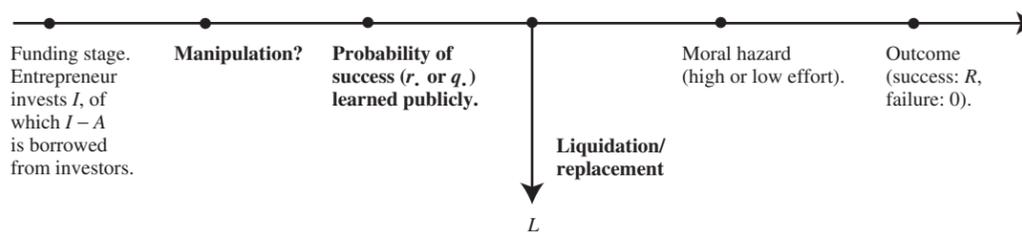
**Figure 7.7**

freedom. A raider may take over the firm and replace management or implement a new strategy. A bank may select not to roll over its short-term debt and therefore to confront the firm with limited liquidity.

The trouble is that management may boost short-term profit through desirable and undesirable means: when faced with the threat of firing, liquidation or merely restricted freedom, management may have an incentive to inefficiently inflate short-run performance at the cost of long-term loss that exceeds the short-term gain, a behavior often called "managerial myopia"; this behavior is rational from the manager's perspective, though: "myopia" refers to the perception of an external observer who witnesses a short-term orientation and fails to account for the agency considerations inherent in this behavior. Thus, solving one agency problem gives rise to a different one. This point has been developed in particular by Stein (1989).[38]

Consider the fixed-investment model of Section 3.2, with the new ingredient that there is some learning at an intermediate stage about the entrepreneur's ability to run the project and the concomitant opportunity to replace her (or to liquidate the project) on the basis of this information (see Figure 7.7). The manager's type, which is a synonym for the probability of success, is either $r_\bullet$ or $q_\bullet$, where the dot subscript refers to the fact that the probability of success is not solely determined by

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38. For other investigations of managerial myopia, see, for example, Darrough (1987), Narayanan (1985), and especially von Thadden (1995).

There is a closely related literature on second sourcing in procurement and regulation (see, for example, Laffont and Tirole 1988). In that literature, a franchised supplier privileges current cost reduction over long-term investment in facilities when faced with the possibility that the franchise be terminated and the facilities turned over to a new management team.

the manager's ability and is a function of later effort (high or low).

*No manipulation.* Let us for the moment rule out any managerial manipulation of the intermediate information received by the investors. The latter learn at the intermediate stage that the probability of success in the case of continuation $\pi_\bullet = (\pi_H, \pi_L)$ (that is, contingent on effort: $\pi_H$ in the case of good behavior, $\pi_L$ in the case of misbehavior) is either high ($r_\bullet = (r_H, r_L)$) or low ($q_\bullet = (q_H, q_L)$), with $r_H > q_H$ and $r_L > q_L$. At the funding stage, no one knows which prevails, and the prior on the two possibilities is $(\alpha, 1 - \alpha)$:

$$\pi_\bullet = \begin{cases} r_\bullet & \text{with probability } \alpha, \\ q_\bullet & \text{with probability } 1 - \alpha. \end{cases}$$

Although a number of applications involve the manipulation of short-term earnings, we will for notational simplicity assume that the signal is a pure signal, and is not linked to an intermediate profit. One can think of this signal as some balance-sheet information regarding the final payoff. The basic ideas would carry over to information revealed by a short-term profit.

For simplicity, we will also assume that the manager's "type" ($r_\bullet$ or $q_\bullet$) is orthogonal to later moral hazard. So, if $r_H$ and $q_H$ denote the probabilities of success in the case of good behavior, and $r_L$ and $q_L$ those in the case of misbehavior, then

$$r_H - r_L = q_H - q_L = p_H - p_L = \Delta p,$$

letting $p_H \equiv \alpha r_H + (1-\alpha)q_H$ and $p_L \equiv \alpha r_L + (1-\alpha)q_L$ refer to the prior beliefs that the project will succeed under good and bad behavior, respectively. Thus, regardless of the manager's type, shirking reduces the probability of success by $\Delta p$.

Suppose that, when it accrues, the information about the manager's type is public and, for simplicity, verifiable;[39] and that, contingent on the signal, the initial contract specifies whether management is allowed to continue or not.[40] In the case of termination, the firm generates an expected profit $L$ that can be shared between investors and incumbent management.

*Example.* Suppose that the manager's replacement is another similar manager of unknown ability in the job. Then, the "liquidation" value is

$$L = p_H\left(R - \frac{B}{\Delta p}\right).$$

For, the new management must be provided with a reward, $B/\Delta p$, in the case of success that induces the high effort. The pledgeable income is therefore equal to $p_H[R - B/\Delta p]$.

We make the following assumption:

$$q_H R > L. \tag{7.9}$$

Inequality (7.9) says that, ceteris paribus, even a low-ability manager would prefer to keep her job, as this yields a higher NPV than termination. Put differently, it is *ex ante* efficient for the entrepreneur to retain her job. In the example above, in which the entrepreneur is replaced by another entrepreneur with unknown ability, (7.9) is satisfied if the agency cost, and thus the rent to be left to the new entrepreneur, are high.

We will also assume that

$$I - A > \max\left\{p_H\left(R - \frac{B}{\Delta p}\right), L\right\}, \tag{7.10}$$

while

$$I - A < \alpha r_H\left(R - \frac{B}{\Delta p}\right) + (1 - \alpha)L. \tag{7.11}$$

The first inequality (7.10) states that guarantee of either tenure (the entrepreneur always keeps her job) or termination (the entrepreneur is always fired) does not generate enough pledgeable income to attract investors. Because the incentive problem is independent of the entrepreneur's type, the entrepreneur must be rewarded at least $B/\Delta p$ for success in order to have an incentive to behave. And so the pledgeable income under guaranteed tenure is insufficient to cover the investors' initial outlay, $I - A$. By contrast, the second inequality, (7.11), which requires that

$$q_H\left(R - \frac{B}{\Delta p}\right) < L < r_H\left(R - \frac{B}{\Delta p}\right),$$

implies that there is enough pledgeable income to attract investors when there is termination in case of low ability, provided that the investors receive the return $L$ in the case of termination.

Under a competitive capital market the entrepreneur's utility in case of funding is equal to the NPV:

$$U_b(z^r, z^q) = \alpha[z^r(r_H R) + (1 - z^r)L] \\ + (1 - \alpha)[z^q(q_H R) + (1 - z^q)L] - I,$$

where $z^r$ and $z^q$ are the contracted-for probabilities of continuation of employment of a high- and low-ability entrepreneur, respectively. From (7.9), this utility is maximized by a guaranteed tenure:

$$z^r = z^q = 1.$$

Guaranteed tenure, however, does not attract funds (from (7.10)); and so some (contingent) termination must be conceded in order to satisfy the investors' breakeven constraint:

$$\alpha\left[z^r r_H\left(R - \frac{B}{\Delta p}\right) + (1 - z^r)L_l^r\right] \\ + (1 - \alpha)\left[z^q q_H\left(R - \frac{B}{\Delta p}\right) + (1 - z^q)L_l^q\right] \geqslant I - A,$$

where $L_l^r$ and $L_l^q$ ($\leqslant L$) are the lenders' returns in the case of termination of a high- and low-ability manager, respectively. Clearly, setting

$$L_l^r = L_l^q = L$$

is optimal since this relaxes the investors' breakeven constraint without altering the NPV.[41] Also, it is

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39. That is, a court can ascertain the realization of this type. Alternatively, and equivalently, the type can be inferred from the market value of risky financial claims on this firm (since these values fall when the manager has low ability and increase when she has high ability).

40. Following up on the previous footnote: if the realization of the type cannot be directly ascertained by the court, a mechanism must be designed that indirectly yields the same outcome as that given by direct court verification. For example, some debt may be due at the intermediate stage, and management may be given the right to issue equity in order to repay the debt. Since the value of the equity issue grows with the manager's observed ability, the continuation decision is thus made contingent on the type. We will discuss a similar mechanism in Chapter 9.

41. By the same token, it is optimal to minimize the entrepreneur's reward in the case of continuation of employment. This property is

more efficient (in terms of maximizing both the NPV and the pledgeable income) to retain a high-ability manager:

$$z^r = 1.$$

Let $z^q = z^*$. From (7.10) and (7.11), the value $z^* \in (0, 1)$ is the smallest value[42] that satisfies the investors' breakeven constraint:

$$\alpha r_H \left( R - \frac{B}{\Delta p} \right)$$
$$+ (1 - \alpha) \left[ z^* q_H \left( R - \frac{B}{\Delta p} \right) + (1 - z^*)L \right] = I - A.$$
$$(7.12)$$

Some termination in case of low ability is the concession made by the entrepreneur to attract investors. As is familiar, the entrepreneur sacrifices value (NPV) to boost pledgeable income.

*Manipulation.* Until now, we have assumed that the information received by the investors at the intermediate stage lies outside the entrepreneur's control. Let us now assume that the entrepreneur can, at a cost, alter this information.

More precisely, suppose that the entrepreneur can generate the high signal $r_\bullet$ by (secretly) manipulating the information. This manipulation comes at a cost: the probability of success falls (uniformly) by $\tau > 0$.[43]

We distinguish two forms of manipulation:

*Uninformed manipulation.* The entrepreneur does not know her type when deciding whether to manipulate information (so, she learns her type at the same time as the investors in Figure 7.7).

*Informed manipulation.* The entrepreneur knows her type when choosing whether to manipulate the information (but learns it only after the funding

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already embodied in the breakeven constraint by setting the investors' return at $R - B/\Delta p$ in the case of success.

42. The reader may find this "random termination contract" unrealistic. This randomness is, however, an artifact of the discrete representation of the type space. With a continuum of possible types for the entrepreneur, the optimal policy would take the form of a deterministic cutoff rule: employment would continue if and only if the entrepreneur's ability exceeds some threshold.

43. Since we will focus on policies that incentivize management not to engage in such manipulations, we do not need to specify the impact of the manipulation on $L$. This impact may be small or nonexistent if termination is interpreted as a liquidation and the resale of the firm's collateral; in contrast, in the replacement interpretation given in the example above, it may make sense to assume that $L$ is reduced from $p_H[R - B/\Delta p]$ to $(p_H - \tau)[R - B/\Delta p]$.

stage, which therefore still occurs under symmetric information).[44]

Suppose, in the first step, that the financing contract specifies, besides the probabilities of continuation $z^r$ and $z^q$ for signals $r_\bullet$ and $q_\bullet$, a reward $R_b \geqslant B/\Delta p$ in the case of continuation and success (and no payment to the entrepreneur otherwise).

Under *uninformed manipulation*, the entrepreneur decides whether to generate signal $r_\bullet$ for certain before learning her type. Assume throughout that it is optimal to induce the entrepreneur not to manipulate the investors' information.[45]

Under uninformed manipulation, the no-manipulation constraint is

$$z^r [(p_H - \tau)R_b] \leqslant [\alpha z^r r_H + (1 - \alpha)z^q q_H]R_b.$$

The left-hand side of this constraint is the entrepreneur's expected reward in the case of manipulation. In that case, signal $r_\bullet$ is generated, yielding continuation probability $z^r$. The average probability of success is then $p_H - \tau$. The right-hand side accounts for the entrepreneur's not knowing her type when deciding whether to manipulate the information.

This inequality can be rewritten as

$$\frac{z^r}{z^q} \leqslant \frac{1}{1 - \tau/(1 - \alpha)q_H}. \qquad (7.13)$$

Inequality (7.13) states that the probability of continuation in the case of a good signal cannot be much greater than that in the case of a bad signal. For example, when the cost of manipulation (as measured by $\tau$) converges to 0, these probabilities must be approximately equal (given that continuation for a good signal is otherwise more appealing and so $z^r \geqslant z^q$).

Under *informed manipulation*, the entrepreneur is tempted to manipulate the information only when she learns that she is inefficient. The new no-manipulation constraint is

$$z^r [(q_H - \tau)R_b] \leqslant z^q [q_H R_b]$$

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44. If the entrepreneur were to learn her type before contracting with the investors, she might use dissipative signals such as a distorted continuation rule in order to reveal her type (see Chapter 6).

45. With this class of contract, it cannot be the case that the entrepreneur manipulates the information. If she did, then $z^r = z^q = z$, since the investors cannot tell the two states apart. The initial contract should instead set $z^r = z^q = z$, which provides no incentive for manipulation and yields the same continuation decision.

or

$$\frac{z^r}{z^q} \leqslant \frac{1}{1 - \tau/q_H}. \tag{7.14}$$

Note that constraint (7.14) is harder to satisfy than constraint (7.13). That is, the continuation decision must be made even less signal dependent (in the sense that $z^r/z^q$ is closer to 1) under informed manipulation. This is intuitive: the entrepreneur is more likely to want to look good and to start cheating if she knows that she will be in trouble otherwise. By contrast, under uninformed manipulation, the cost of manipulation is wastefully incurred when the entrepreneur turns out to be efficient. The relevant no-manipulation constraint, (7.13) in the case of uninformed manipulation and (7.14) in the case of informed manipulation, will be labeled (NM).

Whether manipulation is uninformed or informed, the initial contract must in general lower $z^r$ or increase $z^q$—in a nutshell, make continuation less signal dependent—or both. This is reminiscent of the analysis of the predation-deterrence constraint (PD) earlier in this chapter. The difference is that the lack of responsiveness of the continuation rule is meant to alter the behavior of the entrepreneur, rather than that of a product-market rival.

The threat of manipulation may prevent the firm from receiving funding in the first place. Start from the solution ($z^r = 1$, $z^q = z^*$) as defined by equation (7.12) when there is no scope for manipulation, and suppose that the ratio $1/z^*$ does not satisfy the relevant (NM) constraint. That is,

$$\frac{1}{z^*} > \frac{1}{1 - \tau/(1-\alpha)q_H}$$

under uninformed manipulation and

$$\frac{1}{z^*} > \frac{1}{1 - \tau/q_H}$$

under informed manipulation.

If one keeps $z^r \equiv 1$, then $z^q$ must be increased about $z^*$ so as to satisfy the (NM) constraint. Increasing $z^q$ above $z^*$, however, is not feasible since this reduces pledgeable income, which then becomes insufficient to cover the investors' initial outlay. Thus continuation cannot be guaranteed to a high-ability entrepreneur ($z^r < 1$).

This reduction in $z^r$ reduces pledgeable income as $r_H[R - B/\Delta p] > L$.[46] Hence, $z^q$ must also be brought down below $z^*$ in order to make up for the shortfall in pledgeable income.[47]

As one could have expected, *the entrepreneur's ability to cook the books ex post may jeopardize funding ex ante.* And, even if funding is feasible, this ability reduces the NPV.

### 7.2.1.2 Golden Parachutes

Top managers often receive very large compensation packages when their employment is terminated. These "golden parachutes" appear particularly "obscene" when termination is motivated by poor performance. Of course, many of these packages result from the board being in cahoots (or not wanting to enter any conflict) with top management. There is also some efficiency rationale for golden parachutes. Intuitively, the "softened landing" that they offer to managers makes them less prone to engage in various venal behaviors, such as earnings manipulations, in order to keep their job. In a nutshell, proponents of golden parachutes argue that they are the price to pay for incentive compatibility.[48]

Are golden parachutes beneficial here? They are clearly costly as they reduce pledgeable income.[49] However, a golden parachute helps relax the (NM) constraint. In a sense, they create more "balanced"

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46. Note, though, that $z^r < 1$ requires commitment power. Otherwise termination with some probability would not be renegotiation proof, since both parties would be better off agreeing on continuation.

47. But this still may not create enough pledgeable income. Write the (binding) (NM) constraint as $z^q = \theta z^r$ with $\theta < 1$. The derivative of the pledgeable income with respect to $z^r$ is (with obvious notation)

$$\frac{d\mathcal{P}(z^r, \theta z^r)}{dz^r} = \alpha\left[r_H\left(R - \frac{B}{\Delta p}\right) - L\right] - (1-\alpha)\theta\left[L - q_H\left(R - \frac{B}{\Delta p}\right)\right].$$

Because $\mathcal{P}(1, \theta) < I - A$, satisfying the investors' breakeven constraint requires that $d\mathcal{P}/dz^r < 0$ (this is a necessary, but not a sufficient, condition). And so, necessarily, $p_H(R - B/\Delta p) < L$. In particular, financing cannot be secured in the example in which $L$ is derived from replacing the manager by another one with unknown ability (then, $L = p_H(R - B/\Delta p)$).

48. Jensen (1988), in the context of takeovers, was one of the first advocates of golden parachutes, on the grounds that they help align managerial incentives with those of investors and thereby facilitate takeovers.

49. A further cost might arise if we added to the model an "*ex ante* moral hazard" problem, in which the $r_\bullet$ or $q_\bullet$ signal would result not from an exogenously determined managerial ability to accomplish the task, but from an *ex ante* "investment effort" of the entrepreneur (as, for example, in Section 5.5). The golden parachute might exacerbate this form of moral hazard.

incentives for the manager by increasing her payoff in the case of liquidation.[50] Indeed, consider (for example) the case of informed manipulation and suppose that the entrepreneur receives some amount $T \geqslant 0$ when admitting that prospects are poor, i.e., when the signal is $q_\bullet$.[51] The new (NM) constraint is

$$z^r[(q_H - \tau)R_b] \leqslant z^q[q_H R_b] + T, \qquad (7.15)$$

where $R_b = B/\Delta p$ in order to maximize the income that can be pledged to investors.[52]

The key question is whether it is cheaper to prevent manipulation by making tenure relatively insensitive to new information or by granting a golden parachute ($T > 0$). To answer this question, let us write the NPV (which does not depend on $T$),

$$U_b(z^r, z^q, T) = \text{NPV}$$
$$= \alpha[L + z^r(r_H R - L)]$$
$$\quad + (1 - \alpha)[L + z^q(q_H R - L)] - I,$$

and the pledgeable income,[53]

$$\mathcal{P}(z^r, z^q, T)$$
$$= \alpha[L + z^r[r_H(R - R_b) - L]]$$
$$\quad + (1 - \alpha)[L + z^q[q_H(R - R_b) - L] - T]$$
$$= I - A.$$

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50. The need for balanced managerial incentives to prevent income manipulation is a much more general theme in corporate finance, and arises even in situations where the manager's tenure or the continuation of the project are not at stake.

For example, Friebel and Guriev (2005) show how incentives for earnings manipulation depend on the structure of managerial compensation, that is on the ratio of short versus long incentives (note the analogy with the point made on payouts in Application 7 in Section 6.3). A key aspect of Friebel and Guriev's model is the presence of division managers, who may act as whistleblowers in the case of income manipulation by the CEO (in the United States, the Sarbanes–Oxley Act of 2002 has tried to make whistleblowing easier by, for example, protecting employees who provide evidence about violations of regulations). The paper shows how top managers can neutralize the incentive to blow the whistle by providing lower-level managers with short-term incentives and thereby provides an explanation for the propagation of short-term incentives (based on stock options) within the corporate hierarchy.

51. This compensation is slightly different from a golden parachute, since the latter would be received contingent on termination (in particular, when $z^r < 1$, the golden parachute would be received with positive probability even though the manager does not admit to poor prospects). The form of golden parachute considered here is more efficient because it is more effective at addressing the (NM) constraint. But it relies on our assumption that the state of nature is contractible. The analysis would not change much with the alternative formalization.

52. $R_b$ is assumed to be the same in both states, but this involves no loss of generality.

53. So, in the previous notation, $L_1^r = L$ and $L_1^q = L - T/(1 - z^q)$.

Intuitively, there are two "currencies" available for paying the manager: continuation and golden parachute. A golden parachute is just a cash transfer while the continuation policy affects the NPV. One would therefore expect a golden parachute to be used exactly when the continuation policy is an inefficient policy, that is, when continuation under poor prospects reduces the NPV.

To demonstrate this "efficient currency result," suppose that $T > 0$. Looking at the pledgeable income, a unit increase in $z^q$ (which increases the *ex ante* utility $U_b$ because of the assumption that $q_H R > L$, but reduces pledgeable income), must be compensated by a decrease in the golden parachute equal in absolute value to

$$\left| \frac{dT}{dz^q} \right| = L - q_H(R - R_b).$$

From (7.15), this marginal change that keeps investor income constant relaxes the (NM) constraint:

$$dz^q(q_H R_b) + dT = dz^q[q_H R_b - L + q_H(R - R_b)]$$
$$= (q_H R - L) dz^q > 0.$$

Thus the optimal golden parachute policy is to have none:
$$T^* = 0.$$

Not so when continuation under poor prospects reduces the NPV, and not only the investor income. Suppose now that
$$q_H R < L.$$

Then, from the previous reasoning, a golden parachute is a cheaper instrument than an insensitive tenure to keep the entrepreneur from manipulating accounts. When it is optimal to fire the manager in the case of poor prospects, she is paid a golden parachute:

$$z^{q*} = 0 \quad \text{and} \quad T^* = z^r(q_H - \tau)R_b > 0.$$

Exercise 7.9 asks the reader to check this heuristic reasoning more formally.

### 7.2.1.3 The Importance of Commitment

We have assumed that the review and the concomitant decision over whether to retain the entrepreneur are contingent on some performance measure that is objective[54] (although manipulable) and can

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54. In the sense of being verifiable. Note that the court, even if it does not itself observe the manager's productivity, could infer it

be contracted upon. By contrast and by the same reasoning, softer pieces of information can less easily enter the decision to fire/retain the entrepreneur. To see this, suppose that the investors have control over the tenure decision, and that they, but not the court, observe the signal.

It is then clear that manipulation must occur. Indeed, were the equilibrium separating, the investors would perfectly learn the entrepreneur's ability and so would set (*ex post*)

$$z^r = 1 \quad \text{and} \quad z^q = 0.$$

Unless they are able to develop a reputation for implementing the optimal commitment policy $(z^r, z^q)$, the investors are too tough in the case of low ability (or too lenient in the case of high ability!). Thus, manipulation is more likely in the absence of commitment. Or, put differently, it may be worth reestablishing commitment by not giving investors the control right over the firing decision; but then the entrepreneur is never fired and funding is impossible to secure if (7.10) holds.

#### 7.2.1.4   Relationship to the "Early Signal" Literature

Levitt and Snyder (1997) consider a moral-hazard environment that is similar in spirit to the situation described in Figure 7.7. In our terminology, an entrepreneur, after receiving funding for an investment, chooses a high or low effort. She then privately learns a signal about the probability of success of the project. Thus, the situation is similar to the "informed manipulation" case studied above in that, despite the absence of adverse selection at the *ex ante* stage, the entrepreneur acquires hidden knowledge during the relationship. Liquidation is desirable if the news is bad and continuation is optimal if the news is good. The issue, though, is to provide the entrepreneur with an incentive to disclose bad news. Levitt and Snyder analyze the outcome when investors are able or unable to commit to a liquidation policy. Let us, for conciseness, focus on the commitment case. A key result is that the investors should reward the entrepreneur for coming forward with bad news. Also, the investors optimally commit

to not systematically liquidate the project when the continuation value is negative; in particular, liquidation weakens the link between the agent's effort and the project's outcome, and therefore garbles performance measurement.

### 7.2.2   Career Concerns

#### 7.2.2.1   A Noncontingent-Continuation Result

We have assumed that managerial incentives to behave are exclusively monetary, e.g., come from stock options that become vested with tenure.[55] Very similar phenomena arise when managers want to keep their jobs because of the attached private benefits (perks, third-party favors, prestige).[56]

The version of the model we consider here is very similar to that described in Figure 7.7. Hence, to simplify things to the extreme, it assumes that monetary incentives are not effective at motivating the entrepreneur. Namely, make the following two modeling changes:

• The manager does not respond to all monetary incentives. That is, her utility from money is

$$U(w) = \begin{cases} w_0 & \text{if } w \geqslant w_0, \\ -\infty & \text{if } w < w_0. \end{cases}$$

The manager wants some (subsistence) income $w_0$ corresponding to the standard of living that she could obtain in another activity, but is not interested in money beyond that level. Consequently, any contract that with some probability will result in a wage below $w_0$ will not be accepted by the manager, and any reward beyond $w_0$ is wasted money for the investors; the manager will thus receive a fixed wage $w_0$. Thus, while the "career-concerns model" generically refers to situations in which economic agents are incentivized by the future gains (monetary or nonmonetary) attached to a good reputation, this section focuses on the specific incentives

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through, say, the variation in the firm's stock price if this firm is traded in a public market.

55. There are also, of course, (potential) private benefits in the model; but these private benefits, which motivate the monetary incentives in the first place, are linked to misbehavior.

56. The seminal paper by Holmström (1982) on the incentives surrounding career concerns has generated a large literature on their implications, starting with the work of Holmström and Ricart i Costa (1986) on their impact on managerial investment choices. Holmström's single-effort, single-performance-measure model is extended to a general multitask environment in Dewatripont et al. (1999a,b).

provided by the desire to keep the private benefit associated with the job.

• In the case of continuation there is no moral hazard, but the manager receives a private benefit $\mathcal{B} > 0$, rather than 0 when her firm is liquidated or she is replaced.

The rest of the timing is unchanged.

Because the entrepreneur must be given wage $w_0$, but no incentive payment is needed, the pledgeable income becomes $p_H R - w_0$ instead of $p_H[R - B/\Delta p]$ in condition (7.10) and $\alpha r_H R + (1 - \alpha)L - w_0$ instead of $\alpha r_H[R - B/\Delta p] + (1 - \alpha)L$ in condition (7.11). Hence, assumptions (7.10) and (7.11) are replaced by

$$I + w_0 - A > \max\{p_H R, L\} \qquad (7.12')$$

and

$$I + w_0 - A < \alpha r_H R + (1 - \alpha)L \qquad (7.13')$$

(as earlier, one possible interpretation of $L$ is obtained by assuming that the entrepreneur is replaced by a manager with unknown ability: for example, $L = p_H R$ if the subsistence income is equal to 0).

The (NM) constraint becomes, whether manipulation is informed or uninformed,

$$z^r \mathcal{B} \leqslant z^q \mathcal{B}. \qquad (\text{NM}')$$

Given that continuation is more desirable for investors in the productive state (the manager does not have a relative preference for continuation in the high- versus low-productivity state because she does not respond to monetary incentives and therefore her utility is unaffected by the profit realization), they will set

$$z^r = z^q.$$

Thus, the continuation decision is no longer contingent on the information accruing regarding the entrepreneur's ability when the latter is driven solely by the desire to keep the private benefits attached to the job. First, as we just noted, the entrepreneur cares about the job's perks and therefore is not affected by the loss in profit associated with earnings manipulation. Second, golden parachutes are ineffective if keeping her job is the manager's primary incentive. Thus, investors have no instrument to induce the entrepreneur to refrain from manipulating earnings. By contrast, and as we will see when we

discuss income smoothing, the entrepreneur faces a nontrivial choice when there is more than one "review period" at which the opportunity of retaining the manager is reconsidered.

### 7.2.2.2 Other Forms of Posturing: Gambling and Herding

The literature has considered several forms of posturing associated with risk taking and herding behaviors. Although these forms of posturing apply to managers driven by money as well as those driven by career concerns, we choose to discuss them in the latter context so as to provide examples of managers driven by career concerns facing nontrivial manipulation decisions (unlike in the situation we just described).

*Risk taking.* The propensity for managers to take risks when their job is endangered and to be conservative when it is relatively secure is well-known among practitioners and economists. To show why this behavior is privately optimal for the manager, consider a two-activity, two-period firm and the timing described in Figure 7.8.

The description of the firm's activities in each period is similar to that in Diamond's (1984) model of diversification (reviewed in Section 4.2). The possibility of manipulation here refers to the entrepreneur's secretly choosing the correlation (perfect or none) of the two projects.[57] We assume the following:

• The entrepreneur (and her potential replacement) do not respond to monetary incentives. Rather, they get a private benefit $\mathcal{B}$ per period of tenure.

• The entrepreneur has, as earlier, unknown ability. With probability $\alpha$, she is a high-ability manager (the probability of success of a project is $r$); with probability $1 - \alpha$, she has low ability (the probability of success is $q$).[58]

• The investors have the control right over the replacement of the entrepreneur by an alternative manager; there is no commitment regarding this

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57. There is no need to introduce such a choice at date 1 since the manager in place has no career concerns then, and expected profit is independent of the degree of correlation.

58. Because the entrepreneur does not respond to monetary incentives, there is no point introducing moral hazard.
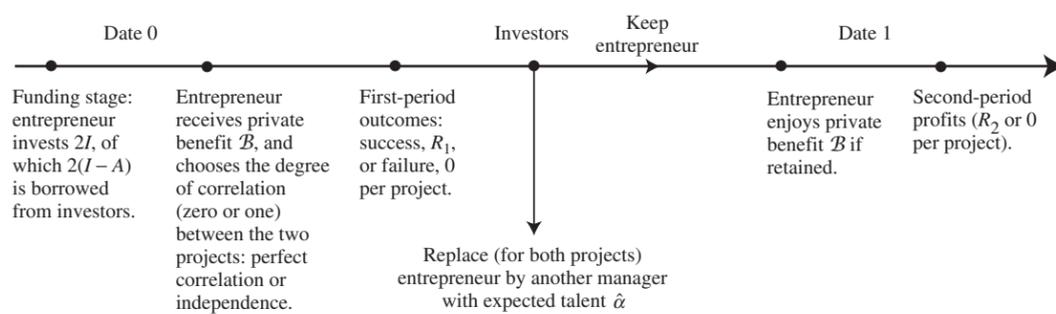
**Figure 7.8**

decision, and so investors just choose the manager with the highest perceived expected ability. The alternative manager's perceived expected ability is (arbitrarily) equal to $\hat{\alpha}$.

Suppose that the firm receives funding. The entrepreneur then chooses the degree of correlation (0 or 1, for simplicity) so as to maximize the probability of keeping her job.

The equilibrium behavior is summarized in Figure 7.9.

We are interested in situations in which the replacement decision is not a foregone conclusion (which it would be if the expected ability $\hat{\alpha}$ of the replacement manager were extremely high, so that a fully successful manager would be replaced anyway, or extremely low, so the incumbent manager would keep her job even after two failures).

Suppose first that the entrepreneur is expected to hedge.[59] Let $\alpha_0^H$, $\alpha_1^H$, and $\alpha_2^H$ denote the posterior probabilities that the incumbent manager has high ability, conditional on 0, 1, and 2 successes at date 0, where "H" stands for "hedging."[60]

For this behavior to be part of an equilibrium (and therefore to be rationally expected by the investors), the entrepreneur must not find it optimal to deviate and choose two perfectly correlated projects instead. Suppose first that

$$\hat{\alpha} < \alpha_1^H.$$

That is, a single success out of two realizations suffices to keep the job. Because gambling increases the probability of two failures,[61] it increases the likelihood that the entrepreneur loses her job. Hence, it is indeed suboptimal for the manager to gamble. By analogy with the notion that financial options are "in the money" when things are going well (in that case, the underlying asset's price is high), we can say that the position is "*in-the-job*," that is, secure (only a disaster can lead to removal).

Suppose instead that

$$\hat{\alpha} > \alpha_1^H.$$

Then, the entrepreneur keeps her job only if both projects succeed. But gambling augments the probability that both projects are successful.[62] The entrepreneur's position is "*out-of-the-job*," and the entrepreneur is incentivized to "gamble for resurrection." Hence, hedging is no longer an equilibrium behavior.

The search for a "gambling equilibrium" in which the investors rationally anticipate that the entrepreneur will correlate the proceeds of the two projects in an almost identical fashion, except for one quantitative point: because of gambling, the date-0 performances are less informative about the entrepreneur's ability. Thus, and as depicted in Figure 7.9,

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59. "Hedging" is a slight misnomer since the term refers to the absence of correlation rather than to negative correlation. The terminology is motivated by the contrast with the gambling behavior.

60. So, using Bayes' rule:

$$\alpha_0^H = \frac{\alpha(1-r)^2}{\alpha(1-r)^2 + (1-\alpha)(1-q)^2},$$

$$\alpha_1^H = \frac{\alpha r(1-r)}{\alpha r(1-r) + (1-\alpha)q(1-q)},$$

$$\alpha_2^H = \frac{\alpha r^2}{\alpha r^2 + (1-\alpha)q^2}.$$

61. This probability is $\alpha(1-r) + (1-\alpha)(1-q)$ under gambling, and $\alpha(1-r)^2 + (1-\alpha)(1-q)^2 < \alpha(1-r) + (1-\alpha)(1-q)$ under hedging.

62. This probability is $\alpha r + (1-\alpha)q$ under gambling, and $\alpha r^2 + (1-\alpha)q^2 < \alpha r + (1-\alpha)q$ under hedging.
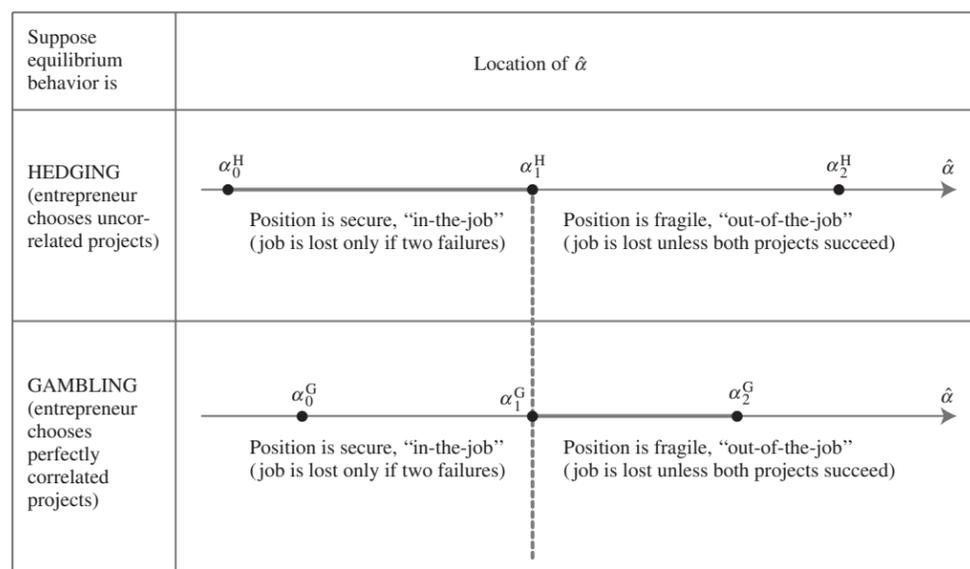
| Suppose equilibrium behavior is | Location of $\hat{\alpha}$ | | |
|---|---|---|---|
| HEDGING (entrepreneur chooses uncorrelated projects) | $\alpha_0^H$    Position is secure, "in-the-job" (job is lost only if two failures) | $\alpha_1^H$    Position is fragile, "out-of-the-job" (job is lost unless both projects succeed) | $\alpha_2^H$    $\hat{\alpha}$ |
| GAMBLING (entrepreneur chooses perfectly correlated projects) | $\alpha_0^G$    Position is secure, "in-the-job" (job is lost only if two failures) | $\alpha_1^G$    Position is fragile, "out-of-the-job" (job is lost unless both projects succeed) | $\alpha_2^G$    $\hat{\alpha}$ |

**Figure 7.9**

the thresholds $\alpha_0^G$ and $\alpha_2^G$ are closer to $\alpha_1^G$ (where "G" stands for "gambling") than were $\alpha_0^H$ and $\alpha_2^H$.[63]

To sum up, the entrepreneur plays conservatively when her position is relatively secure, and gambles for resurrection when her position is seriously threatened. More generally, an "in-the-job" manager will be biased toward actions that reveal less

about her ability (such as actions with long-term payoffs, lots of noise, no action at all, suboptimal actions where she is sure to succeed, etc.). And, as we have noted earlier, a similar insight applies to monetary-incentives-driven managers. Namely, a manager whose stock options are "in the money" tends to play safe, while one whose stock options are "out of the money" tends to gamble for resurrection in order to make these options profitable.

Empirical evidence comforts the theoretical prediction. In particular, Chevalier and Ellison (1997) analyze the portfolio choices of mutual fund managers. The latter's objective function is similar to that described in the career-concerns model. For, the year's top-rank performers attract a disproportionate share of savings in the following years. And because fees are linked to assets under management, and therefore the funds' profit is related to the volume of investments they attract, there is a strong incentive to be "among the top performers," while there is not much difference between a mediocre and an abysmal performance since in any case the fund is unlikely to attract savings later on (and may well be closed down). Chevalier and Ellison show that funds with a poor performance in the first three quarters of the year choose very risky portfolios (gamble for

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63. More precisely,

$\alpha_0^G = \Pr(\text{high ability} \mid \text{two failures})$

$$= \frac{\alpha(1-r)}{\alpha(1-r) + (1-\alpha)(1-q)} > \frac{\alpha(1-r)^2}{\alpha(1-r)^2 + (1-\alpha)(1-q)^2}$$

$= \alpha_0^H$

and

$\alpha_2^G = \Pr(\text{high ability} \mid \text{two successes})$

$$= \frac{\alpha r}{\alpha r + (1-\alpha)q} < \frac{\alpha r^2}{\alpha r^2 + (1-\alpha)q^2}$$

$= \alpha_2^H$.

What about $\alpha_1^G$ (which is depicted as being equal to $\alpha_1^H$ in Figure 7.9)? Strictly speaking, the probability of one success is equal to 0 when the two projects are perfectly correlated, and so any posterior belief $\alpha_1^G$ is consistent with Bayes' rule. To pin down this belief in a reasonable way, we compute the posterior belief when the projects are not perfectly correlated and take the correlation to 1. Namely, suppose that the entrepreneur does not fully control the correlation. A choice of gambling results in perfect correlation with probability $\rho$ and the absence of correlation with probability $1 - \rho$ (where, presumably, $\rho$ is close to 1). A single success then means that the two activities turned out to be uncorrelated and so

$\alpha_1^G = \Pr(\text{high ability} \mid \text{one success}) = \alpha_1^H$.

resurrection) while those with a good performance in these first three quarters choose a much more conservative strategy.

*Herding.* "Herding" refers to the behavior of managers who mimic the choices made by the rest of the industry.[64] This behavior has attracted a lot of attention in economics because it may lead to a gregarious accumulation of wrong choices and yet be individually rational. Banerjee (1992) and Bikhchandani et al. (1992) look at "social learning" models in which, at each date $t$, an agent makes a choice between, say, two alternatives based on her own information (signal) as well as the observation of what previous agents chose at dates $0, 1, \ldots, t - 1$ on the basis of their own signals and the observation of previous agents' behaviors. From some point in time on, the current agent has seen enough choices from previous agents and therefore puts more weight on these than on her signal, which she completely discards.[65] From that point in time, all agents choose the same action. Therefore, they may herd on the wrong action, which they would not do if they observed all past signals rather than all past actions.

Scharfstein and Stein (1990) show that herding may be motivated by career concerns. In their model (as in the ones considered in this section), a manager may have high or low ability, which no one knows *ex ante*. Scharfstein and Stein assume that only high-ability managers obtain an informative signal, indeed the same one. Low-ability managers receive random signals. Because high-ability managers agree on which action is best while low-ability ones disagree, a manager under the threat of being replaced is better off mimicking what another manager chose previously, even though the late-moving manager may have the right idea while the early-moving one does not.[66]

As Scharfstein and Stein note, countervailing forces may discourage herding. For example, creativity may be a valued talent, or superstars (those whose performance is superior to that of others) may capture large rents. Another factor pushing toward differentiation is the profit incentive: if the projects result in competition between the firms in the product market, the latter are usually better off offering differentiated products. Lastly, differentiation may enable the manager to gamble.[67]

In Zwiebel's (1995) model of herd behavior, managers' *performances* rather than their actions (as in Scharfstein and Stein) are benchmarked. Managers know their own ability (but investors do not) and can select a "standard action" (or "old action") or else deviate from it. The standard action is less profitable[68] than the more innovative one, but it leads to more accurate inferences of managerial ability through relative performance evaluation: suppose that few managers are able to take the innovative action; then benchmarking is more powerful on the old action than on the innovative one. Suppose further that there is a positive cost attached to replacing the manager.

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64. Chapter 6 already discussed the issue of herding in the context of financing under asymmetric information.

65. If the action set is finite. With a continuum of actions, one's own information in general has at least a tiny impact on one's own behavior even after observing the behavior of many other agents.

66. For example, suppose that there are two managers (whose ability is unknown, even to them) and $n$ possible projects among which each manager must choose one (projects are not exclusive, so the two can choose the same; and there is no externality other than informational). Manager 1 privately observes a signal and then publicly picks a project. Manager 2 then receives a private signal and then publicly picks her own project. One project is profitable and the $(n - 1)$ others

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unprofitable. The profitability of a project is revealed only in the distant future.

There are $n$ signals. "Signal $k$" points to project $k$. Suppose that a high-ability manager's signal reveals the identity of the profitable project, while a low-ability manager receives each of the $n$ signals with probability $1/n$ (that is, her signal is uninformative). Assume that manager 1 chooses the project corresponding to her signal (this turns out to be optimal for her). What should manager 2 do in order to maximize the investors' posterior probability that she has high ability? Suppose that in equilibrium she chooses to do the project that is suggested by her signal even though this project differs from that selected by manager 1. Then

Pr(manager 2 has high ability | different projects)

$$= \frac{\alpha(1 - \alpha)((n - 1)/n)}{2\alpha(1 - \alpha)((n - 1)/n) + (1 - \alpha)^2((n - 1)/n)}$$

$$= \frac{\alpha}{1 + \alpha}$$

and

Pr(manager 2 has high ability | same project)

$$= \frac{\alpha^2 + \alpha(1 - \alpha)/n}{\alpha^2 + 2\alpha(1 - \alpha)/n + (1 - \alpha)^2/n^2} > \frac{\alpha}{1 + \alpha}.$$

Hence, manager 2 would be better off ignoring her signal and mimicking manager 1's choice of project.

67. For example, while head-to-head competition in the product market leads to low profits, it also provides some hedging to firms because competitors face high input costs when the firm faces high input costs and because demands are obviously highly correlated (for more on this, see Rey and Tirole (1986)).

68. In the first-order stochastic dominance sense.

Zwiebel shows that managers with average ability choose the standard action, while those with either low or high ability choose the innovative action if they have the opportunity to do so. Intuitively, the difficulty in benchmarking performance makes the innovative action de facto riskier for the manager. Average managers are "in-the-job" due to the firing cost, and so do not want to take risks. Low-ability managers gamble for resurrection because they are "out-of-the-job." Lastly, when choosing the innovative action, high-ability managers, in Zwiebel's model, obtain a high profit and therefore do not risk being confused with low-ability ones; and so they are willing to pick the innovative action.

### 7.2.2.3 Income and Dividend Smoothing

A well-established fact in the accounting literature is that managers (from the CEO to lower-level division managers) smooth the earnings of their firm or unit. Thus, they may delay income recognition when things go well, and move income forward in time when they are in trouble. The latter behavior is easily understood and has been studied at length in this section. The puzzle is therefore the low-profile behavior in good times.

Fudenberg and Tirole (1995) develop an agency-based theory of income smoothing, building on the idea that managerial tenure is quite secure as long as the manager does well and her job is jeopardized when things go sour. Suppose that the manager's job is secure in the forthcoming review, but might be threatened in the future. Because continuation in the job is a nonissue today, the manager has no incentive to look particularly good today, and can even afford to hide some of her current accomplishments by delaying income recognition until later. The latter strategy makes the manager look worse today than she really is, but will boost her future performance.

Delaying income recognition in good times benefits the manager if the improvement in tomorrow's performance carries more weight in the investors' updating about the manager's ability than the associated deterioration in today's performance. Hence, the role of an *information decay* assumption: that future performance is better predicted by recent than by ancient performance. Information decay can be grasped through the following analogy: to know how a soccer player will do between ages 30 and 32, his performance between ages 25 and 30 is more informative than that between ages 20 and 25. Under information decay, the strategy of playing low key in good times increases the manager's "average" tenure in the firm.[69]

*Illustration of the role of information decay.* To illustrate in the simplest possible way the incentive to delay income recognition when one's job is not at stake, let us consider the extreme case in which the income initially reveals nothing about the entrepreneur's talent. For example, it could be a "legacy income" determined by the previous manager; or it could be heavily driven by exogenous uncertainty; or else the initial income could relate to a task that differs substantially from future ones (for instance, the current task might consist in reorganizing and rationalizing the firm's organization; future tasks will consist in managing growth) and so the manager's ability to perform tasks is uncorrelated over time. Exercise 7.10 allows an arbitrary correlation of ability over time.

Consider the timing in Figure 7.10.

Let us normalize the discount factor to 1, as usual. To simplify the resolution, we assume that there is no moral hazard. Managers do not respond to monetary incentives and receive a fixed wage $w_0$, say, equal to what they would receive outside the firm. By contrast, they enjoy a private benefit $\mathcal{B} > 0$ per period. Thus, their objective is to stay in the job as long as possible.

A manager's probability of success at date $t$ depends on the manager's ability at the date-$t$ task (her "current ability"). In the absence of hidden savings, a manager with high current ability succeeds with probability $r$, while one with low current ability succeeds with probability $q < r$.

A manager is in place at dates 1 and 2, and may or may not be retained at the end of date 2. The manager's ability is the same at dates 2 and 3 (perfect correlation), and is unrelated to that at date 1

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69. Note that the manager, as in the career-concerns model above, only cares about being retained. An apparently poor short-term performance might more generally have costs, such as reduced investor trust in managerial decision making (see Chapter 10). What matters for the theory is therefore that tenure in the job be an important managerial objective.
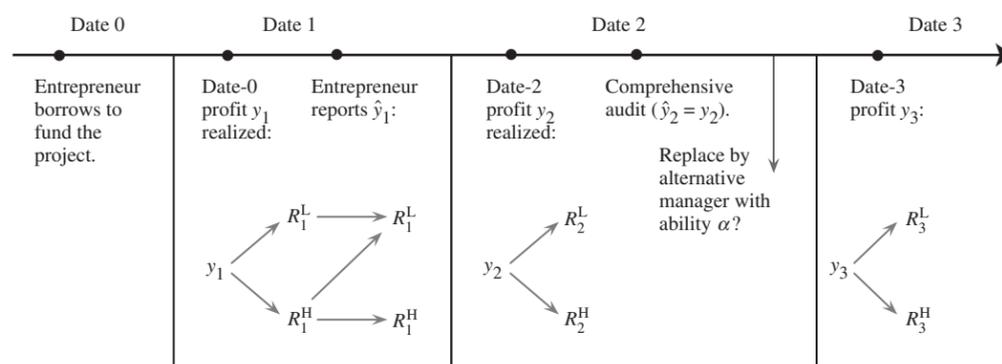
**Figure 7.10**

(independence). Thus, nothing can be learned from the date-1 income: $y_1 \in \{R_1^L, R_1^H\}$. The key assumptions are that

- the manager's job is secure until date 2; perhaps, the manager must be given some time, or there is no available replacement at date 1;[70]
- the date-1 income $y_1$ is observed only by the manager.

The manager, when having a high first-period income $R_1^H$, can report $R_1^L$ and hide $R_1^H - R_1^L$ in the firm. Those hidden savings increase the probability of date-2 success ($y_2 = R_2^H$) by a uniform amount $\tau$ (so it becomes $r + \tau$ if the date-2 ability is high, and $q + \tau$ if it is low).

The date-2 income $y_2$, in contrast with the date-1 income, is observed by the investors. This can be given two interpretations: first, there may be a comprehensive audit at date 2; second, even in the absence of such an audit, the manager anyway has an incentive to disclose a high date-2 income ($R_2^H$) when income is indeed high (see below).

At date 1 no one knows the manager's ability at dates 2 and 3. Let $\alpha$ denote the probability that she has high ability (is talented), and

$$p \equiv \alpha r + (1 - \alpha)q.$$

If this manager is fired at date 2, the replacement manager also has probability $\alpha$ of being talented and

therefore probability $p$ of being successful at date 3. For simplicity, there is no switching cost. And so the manager keeps her position at the end of date 2 if and only if her updated probability $\alpha_2$ of being talented exceeds $\alpha$.

As long as $\tau > 0$, it is privately optimal for the incumbent manager to hide any date-1 profit:

$$\hat{y}_1 = R_1^L \quad \text{for all } y_1 \in \{R_1^L, R_1^H\}.$$

Suppose, in particular, that she did report date-1 income truthfully. Then, recalling that the *ex ante* probability of date-2 success (failure) is $p$ (respectively, $1 - p$), the updated probability that the manager has high ability is

$$\alpha_2 = \begin{cases} \dfrac{\alpha r}{p} > \alpha & \text{in the case of date-2 success,} \\[2mm] \dfrac{\alpha(1-r)}{1-p} < \alpha & \text{in the case of date-2 failure.} \end{cases}$$

Thus, the manager retains her position if and only if she is successful at date 2. Therefore, hiding income $R_1^H$ at date 1 is optimal, since it raises the date-2 probability of success from $p$ to $p + \tau > p$.[71]

Of course, the optimality of the low-profile strategy (underreporting date-1 income) hinges on the fact that the entrepreneur's job is not in danger in the short term. Otherwise, the entrepreneur could well be more tempted to inflate than to deflate earnings at date 1, as we saw previously.[72]

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70. Note also that $y_1$ here conveys no information about $y_2$ and $y_3$. There is therefore no reason to replace the manager at date 1. So, if there is at least a small cost of replacement or if the alternative manager's expected ability is lower, then replacement at date 1 is not credible.

71. More generally, the reader can check that for any equilibrium probability that the manager misreports at date 1, the manager is strictly better off misreporting. Hence, the manager always misreports.

72. A couple of papers have found empirical support for the theory outlined here. De Fond and Park (1997) find that the link between,

An extreme, but familiar, illustration of this behavior occurs when new CEOs darken the legacy of their predecessors precisely because it does not reflect badly on their own ability. In fact, it might even reflect well, i.e., if they appear to manage a great turnaround.

The idea that management has an incentive to delay income recognition and save for future (and potentially more job-threatening) times when there is currently less pressure to perform can be extended to the distribution of dividends, yielding a theory of *dividend smoothing*. Add to the model a (concave) investment function. Dividends then matter as they determine retentions and investment. To the extent that the marginal productivity of reinvestment is decreasing, distributing dividends is more costly to the firm when the actual income is low. Investors choose the dividend level but are imperfectly informed about the marginal productivity of retentions. They therefore must elicit this information in an incentive-compatible way from the manager (the manager "recommends" a dividend and makes an earnings report).

To illustrate this, generalize the previous example by introducing a date-1 reinvestment $J$ that occurs after the date-1 income is realized. Let $\tau(J)$ denote the corresponding increase in date-2 probability of success with $\tau' > 0$, $\tau'' < 0$, $\tau(0) = 0$, $\tau'(0)(R_2^{\mathrm{H}} - R_2^{\mathrm{L}}) > 1$ (some reinvestment is desirable). Investors observe neither the date-1 income, nor the actual reinvestment. Let $d(\hat{y}_1)$ denote the dividend that is demanded by investors when the manager reports $\hat{y}_1$. The reinvestment is then[73]

$$J(y_1, \hat{y}_1) = y_1 - d(\hat{y}_1).$$

As earlier, it is easy to check that the manager keeps her job at the end of date 2 if and only if she is successful at that date. The probability of a date-2 success is

$$p + \tau(J(y_1, \hat{y}_1))$$

and so the manager wants to minimize $d(\hat{y}_1)$ regardless of her date-1 income. The equilibrium is therefore a *pooling* equilibrium in dividends at date 1.[74]

This barebones model thus predicts that when the managerial position is not threatened (that is, at date 1) the dividend is insensitive to the firm's actual income. By contrast, when the manager's job is at stake (date 2), the manager has an incentive to disclose her true income (at least if $R_2 = R_2^{\mathrm{H}}$; by implication, the income is also de facto "disclosed" when $R_2 = R_2^{\mathrm{L}}$), and thus the dividend varies with the actual income.[75] At date 2, the stock price reacts positively to earnings and dividend announcements.[76] The threat of investor intervention forces the manager to disgorge cash in the form of a dividend.[77]

Dividend smoothing has been a stylized fact in corporate finance since the work of Lintner (1956), who showed that firms by and large smooth their dividends and trigger very negative stock price reactions when they cut them. Lintner further pointed out that share repurchases (an alternative to dividends to pay out income to shareholders) provide flexibility in the payout policy (are quite large in good times and nonexistent in bad ones) and are much more volatile than dividends although he did not provide a theory for why this is so.

The model above (and its less extreme extensions[78]) only partly accounts for income and

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74. It is optimal for investors to demand dividend $d^*$ given by (assuming that $d^* \leqslant R_1^{\mathrm{L}}$)

$$[p_1 \tau'(R_1^{\mathrm{H}} - d^*) + (1 - p_1)\tau'(R_1^{\mathrm{L}} - d^*)](R_2^{\mathrm{H}} - R_2^{\mathrm{L}}) = 1,$$

where $p_1$ is the probability that $y_1 = R_1^{\mathrm{H}}$. Let

$$\tau \equiv p_1 \tau(R_1^{\mathrm{H}} - d^*) + (1 - p_1)\tau(R_1^{\mathrm{L}} - d^*).$$

Note also that the date-3 probability of success,

$$[\alpha(r + \tau)r + (1 - \alpha)(q + \tau)q] + [1 - (p + \tau)]p$$
$$= p + \alpha(1 - \alpha)(r - q)^2$$

(accounting for the possibility of replacement at date 2), is independent of the date-1 payout policy.

75. If one depicts the date-2 reinvestment as the date-1 one, the optimal dividend is such that the reinvestment is $J_2^*$ with $\tau'(J_2^*)[R_3^{\mathrm{H}} - R_3^{\mathrm{L}}] = 1$.

76. Here, the earnings and dividend announcement convey the same information. See Fudenberg and Tirole (1995) for examples in which both announcements convey information and sequentiality trigger positive stock price reactions.

77. Other models making a similar prediction are those of Zwiebel (1996) (in which managers engage in payouts as a commitment to limit future inefficiency rather than to signal their ability) and Fluck (1999).

78. For example, if the manager responded to monetary incentives, a stock-based compensation scheme would induce her to recommend

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on the one hand, current performance and predicted performance in the next period and, on the other, reported (income-decreasing) discretionary accruals goes as predicted by the theory. Kanagaretnam et al. (2003) look at banks' loan loss provisions and find that banks save earnings through such provisions in good times and lower loan loss provisions in bad times. See also Ahmed et al. (2000).

73. We assume that the date-1 income $y_1$ is sufficient to cover the dividend.

dividend smoothing. For one thing, dividends are smoothed across states of nature rather than across time. Furthermore, like most models of dividends (see Chapter 6) it makes no distinction between dividends and share repurchases.[79]

### 7.2.3 Effort and Risk Taking

As we observed in Chapters 3 and 4, encouraging effort calls for rewarding management for performances in the upper tail (this is indeed what stock options attempt to achieve), but such high-powered incentives also create incentives for risk taking (often called "asset substitution" in corporate finance). Unfortunately, the analysis of this multifaceted moral-hazard problem is not well-developed. We can avail ourselves only of specific examples.

We begin with a discrete-effort, discrete-outcome version due to Biais and Casamatta (1999),[80] and then move on to a continuous-effort, continuous-outcome version first studied by Bester and Hellwig (1987).

#### 7.2.3.1  A Discrete Version

Consider the fixed-investment model and add the following two twists:

- there are three possible payoffs: $R^S > R^M > R^F$ (success, middle/intermediate, failure);
- the entrepreneur's moral hazard has two dimensions: effort (which involves a loss of private benefit and raises income) and risk taking (which increases the probabilities of $R^S$ and $R^F$ to the detriment of $R^M$).[81]

We return to the assumption that the entrepreneur is risk neutral and protected by limited liability. She owns a project involving an investment cost $I$ and has cash $A < I$. Ignoring risk taking for the moment, the impact of effort is as follows.

- The entrepreneur receives private benefit $B$ in the case of misbehavior. The three outcomes are then equally likely. The NPV is negative in the case of misbehavior:

$$\tfrac{1}{3}(R^S + R^M + R^F) + B < I.$$

- In the case of good behavior, the entrepreneur receives no private benefit, and raises the probability of success and lowers the probability of failure by $\theta > 0$.[82] The NPV is then positive:

$$(\tfrac{1}{3} + \theta)R^S + \tfrac{1}{3}R^M + (\tfrac{1}{3} - \theta)R^F > I.$$

Whether the entrepreneur behaves or misbehaves in this direction, she can take further actions that affect the project's outcome: namely, she can gamble and increase the probability of success by $\alpha$ and the risk of failure by $\beta$ (and so reduce the probability of an intermediate outcome by $\alpha + \beta$). Risk taking reduces the NPV:[83]

$$\alpha(R^S - R^M) \leqslant \beta(R^M - R^F).$$

The impact of the two forms of moral hazard is summarized in Figure 7.11.

Let $R_b^S, R_b^M, R_b^F$ denote the borrower's (nonnegative) rewards in the case of success, intermediate profit, and failure. Intuitively, the borrower should not be rewarded in the case of failure:

$$R_b^F = 0;$$

for, failure is indicative of low effort and/or risk taking.[84] We leave it to the reader to check (that is, by not imposing $R_b^F = 0$ in the following incentive constraints) that this is indeed the case. Here, and without loss of generality, we set $R_b^F$ to be equal to 0.

We first assume that risk taking is to be discouraged, and later investigate when this is indeed so.

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dividends that are more in line with current earnings (as long as current earnings are not too correlated with the profitability of reinvestment); see Application 7 in Section 6.3.

79.  Attempts to distinguish between the two often introduce a differential tax treatment of the two policies or a differential impact on managerial wealth (because of the specific structure of stock options): see Section 2.5.2.

80.  See also Alger (1999) for related modeling choices and an application to prudential regulation, as well as Gollier et al. (1997), Hellwig (1994), Hirshleifer and Thakor (1992), Palomino and Prat (2003), and Sung (1995). Biais and Casamatta further derive their model's general-equilibrium implications (see Chapter 13 for the embedding of corporate finance models in a general-equilibrium setup).

81.  Technically, the former refers to a first-order-stochastic-dominance shift in income, the latter to a second-order-stochastic-dominance shift.

82.  In what follows, we will naturally assume that parameters are such that all probabilities are between 0 and 1.

83.  The case of pure second-order stochastic dominance (a mean-preserving spread) corresponds to an equality:

$$\alpha(R^S - R^M) = \beta(R^M - R^F).$$

But we consider a case in which risk taking has the potential to reduce NPV.

84.  A more precise characterization is in terms of likelihood ratios, as in, for example, Sections 3.6 and 5.5.2.
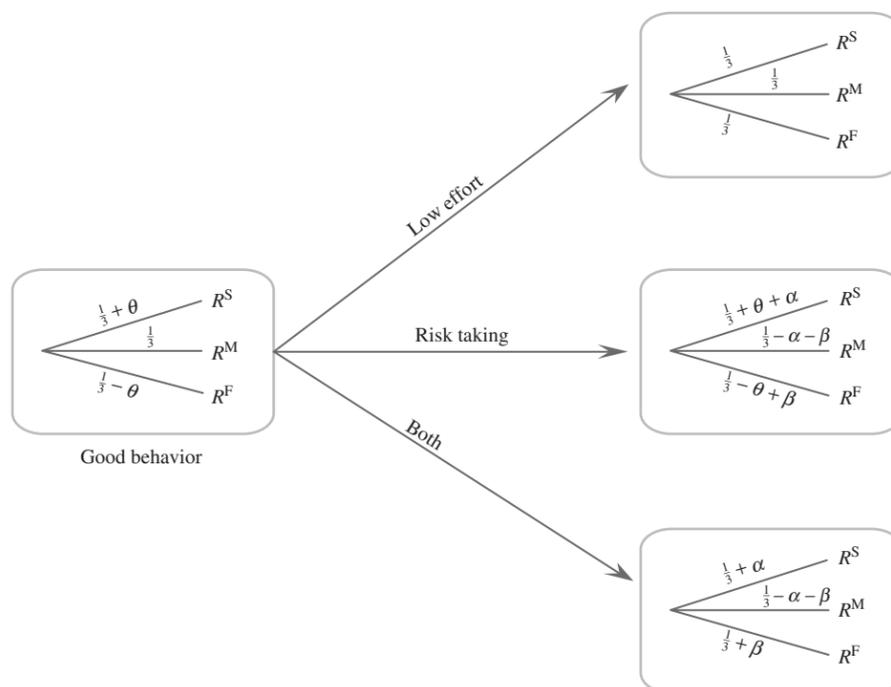
**Figure 7.11**

The entrepreneur's misbehavior takes several forms, and so there are *a priori* three relevant incentive constraints (see Figure 7.11).

*Effort.* Assuming no risk taking, the entrepreneur must be incentivized not to take the private benefit:

$$(\tfrac{1}{3} + \theta)R_b^S + \tfrac{1}{3}R_b^M \geqslant \tfrac{1}{3}R_b^S + \tfrac{1}{3}R_b^M + B$$

or

$$\theta R_b^S \geqslant B. \tag{7.16}$$

Note that the parameter $\theta$ here plays the same role as "$\Delta p$" in the two-outcome case.

*No risk taking.* Next, the entrepreneur may refrain from taking a private benefit, but choose to take risk. We must therefore require that

$$(\tfrac{1}{3} + \theta)R_b^S + \tfrac{1}{3}R_b^M \geqslant (\tfrac{1}{3} + \theta + \alpha)R_b^S + (\tfrac{1}{3} - \alpha - \beta)R_b^M$$

or

$$(\alpha + \beta)R_b^M \geqslant \alpha R_b^S. \tag{7.17}$$

Intuitively, the entrepreneur should not be paid solely in the upper tail if risk taking is to be avoided. Or,

put differently, very high powered incentive schemes encourage gambling.

What about the third incentive constraint? This constraint, which states that the entrepreneur must prefer exerting effort and not taking risk to misbehaving along both moral-hazard dimensions, turns out to be redundant, due to the separability embodied in the impact of these two forms of misbehavior.[85]

If feasible, funding yields NPV, or equivalently a utility for the borrower:

$$U_b^1 \equiv (\tfrac{1}{3} + \theta)R^S + \tfrac{1}{3}R^M + (\tfrac{1}{3} - \theta)R^F - I.$$

Given the incentive-compatibility (IC) constraints (fully depicted by (7.16) and (7.17), whose conjunction determines the incentive-compatible set {IC}),

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85. Namely, the third incentive constraint is

$$(\tfrac{1}{3} + \theta)R_b^S + \tfrac{1}{3}R_b^M \geqslant (\tfrac{1}{3} + \alpha)R_b^S + (\tfrac{1}{3} - \alpha - \beta)R_b^M + B,$$

which can be rewritten as

$$[\theta R_b^S - B] + [(\alpha + \beta)R_b^M - \alpha R_b^S] \geqslant 0,$$

which is implied by (7.16) and (7.17).

the pledgeable income is then

$$\mathcal{P}_1 = (\tfrac{1}{3} + \theta)\left(R^S - \min_{\{IC\}} R_b^S\right) + \tfrac{1}{3}\left(R^M - \min_{\{IC\}} R_b^M\right)$$
$$+ (\tfrac{1}{3} - \theta)R^F$$
$$= (\tfrac{1}{3} + \theta)\left(R^S - \frac{B}{\theta}\right) + \tfrac{1}{3}\left(R^M - \frac{\alpha}{\alpha + \beta}\frac{B}{\theta}\right)$$
$$+ (\tfrac{1}{3} - \theta)R^F$$
$$= [U_b^1 + I] - (\tfrac{1}{3} + \theta)\frac{B}{\theta} - \frac{1}{3}\frac{\alpha}{\alpha + \beta}\frac{B}{\theta}.$$

Funding is then feasible if and only if

$$\mathcal{P}_1 \geqslant I - A. \qquad (7.18)$$

Alternatively, the contract between the entrepreneur and the investors may not attempt to avoid risk taking. It is then intuitive that the entrepreneur should be paid only in the upper tail, which is the most indicative of a high effort:

$$R_b^M = R_b^F = 0.$$

The only incentive constraint is then

$$(\tfrac{1}{3} + \theta + \alpha)R_b^S \geqslant (\tfrac{1}{3} + \alpha)R_b^S + B$$

or

$$\theta R_b^S \geqslant B.$$

The entrepreneur no longer needs to be rewarded for an intermediate performance.

Her utility is then

$$U_b^2 = (\tfrac{1}{3} + \theta + \alpha)R^S$$
$$+ (\tfrac{1}{3} - \alpha - \beta)R^M + (\tfrac{1}{3} - \theta + \beta)R^F$$
$$= U_b^1 - [\alpha(R^S - R^M) - \beta(R^M - R^F)]$$
$$< U_b^1.$$

The pledgeable income is

$$\mathcal{P}_2 = (\tfrac{1}{3} + \theta + \alpha)\left(R^S - \frac{B}{\theta}\right) + (\tfrac{1}{3} - \alpha - \beta)R^M$$
$$+ (\tfrac{1}{3} - \theta + \beta)R^F$$
$$= \mathcal{P}_1 - [U_b^1 - U_b^2] + \left[\frac{1}{3}\frac{\alpha}{\alpha + \beta} - \alpha\right]\frac{B}{\theta}$$

and funding is feasible if and only if

$$\mathcal{P}_2 \geqslant I - A.$$

Finally, let us investigate the optimal contract. Because risk taking reduces the NPV ($U_b^1 > U_b^2$), the entrepreneur prefers to design incentives that

induce her not to take risk, as long as funding is feasible. More precisely, we must consider two cases:

(i) If $\mathcal{P}_1 \geqslant I - A$, then the optimal contract induces the entrepreneur to exert effort and not to take risk. This contract $\{R_b^S, R_b^M, R_b^F = 0\}$ satisfies

$$\theta R_b^S \geqslant B, \qquad (7.19)$$
$$(\alpha + \beta)R_b^M \geqslant \alpha R_b^S, \qquad (7.20)$$
$$A \geqslant (\tfrac{1}{3} + \theta)R_b^S + \tfrac{1}{3}R_b^M - U_b^1. \qquad (7.21)$$

The optimal contract can be implemented through a mixture of debt and equity held by investors: let $D$ denote the level of debt, and let $(1 - x)$ denote the fraction of equity held by investors. $D$ and $x$ must satisfy two equations with two unknowns:

$$x(R^S - D) = R_b^S$$

and

$$x(R^M - D) = R_b^M.$$

Letting (7.20) be satisfied with equality,[86] it is straightforward to show that the variable thus defined satisfies[87]

$$0 < x < 1$$

and

$$R^F < D < R^M.$$

The implementation in this simple model is in general not unique, though. Biais and Casamatta show that alternatively the investors could hold convertible debt $D$ with an option to convert this debt for a fraction $1 - x$ of the shares. (Convertible debt has other benefits when investors observe risk taking *before* the profit is realized (see Jensen and Meckling 1976; Green 1984).)

(ii) If $\mathcal{P}_1 < I - A$, then the entrepreneur cannot secure funding while "committing" to exert effort and not to take risk. Funding may, however, be feasible if risk taking is not too costly in terms of NPV, and raises pledgeable income, i.e., if $\mathcal{P}_2 > \mathcal{P}_1$, or

$$\left(\frac{1}{3}\frac{\alpha}{\alpha + \beta} - \alpha\right)\frac{B}{\theta} > U_b^1 - U_b^2.$$

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86. As it would if there were another "margin" (for example, if the investment size were variable).

87. Note that
$$\frac{R^S - D}{R^M - D} = \frac{\alpha + \beta}{\alpha}.$$
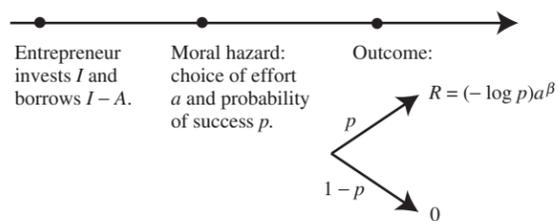Because
$$\alpha R^S + \beta R^F < (\alpha + \beta)R^M$$
(gambling reduces the NPV), $D > R^F$.

**Figure 7.12**

To see how this can occur, suppose that gambling hardly reduces the NPV:

$$\alpha(R^S - R^M) \simeq \beta(R^M - R^F)$$

or

$$U_b^1 \simeq U_b^2.$$

Then, $\mathcal{P}_2 > \mathcal{P}_1$ if and only if

$$\tfrac{1}{3} > \alpha + \beta.$$

But this inequality is automatically satisfied because of the requirement that all probabilities be nonnegative.

Hence, *if gambling involves a low cost in terms of NPV, discouraging gambling reduces the pledgeable income and makes financing more difficult.*

Note that in case (ii), the financial structure of the firm is in a sense "more levered" than in case (i) since the entrepreneur is paid solely in the upper tail. An interesting result is therefore that a reduction in net worth ($A$) may result in a financial structure that is more levered.[88]

(iii) Finally, if $\mathcal{P}_1$ and $\mathcal{P}_2$ are both smaller than $I - A$, there is no funding.

### 7.2.3.2 A Continuous Version

Bester and Hellwig (1987) build a tractable fixed-investment, continuous-effort model (see Figure 7.12).

The entrepreneur is risk neutral, is protected by limited liability, and has utility from wage $w$ and effort $a$ equal to $w - a$. Here, effort increases the payoff in the case of success, which is proportional to $a^\beta$, with $\beta < 1$. The choice of the probability of success can here be interpreted as a risk choice: a lower probability of success corresponds to a larger

payoff in the case of success, as

$$R = (-\log p)a^\beta.$$

*No-agency-cost benchmark.* Suppose first that the parties can contract on $a$ and $p$.[89] These variables are chosen so as to maximize the NPV:

$$\max_{\{a,p\}} \text{NPV} = p[(-\log p)a^\beta] - a - I,$$

yielding the first-best values.

Note that the optimal choice of $p$ is independent of $a$, while the optimal choice of $a$ depends on $p$,

$$a^*(p) = (\beta p(-\log p))^{1/(1-\beta)}$$

(and so $a^* = a^*(p^*)$), while

$$p^* = 1/e,$$

where $\log e = 1$. And so

$$a^* = \left(\frac{\beta}{e}\right)^{1/(1-\beta)}.$$

*Agency cost.* Suppose now that investors observe only the final profit, and so the reward $w$ depends on this profit only. The initial contract can still specify the level of profit $R$ to be reached in the case of success (by specifying $w(R') = 0$ for $R' \neq R$).[90] Thus a second-best contract sets $R$ as well as a sharing rule specifying a reward $R_b$ for the borrower and $R_l$ for the lenders:

$$R = R_b + R_l.$$

Given target $R$ and reward $R_b$ in the case of success, the entrepreneur solves

$$\max_{\{p,a\}}\{pR_b - a\}$$

s.t.

$$(-\log p)a^\beta = R.$$

Using the constraint to substitute $p$ into the objective function, the first-order condition is

$$pR_b = \frac{a}{\beta(-\log p)}.$$

The investors' breakeven constraint is then

$$pR_l \geqslant I - A$$

---

or

$$pR - \frac{a}{\beta(-\log p)} \geqslant I - A.$$

The second-best optimum when there is an agency cost and the investors' breakeven constraint is binding is given by the maximization of the NPV subject to that constraint:

$$\max_{\{p,a\}} \{U_{\mathrm{b}} = p(-\log p)a^{\beta} - a\}$$

s.t.

$$p(-\log p)a^{\beta} - \frac{a}{\beta(-\log p)} \geqslant I - A.$$

The analysis of the first-order conditions for this program reveals that the level of risk exceeds the first-best level, while the level of effort is suboptimal:

$$p < p^* \quad \text{and} \quad a < a^*(p).$$

To gain intuition about this result, consider the two "polar" cases in which investors hold a debt and an equity claim, respectively.

*Pure-debt contract.* Suppose that the entrepreneur owes a fixed amount $\mathcal{D}$ (which, due to the entrepreneur's limited liability, is paid back only in the case of success).[91] Then the entrepreneur chooses risk and effort so as to solve

$$U_{\mathrm{b}} = \max_{\{p,a\}} \{p[(-\log p)a^{\beta} - \mathcal{D}] - a\},$$

and so

$$a = a^*(p).$$

Because the entrepreneur is residual claimant in the case of success, she chooses the conditionally optimal level of effort. A debt contract here provides the right incentives. By contrast, a debt contract induces the entrepreneur to take too much risk:[92] as long as $\mathcal{D} > 0$,

$$p < p^*.$$

Intuitively, the debtholders do not bear the effort cost and would like $p$ to be as large as possible. Their concern is not internalized by the entrepreneur.

At the margin, some sharing of marginal profit with the investors is desirable. This sharing reduces

the effort, which is inconsequential if $a$ is in the neighborhood of the conditional optimum $a^*(p)$ (the loss is of second order only). And this sharing reduces risk taking.

*Pure-equity contract.* Conversely, suppose that investors get a fraction $\theta_{\mathrm{l}}$ of profit and the entrepreneur a fraction $\theta_{\mathrm{b}}$ (with $\theta_{\mathrm{b}} + \theta_{\mathrm{l}} = 1$).[93] The entrepreneur then solves

$$U_{\mathrm{b}} = \max_{\{p,a\}} \{\theta_{\mathrm{b}}p(-\log p)a^{\beta} - a\}.$$

The pure-equity contract distorts the effort decision downward,

$$a < a^*(p),$$

but it introduces no distortion in the risk choice:

$$p = p^*.$$

An increase in welfare can be achieved by giving the entrepreneur a bit more of the profit at the margin, that is by reducing $\theta_{\mathrm{l}}$ and compensating this reduction by issuing some debt. Of course, this move leads to an increase in risk, but starting from the optimal value $p^*$, this introduces only a second-order loss.

This analysis suggests that the second-best optimum can be implemented through a mixture of debt and equity in which the firm owes an amount $\mathcal{D}$ of debt, and the entrepreneur owns a fraction $\theta_{\mathrm{b}}$ of shares and therefore has utility

$$\theta_{\mathrm{b}}\max\{0, p(R - \mathcal{D})\} - a.$$

Bester and Hellwig indeed show that these two instruments ($\mathcal{D}$ and $\theta_{\mathrm{b}}$) are sufficient to implement the second-best allocation.

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## Supplementary Section

### 7.3  Brander and Lewis's Cournot Analysis

Section 7.1.1.3 argued that a firm may want to choose its financial structure so as to commit to specific forms of product-market behavior (aggressivity in that section) and thereby indirectly influence

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91. $\mathcal{D}$ is computed to satisfy the investors' breakeven constraint, if this is feasible.

92. To see this, one can either write the first-order condition with respect to $p$, or note that the cross-partial derivative of the entrepreneur's objective function with respect to $p$ and $\mathcal{D}$ is negative (equal to $-1$).

---

93. Where the sharing rule satisfies the investors' breakeven constraint, if feasible.

Entrepreneur 1 decides
whether to invest $I$ and
how much of her wealth
$A$ to invest in the project
(she consumes the rest).

Entrepreneur 2 observes
entrepreneur 1's choices,
and makes her own
choices in the matter.

Cournot competition:
entrepreneurs who have
invested choose quantities.

Demand parameter
$\theta$ realized.
Revenues accrue.
Debt reimbursed
(subject to entrepreneur's
limited liability constraint).

The investors' breakeven
condition determines
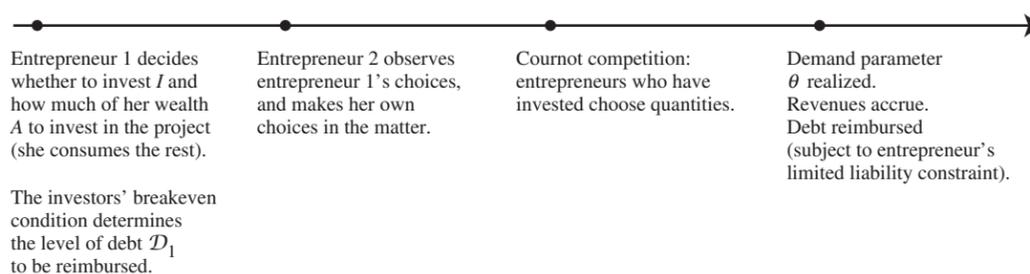the level of debt $\mathcal{D}_1$
to be reimbursed.

**Figure 7.13**

the rivals' behavior. This supplementary section describes Brander and Lewis's original analysis. In Brander–Lewis, firm $i$'s profit, that is the combined profit of entrepreneur $i$ and firm $i$'s claimholders, is the standard Cournot profit with linear demand:

$$\pi_i = q_i(\theta - q_i - q_j) - I,$$

where $I$ is the fixed investment cost and $q_i$ is firm $i$'s output.[94] Demand is assumed to be random. That is, the demand curve

$$Q = q_1 + q_2 = \theta - p$$

(where $p$ is the price in the market) has a random intercept $\theta$ distributed in some interval $[\underline{\theta}, \bar{\theta}]$ according to cumulative distribution function $H(\theta)$ and density $h(\theta)$. Assume that the realization of the demand parameter $\theta$ is not known at the time at which the firms choose outputs (and, *a fortiori*, at the time at which they sink the investment cost).

Even if the entrepreneur has enough wealth to finance the investment herself ($A \geqslant I$), she may want to consume some of this wealth up front and borrow from investors by issuing debt (while keeping control over the choice of output). To see this, suppose that the entrepreneur issues debt, so she is meant to reimburse a fixed amount $\mathcal{D}_i$ *ex post*. If she is unable to reimburse $\mathcal{D}_i$, i.e., when

$$q_i(\theta - Q) < \mathcal{D}_i,$$

she is protected by limited liability and receives 0.[95] The timing of the Brander–Lewis model is depicted in Figure 7.13.

Entrepreneur $i$'s *ex post* revenue (that is, gross of her pre-competition consumption) is

$$\int_{Q + \mathcal{D}_i/q_i}^{\bar{\theta}} [q_i(\theta - q_i - q_j) - \mathcal{D}_i] h(\theta)\, d\theta.$$

Let

$$MR_i(\theta, q_i, q_j) \equiv \theta - 2q_i - q_j$$

denote the firm's marginal revenue. The entrepreneur chooses output so as to maximize her *ex post* revenue,

$$\int_{Q + \mathcal{D}_i/q_i}^{\bar{\theta}} MR_i(\theta, q_i, q_j) h(\theta)\, d\theta = 0, \qquad (7.22)$$

while the firm as a whole (that is, internalizing the stakes of both the entrepreneur and the debtholders) would choose output so as to equate average marginal revenue to 0:

$$\int_{\underline{\theta}}^{\bar{\theta}} MR_i(\theta, q_i, q_j) h(\theta)\, d\theta = 0. \qquad (7.23)$$

The difference between (7.22) and (7.23) is illustrated in Figure 7.14. Protected by limited liability, the entrepreneur internalizes none of the lower tail of the distribution (her perceived marginal revenue is equal to 0 in this region: see part (a) of the figure). Because marginal revenue increases with demand, the first-order condition (7.22) can be depicted as in

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94. We assume zero marginal costs. Alternatively, a positive marginal cost can be incorporated into the parameter $\theta$. Also, $q_i$ could be a strategic variable other than quantity, as long as the firms' choices remain strategic substitutes and that an increase in $q_i$ makes profit riskier.

95. In principle, limited liability might be invoked even in the absence of debt if prices could become negative (i.e., $\underline{\theta} < Q$). But we are not interested in this possibility (which, technically, can be ruled out by assuming an upper bound of $\frac{1}{2}\underline{\theta}$ on individual outputs), because it would require a more explicit description of how these quantities are financed. We here stick to the Brander–Lewis assumption that the entrepreneur has full discretion over her quantity.
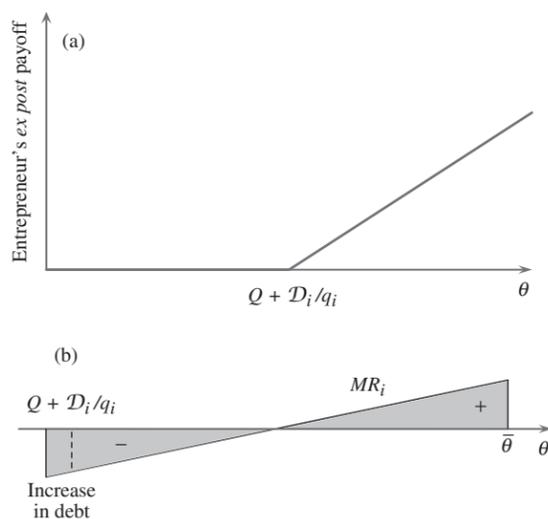
**Figure 7.14** (a) Entrepreneur's incentive;
(b) marginal revenue.



**Figure 7.15**

part (b) of the figure. When debt $\mathcal{D}_i$ increases, some of the negative realizations of the entrepreneur's marginal revenue disappear; and so to restore equality in (7.22), the entrepreneur raises output $q_i$. Intuitively, an increase in output increases the riskiness of the firm's revenue. Because the entrepreneur's stake is convex in the firm's revenue (Figure 7.14(a)), she has an incentive to take risk, i.e., to increase output, and the more so, the higher the level of debt. Note that this would not be so if the entrepreneur issued equity rather than debt. The entrepreneur's objective function would be $s_i[q_i(\theta - q_i - q_j)]$, where $s_i$ is the entrepreneur's share of profit, and so $q_i$ would be independent of the extent, $1 - s_i$, of dilution. Note also that it is important that the entrepreneur keep the control right over the choice of output. Debtholders, if they had their say in the matter, would reduce output relative to the optimal choice of the firm as a whole (entrepreneur cum debtholders) so as to reduce risk.

The strategic impact of debt is illustrated in Figure 7.15. Figure 7.15, for expositional purposes,[96] assumes that firm 2 has no debt (or, equivalently, that its debtholders and entrepreneur act in concert to choose output $q_2$). Firm 2's reaction function $\mathcal{R}_2^0$
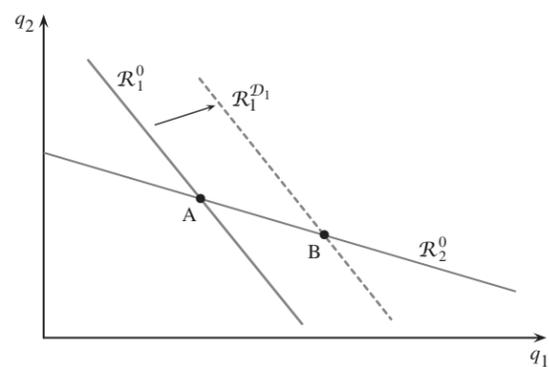
depicts the optimal choice of output for a given output $q_1$ of firm 1:

$$q_2 = \mathcal{R}_2^0(q_1) \quad \text{maximizes } q_2[E(\theta) - q_1 - q_2],$$

where $E(\theta)$ is the mean value of $\theta$. That is,

$$\mathcal{R}_2^0(q_1) = \tfrac{1}{2}(E(\theta) - q_1).$$

Similarly, if firm 1 issues no debt, its reaction curve is

$$\mathcal{R}_1^0(q_2) = \tfrac{1}{2}(E(\theta) - q_2).$$

By issuing debt $\mathcal{D}_1$, though, entrepreneur 1 shifts her reaction curve $\mathcal{R}_1^{\mathcal{D}_1}$ outward, where

$$\mathcal{R}_1^{\mathcal{D}_1}(q_2) = \tfrac{1}{2}(E(\theta \mid \theta \geqslant Q + \mathcal{D}_1/q_1) - q_2)$$
$$> \tfrac{1}{2}(E(\theta) - q_2).$$

Thus, the Cournot outcome if firm 2 enters shifts from A to B, with a higher firm-1 output, and lower firm-2 output and profit. In essence, entrepreneur 1 can indirectly behave as a Stackelberg leader by choosing to issue debt.[97]

So far, we have seen that for a given output $q_2$, say, entrepreneur 1 can commit to raise his own output by raising his debt level. The next step is to note that an expectation of a high output by firm 1 reduces the profitability of firm 2. And so firm 2 may no longer want to sink investment $I$.

Does entrepreneur 1 gain from committing to raise output and deter entry? From the investors'

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96. Indeed, by the very reasoning below, firm 2, if it enters, will want to issue some debt.

97. A slight difference with the Stackelberg model, though, is that firm 2, if it enters, will also have an incentive to shift its reaction curve outward by issuing debt. "Stackelberg leadership" is then somewhat symmetrical.

breakeven condition, entrepreneur 1 receives the entire NPV and therefore has utility

$$U_b^1 = q_1[E(\theta) - q_1 - q_2] - I.$$

In fact, we have a Stackelberg model,[98] for which we know that entry deterrence is optimal if $I$ is sufficiently large (so that the increase in $q_1$ needed to deter entry is relatively small) (see, for example, Tirole 1988, p. 317).

We have discussed only the strategic benefit of debt. The cost is clear: debt creates a divergence of objectives between the manager and the claimholders, and thus leads to quantities (or prices) that are not optimal for the firm from an *ex ante* viewpoint (keeping the strategy of the rival firm fixed in order to abstract from the beneficial strategic effect). Thus, in the Cournot game depicted in Figure 7.15, it is suboptimal to force the reaction curve as far out as possible, since at some point the marginal cost of debt exceeds its marginal benefit.

Let us make a couple of final points to conclude this discussion of the original version of Brander and Lewis. First, as long as firms compete in quantities, the "Stackelberg" incentive to issue debt carries over to situations where firms do not attempt to deter each other's entry, i.e., they accommodate each other's entry. Quantities are strategic substitutes[99] in that an expectation of a high output by one's rival reduces one's incentive to produce.[100] Thus, each firm wants to take on (a reasonable amount of[101]) debt in order to commit to be more aggressive. Thus, the Brander–Lewis result on Cournot competition is robust to the absence of intention to deter entry.

By contrast, it is sensitive to the mode of product-market competition: suppose instead that firms produce differentiated products and compete in prices. Firm $i$ sets price $p_i$ and then faces demand $q_i = \theta - p_i - dp_j$ (with $0 < d < 1$). Again, the demand intercept $\theta$ is random. Firm $i$'s revenue, assuming away marginal costs, is $p_i(\theta - p_i - dp_j)$. So an increase in risk corresponds to a high price $p_i$. Or, put differently, debt will lead to the maximization of the firm's profit in high states of demand, which are states in which the firm wants to charge a high price. Thus, debt leads the entrepreneur to select a high price. This is advantageous, as Showalter (1995)[102] shows, when firm $i$ accommodates entry to the extent that a high price by firm $i$ makes it nonaggressive and induces firm $j$ to increase its own price (prices are strategic complements). By contrast, "committing" to a high price is not a good strategy if one attempts to deter entry. Issuing debt is then suboptimal.[103]

The Brander–Spencer result is also not robust to costs of default or of illiquidity. Faure-Grimaud (2000) introduces costs of default in a Cournot model and shows that debt may make the firm less aggressive (it becomes more conservative as larger quantities increase the risk of default). Similarly, one can introduce multiperiod financing as in Chapter 5; a low level of short-term debt guarantees financial muscle and makes it less profitable for rivals to invest (see Exercise 7.2).

Finally, managerial incentive schemes may be strategically designed so as to promote tacit collusion in oligopoly (Spagnolo 2000). Comparing the situation in which the manager receives a yearly bonus proportional to profit (and therefore in the absence of risk aversion or career concerns is led to maximize the firm's present discounted value of profits) and that in which her incentives are biased toward the future (perhaps through the award of stocks or stock options), the firm may end up be-

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98. At least if firm 2 is constrained to be an all-equity firm. As was noted in footnote 96, firm 2, if it enters, will itself want to issue some debt $\mathcal{D}_2$ so as to commit to a higher output and therefore force firm 1 to curtail its production back a bit. But the flavor of the analysis remains similar to Stackelberg's.

99. For more on strategic complements (upward-sloping reaction curves) and substitutes (downward-sloping reaction curves), and strategies of commitment under entry deterrence or accommodation, see Bulow et al. (1985) and Fudenberg and Tirole (1984).

100. Here, note that $MR_i(\theta, q_i, q_j)$ decreases with $q_j$. So, in Figure 7.15(b), the $MR_i$ curve shifts down as $q_j$ increases. This leads to a decrease in $q_i$ in order to restore equality in the first-order condition (7.22).

101. As we noted, beyond some level of debt the Stackelberg strategy becomes counterproductive, because the strategic/product market benefit is offset by too big a misalignment between the entrepreneur's objective and that of her firm as a whole, and so the marginal cost of high outputs ends up exceeding the marginal benefit.

102. Showalter also looks at the case of uncertain marginal cost. There, the optimization emphasizes low-cost states (those of no default), and therefore leads to *low* prices, which are strategically disadvantageous in a situation of accommodation.

103. These conclusions are common to all games of entry deterrence and accommodation (see Fudenberg and Tirole 1984; Shapiro 1989). Here the instrument providing commitment is the choice of debt.

ing more profitable in the latter case even though the manager no longer maximizes its present discounted value; for, the managerial bias toward the future tells rival firms that the manager is not keen on undercutting and starting a price war, that is, on privileging current income at the cost of future earnings. It thereby provides these rival firms with an incentive to themselves refrain from undercutting. The strategic gain attached to softening the rivals' market behavior may well offset the loss attached to the divergence of objectives between manager and investors.

## 7.4  Exercises

**Exercise 7.1 (competition and vertical integration).** This exercise is inspired by Cestone and White (2003).

(i) A *cashless* entrepreneur ($A = 0$) considers a research project requiring a fixed investment $I$. When financed, the project succeeds with probability $p_H = 1$ (for certain) if she works, and with probability $p_L = 1 - \Delta p$ if she shirks, in which case she receives private benefit $B$. Regardless of the outcome, there is a verifiable salvage value $R^F \geqslant 0$ (equipment, real estate) at the end. For the moment, there is no other firm in the market and so success brings an additional income $R = M$ (monopoly profit) on top of the salvage value. Assume that

$$R^F + \left(M - \frac{B}{\Delta p}\right) \geqslant I. \qquad (1)$$

The investment cost $I$ includes a fixed cost $K \leqslant I$ borne by a supplier who must develop an enabling technology. There is *ex ante* a competitive supply of such suppliers, who for simplicity have enough cash to finance the entrepreneur's remaining investment cost, $I - K$, besides their own cost $K$. So we can formalize the supplier as a "competitive capital market" for the moment.

In exchange for his contribution (supplying the technology and providing complementary financing $I - K$ to the entrepreneur), the selected supplier receives a debt claim (the equivalent of a fixed price) and an equity stake in the entrepreneurial firm.

A *debt claim* is a payment $R_1^F$ to the supplier/lender from the safe income $R^F$:

$$0 \leqslant R_1^F \leqslant R^F.$$

An *equity claim* is a share $\theta_1 \in [0, 1]$ of the firm's profit beyond $R^F$ (here, a claim on $M$).
- Can the project be financed?
- Characterize the set of feasible contracts $(R_1^F, \theta_1)$. (There is some indeterminacy, except when the inequality in (1) is an equality. Discuss informally extra elements that could be added to the model to make a debt contract strictly optimal.)

(ii) Suppose now that, after having developed the enabling technology for the entrepreneur, the supplier can, at no extra cost (that is, without incurring $K$ again), offer the technology to a rival who is in every respect identical to the entrepreneur. If he does so, and the two downstream projects are successful, then the per-firm duopoly profit is $D$ (on top of the salvage value $R^F$), where

$$2D < M$$

(competition destroys profit). Assume that

$$R^F + \left(D - \frac{B}{\Delta p}\right) \geqslant I - K > R^F. \qquad (2)$$

- Note that the entrepreneur always wants to sign an exclusivity contract with the selected supplier (hint: look at the industry profit when the rival receives the enabling technology).
- In the absence of exclusivity provision (say, for antitrust reasons), look at whether the entrepreneur can obtain de facto exclusivity by choosing the debt/equity mix of the supplier properly. Assume for simplicity that $(\Delta p)(1 - \theta_1)D \geqslant B$. This will hold true in an optimal contract.

**Exercise 7.2 (benefits from financial muscle in a competitive environment).** This exercise extends to liquidity choices the Aghion–Dewatripont–Rey idea that pledgeable income considerations may make financial structures and corporate governance strategic complements in a competitive environment.

(i) Consider a single firm. At date 0, the entrepreneur borrows $I - A$ in order to finance a fixed-size project costing $I$. At date 1, the firm may need to reinvest an amount $\rho$ with probability $\lambda$. With probability $1 - \lambda$, no reinvestment is required. In the case

of continuation the entrepreneur may behave (probability of success $p_H$, no private benefit) or misbehave (probability of success $p_L = p_H - \Delta p$, private benefit $B$). Let

$$\rho_1(R) \equiv p_H R \quad \text{and} \quad \rho_0(R) \equiv p_H\left(R - \frac{B}{\Delta p}\right),$$

where $R$ is the profit in the case of success at date 2 (the profit is equal to 0 in the case of failure).

The firm is said to have "financial muscle" if $\rho > \rho_0(R)$ and the firm chooses to withstand the liquidity shock if it occurs.

• Explain the phrase "financial muscle."

• Does the firm want to have financial muscle when $\rho > \rho_0(R)$? (Hint: consider three regions for the term $(1 - \lambda)\rho_0(R) - (I - A)$: $(-\infty, 0)$, $(0, \lambda[\rho - \rho_0(R)])$, and $(\lambda[\rho - \rho_0(R)], +\infty)$.)

(ii) Suppose now that the firm (now named the incumbent) faces a potential entrant in the innovation market. The entrant is *identical* to the incumbent in all respects (parameters $A$, $I$, $p_H$, $p_L$, $B$ and profits (see below)) *except that the entrant will never face a liquidity shock if he invests* (the entrant is therefore endowed with a better technology). Let $R = M$ denote the monopoly profit made by a firm when it succeeds and the other firm either has not invested in the first place or has invested but not withstood its liquidity shock; let

$$R = C = p_H D + (1 - p_H)M$$

(where $D < M$ is the duopoly profit) denote its expected profit when it succeeds and the other firm has invested and withstood its liquidity shock (if any). Assume that

$$\rho > \rho_1(M), \qquad (1)$$
$$(1 - \lambda)\rho_0(C) + \lambda\rho_0(M) > I - A > \rho_0(C), \qquad (2)$$
$$(1 - \lambda)\rho_1(C) + \lambda\rho_1(M) > I. \qquad (3)$$

• Suppose, first, that the two firms choose their financial structures (liquidity) *simultaneously* at date 0. Show that the entrant invests and the incumbent does not.

• Suppose, second, that, at date 0, the incumbent chooses her financial structure *before* the entrant. And assume, furthermore, that

$$\rho_0(M) - \lambda\rho > I - A. \qquad (4)$$

Show that the incumbent invests, while the (more efficient) entrant does not.

**Exercise 7.3 (dealing with asset substitution).** Consider the fixed-investment model with a probability that the investment must be resold (redeployed) at an intermediate date because, say, it is learned that there is no demand for the product. The timing is summarized in Figure 7.16.

An entrepreneur has cash $A$ and wants to invest a fixed amount $I > A$ into a project. The shortfall must be raised in a competitive capital market. The project yields $R$ with probability $p$ and 0 with probability $1 - p$, provided that there is a demand for the product (which has probability $x$ and is revealed at the intermediate stage; the final profit is always 0 if there is no demand, and so it is then optimal to liquidate at the intermediate stage). Investors and entrepreneur are risk neutral, the latter is protected by limited liability, and the market rate of interest is 0.

(i) In a first step, ignore the possibility of asset substitution. The liquidation value is $L = L_0$, and the probability of success is $p_H$ if the entrepreneur works and $p_L = p_H - \Delta p$ if she shirks (in which case she obtains a private benefit $B$). Assume that the NPV of the project is positive if the entrepreneur works, and negative if she shirks.

Assume that $A \geqslant \bar{A}$, where

$$(1 - x)L_0 + xp_H\left(R - \frac{B}{\Delta p}\right) = I - \bar{A} \qquad (1)$$

(and that $L_0 \leqslant p_H(R - B/\Delta p)$).

• Interpret (1).

• Compute the entrepreneur's expected utility.

• What is the class of optimal contracts (or, at least, characterize the optimal contract for $A = \bar{A}$)?

(ii) Suppose now that, before the state of demand is realized, but after the investment is sunk, the entrepreneur can engage in asset substitution. She can reallocate funds between asset maintenance (value of $L$) and future profit (as characterized by the probability of success, say).

More precisely, suppose that the entrepreneur chooses $L$ and

• the probability of success is $p_H + \tau(L)$ if the entrepreneur behaves and $p_L + \tau(L)$ if she misbehaves;
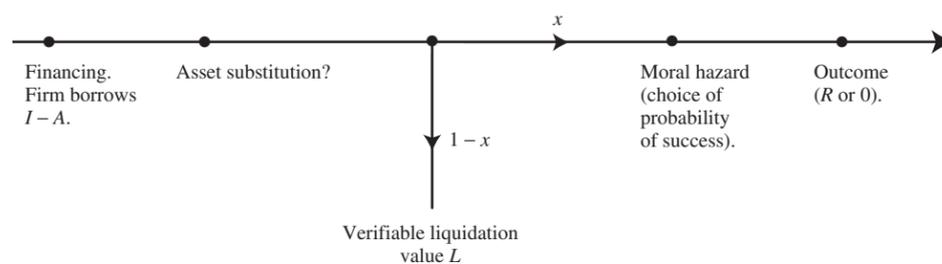
**Figure 7.16**

- the function $\tau$ is decreasing and strictly concave;
- 
$$\tau(L_0) = 0 \quad \text{and} \quad \tau'(L_0)R = -\frac{1-x}{x}; \quad (2)$$
- the entrepreneur secretly chooses $L$ (multitasking).

Consider contracts in which

- liquidation occurs if and only if there is no demand (hence, with probability $x$);
- the entrepreneur receives $r_b(L)$ if the assets are liquidated, and $R_b$ if they are not and the project is successful (and 0 if the project fails).

Interpret (2). Compute the minimum level of $A$ such that the threat of (excessive) asset substitution is innocuous. Interpret the associated optimal contract. (Hint: what is the optimal asset maintenance (liquidation value)? Note that, in order to induce the entrepreneur to choose this value, in the case of liquidation you may pay $r_b(L) = r_b$ if $L$ is at the optimal level and 0 otherwise.)

**Exercise 7.4 (competition and preemption).** Consider the "profit-destruction model (with independent processes)" of Section 7.1.1.

As in Fudenberg and Tirole (1985), time is continuous, although both investment $I$ and the research process and outcome are instantaneous (this is in order to simplify expressions). The actual R&D can be performed only at (or after) some fixed date $t_0$. The instantaneous rate of interest is $r$. The monopoly and duopoly profits, $M$ and $D$, and the private benefit $B$ then denote present discounted values (at interest rate $r$) from $t_0$ on. The entrepreneur's cash is worth $e^{r(t_0-t)}A$ at date $t$ and so it grows with interest rate $r$ and is worth $A$ at date $t_0$.

Assume that

$$p_H\left(M - \frac{B}{\Delta p}\right) \geqslant I - A$$
$$\geqslant p_H\left[(1 - p_H)M + p_H D - \frac{B}{\Delta p}\right].$$

This condition states that if investment were constrained to occur at $t_0$, there would be scope for funding exactly one entrepreneur (see Section 7.1.1).

The twist is that the investment $I$ can be sunk at any date $t \leqslant t_0$ (implying an excess expenditure of $[e^{r(t_0-t)} - 1]I$ from the point of view of date $t_0$ since the investment is useless until date $t_0$). The investment is then publicly observed.

Analyze this preemption game, distinguishing two cases depending on whether

$$p_H M \gtrless p_H\left(M - \frac{B}{\Delta p}\right) + A.$$

**Exercise 7.5 (benchmarking).** This exercise generalizes the benchmarking analysis of Section 7.1.1.

The assumptions are the same as in that section, except for the descriptions of risk aversion and correlation. Two firms, $i = 1, 2$, must develop, at cost $I$, a new technology in order to be able to serve the market. Individual profits are $M$ for the successful firm if only one succeeds, $D$ if both succeed, and 0 otherwise. The probability of success is $p_H$ in the case of good behavior and $p_L$ in the case of misbehavior (yielding private benefit $B$). Each entrepreneur starts with cash $A$.

The entrepreneurs exhibit the following form of risk aversion: their utility from income $w$ is

$$w \quad \text{for } w \geqslant 0,$$
$$(1 + \theta)w \quad \text{for } w < 0,$$

where $\theta > 0$ is both a parameter of risk aversion and a measure of deadweight loss of punishment (similar to that of costly collateral pledging (see Chapters 4 and 6)).

With probability $\rho$, the realization of the random variable determining success/failure (see Section 7.1.1) is the same for both firms. With probability $1 - \rho$, the realizations are independent for the two firms. (So Section 7.1.1 considered the polar cases $\rho = 0$ and $\rho = 1$.) No one ever learns whether realizations are correlated or not.

(i) Find conditions under which both entrepreneurs' receiving funding (and exerting effort) is an equilibrium. Describe the optimal incentive schemes.

Hints:

(a) Let $w = a_k \geqslant 0$ denote the reward of a successful entrepreneur when $k$ ($= 1, 2$) is the number of successful firms. Let $w = -b_k < 0$ denote the reward (really, a punishment) of an unsuccessful entrepreneur when the number of unsuccessful firms is $k$ ($= 1, 2$).

(b) Each entrepreneur maximizes her NPV subject to (IR$_l$) (the investors' breakeven condition) and (IC$_b$) (the entrepreneur's incentive constraint).

(c) Show that there is no loss of generality in assuming that
$$a_2 = b_2 = 0.$$

(d) Use a diagram in the $(a_1, b_1)$-space.

(ii) What happens when $\theta$ goes to 0 or $\infty$? When $\rho$ goes to 0 or 1?

**Exercise 7.6 (Brander–Lewis with two states of demand).** Analyze the Brander–Lewis Cournot model with two states of demand, $\bar{\theta}$ and $\underline{\theta}$, with $\Delta\theta = \bar{\theta} - \underline{\theta} > 0$, and
$$\theta = \begin{cases} \bar{\theta} & \text{with probability } \alpha, \\ \underline{\theta} & \text{with probability } 1 - \alpha. \end{cases}$$
The demand function is $p = \theta - Q$.

Let $\theta^e \equiv \alpha\bar{\theta} + (1 - \alpha)\underline{\theta}$ denote the mean. Assume that $\frac{1}{9}(\theta^e)^2 > I$.

(i) Compute the equilibrium when the two firms issue no debt.[104]

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104. To shorten the analysis, ignore the limited liability problem that may arise for high-quantity choices. These technical problems can be eliminated by assuming that outputs cannot exceed $\frac{1}{2}\underline{\theta}$ and that $\Delta\theta$ is not too large.

Show that both firms invest.

(ii) Next, follow Brander and Lewis in assuming that firm 1 chooses its financial structure first and picks a debt level $\mathcal{D}_1$ high enough so that when the intercept is $\underline{\theta}$, firm 1 goes bankrupt.

Note that entrepreneur 1 then ignores the bad state. Show that the new equilibrium (assuming that firm 2 enters and remains an all-equity firm) is
$$q_1 = \tfrac{1}{3}(\theta^e + 2(1 - \alpha)\Delta\theta)$$
and
$$q_2 \equiv \tfrac{1}{3}(\theta^e - (1 - \alpha)\Delta\theta).$$

(iii) Assume that firm 1 accommodates entry and that firm 2 cannot issue debt. What is the optimal level of debt $\mathcal{D}_1$ issued by entrepreneur 1?

**Exercise 7.7 (optimal contracts in the Bolton–Scharfstein model).** Redo the Bolton and Scharfstein analysis of Section 7.1.2, allowing for fully general contracts: the entrepreneur receives $r_b^S$ in the case of date-0 success but no refinancing, $R_b^{SS}$ in the cases of date-0 and date-1 success, and $R_b^{FS}$ in the cases of date-1 success and date-0 failure (with $R_b^{SS}, R_b^{FS} \geqslant B/\Delta p$). (Under risk neutrality, there is no point rewarding failures unless it serves to deter predation. Hence, the exception $R_b^{FS}$.) Generalize the conditions (PD) and (IC) and show that $r_b^S = 0$ and that $R_b^{SS} \geqslant R_b^{FS}$ ($\geqslant B/\Delta p$).

**Exercise 7.8 (playing the soft-budget-constraint game vis-à-vis a customer).** Consider a supplier–customer relationship with the timing as in Figure 7.17.

For simplicity, the customer is described as a self-financing entrepreneur (hence, without external investors). By contrast, the supplier is an entrepreneur who must borrow from the capital market. Thus, the context is that of the standard risk-neutral, fixed-investment model except for one twist: the payoff in the case of success, $R$, is determined endogenously as part of a later bargaining process with the user of the input. The customer receives gross benefit $v$ from using the (successfully developed) input and 0 otherwise. The entrepreneur/supplier would therefore like to extract as much of $v$ as possible from the customer.

Assume that
$$p_H\left(v - \frac{B}{\Delta p}\right) \geqslant \max(I - A, p_L v)$$

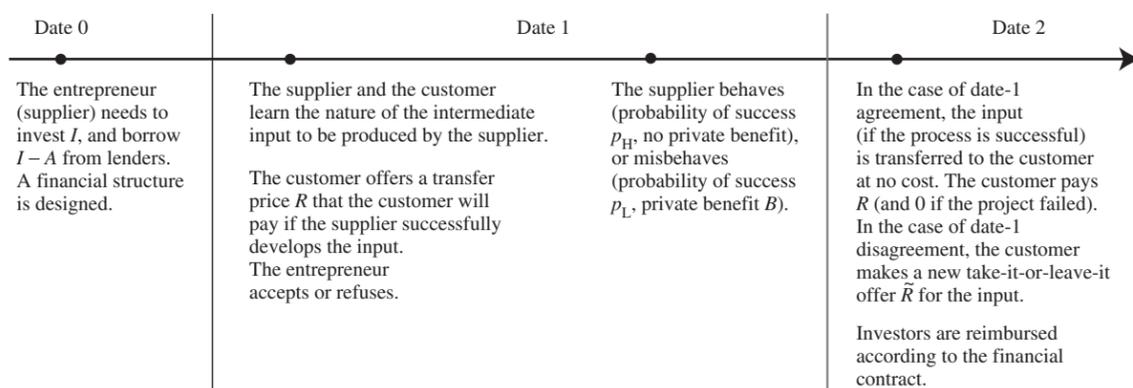| Date 0 | Date 1 | Date 2 |
|---|---|---|
| The entrepreneur (supplier) needs to invest $I$, and borrow $I - A$ from lenders. A financial structure is designed. | The supplier and the customer learn the nature of the intermediate input to be produced by the supplier.<br><br>The customer offers a transfer price $R$ that the customer will pay if the supplier successfully develops the input. The entrepreneur accepts or refuses. | The supplier behaves (probability of success $p_H$, no private benefit), or misbehaves (probability of success $p_L$, private benefit $B$). | In the case of date-1 agreement, the input (if the process is successful) is transferred to the customer at no cost. The customer pays $R$ (and 0 if the project failed). In the case of date-1 disagreement, the customer makes a new take-it-or-leave-it offer $\tilde{R}$ for the input.<br><br>Investors are reimbursed according to the financial contract. |

**Figure 7.17**

and

$$p_L v + B < I$$

(and so, if all parties are rational, the investment will not take place if it subsequently induces the entrepreneur to misbehave). One will further assume that the input has no outside value (it is wasted if not used by the customer) and that the date-0 contract between the entrepreneur and the lenders is perfectly observed by the customer.

(i) *Long-term, nonrenegotiable debt.* Suppose, first, that the date-0 contract between the entrepreneur and her investors specifies an amount $R_l$ of senior debt to be repaid to investors at date 2. This senior debt is purchased by investors who are unable to renegotiate their contract at any date.

Show that, when optimizing over the debt level $R_l$, the entrepreneur cannot obtain *ex ante* utility exceeding

$$U_b = (\Delta p)v - I.$$

(Hint: work by backward induction. What happens at date 2 if no contract has yet been signed with the customer and the project has been successful? Moving back to date 1, distinguish two cases depending on whether $p_L v \gtrless p_H(v - R_l - B/\Delta p)$.)

(ii) *Short-term, nonrenegotiable debt.* Second, assume that the entrepreneur issues an amount of short-term debt $r_l$ and no long-term debt. This short-term debt is due at date 1 and thus the firm is liquidated if the debt is not reimbursed (again, we assume that the debt is purchased by dispersed investors who are unable to renegotiate the initial

contract). Because the firm has no date-1 revenue, the customer, if he wants the supplier to continue operating, must offer to cover the debt payment $r_l$, besides offering a transfer price $R$ in case of a successful development of the input. Show that the entrepreneur can obtain expected utility

$$U_b = p_H v - I.$$

(Hints: show that the customer offers $R = B/\Delta p$. Note that the entrepreneur consumes $(A + r_l) - I$ at date 0.)

**Exercise 7.9 (optimality of golden parachutes).** Return to the manipulation model of Section 7.2.1, with the possibility of informed manipulation. Confirm the heuristic analysis of that section through a careful analysis, allowing for general contracts (the reward $R_b^r$ or $R_b^q$ is contingent on the revealed information and may *a priori* exceed $B/\Delta p$; a fixed payment can be made in both states and only under revealed poor prospects: $L_l^r$ and $L_l^q \leqslant L$; allow $q_H R$ to be larger or smaller than $L$).

**Exercise 7.10 (delaying income recognition).** Consider the timing in Figure 7.18.

Assume the following.

• The discount factor is $\delta = 1$.

• There is no moral hazard. A manager's probability of success depends only on the manager's current ability. Managers do not respond to monetary incentives and get a constant wage normalized at 0. They just get private benefit $\mathcal{B}$ per period of tenure. All incomes $(y_1, y_2, y_3)$ go to investors.
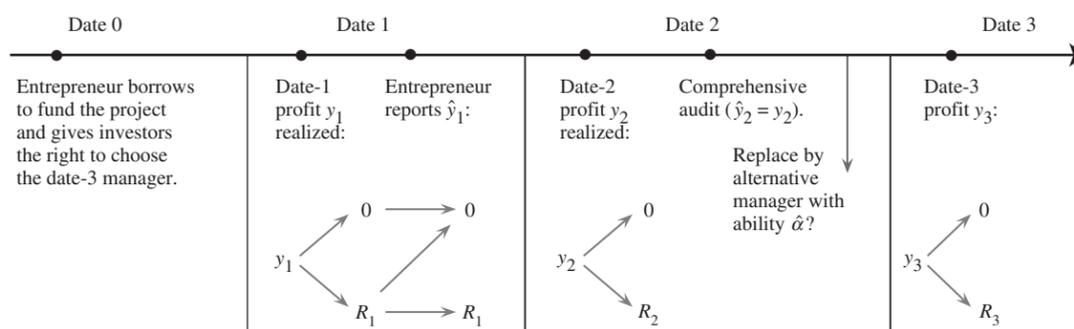
**Figure 7.18**

• A manager with high current ability succeeds with probability $r$, while one with low current ability succeeds with probability $q < r$.

• The entrepreneur's date-1 ability is high with probability $\alpha$ and low with probability $1 - \alpha$ (no one knows this ability). The correlation of ability between dates 1 and 2 is equal to $\rho \in [\frac{1}{2}, 1]$. That is, the entrepreneur's ability remains the same at date 2 with probability $\rho$. To simplify computations, assume that the manager's ability does not change between dates 2 and 3 (this assumption is not restrictive; we could simply require that the date-3 ability be positively correlated with the date-2 ability).

• At date 1, the entrepreneur privately observes the date-1 profit. If the entrepreneur has been successful ($y_1 = R_1$), she can defer income recognition. The reported profit is then $\hat{y}_1 = 0$. These savings increase the probability that $y_2 = R_2$ by a uniform amount $\tau$ ($\leqslant 1 - r$) (independent of type), presumably at a cost in terms of NPV ($R_1 > \tau R_2$).[105]

• Investors at the end of date 2 have the opportunity to replace the entrepreneur with an alternative manager who has probability $\hat{\alpha}$ of being a high-ability manager. (There is no commitment with regards to this replacement decision.) This decision is preceded by a careful audit that prevents the entrepreneur from manipulating earnings ($\hat{y}_2 = y_2$). One can have in mind a yearly report or a careful audit preceding an opportunity to replace management by a new managerial team.

Find conditions under which a "pooling equilibrium," in which the entrepreneur keeps a low profile ($\hat{y}_1 = 0$) when successful ($y_1 = R_1$), prevails.

## References

Aghion, P., M. Dewatripont, and P. Rey. 2000. Agency costs, firm behavior and the nature of competition. IDEI Working Paper 77, Toulouse.

Ahmed, A., G. Lobo, and J. Zhou. 2000. Job security and income smoothing: an empirical test of the Fudenberg and Tirole (1995) model. (Available at http://ssrn.com/abstract=24828.)

Alger, G. 1999. Moral hazard, regulation and peer monitoring. PhD Thesis, University of Toulouse 1.

Areeda, P. and D. Turner. 1975. Predatory pricing and related practices under Section 2 of the Sherman Act. *Harvard Law Review* 88:697–733.

Banerjee, A. 1992. A simple model of herd behavior. *Quarterly Journal of Economics* 107:797–817.

Bester, H. and M. Hellwig. 1987. Moral hazard and equilibrium credit rationing: an overview of the issues. In *Agency Theory, Information and Incentives* (ed. G. Bambers and K. Spremann). Heidelberg: Springer.

Biais, B. and C. Casamatta. 1999. Optimal leverage and aggregate investment. *Journal of Finance* 54:1291–1323.

Bikhchandani, S., D. Hirshleifer, and I. Welch. 1992. A theory of fads, fashion, custom, and cultural change as informational cascades. *Journal of Political Economy* 100: 992–1026.

Bolton, P. and D. Scharfstein. 1990. A theory of predation based on agency problems in financial contracting. *American Economic Review* 80:93–106.

Bolton, P., J. Brodley, and M. Riordan. 2000. Predatory pricing: strategic theory and legal policy. *Georgetown Law Journal* 88:2239–2330.

———. 2001. Predatory pricing: strategic theory and legal policy: response to critique and further elaboration. *Georgetown Law Journal* 89:2495–2529.

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105. We could also allow the entrepreneur to inflate date-1 earnings from 1 to $R_1$ at the cost of a reduction $\tau'$ in the probability of success at date 2 ($R_1 < \tau' R_2$). But if $\tau'$ is "not too large," there is no such incentive.

Brander, J. and T. Lewis. 1986. Oligopoly and financial structure: the limited liability effect. *American Economic Review* 76:956–970.

Bronars, S. and D. R. Deere. 1991. The threat of unionization, the use of debt, and the preservation of shareholder wealth. *Quarterly Journal of Economics* 106:231–254.

Bulow, J., G. Geanakoplos, and P. Klemperer. 1985. Multimarket oligopoly: strategic substitutes and complements. *Journal of Political Economy* 93:488–511.

Caillaud, B., B. Jullien, and P. Picard. 1995. Competing vertical structures: precommitment and renegotiation. *Econometrica* 63:621–647.

Cestone, G. 2000. Corporate financing and product market competition: an overview. *Giornale degli Economisti e Annali di Economia* 58:269–300.

Cestone, G. and C. Fumagalli. 2005. The strategic impact of resource flexibility in business groups. *RAND Journal of Economics* 36:193–214.

Cestone, G. and L. White. 2003. Anti-competitive financial contracting: the design of financial claims. *Journal of Finance* 58:2109–2142.

Chemla, G. and A. Faure-Grimaud. 2001. Dynamic adverse selection and debt. *European Economic Review* 45:1773–1792.

Chevalier, J. 1995a. Capital structure and product market competition: empirical evidence from the supermarket industry. *American Economic Review* 85:415–435.

——. 1995b. Do LBO supermarkets charge more? An empirical analysis of the effects of LBOs on supermarket pricing. *Journal of Finance* 50:1112–1195.

Chevalier, J. and G. Ellison. 1997. Risk taking by mutual funds as a response to incentives. *Journal of Political Economy* 105:1167–1200.

Chevalier, J. and D. S. Scharfstein. 1996. Capital-market imperfections and countercyclical markups: theory and evidence. *American Economic Review* 86:703–725.

Coase, R. 1972. Durability and monopoly. *Journal of Law and Economics* 15:143–149.

Darrough, M. 1987. Managerial incentives for short-term results: a comment. *Journal of Finance* 42:1097–1102.

Dasgupta, S. and K. Sengupta. 1993. Sunk investment, bargaining and choice of capital structure. *International Economic Review* 34:203–220.

De Fond, M. and C. Park. 1997. Smoothing income in anticipation of future earnings. *Journal of Accounting and Economics* 23:115–139.

Degeorge, F., J. Patel, and R. Zeckhauser. 1999. Earnings management to exceed thresholds. *Journal of Business* 72:1–33. (Reprinted in 2001 in *Behavioral Finance* (ed. H. M. Shefrin). Cheltenham, U.K.: Edward Elgar Publishing.)

Demski, J. 2003. Corporate conflicts of interests. *Journal of Economic Perspectives* 17:51–72.

Dewatripont, M. and J. Tirole. 1994. *The Prudential Regulation of Banks*. Cambridge, MA: MIT Press.

Dewatripont, M., I. Jewitt, and J. Tirole. 1999a. The economics of career concerns. Part I. Comparing information structures. *Review of Economic Studies* 66:183–198.

——. 1999b. The economics of career concerns. Part II. Application to missions and accountability of government agencies. *Review of Economic Studies* 66:199–217.

Diamond, D. 1984. Financial intermediation and delegated monitoring. *Review of Economic Studies* 51:393–414.

Faure-Grimaud, A. 2000. Product market competition and optimal debt contracts: the limited liability effect revisited. *European Economic Review* 44:1823–1840.

Fluck, Z. 1999. The dynamics of the management–shareholder conflict. *Review of Financial Studies* 12:379–404.

Friebel, G. and S. Guriev. 2005. Earnings manipulation and incentives in firms. Mimeo, IDEI, Toulouse, and New Economic School, Moscow.

Fudenberg, D. and J. Tirole. 1984. The fat-cat effect, the puppy-dog ploy and the lean and hungry look. *American Economic Review, Papers and Proceedings* 74:361–368.

——. 1985. Preemption and rent equalization in the adoption of new technology. *Review of Economic Studies* 52:383–402.

——. 1986. A "signal-jamming" theory of predation. *RAND Journal of Economics* 17:366–376.

——. 1995. A theory of income and dividend smoothing based on incumbency rents. *Journal of Political Economy* 103:75–93.

Fulghieri, P. and S. Nagarajan. 1992. Financial contracts as lasting commitments: the case of a leveraged oligopoly. *Journal of Financial Intermediation* 1:2–32.

Glazer, J. 1994. The strategic effects of long-term debt in imperfect competition. *Journal of Economic Theory* 62:428–443.

Gollier, C., P. F. Koehl, and J. C. Rochet. 1997. Risk-taking behavior with limited liability and risk aversion. *Journal of Risk and Insurance* 64:347–370.

Green, R. 1984. Investment incentives, debt, and warrants. *Journal of Financial Economics* 13:115–136.

Healy, P. 1985. The effect of bonus schemes on accounting decisions. *Journal of Accounting and Economics* 7:85–107.

Healy, P. and K. Palepu. 2003. The fall of Enron. *Journal of Economic Perspectives* 17:3–26.

Hellwig, M. 1994. A reconsideration of the Jensen–Meckling model of outside finance. Working Paper 9422, WWZ, Basel.

Hirshleifer, D. and A. Thakor. 1992. Managerial conservatism, project choice and debt. *Review of Financial Studies* 5:437–470.

Holmström, B. 1982. Managerial incentive problems: a dynamic perspective. In *Essays in Economics and Management in Honor of Lars Wahlbeck*. Helsinki: Swedish School of Economics. (Published in *Review of Economic Studies* (1999) 66:169–182.)

Holmström, B. and J. Ricart i Costa. 1986. Managerial incentives and capital management. *Quarterly Journal of Economics* 101:835–860.

Holthausen, R., D. Larcker, and R. Sloan. 1995. Business unit innovation and the structure of executive compensation. *Journal of Accounting and Economics* 19:279–313.

Jensen, M. 1988. Takeovers: their causes and consequences. *Journal of Economic Perspectives* 2:21–48.

Jensen, M. and W. R. Meckling. 1976. Theory of the firm, managerial behaviour, agency costs and ownership structure. *Journal of Financial Economics* 3:305–360.

Joskow, P. and A. Klevorick. 1979. A framework for analyzing predatory pricing policy. *Yale Law Journal* 89:213–270.

Kanagaretnam, K., G. Lobo, and R. Mathieu. 2003. Managerial incentives for income smoothing through bank loan loss provisions. *Review of Quantitative Finance and Accounting* 20:63–80.

Kasanen, E., J. Kinnunen, and J. Niskanen. 1996. Dividend-based earnings management: empirical evidence from Finland. *Journal of Accounting and Economics* 22:283–312.

Katz, M. 1991. Game-playing agents: unobservable contracts as precommitments. *RAND Journal of Economics* 22:307–328.

Kovenock, D. and G. Phillips. 1997. Capital structure and product market rivalry: how do we reconcile theory and evidence. *American Economic Review* 85:403–408.

Laffont, J.-J. and J. Tirole. 1988. Repeated auctions of incentive contracts, investment and bidding parity, with an application to takeovers. *RAND Journal of Economics* 19:516–537.

Lev, B. 2003. Corporate earnings: facts and fiction. *Journal of Economic Perspectives* 17:27–50.

Levitt, S. and C. Snyder. 1997. Is no news bad news? Information transmission and the role of "early warning" in the principal-agent model. *RAND Journal of Economics* 28:641–661.

Lintner, J. 1956. Distribution of incomes of corporations among dividends, retained earnings, and taxes. *American Economic Review* 46:97–113.

McGee, J. 1958. Predatory price cutting: the Standard Oil (NJ) case. *Journal of Law and Economics* 1:137–169.

MacKay, P, and G. Phillips. 2005. How does industry affect firm financial structure? *Review of Financial Studies*, in press.

Maksimovic, V. 1988. Capital structure in repeated oligopolies. *RAND Journal of Economics* 19:389–407.

Matsa, D. 2005. Evidence of strategic capital structure: how firms use debt to influence collective bargaining. Mimeo, MIT.

Merchant, K. 1989. *Rewarding Results: Motivating Profit Center Managers.* Boston, MA: Harvard Business School Press.

Müller, H. and F. Panunzi. 2004. Tender offers and leverage. *Quarterly Journal of Economics* 119:1217–1248.

Murphy, K. and J. Zimmerman. 1993. Financial performance surrounding CEO turnover. *Journal of Accounting and Economics* 16:273–316.

Narayanan, N. P. 1985. Managerial incentives for short-term results. *Journal of Finance* 40:1469–1484.

Palomino, F. and A. Prat. 2003. Risk taking and optional contracts for money managers. *RAND Journal of Economics* 34:113–137.

Perotti, E. and K. Spier. 1993. Capital structure as a bargaining tool. *American Economic Review* 83:1131–1141.

Phillips, G. 1995. Increased debt and industry product markets: an empirical analysis. *Journal of Financial Economics* 37:189–238.

Poitevin, M. 1989. Financial signaling and the deep-pocket argument. *RAND Journal of Economics* 20:26–40.

Rey, P. and J. Tirole. 1986. The logic of vertical restraints. *American Economic Review* 76:921–939.

Ronen, J. and S. Sadan. 1981. *Smoothing Income Numbers: Objectives, Means, and Implications.* Reading, MA: Addison-Wesley.

Scharfstein, D. and J. Stein. 1990. Herd behavior and investment. *American Economic Review* 80:465–479.

Schroth, E. and D. Szalay. 2004. Cash breeds success: the role of financing constraints in innovation. Mimeo, Université de Lausanne.

Shapiro, C. 1989. Theories of oligopoly behavior. In *Handbook of Industrial Organization* (ed. R. Schmalensee and R. Willig), Volume 1. Amsterdam: North-Holland.

Showalter, D. 1995. Oligopoly and financial structure: comment. *American Economic Review* 85:647–653.

Snyder, C. 1996. Negotiation and renegotiation of optimal financial contracts under the threat of predation. *Journal of Industrial Economics* 44:325–343.

Spagnolo, G. 2000. Stock-related compensation and product-market competition. *RAND Journal of Economics* 31:22–42.

Spiegel, Y. 1996. The role of debt in procurement contracts. *Journal of Economics and Management Strategy* 5:379–407.

Spiegel, Y. and D. F. Spulber. 1994. The capital structure of a regulated firm. *RAND Journal of Economics* 25:424–440.

Stein, J. 1989. Efficient capital markets, inefficient firms: a model of myopic corporate behavior. *Quarterly Journal of Economics* 104:655–669.

Sung, J. 1995. Linearity with project selection and controllable diffusion rate in continuous-time principal–agent models. *RAND Journal of Economics* 26:720–743.

Telser, L. 1966. Cutthroat competition and the long purse. *Journal of Law and Economics* 9:259–277.

Tirole, J. 1988. *The Theory of Industrial Organization.* Cambridge, MA: MIT Press.

Von Thadden, E. L. 1995. Long-term contracts, short-term investment and monitoring. *Review of Economic Studies* 62:557–575.

Weisbach, M. S. 1988. Outside directors and CEO turnover. *Journal of Financial Economics* 20:431–460.

Williamson, O. 1975. *Markets and Hierarchies: Analysis of Antitrust Implications*. New York: Free Press.

Zingales, L. 1998. The survival of the fittest or the fattest: exit and financing in the trucking industry. *Journal of Finance* 53:905–938.

Zwiebel, J. 1995. Corporate conservatism and relative compensation. *Journal of Political Economy* 103:1–25.

———. 1996. Dynamic capital structure under managerial entrenchment. *American Economic Review* 86:1197–1215.