8

Investors of Passage: Entry, Exit, and Speculation

8.1 General Introduction to Monitoring in Corporate Finance

This section provides an overview of the complex patterns of corporate monitoring. After motivating the study through a recap of the popular debate on the matter, the section introduces a key distinction between active and passive monitoring. It then discusses the attributes of a "good monitor," in particular, the incentives provided by his claims' return structure. Finally, it describes the organization of this chapter.

8.1.1 The Popular Debate

As discussed in Chapter 1, the popular press and the political debate about comparative corporate governance like to distinguish between the AS model (the Anglo-Saxon paradigm exemplified by the United States and the United Kingdom) and the GJ model (which prevails in Germany, Japan, and much of continental Europe in various forms). Empirical and theoretical research has undertaken cross-country comparisons of financial and governance systems and studied their costs and benefits.

In a nutshell, the AS model of corporate governance tends to emphasize a well-developed stock market, with strong investor protection, substantial disclosure requirements, shareholder activism (e.g., by pension funds), proxy fights, and takeovers. Banking is arm's length while the public debt market (commercial paper, bonds) may flourish. The AS model is often criticized in Europe for encouraging short-termism[1] and for preventing long-term, trust relationships between management and stakeholders from developing. In contrast, the GJ model puts banks more to the fore and, according to its proponents, encourages long-term relationships between investors and managers to the detriment of investor liquidity. Firms reputedly do relatively little shopping around for low interest rates, although some evolution to the contrary has recently been observed, for example, among German firms. Many firms stay private and the stock market is thin. Ownership is usually quite concentrated. Furthermore, in countries like France and Japan, pervasive cross-shareholdings among firms, and between firms and financial institutions (banks, insurance companies),[2] seriously limit the scope for managerial contests. The GJ system is often depicted by its critics as being collusive and as favoring entrenched managements.

This debate in part reflects the importance of monitoring in corporate governance. The prominence of monitoring mechanisms should not surprise the reader; Part II emphasized the many implications and distortions of asymmetric information (adverse selection, moral hazard) and monitoring can be seen as a way of reducing informational asymmetries between firms and investors.[3]

1. There are two possible definitions of short-termism. The first is that managers do not invest enough, because the prospect of cashing in on stock options or the fear of facing external interference or a takeover, or of being fired, make them too concerned with short-term performance (stock price, quarterly or yearly income). The second is that financial markets are too short-term oriented, in that analysts and institutional investors look for firms that will perform well in the short term but not necessarily in the long term. The argument is similar in both cases, as it implies that the incentives of corporate managers or of those, "one tier up," who analyze their performance, are too oriented toward the short term. The two forms of short-termism, furthermore, interact, as institutional short-termism puts pressure on corporate managers to "posture" and generate good short-term performance.

2. In Japan cross-ownerships are often organized within keiretsus.

3. The oversight issue may also be key to a proper definition of equity and leverage for firms and financial institutions. Although everyone would agree that short-term debt is not part of a firm's or a bank's capital, it is often suggested that a fraction of long-term debt be included in the definition of capital. (For example, international banking regulations (defined by the 1988 Basel Accord) allow subordinated debt with maturity exceeding five years to be counted, up to a limit, as "supplementary capital.") One leading interpretation of this viewpoint is that the firm or the bank is less likely to face a liquidity

8.1.2 Active and Passive Monitoring

The generic distinction between exit and voice was introduced by Hirschman (1970) in order to contrast the behaviors of organizations' members who either vote with their feet when discontented with the evolution of their organizations or stay and try to improve things.

In the context of corporate finance, the two forms of monitoring in turn correspond to the two types of information that ought to be gathered by investors in an efficient governance structure:[4]

Prospective or value-enhancing information is information that bears on the optimal course of action to be followed by the firm. It is information that ought to be collected before managerial decisions are implemented and ought to be exploited to improve decision making. These decisions may be structural (investments, spinoffs, diversification, etc.), strategic (product positioning, advertising, pricing, etc.), or related to personnel (replacement of management, downsizing, etc.).

It can be collected by an equityholder, as in the case of a venture capitalist or a large shareholder.[5] Prospective information may also be collected by debtholders, as in the case of a bank that imposes specific covenants to force or prevent a course of action, or uses the violation of a covenant to impose a change of policy by the borrower.

This form of monitoring is called *active* monitoring; it is associated with either formal or real control. Formal control exists when the monitor has control rights through, for example, a majority of seats on the board or a majority of votes at the general assembly. Real control refers to investors with minority positions who succeed in persuading a majority of the board or the general assembly to go along with a given policy.[6]

Retrospective or value-neutral or speculative information is information that has no direct bearing on future decisions and is therefore a mere measurement of past managerial performance. Acquiring speculative information may be akin to taking a picture of the value of the assets of the firm at a given point in time. (Note that "retrospective" refers to an assessment of the impact of *past* managerial choices on future profits.)

Speculative information may be acquired by equityholders, as in the case of analysts who wish to speculate by selling shares in the case of bad news and buying shares in the case of good news, but do not wish to interfere with the firm's management. It can be acquired by holders of (short-term) debt as well, as illustrated by the case of a run in the commercial paper market (for a firm) or in the interbank market (for a bank). To the extent that they vote with their feet, short-term debtholders are speculators.

In contrast with prospective information, speculative information has no value per se, as it forms the basis for *passive* (noninterventionist) monitoring. But it can serve the purpose of rewarding or punishing the management for its past behavior. For instance, an increase in the stock price associated with optimistic views about the firm's prospects benefits management through its holdings of stock options.

Several points with respect to this distinction are in order.

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crisis if its debt is long rather than short term (see Chapter 5). An objection to this interpretation is that the enhanced liquidity would be better reflected in the liquidity rather than the solvency ratio.

An alternative interpretation is that the borrower is better monitored at the issuance date by buyers of long-term than by buyers of short-term debt, since the holders of short-term debt can usually "exit" or "run" before trouble occurs, and therefore have little incentive to monitor *ex ante* the quality of the borrower. The holders of long-term debt, according to this interpretation, have more incentives to assess the borrower's quality and to design and monitor compliance with covenants; this then "certifies" the firm, whose borrowing capacity should therefore be enhanced (which is, for example, achieved, for a bank, by raising its regulatory capital, and for a firm, by boosting the measure of its capital if lenders operate with a standard, industry-contingent target leverage ratio). We will later come back to the question of who is a good monitor.

4. These two types of information are called "strategic" and "speculative" in Holmström and Tirole (1993).

5. The threat of a proxy fight, rather than a strong presence on the board of directors, may be the conduit for shareholder intervention. CalPERS, the California Public Employees' Retirement System, draws annual lists of firms in its portfolio that it analyzes to be poor performers (relative to where they should stand if they were better managed, rather than to the market performance). It then brings its expertise and puts the case for reform to management. CalPERS, if needed, may then fight a proxy battle.

6. A venture capitalist or a takeover artist may have formal decision rights, either through previous contracting or through the acquisition of a majority of shares or both. But control is often simply real and not formal. That is, the collector of prospective information has no or limited authority and does not own a majority of shares. A case in point is the proxy fight mechanism, in which a shareholder activist (e.g., a pension fund) convinces a majority of shareholders to take action against management (see footnote 5).

(a) *Relationship to the AS–GJ debate.* The distinction between speculative and prospective information can be related to the debate on comparative corporate governance. Its critics often argue that the AS model encourages short-term profit maximization to the detriment of a long-term involvement by investors. This can be interpreted as the viewpoint that Anglo-Saxon investors exercise insufficient voice and engage in excessive speculation.

(b) *Holding period and activism.* It is tempting to identify voice with long-term involvement and exit with a short-term one. Although there is some truth in this view, as we will see in Chapter 9, we should be careful about the relevant timescale. A raider who takes over a mismanaged firm, refocuses it on its core business through spinoffs, changes management, and then resells his stake, may operate on a small timescale, that is, be a "short-term investor," and yet he exercises a substantial amount of voice because he alters in a significant way the firm's future course of action. Conversely, retrospective information can be collected by a long-term investor. A case in point is credit enhancement in the securitization of mortgages, credit card receivables, loans, and so forth. The credit enhancer "takes a picture" of the quality of the underlying assets, and certifies this quality by providing guarantees to other investors or taking a subordinate position. The issue then is not voice—the assets' returns have a life of their own—but rather the measurement of the issuer's past performance.

(c) *Dual nature of information.* Some types of information are both prospective and retrospective. In an adverse-selection context, in which the capital market has imperfect information about managerial talent, information about past managerial performance can be used both to reward or punish management and to infer whether management is likely to be fit for the firm's future challenges and thus to decide whether to keep the current management in place. Similarly, the analysis of the value of assets in place may reveal whether further investment is warranted. For example, a large lender who refuses to roll over a loan, a prestigious investment bank which refuses to underwrite an issue, or a rating agency that gives the firm a low rating, all refuse to certify the firm and may well convince other investors not to lend to the firm, resulting in lower investment or distress.

The distinction between prospective and retrospective information is somewhat cleaner in a moral-hazard context, because past and future performances are then unrelated, than in an adverse-selection context, where assessed performances across periods are linked through inferences about managerial talent.

(d) *Complements or substitutes?* Our discussion of prospective and retrospective information indicates that the two types of information perform different functions, and so both should be collected. But information collection is costly, and one may therefore wonder whether the two types of information are substitutes (the collection of speculative information reduces the marginal benefit of collecting prospective information, say) or complements (the collection of speculative information raises this marginal benefit, say). This question is central to the design of the financial system and thus to the debate on comparative corporate governance and yet it has not been investigated in detail in the literature. The next two chapters will point at some considerations relevant to the matter, but will bring no definitive answer to the question.

(e) *Rationale for delegated monitoring.* Information is basically a public good in that, once acquired by a monitor, it can be disseminated to other investors at a very low cost. Information collection is a "natural monopoly." Thus, it often makes sense to delegate the collection of specific information to a single or a small number of monitors, as was recognized by Leland and Pyle (1977), Campbell and Kracaw (1980), and Diamond (1984). Another and related implication of the public-good feature of information is that the collection of information by an investor gives rise to substantial free riding by other investors, employees (if their wage and pension claims are unsecured), trade creditors, customers, government agencies, and other stakeholders in the firm.

8.1.3 Incumbents versus Entrants: Entry into Corporate Governance

Active monitoring can be undertaken by "hired guns" (more prosaically, "enlisted or designated

monitors," or "incumbents") such as a venture capitalist or a board of directors. Alternatively, it may rely on "unenlisted monitors" or "entrants," such as a raider or a proxy fight organizer. One may wonder why corporate charters and financial agreements should design mechanisms for entry into the monitoring market. Somehow, incumbent monitoring must face some limitations. Entry into monitoring may be desirable for reasons that are often similar to those underlying the benefits of entry into more familiar markets:

Ineffective monitoring. Incumbent monitors may not perform their monitoring function, say, because they collude with management. For example, collusion[7] has often been advanced as one explanation for rubber-stamping by boards of directors. Or the choices of monitors, like those of managers, may be distorted by agency problems such as career concerns. For example, they may want to stick to their earlier positive assessments of the firm even when they observe a degradation of its state.

Wrong monitor syndrome. It may be difficult to foresee in advance who will be the proper monitor in the future. The monitor's talent and the adequacy of his skills to the firm's future environments may not be known.

Liquidity needs. As Chapter 9 will emphasize, an active monitor may need to commit funds for a long period of time in order to be credible. But this active monitor may face liquidity shocks and need the invested funds for other purposes (he may also go bankrupt). In such circumstances, the active monitor may need to be replaced.

Entry into corporate monitoring is, of course, costly to the firm:

Coordination problems. Because entrants are not "enlisted" but in general appear spontaneously, there may be coordination problems among entrants. There may be duplication of information acquisition as in the case of multiple raiders. Conversely, no one may acquire the necessary information.

Lack of trust. A criticism often leveled at takeovers is that they prevent the development of a trust relationship between insiders (management and employees) and investors (see, in particular, Shleifer and Summers 1988). Under concentrated, long-term ownership, the large owner may be able to build a reputation for being fair to insiders and not expropriate the latter's past investments into the firm by acting opportunistically and imposing tough conditions once they have invested. Such a trust relationship may be impossible to develop in a context where entry (takeovers, proxy fights) makes monitoring more anonymous. Newcomers may then enter and renege on the previous monitor's promise to leave insiders with a rent commensurate with their investment.

Rents. (This technical point will be clarified in Chapters 9 and 11.) *Ex post* interactions with entrants is likely to cost the firm more rents than when the interaction with monitors is planned *ex ante*. The reason for this is that the *ex post* interaction generally occurs when the entrants have already acquired their information. Entrants may refrain from interacting when their information is unfavorable and enter only when they have good information. For example, a pension fund or a takeover artist may only target undervalued companies. This is to be contrasted with the case of an initial and long-term shareholder who bears the upside as well as the downside risk.

Limited investments by incumbents. Incumbent monitors have fewer incentives to invest in long-term value enhancements, that is, improvements that do not become obvious to the public until they pay off, if they know that they have a decent chance of being replaced by entrants (see Chapters 9 and 11).

8.1.4 Who Is a Good Monitor?

A somewhat unsettled issue in the literature relates to the incentive scheme that ought to be given to monitors. One illustration (among others) of this unsettledness is the old debate about whether debtholders should be senior or secured in order to have a proper incentive to monitor. The first strand in the literature (Jackson and Kronman 1979; Fama 1985; see also Calomiris and Kahn (1991) and Rey and

7. Or, more mildly, the need for directors to maintain a good ongoing relationship with managers and thereby decent access to information.

Stiglitz (1991) on the depositors' incentives to monitor banks provided by a first-come-first-served payment of depositors in the case of a run) argues that junior claimants have greater incentives to monitor, on the basis that their claim is more sensitive than a senior claim to managerial moral hazard (see also Exercise 9.6). The second and revisionist strand dates back to Schwartz's 1981 observation that many actual unsecured creditors appear relatively inferior monitors, while presumably superior monitors such as banks often hold short-term, secured debt. This alternative strand has developed theories as to why this may be the case (see, for example, Burkart et al. 1995; Levmore 1982; Gorton and Kahn 2000; Rajan and Winton 1995).

It should be clear, however, that there is no general answer to the question of the monitor's optimal incentive scheme. It is efficient to have different monitors collect different pieces of information, and a monitor's incentive scheme ought to depend on the type of information to be collected, on the firm's "technology" (timing of cash flows, riskiness of environment, etc.), on the existence of other monitors (to the extent that different types of information interact), and on market conditions (through the supply side of the monitoring market). For example, a simple (but perhaps misleading) guess is that a large equityholder has good incentives to monitor value enhancements (that is, managerial moral hazard that shifts the distribution of returns in the sense of first-order stochastic dominance), that a large holder of convertible, demandable, or short-term debt has good incentives to monitor risk taking (that is, managerial moral hazard that shifts the distribution of returns in the sense of second-order stochastic dominance), that a large secured claimholder has good incentives to monitor the maintenance of collateralized assets, and so forth.

The absence of general answers should not surprise us for two reasons. First, in practice, we observe a wide array of claims held by monitors. Second, monitors, although conventionally allocated to the nonexecutive side of the firm, are in part insiders. And we know from previous chapters that insiders' optimal incentive schemes depend on a variety of considerations.

8.1.5 A Recap

We can illustrate our distinctions between active and passive monitoring, and between incumbent and entrant monitoring as in Figure 8.1.

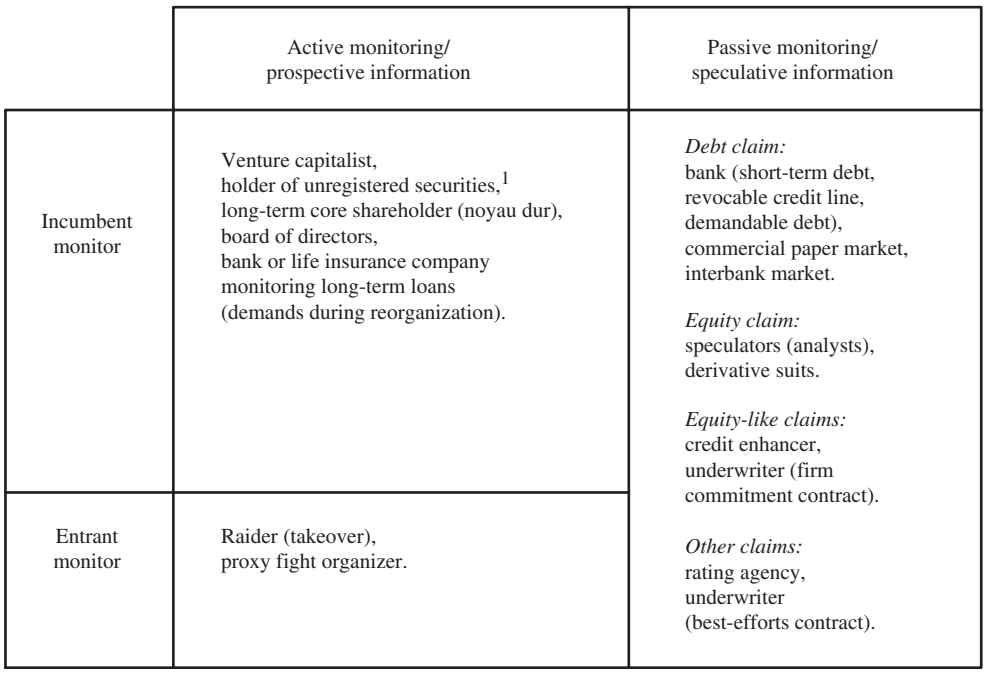
8.1.6 Chapter Outline

The chapter's main theme is that a firm's stock market price provides a measure of the value of assets in place and therefore of the impact of managerial behavior on investors' returns. It thereby creates precious information about managerial performance to the extent that managers make decisions, such as investments, whose consequences are realized only years, and sometimes decades, later.

Participants in the stock market, however, acquire costly information about the value of assets in place only if they expect to make money on this information. If the secondary market for shares is not deep, though, any attempt at buying shares, for example, will trigger a strong upward price adjustment and leave little margin for profiting from private knowledge that the firm is undervalued. By contrast, deep markets, i.e., markets with a fair amount of liquidity (nonspeculative) trading, provide substantial opportunities to speculators to conceal their trades behind liquidity trading and to benefit from their information.

This demonstrates two limits of market monitoring: first, stock market prices reflect information about the value of assets in place only to the extent that they are also garbled by other forms of uncertainty (such as liquidity trading). Second, because they may face superiorly informed speculators, shareholders who trade shares for liquidity reasons necessarily enjoy a lower return than those who can hold them for the long run. Ultimately, this cost must be borne by the issuing firm, which must issue the shares at a low price; put differently, investors who are able to keep their stocks in the long run enjoy an equity premium.

The chapter is organized as follows. Section 8.2 starts with a simple demonstration that the existence of early signals of performance reduces the agency cost and thereby increases the pledgeable income, facilitating financing. It then shows how a designated monitor can be incentivized by call or



1. The buyer of unregistered securities or letter stocks must write to the Security and Exchange Commission that the stocks are not bought for resale.

Figure 8.1

put options to acquire this information. It also discusses the possibility of collusion between monitor and monitoree, and the monitor's biases in information acquisition.

Section 8.3 turns to market monitoring. It first notes that stock market participants also have call and put options as they can buy or sell shares. The specificity of these call and put options, though, is that their exercise price is not fixed but rather endogenously determined: it is the market price. The section shows how speculator profit, and ultimately the market acquisition of information about the value of assets in place, is related to the depth of the market.

Information about the value of assets in place can also discipline management by severing the firm's access to cash rather than by serving as a basis for managerial compensation. To perform this function, though, passive monitoring must be performed by debtholders, since the resale of equity shares in the firm is internal to stock market participants and therefore does not drain the firm's liquidity. Section 8.4, building on Chapter 5, shows how demandable debt contracts discipline management through the threat of liquidity shortage.

8.2 Performance Measurement and the Value of Speculative Information

This section uses a straightforward extension of the fixed-investment model of Section 3.2 to obtain an elementary mechanism-design version of the Holmström and Tirole (1993) model of stock market monitoring.[8]

8. An early paper on the use of stock prices in optimal managerial incentives is Diamond and Verrecchia (1982). The starting point of that paper is that, from the sufficient statistic theorem of Holmström (1979) and Shavell (1979), "any information is of positive value if it reduces the *ex post* noise of direct estimates of an agent's level of effort." Diamond and Verrecchia assume that, after the managerial choice of effort but before income is realized, all investors exogenously observe an imperfect signal of final income, and the stock price perfectly reveals the common signal. This signal, or equivalently the stock price, is then used together with the final income to build the optimal managerial incentive scheme. In their paper, the manager's reward decreases with the stock price, because the common signal is about an exogenous, that is, action-independent, variable, which must be filtered out of the final income.

8.2.1 Introducing Early Performance Monitoring

Consider a biotech entrepreneur or a pharmaceutical company attempting to develop a molecule to cure a disease or treat its symptoms. The basic research activity will last for three or four years, after which the project, if successful heretofore, will move on to a development phase, then to a lengthy testing and regulatory approval process (say, through the Federal Drug Administration in the United States), and finally to a commercialization and marketing stage until the twenty-year patent expires (and often even after the drug gets off-patent). Clearly, the final profit made on the drug reflects much uncertainty realized years and even decades after the initial research stage: changes in regulatory standards, accrual of competing drugs, shocks to demand for the drug, changes in national health systems' organization, and so forth. The final profit is therefore a poor (by which I mean very garbled) indicator of the prospects created by the initial activity. Put differently, it very imperfectly measures the value of assets in place at the end of the research stage.

Consider, therefore, the problem of rewarding the entrepreneur or the manager for her performance during this period. It would be desirable to measure this performance early for two reasons: first, the entrepreneur or manager may need the money long before the final profit is realized; second, even if she can wait for the final profit to be realized (as will be the case in the treatment below), better incentive schemes can be tailored if some advance measure of the value of assets in place can be obtained.

The drug example illustrates a much more general point: many investment decisions bear their fruit many years and even decades after they are made. The design of managerial compensation requires obtaining performance measures that do not rely solely on accounting and income recognition.

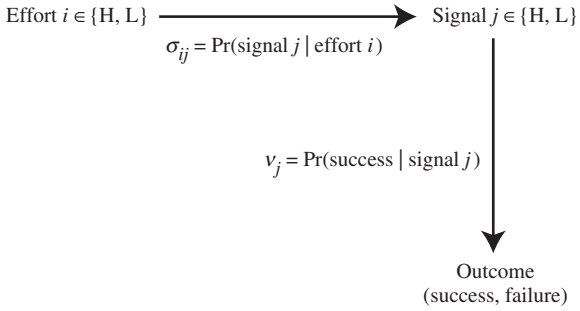


Figure 8.2

Let us start with the basic framework, which is that of Section 3.2, with an early signal of performance appended: an entrepreneur has a fixed-size project that requires investment I. The entrepreneur's cash, A, is insufficient to cover the cost of investment, $A < I$, and so the entrepreneur must borrow $I - A$ from investors. The project yields R in the case of success and 0 in the case of failure, and is subject to moral hazard. The probability of success is p_H if the entrepreneur works and $p_L = p_H - \Delta p$ if she shirks. So, the effort can be high (H) or low (L). Shirking provides private benefit B.

The new modeling feature is that, after the entrepreneurial choice of effort and before the project succeeds or fails, information can be acquired that is informative about the final outcome.

Let us assume that there are two possible signals, high (H) and low (L). (By an abuse of notation but for mnemonic reasons, we use the same notation for efforts and signals.) The (positive) probability of signal $j \in \{H, L\}$ conditional on effort $i \in \{H, L\}$ is denoted σ_{ij} (of course, $\sigma_{iH} + \sigma_{iL} = 1$ for all i). We simplify the analysis by assuming that the signal is a sufficient statistic for the final outcome (this assumption is easily relaxed). Let v_j denote the probability of success given signal j. The sufficient statistic property means that v_j is independent of effort. Figure 8.2 summarizes the stochastic structure.

In order for the *ex ante* probabilities of success given a high and a low effort to be equal to p_H and p_L, respectively, it must be the case that

$$p_H = \sigma_{HH} v_H + \sigma_{HL} v_L \tag{8.1}$$

The Holmström and Tirole paper builds on the insight of Diamond and Verrecchia in two ways. First, the stock market acquires information that is informative about value enhancement. This yields a positive relationship between managerial reward and stock price. Second, and more importantly, it assumes that information is costly to acquire. Proper incentives must then be given to speculators to acquire information, which leads to a study of the relationship between stock market liquidity and performance monitoring. The Holmström and Tirole analysis takes the stock market institution for granted, though, while the Diamond and Verrecchia paper, like this section, designs an optimal mechanism.

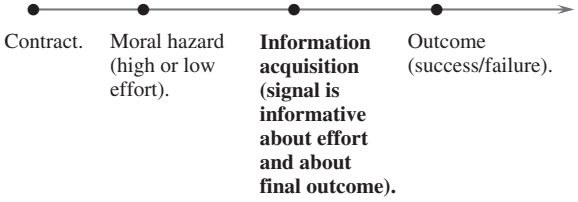


Figure 8.3

and

$$p_L = \sigma_{LH}\nu_H + \sigma_{LL}\nu_L. \tag{8.2}$$

Let us now interpret the high signal as good news about the final outcome.[9]

Assumption 8.1. *The high signal enhances the confidence in success:* $\nu_H > p_H$ (*equivalently,* $\nu_L < p_L$).

The timing of the extended fixed-investment model is summarized in Figure 8.3.

First we look at the benchmark in which the signal can be obtained for free and can be verified so that the entrepreneur's incentive scheme can be made directly contingent on this signal. Then we assume that information acquisition is costly and subject to moral hazard, and study information collection by an "incumbent monitor" and by an "entrant monitor" (see Section 8.1.3).

8.2.2 The Benchmark of Free Performance Monitoring

Suppose, temporarily, that the signal can be costlessly observed and verified, and so the entrepreneurial contract can depend both on the realization of the signal and on the final outcome. The optimal incentive contract, however, can be chosen so as to depend only on the realized signal. Intuitively, there is no reason to make the entrepreneur accountable for shocks she has no control over; here, for a given realization of the signal, the final outcome is totally out of the entrepreneur's control and thus her reward should not be made contingent on the realized outcome. This intuitive property results directly from the more general sufficient statistic theorem of Holmström (1979) and Shavell (1979), according to which an agent's compensation should be based only on a statistic that is "sufficient" with respect to the inference about her effort; that is, the final profit brings no information about the borrower's choice of effort to someone who already knows the signal.

Because the entrepreneur is risk neutral and protected by limited liability, and because the high (low) signal is good (bad) news for the high effort, it is clear that the entrepreneur should receive a reward R_b *in the case of a high signal* (regardless of success or failure, as we have argued), and 0 in the case of a low signal. The reward for a good signal should be sufficient to induce the entrepreneur to choose the high effort. A high effort increases the probability of a high signal from σ_{LH} to σ_{HH}, but does not enable the entrepreneur to enjoy private benefit B. And so we require that

$$(\sigma_{HH} - \sigma_{LH})R_b \geqslant B. \tag{IC$_b$}$$

As in Chapter 3, let us compute the pledgeable income. The entrepreneur's incompressible share is, in expected value,

$$\sigma_{HH}R_b = \frac{\sigma_{HH}}{\sigma_{HH} - \sigma_{LH}}B.$$

And so the necessary and sufficient condition for the entrepreneur to obtain funding is that the project's NPV net of the entrepreneur's incompressible share exceeds the investors' contribution to the initial investment:

$$p_H R - \frac{\sigma_{HH}}{\sigma_{HH} - \sigma_{LH}}B \geqslant I - A. \tag{8.3}$$

Let us compare this condition with condition (3.3) prevailing when no signal is available:

$$p_H R - \frac{p_H}{p_H - p_L}B \geqslant I - A.$$

Identities (8.1) and (8.2) imply that

$$\frac{p_H}{p_H - p_L} = \frac{\sigma_{HH}(\nu_H - \nu_L) + \nu_L}{(\sigma_{HH} - \sigma_{LH})(\nu_H - \nu_L)} > \frac{\sigma_{HH}}{\sigma_{HH} - \sigma_{LH}}.$$

We conclude that *the existence of the signal increases pledgeable income and thus facilitates funding* (the minimum entrepreneurial equity required to obtain financing is smaller). This elementary model illustrates a general point: *early signals provide information about future performance, and thus about the moral-hazard activity, that is not yet garbled by the future environmental noise* that accrues after the signal is revealed and before the final outcome is realized. Its use improves performance measurement

9. That $\nu_H > p_H$ implies that $\nu_L < p_L$ can be derived from condition (8.2) together with $\nu_H > p_L$ and $\sigma_{LH} = 1 - \sigma_{LL}$.

and de facto reduces the extent of moral hazard. Indeed, this model with a signal is equivalent to the model of Section 3.2 (without signal) but with a lower private benefit equal to

$$B_1 = \frac{\sigma_{HH}/(\sigma_{HH}-\sigma_{LH})}{p_H/(p_H-p_L)}B = \frac{\sigma_{HH}(\nu_H-\nu_L)}{\sigma_{HH}(\nu_H-\nu_L)+\nu_L}B < B.$$

Note that the coefficient of B in the first expression of B_1 is equal to the ratio of the likelihood ratios.

Remark (early measurement and NPV). In the fixed-investment model, the existence of the signal increases the pledgeable income and facilitates funding, but it does not alter the project's NPV, $p_H R - I$, also equal to the borrower's welfare in case of funding.[10] In the variable-investment model of Section 3.4, the introduction of a signal boosts debt capacity and, while it does not affect the NPV per unit of investment, raises the borrower's welfare (see Exercise 8.1).

Remark (what is the signal informative about?). A key insight is that although the signal is informative about the entrepreneur's effort, the monitor will not collect the signal in order to learn the entrepreneur's effort. Indeed, the monitor here knows for certain that the entrepreneur has worked. It is only to the extent that the signal *also* contains information about the exogenous shocks that affect the final outcome that the monitor will have an incentive to engage in costly information acquisition.[11]

Implementation. To implement the optimal incentive scheme when the signal is publicly observable but not necessarily directly verifiable by a court, one can, *for example*, let the investors' claims be publicly traded shares. (Here and below we normalize the number of shares to be one.) Their interim value is equal to $\nu_H R$ in the case of a high signal and $\nu_L R$ in the case of a low one. A fraction x of the shares is initially set aside and given to the entrepreneur if and only if the stock price is equal to $\nu_H R$. The entrepreneur receives no bonus, that is, no compensation based on realized income. (A bonus would coexist with stock options if the signal were not a sufficient statistic for managerial effort and the entrepreneur were risk averse.) Nor is the entrepreneur allowed to engage in insider trading by purchasing or selling shares not specified in the contract. The fraction of shares to be allocated to the entrepreneur in case of a high stock price is given by

$$x(\nu_H R) = R_b^*,$$

where R_b^* is the managerial reward for a high signal that makes investors break even: $p_H R - \sigma_{HH} R_b^* = I - A$. (In the case of a low stock price, the x shares are distributed among the investors.)

Note that this reward scheme is basically a *stock option*. It *gives* shares to the entrepreneur for the high realization of the stock price. A straight share, that is a noncontingent share given *ex ante* to the entrepreneur, is suboptimal here since it provides a positive reward even in the case of a low stock price. We invite the reader to go through the (slightly more complex) arithmetic of the design of stock options in which the entrepreneur's reward is linked to the appreciation in the stock price when the strike price is the stock price at the date at which the options are granted, i.e., $p_H R$. For such stock appreciation rights (SARs), the entrepreneur receives the capital gain $(\nu_H - p_H)R$ associated with a given number y of shares, without the requirement to supply cash to exercise the options. The difference with the reward scheme considered above is merely one of an accounting nature.

8.2.3 Designated Monitor

8.2.3.1 The Monitor's Option Contract

We now consider the case of an "enlisted incumbent" or "designated monitor" ("he") with costly monitoring. Let us now assume that a party who collects the signal incurs a nonobservable private cost c of doing so.[12] Furthermore, the information he

10. This would not be so if the borrower were risk averse, since the reduction in noise due to the signal would enhance the scope for insurance (see Holmström and Tirole 1993).

11. Put differently, in the absence of exogenous shock that is realized before monitoring takes place, the monitor would have no incentive to commit resources to learn an effort that he can perfectly anticipate.

12. Note that there is no asymmetry of information about the talent of the monitor (or about his cost of acquiring information). To reflect the possibility of adverse selection about the monitor, one can make use of the building blocks supplied by the literatures on delegated portfolio management (Bhattacharya and Pfleiderer 1985) and on the optimal elicitation of forecasts (Osband 1989); both literatures are concerned with the incentive scheme to be designed for a collector

collects is private, soft information. There is therefore some moral hazard in the collection of information about entrepreneurial performance. The monitor must thus be given an incentive scheme that induces him (1) to collect the information and (2) to reveal truthfully this information so that it can be used for managerial compensation purposes.[13]

There is a simple incentive scheme that induces the monitor to collect and reveal the information, and furthermore does not leave any rent (supranormal profit) to the monitor.[14] Namely, the entrepreneur can select a monitor and offer him a *stock option contract* with strike price equal to the stock price at the date at which the options are granted. The monitor has the right to purchase s^* shares at the *ex ante* par value, $p_H R$ per share (and the monitor then commits not to engage in insider trading by selling some shares or purchasing other shares).[15] The number s^* of options is given by

$$s^* \sigma_{HH}(\nu_H R - p_H R) = c. \tag{8.4}$$

The entrepreneur is rewarded as in Section 8.2.2, that is, she receives R_b^* if the monitor exercises his option (thereby triggering an increase in firm value's assessment), and receives 0 if he does not (which conveys bad news about firm value). Thus, the entrepreneur works if she expects the monitor to collect the information.

Suppose that the entrepreneur is expected to choose the high effort. If the monitor refrains from monitoring, his monitoring cost is equal to 0, but so is the value of his stock options: not knowing the signal, he still values shares at their *ex ante* par value $p_H R$, which is also the strike price. Thus the monitor is indifferent between exercising and not exercising the options, and makes no profit. If the monitor purchases the signal, then, with probability σ_{HH}, this signal is high and so shares are worth $\nu_H R$ to the monitor, resulting in a capital gain equal to $(\nu_H R - p_H R)$ per share. When the signal is low, the monitor values shares at $\nu_L R < p_H R$, and so does not exercise his options. Equation (8.4) thus states that the expected benefit from information collection is equal to its cost. It therefore also implies that the monitor receives no rent.

While the idea of providing the monitor with options to give him incentives to measure the entrepreneur's performance seems quite natural, it is not clear that one necessarily observes such arrangements frequently, at least for the acquisition of purely speculative information. (Venture capitalists or LBO fund managers typically receive 20% of the value created and structure their contracts with a number of options; for example, they generally own convertible preferred stock. However, they collect prospective as well as speculative information.) Yet one can view rolled-over short-term bank debt or revocable credit lines as options that protect the monitor (the bank) if he receives low signals about the borrower, but gives him the possibility to make money if signals are good (see Section 8.4.1).

Remark (multiplicity of equilibria under call options). There exists another equilibrium, in which the monitor does not monitor and never exercises his options, and therefore the entrepreneur shirks. Suppose that the entrepreneur shirks. Then the expected gain from monitoring is $s^* \sigma_{LH}(\nu_H R - p_H R) < c$. And because $p_L R < p_H R$, it is not worth exercising the options in the absence of monitoring.

This multiplicity can be avoided, though, by providing the monitor with put options or a mixture of put and call options (as earlier, the entrepreneur is rewarded when firm value increases). Intuitively, granting call options to the monitor makes the two effort decisions strategic complements (the

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of retrospective information who has private information about his cost of collecting the information.

13. The treatment here is a modified version of Chang and Wang (1995).

14. There is no unique way of designing the optimal schemes for the entrepreneur and the monitor here. Chang and Wang (1995) offer a different one, with the same flavor: the entrepreneur is allowed to sell a fixed fraction of shares and is rewarded on the basis of the sale price.

15. The treatment here is rather loose concerning the accounting of shares in the firm. Our accounting convention is that there is a fixed number, namely, a mass 1, of shares in the firm, and so the *ex ante* (respectively, *ex post*) value of one share is $p_H R$ (respectively, either R or 0). One way to provide the entrepreneur and the monitor with the described incentives goes as follows. A fraction x of shares is set aside for the entrepreneur. These, however, become vested only if the monitor exercises his stock options; otherwise, the shares are distributed to third-party investors (who de facto have a put on the firm). Similarly, a fraction s of shares is set aside for the monitor (the proceeds, $s p_H R$, from the exercise of the call options and the shares s in the case of nonexercise can also be distributed to third-party investors). There are many equivalent accounting procedures; while the one just described is not the most natural, it makes the treatment of incentives mathematically simple.

entrepreneur has more incentive to behave if her performance is better monitored, and, with call options, the gain from monitoring is higher if the entrepreneur behaves); strategic complementarity is a well-known factor facilitating a multiplicity of equilibria in games. Put options eliminate this strategic complementarity: while the entrepreneur still has more incentive to behave when she is monitored, the gain to monitoring is now higher when the entrepreneur misbehaves.[16] Finally, and anticipating a little the study of market monitoring in Section 8.3, note that stock market participants have both call (share purchases) and put (share resales or short-sales) options.

8.2.3.2 Collusion between the Monitor and the Entrepreneur

In the parlance of organization theory, the monitor acts as a "supervisor," working for a "principal" (the other investors) and overseeing an "agent" (the entrepreneur). The supervisory activity is here meant to create a better assessment of managerial performance than is provided by accounting data. The integrity of the measurement process is not to be taken for granted. The entrepreneur has an incentive to convince the monitor in some way to supply a lenient assessment of his performance.[17]

The act of pleasing management is, of course, costly to the monitor. Suppose, for instance, that both agree at the initial date that the monitor will always exercise the call options. Under this agreement, the monitor no longer has an incentive to monitor since his information will not impact the exercise decision; the monitor therefore economizes c. The manager then shirks and obtains $R_b^* + B$ for certain, instead of $\sigma_{HH}R_b^*$ overall. The monitor loses $s^*(p_H - p_L)R$. The monitor loses less than what the entrepreneur gains if, as the reader will check, the number of call options is small, that is if the monitoring cost is small.

A mere increase in the two parties' total surplus does not suffice to generate collusion, though. In particular, collusion requires a quid pro quo. That is, the entrepreneur must be able to compensate the monitor for his sacrifice. Assuming that the entrepreneur has invested all her cash resources into the firm at the initial stage and has therefore not kept hidden reserves outside the firm in order to bribe the monitor, the entrepreneur must pay the monitor in another currency. This currency may be friendship, a symmetrical favor (for example, as when the monitor is himself an entrepreneur, whom the first entrepreneur is in charge of monitoring[18]), or else some financial resources drawn from the firm itself. The latter, "tunneling," possibility is not unrealistic, in that many of those who are *a priori* best qualified to monitor performance have some form of business relationship with the firm (lender, accountant, consultant, competitor, supplier) and thus various ways of receiving from management discrete forms of compensation drawn from corporate resources. Collusion between monitor and monitoree will be treated in more detail in Chapter 9 in the context of active monitoring; see also Exercise 8.2 for an example of collusion under speculative monitoring when the "means of exchange" takes the form of tunneling.

In contrast, anonymous market monitoring, discussed in the next section, is mostly immune to collusive activities and therefore has more integrity. This may explain why it is more frequently observed despite its drawbacks.

8.2.3.3 Excessive Speculation

The informational value of security pricing for contracting purposes stems from the fact that speculators "take a picture" of managerial performance at an early stage, before further noise garbles it. If the

16. Let us show how to avoid the multiplicity of equilibria by presenting the monitor with a choice between a call and a put rather than with a choice between a call and no investment. Let s_C and s_P denote the number of call and put options granted to the monitor. Their exercise prices are both equal to par, namely, $p_H R$. If $s_C\sigma_{HH}(\nu_H R - p_H R) + s_P\sigma_{HL}(p_H R - \nu_L R) \geqslant c$, then the monitor does indeed have an incentive to monitor provided the entrepreneur works. Furthermore, if $s_P(\sigma_{LL} - \sigma_{HL})(p_H - \nu_L) \geqslant s_C(\sigma_{HH} - \sigma_{LH})(\nu_H - p_H)$, then the monitor has even stronger incentives to monitor if the entrepreneur shirks. As earlier, the entrepreneur receives R_b^* if the monitor exercises the call option; she receives 0 if the monitor chooses the put option (or does not exercise any option).

17. See Laffont and Rochet (1997) and Tirole (1992) for surveys of the theory of collusion in organizations.

18. See Laffont and Meleu (1997) for a study of the costs of reciprocal monitoring in situations in which the colluding agents do not have access to efficient means of exchange. In corporate finance, there is some concern that CEOs sitting on each other's board may reach a "gentleman's agreement," i.e., sign a "nonaggression pact."

monitor also collects information about the subsequent uncertainty (that is, the mapping from signal to final outcome in our model), which he certainly has an incentive to do if the cost of this complementary information is small, then the stock price reflects the subsequent noise and may contain no more information about managerial performance than the final outcome itself; the speculative information is then useless for entrepreneurial compensation purposes and costly to collect to boot. *By collecting too much information, the monitor reduces the quality of performance measurement.*

This point is easy to illustrate.[19] Suppose that at cost $c + \varepsilon$, where $\varepsilon \geqslant 0$ is small, the monitor can learn not only the signal $j \in \{H, L\}$, but also the complementary information mapping the signal into the final outcome (see Figure 8.2). That is, at the same or slightly higher cost the monitor learns the final outcome. Faced with the option defined in Section 8.2.3.1, the monitor decides to exercise the options on the basis of the final outcome, and obtains in expectation

$$s^* p_H (R - p_H R) - (c + \varepsilon) > s^* \sigma_{HH} (\nu_H R - p_H R) - c$$

(with probability p_H, the project will be successful; knowing this, the monitor exercises his options and realizes a capital gain of $R - p_H R$ on the s^* shares). The options are therefore exercised with *ex ante* probability p_H.

More generally, it is clear that when the monitor learns the final outcome, monitoring brings no new information and the pledgeable income, which is equal to

$$p_H R - \frac{p_H B}{\Delta p} - (c + \varepsilon),$$

is lower than in the absence of monitoring.

Taking a broader perspective, the final outcome depends on an input that is controllable by the entrepreneur (effort) as well as on noncontrollable shocks. Ideally, one would want the monitor to oversee only the effort, so as to have the most ungarbled measurement of performance (effort). However, as we already observed, the monitor will never spend resources to learn the entrepreneur's effort, since this effort can be inferred from the incentive scheme.[20] The incentive for monitoring stems purely from the possibility of obtaining private information about the noncontrollable shocks. That is, *from the point of view of the monitor, monitoring is motivated precisely by the acquisition of information that is uninformative about entrepreneurial performance and that he should thus not acquire*! There is therefore a trade-off: the ease with which the monitor can acquire information about noncontrollable shocks simultaneously determines the incentive to monitor and the noise in performance measurement. In other words, *the intensity of monitoring and its precision covary negatively.*

It is then not surprising that the monitor may acquire too much information, as in the example above. For example, the monitor may spend resources to obtain inside information about the likely evolution of the firm's regulatory environment or about future exogenous shocks on its demand even in contexts in which the latter should not impact on managerial decisions (they may impact on investment choices, though). For example, the future profitability of a telecom incumbent depends on the future regulatory requirements concerning the terms of local loop unbundling. An analyst may spend more time trying to anticipate this regulatory evolution than analyzing the quality of the telecom incumbent's recent investments.

Transposing this discussion to stock market monitoring (see the next section), it is sometimes asserted in the popular press that speculators may not really monitor managerial performance and may be more preoccupied with learning information that will soon become public and therefore has no informational value about the quality of management. The economic analysis provides a vindication of this argument as well as a caveat: one cannot create incentives for monitoring without tolerating the acquisition of some "useless" information. Thus the popular press is clearly right only in those instances where the information collected by speculators is

19. This insight is based on a remark of Diamond and Verrecchia (1982, p. 283).

20. As long as the entrepreneur plays a pure strategy. There would be an incentive to monitor effort even on a stand-alone basis, if the entrepreneur randomized over effort levels, or, relatedly, if the entrepreneur had hidden knowledge about her willingness to work, say, and so her action could not be perfectly predicted.

purely about exogenous shocks rather than about variables that depend on both managerial performance and exogenous shocks (e.g., learning information about the likely evolution of demand and competitive pressure to know whether the firm's past strategic decisions were right).

We saw that the monitor may acquire "*too much information*." Along the same lines, the monitor may also acquire the "*wrong information*." That is, in a context in which there are multiple measures of performance (e.g., multiple product lines or multiple yearly incomes), he may devote excessive attention to those dimensions of entrepreneurial performance on which he can learn a substantial amount of information about noncontrollable shocks. So, the allocation of monitoring effort in general is not optimal either (see Paul 1992).

8.3 Market Monitoring

8.3.1 Market Microstructure

Let us now assume that, for one of the reasons stated in the introduction to Part III, the firm cannot rely on a designated monitor. Rather, it must resort to a more anonymous market in order to obtain the retrospective information.

The simplest framework in which to study *market monitoring* is the following. Modify the model of the previous section by assuming that the identity of the monitor is (in particular *ex ante*) unknown. For simplicity, there is a single potential monitor. The monitor,[21] who may for example be the investor among many investors who at the interim stage turns out to have the relevant skills or the availability to collect the information, "appears" after the effort has been chosen. To follow common usage, we will call this monitor a "speculator."

As in Section 8.2.3, the entrepreneur must be induced to work and the monitor must have incentives to collect information. We investigate whether these incentives can be provided by a stock market institution. The crux of the analysis is that the monitor's incentives in a market context are more complex to design than those of an enlisted monitor.

Let us assume that the entrepreneur issues publicly tradable shares in the firm. Each share thus entitles its holder to a fraction of the income R in the case of success. For simplicity, short sales are prohibited. Normalizing again the number of shares to be one, and assuming that the entrepreneur's incentive scheme induces her to choose the high effort, the *ex ante* par value of a share is thus equal to $p_{\mathrm{H}}R$.

• Assume, first, that all initial investors in the firm can costlessly hold their shares until the final outcome is realized. That is, they have no liquidity needs and therefore do not derive any intrinsic benefit from reselling their shares early. Suppose then that the speculator acquires the retrospective information and that the signal is high (the speculator would not want to trade if the signal were low given that short sales are prohibited). The speculator knows that the firm is undervalued by $\nu_{\mathrm{H}}R - p_{\mathrm{H}}R > 0$ per share, and so would want to purchase shares.

21. As earlier, we here make two simplifying assumptions. First, there is a single monitor. Second, this monitor is necessarily an outsider. These two assumptions are relaxed in a different context by Fishman and Hagerty (1992), who offer an interesting study of insider trading. Their model has two types of speculators: an endogenous number of external speculators (there is free entry into speculation) and, if insider trading is allowed, the manager. The manager is assumed to receive a more precise signal than external speculators. Fishman and Hagerty therefore take as their starting point Manne's (1966) suggestion that insider trading may lead to more informationally efficient stock prices by enlisting speculators with superior monitoring ability.

As Fishman and Hagerty show, the expected gross (trading) profit of external speculators decreases when insider trading is allowed, as they then face intense competition from a superiorly informed trader; and so insider trading reduces the number of external speculators. Because the fixed costs of information acquisition by external speculators are ultimately borne by the shareholders, who face liquidity needs and must sell their shares, and by the manager (recall that external speculators make no profit on average, and so their expected gross profit from trading is equal to their fixed cost of information acquisition), insider trading creates social benefits (as Fishman and Hagerty note, this might no longer be the case if external speculators faced varying costs of acquiring information, because the decision over whether to allow insider trading would then not internalize the most efficient speculators' inframarginal rents). The impact on informational efficiency, in contrast, is ambiguous. On the one hand, insider trading adds a superiorly informed trade (and therefore increases informational efficiency): just think about the case in which external speculators are very inefficient information acquirers. On the other hand, insider trading crowds out external speculation and introduces an asymmetry among informed traders, thereby reducing competition in the asset market. Finally, the analysis, unlike that of this chapter, does not focus on the impact of speculation on managerial incentives and pledgeable income.

The analysis of disclosure by Boot and Thakor (2001) looks at the impact of the disclosure of information about the firm's prospects on the incentives of outsiders to collect information, depending on whether the disclosed information is substitute or complement with that collected by market participants.

Unfortunately for the speculator, initial investors are willing to sell their stake in the firm only if they expect to make money out of the trade. This implies that any order by the speculator can be satisfied only at price $v_H R$: in equilibrium, uninformed investors do not want to purchase at prices equal to or exceeding $p_H R$, and so any such demand must be interpreted as stemming from a speculator with good news about the firm. Hence, the speculator cannot make money out of his information. (This is a version of the "no-trade theorem" obtained by Stiglitz (1971), Kreps (1977), and Milgrom and Stokey (1982).)

In the absence of an exogenous reason for early trading, such as liquidity needs, no trade occurs and the speculator does not collect any information. In other words, even a well-functioning stock market is informationally inefficient, as in the celebrated Grossman and Stiglitz (1980) contribution.[22] Note the key difference with the case of an enlisted monitor studied in the previous section. *An enlisted monitor can be promised that he will be able to exercise his stock options at a predetermined price, namely, the ex ante par value $p_H R$. The unenlisted monitor, that is, the speculator, also has stock options (the stock market enables him to purchase tradable shares), but the strike price is now a market price and is thus endogenous.*

• In order for the speculator to benefit from his information and thus to have an incentive to collect this information, it must be the case that the price of the securities does not respond too much to the speculator's order flow. Technically, the slope of the supply curve faced by the speculator must not be infinitely steep—the securities market must be "deep."

Market depth is obtained when (a) some initial investors face liquidity needs and so an active securities market creates gains from trade, and (b) the extent of the associated supply is unknown (if the second condition fails, any order from a speculator is automatically recognized by investors or market makers). This suggests the following assumption.

Assumption 8.2 (liquidity trading).

(a) *A fraction s of initial investors are "liquidity traders": with probability $\lambda \in (0,1)$ they (all) will need to sell their shares at the interim stage (that is, before the final outcome is realized). With probability $(1-\lambda)$, none will face such liquidity needs and therefore all will behave like the other investors.*

(b) *The other investors — the "long-term investors" or the "nonliquidity traders" — have no direct information about whether there is liquidity trading.*

A few remarks about this definition are in order.

Remark (deep market). We noted that those investors who can hold shares until the final outcome—the long-term investors—should not know the exact extent of liquidity trading if they are not to infer perfectly the speculator's demand and information. This requirement is reflected in an extreme form in the assumptions that the liquidity shocks of liquidity traders are perfectly correlated and that the long-term investors do not get any direct information about the extent of liquidity trading (they may and will get some indirect information about liquidity trading through the net order flow). The perfect correlation assumption is made for computational simplicity and is obviously much stronger than needed: what is required more generally is that the long-term investors cannot infer the level of liquidity trading perfectly (from the law of large numbers, they could infer this level perfectly if there were a large number of liquidity traders with independent liquidity shocks). Put differently, the speculator's trade has a limited impact on the stock price; in this sense, the market has some "depth."

Remark (is liquidity trading "irrational"?). As will be emphasized in the discussion of the Diamond and Dybvig (1983) model in Chapter 12, liquidity trading need not be irrational. Actually, we will model it in a rational way and make use of this property for the determination of the price of initial claims. Namely, consider a three-stage timing (see Figure 8.4 below), in which initial investors purchase the securities at

22. The Grossman–Stiglitz paper is couched in the context of a competitive stock market. It was later realized that stock markets with privately informed parties are better modeled as games since an informed party is never informationally infinitesimal and thus cannot take the stock price as given. See, for example, Kyle (1989) for a discussion of modeling issues. The standard reference for the game-theoretic modeling of market microstructure is Kyle (1985). See also Kyle (1984), Admati and Pfleiderer (1988), and Laffont and Maskin (1990).

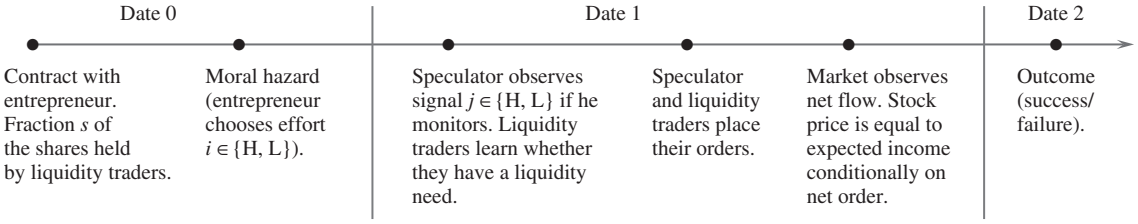

Figure 8.4

date 0, liquidity needs are realized at date 1, and the final income accrues at date 2.

Liquidity traders have utility attached to a consumption stream $\{c_0, c_1, c_2\}$ equal to

$$\begin{aligned} c_0 + c_1 &\quad \text{if they face a liquidity need at date 1,} \\ c_0 + c_1 + c_2 &\quad \text{if they do not.} \end{aligned}$$

That is, in the case of a liquidity shock they have no utility for second-period consumption (this is, of course, stronger than needed to generate sales of securities at stage 1). Long-term investors know at date 0 that their utility is always

$$c_0 + c_1 + c_2.$$

These simple preferences (or their generalization in which liquidity traders have utility $c_0 + c_1 + \theta c_2$, $0 \leqslant \theta < 1$, when facing a liquidity shock) will substantially facilitate the pricing of claims at stage 0.

Remark (exogeneity of s). We take the fraction s of liquidity traders to be an exogenous parameter. See the caveat below for a discussion of this assumption.

Let us now make the following assumption.

Assumption 8.3 (anonymous trading). *The speculator can split his order in such a way that the long-term investors (or any new investor in this market) cannot tell his order apart from those of the liquidity traders; these investors thus observe only the net order, that is the sum of the speculator's and the liquidity traders' orders.*

This assumption does not hold exactly if the speculator is forced to disclose a position exceeding some threshold or if splitting his order involves substantial transaction costs. But again, it is stronger than needed. All that is required is that the market not be able to observe the speculator's trade perfectly. The assumption that the market participants observe only the net order flow is a metaphor for a market in which market makers post bid and ask spreads and revise these in light of the observed net order flow.

Figure 8.4 describes the timing.

8.3.2 Equilibrium Behavior

Letting y and z denote the speculator's and the liquidity traders' demands for shares, the stock price P of shares is equal to the expected income conditional on total order $y + z$:

$$P = [\Pr(\text{success} \mid y + z)]R.$$

The liquidity traders' order is uninformative about the final outcome, but as we will see it plays an important role in the market's inference about the probability of success. This order is

$$z = \begin{cases} -s & \text{in the case of a liquidity shock,} \\ 0 & \text{in the absence of a liquidity shock.} \end{cases}$$

Now consider the speculator's order, assuming for the moment that it is indeed optimal for the speculator to acquire the information. It is clear that the speculator has no incentive to purchase shares if he that knows the firm is overvalued (the signal is low). When the firm is undervalued (the signal is high), he wants to purchase as many shares as is possible. But he must also be wary of not signaling his presence in the market to other investors, otherwise the price would jump to $v_H R$ and there would be no gain for the speculator. Given that the market observes the net order, the only way of possibly disguising one's order while purchasing shares is to purchase s shares. Table 8.1 describes the four possible states of nature.

When the speculator buys shares and there are no liquidity sales, the market knows that the speculator

Table 8.1

	High signal (probability σ_{HH})	Low signal (probability σ_{HL})
Liquidity sales (probability λ)	Stock price: P Net order: 0	Stock price: $\nu_L R$ Net order: $-s$
No liquidity sales (probability $1-\lambda$)	Stock price: $\nu_H R$ Net order: s	Stock price: P Net order: 0

has received favorable information and so the market price is $\nu_H R$; conversely, when the speculator buys no shares and there are liquidity sales, the market knows that the speculator has received the low signal, and so the market price is $\nu_L R$. In both cases the speculator's information is revealed to the market and the speculator makes no money from it.

In contrast, the market faces a nontrivial "signal extraction problem" when the net order is 0. The speculator's and liquidity traders' orders may balance either because the signal is high and there is liquidity trading, which has *ex ante* probability $\lambda\sigma_{HH}$, or because the signal is low and there is no liquidity trading, which has *ex ante* probability $(1-\lambda)\sigma_{HL}$. Using Bayes' rule and the fact that the stock price is equal to the expected payoff of a share, we obtain

$$P = \left[\frac{\lambda\sigma_{HH}}{\lambda\sigma_{HH} + (1-\lambda)\sigma_{HL}}\right]\nu_H R + \left[\frac{(1-\lambda)\sigma_{HL}}{\lambda\sigma_{HH} + (1-\lambda)\sigma_{HL}}\right]\nu_L R. \quad (8.5)$$

Let us compute the speculator's expected profit. With probability $\lambda\sigma_{HH}$, he learns that the firm is undervalued and liquidity trading allows him to disguise his trade, which preserves some undervaluation. The amount of undervaluation is then

$$\nu_H R - P = \left[\frac{(1-\lambda)\sigma_{HL}}{\lambda\sigma_{HH} + (1-\lambda)\sigma_{HL}}\right][(\nu_H - \nu_L)R].$$

That is, it is equal to the conditional probability that the firm is overvalued times the sensitivity of the true share value to the speculator's information. The speculator's expected profit is therefore

$$\pi(s) = \lambda\sigma_{HH}\left[\frac{(1-\lambda)\sigma_{HL}}{\lambda\sigma_{HH} + (1-\lambda)\sigma_{HL}}\right][(\nu_H - \nu_L)R]s. \quad (8.6)$$

On the other hand, this profit is equal to 0 when the speculator acquires no information. This can be checked by computing the expected profit of an uninformed purchase of s shares, using Table 8.1 and equation (8.5). But this result can be obtained more easily and more intuitively by noting that an uninformed speculator is in the same position as the market and the market price is the fair price in each state of nature.

We conclude that the speculator indeed acquires information if and only if

$$\pi(s) \geqslant c,$$

where c is, as earlier, the cost of learning the signal. The speculator further obtains no rent if $s = s^{**}$, where

$$\pi(s^{**}) = c. \quad (8.7)$$

This analysis has a couple of straightforward implications.

Size of the monitor's option. The incentive scheme of the enlisted monitor of the previous section and of the unenlisted monitor of this section is qualitatively the same: it is (explicitly in the first case and implicitly in the second) an option to purchase a predetermined number of shares at a strike price. We chose the strike price to be equal to the *ex ante* par value $p_H R$ in the case of an enlisted speculator. The strike price for the speculator is the market price, whose *ex ante* expectation is also $p_H R$. However, the supply curve faced by the speculator is not perfectly elastic at $p_H R$; and so, conditional on the speculator's wanting to exercise his option, the strike price (which is either P or $\nu_H R$) is on average greater than $p_H R$.[23] To have the same incentives to collect the information as the enlisted monitor, the speculator must be offered a larger option. It is therefore not surprising that (8.4), (8.6), and (8.7) imply

$$s^{**} > s^*. \quad (8.8)$$

Pledgeable income. Let us compare the pledgeable incomes under the two types of monitor. It turns out that the minimum expected entrepreneurial reward—that is, the agency cost—is the same in both cases, and so is the entrepreneur's ability to borrow.[24] This, however, is an artefact of

23. P itself may be larger or smaller than $p_H R$.

24. Suppose that the entrepreneur is given a reward R_b when the stock price at date 1 is equal to $\nu_H R$ and 0 otherwise (again, this can be interpreted as a stock option). Incentive compatibility requires that

$$(1-\lambda)(\sigma_{HH} - \sigma_{LH})R_b \geqslant B,$$

since the entrepreneur receives a reward only when the monitor receives the high signal and there is no liquidity trade.

entrepreneurial risk neutrality. *The pledgeable income is strictly lower under market monitoring than with an enlisted monitor as long as the entrepreneur exhibits (even small) risk aversion.* This results from the fact that the information structure is coarser under market monitoring: the stock price is either $\nu_H R$ or P when the signal is high, and $\nu_L R$ or P when the signal is low, and it is well-known that the agency cost for a risk-averse agent increases when the information structure is garbled in the sense of Blackwell (see, for example, Grossman and Hart 1983). Thus, under entrepreneurial risk aversion the entrepreneur needs more cash on hand in order to be able to borrow. (In the variable-investment model, the entrepreneur's borrowing capacity would be reduced by the garbling of the information structure.)

This point confirms our discussion of incumbent versus entrant monitoring in Section 8.1.3. The monitor's incentive scheme is less effective under entrant monitoring, and so market monitoring must be justified by some other argument such as integrity of the monitoring process (collusion), uncertain availability of the enlisted monitor (liquidity shocks), or uncertain talent of the enlisted monitor.

Trading volume and managerial compensation. The model predicts that stock-based incentives are more desirable in liquid markets. Market liquidity enables speculators to make money on their information and therefore incentivizes them to collect information in the first place. This prediction is borne out in Garvey and Swan's (2002) study of 1,500 publicly traded U.S. corporations over the period 1992–1999. The sample exhibits wide variations in the ratio of turnover to market capitalization, which can be used as a measure of liquidity (they also use the bid–ask spread as a measure of (il)liquidity and find similar results). They find that compensation is more closely tied to shareholder wealth when the firm's shares trade more actively. By contrast, bonuses are employed in firms with a more illiquid stock market.

Equity premium. Liquidity traders are willing to pay less for the stock than long-term investors. Indeed the former each lose in expectation π/s to the speculator. Thus, if stocks are meant to attract liquidity traders, shares must be sold at a discount to compensate liquidity traders who will "lose their shirt" to the speculator. Hence, the long-term investors must earn more than the rate of interest (normalized here at 0) corresponding to their rate of time preference. Put differently, investors who are in for the long term earn an equity premium, while those who may face liquidity needs earn just a fair rate of return. There is indeed empirical evidence that the return on a given stock increases with the holding period; casual evidence to this effect is provided by bankers' classic advice not to buy stocks when having a short holding period in mind.[25]

Important caveat. By assuming an exogenous fraction s of liquidity traders, we finessed the delicate issue of how this fraction comes about. Indeed, we showed that a long-term investor is willing to pay more for a share in the firm than a liquidity trader. One may then wonder why the subscription pattern to the initial issue does not yield $s = 0$, in which case the market has no depth and the speculator has no incentive to collect information. Economic theory has not yet provided a general answer to this question (which arises more generally in the "market-microstructure" literature). Note, though, that in a general equilibrium framework, the amount of money in the economy that can be committed in the long run for certain (that is, is not subject to the possibility of liquidity trading) is limited. In equilibrium, shares attract a heterogeneous clientele (liquidity traders and long-term investors) and the partial equilibrium model of this section is consistent with the general equilibrium framework in which the composition of ownership is endogenized.[26] Furthermore, and as noted above, shares bear an equity premium (that is, yield an expected return

Thus the entrepreneur's noncompressible share is

$$\sigma_{HH}(1-\lambda)R_b = \frac{\sigma_{HH}}{\sigma_{HH}-\sigma_{LH}}B,$$

as in Section 8.2.3.

25. Amihud and Mendelson (1986a,b) find that the empirical relationship between the returns on a stock and the bid–ask spread implies a much higher trading frequency than the average one that is actually observed. Put differently, bid–ask spreads, which are determined by the trading frequency of liquidity traders, predict greater returns for the average securityholder. This observation, which fits with the theoretical prediction, stresses the importance of accounting for the heterogeneity of stockholders.

26. See Holmström and Tirole (1993) for a modest start on this question.

above the market rate, here 0) despite universal risk neutrality.

Another nagging question in this model and the broader market-microstructure literature is why liquidity traders do not hold the stock index so as to avoid selling any given stock on which they face an informational disadvantage.[27] As Subrahmanyan (1991) and Gorton and Pennacchi (1993) have pointed out, index funds protect investors who value flexibility as to the date at which they can cash in (a decent return on) maturity of their investment against better-informed players in the stock market.

Index funds have indeed grown substantially over the years, whether due to the realization that short-term holdings carry a lower yield (for the reasons exposited here), or the new demand for diversification, or more mechanically because of technical progress in running these funds.[28] The long-run tension between the investors' self-interest in diversification for both liquidity and risk-aversion reasons and the social need that individual stock prices properly reflect the value of assets in place is, in my view, a key open topic for research in finance.

8.4 Monitoring on the Debt Side: Liquidity-Draining versus Liquidity-Neutral Runs

This section is based on discussions with Bengt Holmström. It also borrows from the literature on monitoring and liquidation (e.g., Repullo and Suarez 1998) and from that on demandable debt as a disciplining device (e.g., Calomiris and Kahn 1991).[29]

8.4.1 Passive Monitoring by Debt Claims

The theory developed in Sections 8.2 and 8.3 makes no prediction as to whether passive monitoring should be performed by equityholders or holders of risky debt.

We solved for the optimal mechanism for both an enlisted monitor and market monitoring, and in both cases we showed how optimal incentives could be provided by the monitor's option to purchase stocks. Alternatively, the incentive to acquire the retrospective information could be obtained by providing the monitor with *demandable debt*. Consider enlisting a large debtholder who has a nominal claim equal to D at date 2, when the final outcome occurs. In the absence of monitoring, this debt claim has value $p_H D$. Now, assume that the debtholder has the option to accelerate the payment and demand d at date 1 (in which case he is due nothing at date 2).[30] Suppose that

$$\nu_H D > d > \nu_L D, \tag{8.9}$$

so that an informed debtholder demands early repayment if and only if he receives the low signal. The debtholder indeed collects the retrospective information if and only if monitoring dominates the strategy consisting in (a) not monitoring and (b) either rolling over the debt or demanding the debt (in both cases with probability 1, since the debtholder has no information):

$$\sigma_{HL}(d - \nu_L D) \geqslant c \quad \text{and} \quad \sigma_{HH}(\nu_H D - d) \geqslant c. \tag{8.10}$$

Condition (8.10) reflects the fact that rolling over the debt has a cost in the bad state of nature, while demanding it has a cost in the good state of nature.

While the demandable debt mechanism on the debt side is the mirror image of, and is as plausible an incentive scheme for, the monitor as the stock option mechanism on the equity side, its implication for the entrepreneur's incentive scheme is *a priori* less palatable. Under debt monitoring, the entrepreneur should be rewarded if and only if the debt is not demanded. In practice, we observe that managerial incentive schemes are *directly* contingent on the value of equity, but not on whether

27. Similar issues arise when the cost of trading is a transaction cost or a tax rather than adverse selection (Constantinides 1986; Vayanos 1998).

28. Playing individual stocks has traditionally had the favor of professional and individual investors alike. For example, Keynes (1983), himself the manager of a major British insurance company and of the endowment of King's College, Cambridge (cited by Bernstein 1992, p. 48), wrote:

> I am in favor of having as large a unit as market conditions will allow … To suppose that safety-first consists in having a small gamble in a large number of different [companies] where I have no information to reach a good judgment, as compared with a substantial stake in a company where one's information is adequate, strikes me as a travesty of investment policy.

29. See also Rey and Stiglitz (1991), Qi (1998), and Diamond and Rajan (2000). The analysis is also related to Postlewaite and Vives (1987) and Chari and Jagannathan (1988), who look at the impact of withdrawal of demandable debt by informed debtholders.

30. There is no need to specify how d is financed. It might be financed through the sale of liquidity hoarded at date 0, or, possibly, through the dilution of other securities.

debt is demanded, or for that matter on the market value of debt if debt claims are tradable. This apparent disparity with practice leads to a couple of comments.

• Debt monitoring is not inconsistent with the entrepreneur's scheme being based on the value of equity claims. For, when the large debtholder exercises his option and demands early repayment of the debt, the holders of the residual claim—the equityholders—infer that the debtholder has received the low signal and the stock price plunges. (Relatedly, empirical evidence shows that the stock price reacts positively when, for example, a bank renews a loan.) We invite the reader to check that the entrepreneur can then be rewarded properly with a stock option.

• As the next subsection argues, an important difference between monitoring on the equity and debt sides is that a run on the debt drains liquidity and therefore already hurts management by compromising new investments or continuation of old ones.

8.4.2 Passive Monitoring and Liquidity Management

An aspect that is conspicuously missing in the analysis of Sections 8.2 and 8.3 is the impact of the acquisition of retrospective information on the firm's liquidity. In the model of Section 8.2, the acquisition of retrospective information occurs at a time at which the firm's cash flow has a life of its own. That is, at that stage it has become an exogenous random variable and cannot be altered. This was meant to formalize performance monitoring in its purest form. In an ongoing firm, however, the retrospective information may impact on the firm's liquidity and (from Chapter 5) future opportunities.

There is a fundamental difference between stock market monitoring and demandable debt monitoring that cannot transpire when liquidity plays no role: *demandable debt monitoring drains the firm's liquidity while stock market monitoring does not.* A bank that demands the early payment of long-term debt or refuses to roll over short-term debt deprives the firm of liquidity. Furthermore, this source of liquidity is especially hard to replace since other investors rationally interpret the "run" as being bad news about the prospects of the firm. In contrast, the firm's liquidity is not directly affected when the speculators' information makes its stock price move up or down, although it may be indirectly affected through the informational impact on the ability to conduct a seasoned offering.

More generally, recall that the incentive of a monitor, whether an equityholder or a debtholder, to collect retrospective information is always provided by an *option* defining a choice among competing financial claims, and that the way this option is exercised is the mechanism through which the monitor's information can be truthfully elicited. A *liquidity-draining exercise* reduces the liquidity available to the firm to meet current and future liquidity shocks or reinvestment needs. A *liquidity-neutral exercise* has no such impact. A *liquidity-providing exercise*[31] is, of course, the mirror image of a liquidity-draining exercise. A bank's rolling over of the firm's short-term debt or forgiveness of its option to demand early repayment of the long-term debt can be viewed as creating liquidity relative to the situation in which it would deprive the firm of its liquidity. So, there are really two categories, which could also be labeled *liquidity-managing exercise* and *liquidity-neutral exercise.*

Rephrasing our earlier observation, a striking fact is that *monitoring by equityholders is generally liquidity neutral, while monitoring by debtholders is generally liquidity managing.* Speculation on the stock market involves mere transfers among shareholders, while a refusal to roll over short-term debt does not involve a transfer between investors. From the liquidity perspective, the proper distinction, however, is not between debt and equity, but *between long-term and short-term capital.* Consider long-term public debt and suppose that the bonds involve a substantial risk of default (which as we saw in Chapter 2 is often not the case). The speculative activity in such a market very much resembles that on a stock market. The price of bonds can move up or down without impacting the firm's liquidity.

31. An example of a liquidity-providing exercise is the conversion of a convertible bond (recall that convertible debt gives its owner the option to exchange bonds for a predetermined number of shares). The conversion wipes out the future debt payments associated with the bond. A warrant provides liquidity if the cash brought in by the investors exercising the option to purchase shares goes to the firm, and is liquidity neutral if it is distributed as a dividend.

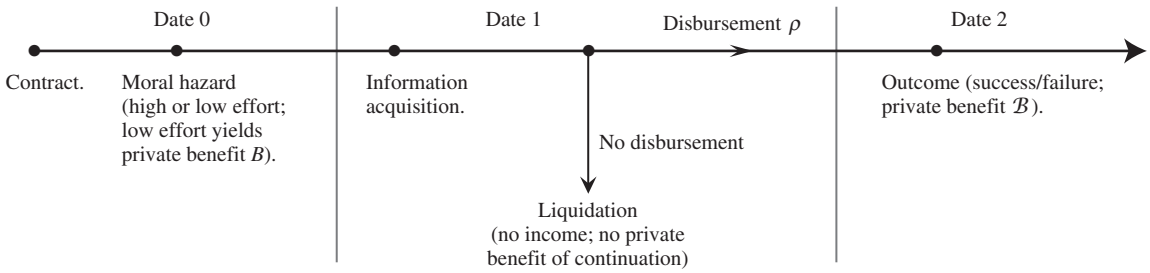

Figure 8.5

An example of a beneficial liquidity-draining exercise. Let us modify the model of Section 8.2 in two respects.

First, and as in Section 7.2.2, the entrepreneur derives no utility from income above the limited liability level (normalized at 0); this in particular implies that rewards based on securities prices are ineffective ($R_b = 0$). The entrepreneur, however, derives a private benefit $\mathcal{B}$ from the project being completed (on top of, possibly, the private benefit B derived from misbehaving at the initial stage). Second, assume that the firm, as in Chapter 5, must withstand a liquidity shock in order to complete the project. Then, a demandable debt mechanism, which induces a large debtholder to demand early repayment in case of a bad signal but not in the case of a good signal (see Section 8.4.1), provides an incentive mechanism for the entrepreneur if an early repayment prevents the firm from continuing.

The timing is summarized in Figure 8.5. For the purposes of this section, we can assume that the liquidity shock, ρ, is deterministic. If ρ is not disbursed, the project is stopped and there is no income; if ρ is disbursed, the project succeeds with probability ν_H or ν_L depending on whether the signal is good or bad. Moral hazard and the stochastic structure for signal and profit are as described in Section 8.2. Let us assume that

$$\nu_H R > \rho \geqslant \nu_L R. \tag{8.11}$$

That is, continuation is profitable (from a monetary point of view, which does not include the entrepreneur's private benefit $\mathcal{B}$ of continuation) only in the case of a good signal.[32]

The following condition will further ensure that there is enough pledgeable income for the investors provided that good incentives can be put in place:

$$\sigma_{HH}(\nu_H R - \rho) - I - c > 0. \tag{8.12}$$

Condition (8.12) says that the total cost of investment, $I + c$ (inclusive of the monitoring cost), is smaller than the income that can be obtained when continuing only for a good signal.

Consider the following financial structure. (a) The entrepreneur is allowed at date 0 to hoard an amount of liquidity (say, in Treasury bonds) equal to ρ, which she can use to meet the liquidity shock (any unused liquidity is returned to the investors). (b) As in Section 8.4.1, a potential monitor is endowed with demandable debt. This monitor has a nominal claim equal to D at date 2, together with an option of demanding d at date 1 instead (that is, then forgoing the long-term claim when exercising the short-term one), where

$$\nu_H D > d > \nu_L D, \tag{8.13}$$

and furthermore

$$\sigma_{HL}(d - \nu_L D) \geqslant c \quad \text{and} \quad \sigma_{HH}(\nu_H D - d) \geqslant c. \tag{8.14}$$

Lastly, we assume that

$$(\sigma_{HH} - \sigma_{LH})\mathcal{B} \geqslant B. \tag{8.15}$$

As earlier, (8.14) implies that the debtholder has an incentive to monitor and to demand the debt early if and only if the signal is bad. When the debtholder demands an early payment, the entrepreneur's leftover liquidity, $\rho - d$, is no longer sufficient to cover

32. An interesting subcase corresponds to $\rho = \nu_L R$. This subcase (or, more generally, the situation in which the loss of continuing in the case of a bad signal is small) is illuminating, in that the acquisition of the signal is suboptimal in the absence of managerial incentive problems, since the signal does not improve the continuation decision and is costly to acquire.

the liquidity shock ρ; besides, the investors are not willing to bring in new funds since, from (8.11), there is no monetary gain to continuation under a bad signal. Lastly, (8.15) ensures that the entrepreneur is motivated to work by the state-contingent decision rule, and (8.12), which accounts for the facts that the large debtholder must be compensated for the monitoring cost and that the entrepreneur receives no income, implies that investors can break even and so the project is funded.

We thus conclude that a demandable debt contract optimally drains the firm's liquidity while providing the creditor with an incentive to monitor.

8.5 Exercises

Exercise 8.1 (early performance measurement boosts borrowing capacity in the variable-investment model). Follow the analysis of Section 8.2.2 (publicly observable signal) and allow that the investment size is variable as in Section 3.4. Derive the entrepreneur's borrowing capacity and utility.

Exercise 8.2 (collusion between the designated monitor and the entrepreneur). Consider the fixed-investment model of Section 8.2.3 (designated monitor), but assume that the entrepreneur can, at no direct cost to her, tunnel firm resources to the monitor through, say, an advantageous supply or consulting contract that reduces the project's NPV. Namely, she can transfer an amount $T(\tau)$ to the monitor at the cost of reducing the probability of success by τ (from ν_j to $\nu_j - \tau$, where ν_j is the probability of success conditional on signal j). Assume that $T(0) = 0$, $T' > 0$, $T'(0) = R$ (a small transfer involves almost no deadweight loss), and $T'' < 0$. (Note that $T(\tau) < \tau R$ for $T(\tau) > 0$ and so tunneling is inefficient.)

By contrast, transfers from the monitor to the entrepreneur are easily detected by investors. Similarly, the entrepreneur cannot offer to share her reward without being detected.

We look at *ex post* collusion: the entrepreneur and the monitor both observe the signal $j \in \{\mathrm{L}, \mathrm{H}\}$ and the entrepreneur offers some level of τ against a specified option exercise behavior by the monitor.

As in the rest of this chapter, we assume that the entrepreneur is incentivized to behave. She obtains $\hat{R}_\mathrm{b}$ if the monitor exercises his option and 0 otherwise. The monitor buys s shares at strike price $p_\mathrm{H} R$ each if he exercises his call options.

Show that the contract studied in Section 8.2.3 is immune to tunneling if and only if s exceeds some threshold.

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