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CHAPTER 2

INFORMATION ASYMMETRY IN FINANCIAL MARKETS:
IMPLICATIONS FOR FINANCIAL CONTRACTING AND
THE FIRM'S FUNDING SOURCE CHOICE

Abstract

In this chapter we review the modern corporate finance and financial intermediation literature which analyzes the consequences of the existence of asymmetric information in financial markets for a firm’s investment and financing decisions. We discuss potential investment distortions which may arise due to adverse selection and moral hazard problems, and present solutions to these inefficiencies in two dimensions: the choice of financial contract and the choice of (external) financing source. Both the investment distortions and their potential solutions are illustrated in a simple, uniform model framework. We furthermore link the financial contracting and funding source solutions to firm characteristics, and derive conclusions with respect to the main determinants of a firm’s financing choice. Our analysis points at the existence of certain frictions in the financing of specific types of firms, in particular for small, new and information-problematic firms with highly specific assets.
1 Introduction

In this chapter we review the recent theoretical corporate finance and financial intermediation literature which analyzes the consequences of the existence of asymmetric information between firms and financiers for a firm’s investment and financing decisions, and for the functioning of financial markets. We consider the potential adverse impact of informational asymmetries on the efficiency of a firm’s investment decisions, and discuss several investment distortions which may arise due to informational problems. In the worst case, informational problems may result in a complete failure of debt and/or equity markets. This implies that well-deserving investment projects may not be financed, and consequently may result in an inefficient allocation of capital in the economy.

The focus in this chapter is on the way a firm’s financing choices may mitigate these investment inefficiencies on the side of the firm. We present solutions to investment distortions in two dimensions: the choice of financial contract and the choice of (external) funding source. The financial contracting solutions address the choice of contract type (debt, equity or hybrid financing), the maturity and priority structure of financing arrangements, and other contractual features (e.g. collateral and covenants). The funding source solutions emphasize the informational role and the comparative advantages of banks, financial markets and venture capitalists in the funding of corporations. Both dimensions interact. That is, the effectiveness of a specific contract or contractual feature in dealing with informational problems depends on the role and expertise of the capital supplier in attenuating informational problems. In this chapter we will address this interaction.

Apart from classifying the most important literature in this field and presenting a framework for the discussion of strategic interactions between firms and/or capital suppliers in the remainder of this dissertation, our main objective in this chapter is to provide a link between firm characteristics and financing behavior. This exercise allows us to draw (tentative) conclusions with respect to the main determinants of a firm’s financing choices. It also shows us where existing institutional arrangements and financing forms in an economy may fall short in financing specific types of firms. One conclusion in this respect is that small, new and information-problematic firms with highly specific assets and in need of risk capital may face substantial problems in obtaining external financing, and are

1 The interaction between a firm’s contract and funding source choice is also the central focus of Chapter 3. In Chapter 3 we provide a rationale for the use of discretion (or flexibility) in bank contracts, and show that the unique combination of discretionary contracts and a bank’s monitoring role may enhance investment efficiency on the side of a borrowing firm.
therefore subject to underinvestment problems and potential market failure.

The review in this chapter is by no means the first to consider these issues. Several other literature reviews exist which address the role of specific financial claims and different types of capital suppliers in improving a firm’s investment incentives in the presence of asymmetric information\(^2\). Bhattacharya and Thakor (1993) give an extensive overview of the main contributions in the contemporary financial intermediation theory, with a particular focus on the existence rationales of financial intermediaries and their role in the allocation of credit in the economy. Carey, Prowse, Rea and Udell (1993) focus on the distinction between the informational roles of private and public financing sources, and examine the characteristics of issuers and lenders in the market for private placements. Finally, Allen and Winton (1995) rationalize various financial innovations and contract characteristics as a solution to informational problems. Although these contributions, on an aggregate basis, capture all the major insights from the extant financial intermediation and contracting literature that are discussed in this chapter, they do not combine the contract and the funding source dimension. Furthermore, these contributions give only little attention to the link between borrower characteristics and financing choices. In this chapter we attempt to explore this link in more detail.

The organization of this chapter is as follows. In Section 2 we give an introductory exposition of the main informational problems and investment inefficiencies which may arise if a firm seeks external financing in the presence of asymmetric information between the firm and outside financiers. We introduce a simple model structure in order to illustrate these investment distortions and establish conditions under which they occur. In Section 3 we discuss and illustrate financial contracting solutions to these investment inefficiencies in the context of this framework. Section 4 presents and demonstrates possible funding source solutions. The links between firm characteristics and the firm’s contract and funding source choices are incorporated in summarizing tables in Section 3 and Section 4. Section 5 concludes.

\(^2\) Some of the insights from the financial intermediation literature discussed in this chapter have also been presented in other recent Dutch dissertations, see e.g. De Lange (1992), Scheepens (1995) and Scholtens (1994). De Lange (1992) and Scholtens (1994) focus primarily on the economic rationales for financial intermediation, and take a more macro-economic perspective. Scheepens (1995) focuses, as we do, on the interaction between firms and financial intermediaries from a more micro-economic perspective. The latter dissertation however gives a less extensive exposition of the financial contracting literature, and explores different ideas.
2 Asymmetric Information, Investment Incentives and Market Failure in Debt and Equity Markets

In this section we describe the consequences of the existence of asymmetric information between a firm and an outside financier for the firm’s investment decisions, its access to external financing and its cost of capital. We show that informational problems may raise a firm’s funding costs and may even frustrate its access to external financing. Dependent on the type of information asymmetry under consideration two types of informational problems can be distinguished: 'adverse selection' and 'moral hazard' (see also Thakor (1989)).

Adverse selection arises from the existence of ex ante (or pre-contracting) information asymmetry between a firm and a capital supplier with respect to, for example, the value of its current assets, the quality of its investment projects and/or its future prospects. If a firm’s manager has better information about these attributes than outsiders, then outsiders cannot assess the true value of the firm, and thus can only assign an average quality (and thus average financing terms) to the firm. Better quality firms therefore would suffer from the presence of lower quality firms in the financial market. As a consequence, better quality firms may refrain from seeking external financing and forego positive net present value (NPV) investments ('underinvestment'). This may trigger a mechanism in which only lower quality firms would seek external financing. Financiers - rationally anticipating this - would then accordingly adjust their financing terms. This mechanism could ultimately result in a total market breakdown (see e.g. Akerlof (1970)).

An important consequence of adverse selection is that well-deserving investment projects may not obtain funding at reasonable cost, and thus may not be financed (and undertaken) at all. Another potential consequence is that the adverse selection premium in a firm’s pooled funding cost may give rise to moral hazard (or agency) problems on the side of the firm. In general, moral hazard problems occur due to the existence of ex post (or post-contracting) information asymmetry, i.e. if a firm’s actions are not completely observable and/or verifiable by outsiders after contracting. In this case, firms may alter their investment behavior ex post, for example by increasing the riskiness of their investment strategies, by underinvesting in (firm-specific) effort or by engaging in other types of opportunistic behavior. Since financiers rationally anticipate this behavior, they will increase the firm’s funding costs ex ante. This may aggravate the firm’s incentive problems and can again result in underinvestment and/or market failure (see e.g. Stiglitz and Weiss (1981) and Petersen and Rajan (1995)).
The adverse selection and moral hazard problems described above can be illustrated using a simple model structure. We present a one-period model with universal risk neutrality. Consider two types of firms which need $1 of external financing in order to invest in a project, a good firm (type G) and a bad firm (type B). Each firm knows its own type, but the outside capital supplier doesn't. The commonly known prior probability that a firm which seeks external financing is of type G equals \( \theta \in [0,1] \). We assume for now that the type G firm has a project which generates a (partially contractible) end-of-period cash flow \( Y \) with a probability \( \eta \in [0,1] \), and 0 with a probability \((1-\eta)\). The type B firm has a project which pays off a (partially contractible) cash flow \( Z \) with a probability \( \zeta \in [0,1] \), and 0 with a probability \((1-\zeta)\). Let \( 0 < \xi < \eta < 1, \ Z > X > 1 \) and \( \eta Y > 1 > \xi Z \). Type G's project thus has a positive expected NPV, type B's project has a negative expected NPV. We furthermore assume that capital markets are perfectly competitive and that the riskfree interest rate equals 0. The sequence of events is as follows. Firms seek external financing and the potential capital supplier sets the contract terms. Firms then decide whether to attract outside financing and to invest or not.

**Adverse Selection and Market Failure ('Credit Rationing') in the Debt Market**

In the case of debt financing, the pooling interest factor (i.e. 1 + the interest rate) \( r \) which yields the lender zero profits in a competitive market equals \( \theta \eta + (1-\theta) \xi \). The following result now can be derived.

**Result 1:** There exists a \( \theta_d \in (0,1) \) such that both types of firms seek debt financing at the pooling interest rate \( r \) and invest if \( \theta \geq \theta_d \). If \( \theta < \theta_d \), the debt market fails.

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3 For ease of exposition, the notation that we use in this chapter is - where possible - similar to that in Chapter 3. The model structure presented here provides one of the simplest possible settings which allows us to illustrate some of the most important insights from the literature. Although the original contributions generally contain a more 'elegant' way of modelling these issues, our purpose in this chapter is to present a relatively uniform framework for demonstrating the main ideas.

4 We assume that the cash flows generated by the respective projects are partially contractible, in order to abstract from problems related to 'reporting' moral hazard (see e.g. Townsend (1979), Gale and Hellwig (1985) and Diamond (1984)). That is, we assume that the capital supplier could observe whether the cash flow generated by the projects is sufficiently high to make repayments to the capital supplier. The capital supplier, however, is not able to unambiguously infer the project choice from the observed cash flow. This issue will be addressed later in this section.

5 In the remainder of this chapter we use the terms interest rate and interest factor interchangeably.
Proof: Define $\theta_D = \left( Y^{-1} - \xi \right) / \left( \eta - \xi \right)$. Then it can easily be seen that $Y \geq r$ for $\theta \geq \theta_D$. In this case the type G borrower seeks financing at the pooling rate $r$ and invests. Since $Z > Y$ it is obvious that the type B borrower also wants to obtain financing and invest at this rate. If $\theta < \theta_D$, $Y < r$ and the type G borrower does not want to invest. In this case only the type B borrower may seek outside financing. A lender who rationally anticipates this then charges $\xi^{-1}$, the full information rate for a type B borrower, in a competitive market. Since $Z < \xi^{-1}$, the type B firm will then however not seek financing, and the debt market consequently fails. Finally, it can easily be seen that $\theta_D \in (0, 1)$, since $\eta^{-1} < Y < \xi^{-1}$.

The intuition is as follows. Since a lender cannot distinguish between borrower types, he charges a pooled funding rate $r$ which reflects the average success probability of the respective borrowers' projects. The type G borrower thus suffers from the presence of type B borrowers in the market (i.e. $r$ is larger than the full information rate $\eta^{-1}$ for a type G borrower, and contains an adverse selection premium). If the quality of the borrower pool is sufficiently high, the wealth transfer from type G firms to type B firms is not too large, and both borrower types will seek debt financing and invest. Observe that since the type B firm has a negative NPV project, 'overinvestment' occurs in this case. If the quality of the borrower pool is low, however, the adverse selection premium in the pooled funding cost $r$ is too high to induce the type G borrower to invest. Since the type G firm has a positive NPV project this results in underinvestment. A lender who rationally anticipates that only type B borrowers will be in the market then charges the full information rate $\xi^{-1}$ for a type B borrower to a firm seeking financing. At this rate, however, the type B borrower would not be willing to invest. The ex ante information asymmetry with respect to the borrower's type thus causes the debt market to fail.

Adverse Selection and Market Failure in the Equity Market

In order to illustrate this argument in the context of equity financing, we assume that there exists ex ante information asymmetry between firms and financiers with respect to both the quality of each firm's investment project and the firm's existing assets. Let the market...

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6 The approach we take here is similar to that in Myers and Majluf (1984). In that paper it is crucial that there exists ex ante information asymmetry between a firm and a capital supplier with respect to the market value of a firm's existing assets. The argument however can also be illustrated if we assume that there exists only ex ante information asymmetry with respect to the market value of the new investment projects, as long as one project has a negative expected NPV and the firm's existing assets have a positive market value. For a more elaborate discussion of adverse selection and market failure in the case of equity
value of type G and type B's existing assets equal G and B respectively, with \( G/B > \eta Y/\xi Z > 1 \). We assume that the firm currently is all-equity financed. Let \( \beta \) be the stake in the market value of the firm that the firm needs to give away to an external equityholder in order to obtain $1 of financing in a competitive equity market. Then it can easily be seen that \( \beta \) equals \( \theta(G+\eta Y)+(1-\theta)(B+\xi Z) \). We can derive the following result.

**Result 2:** There exists a \( \theta_E \in (0,1) \) such that both types of firms seek equity financing and invest if \( \theta \geq \theta_E \). If \( \theta < \theta_E \), the equity market fails.

**Proof:** Define \( \theta_E = [\eta Y(B+\xi Z-1)]/[\eta Y(G-B+\eta Y-\xi Z)] \). Then if \( \theta \geq \theta_E \), both the type G and the type B firm's expected payoff from investing exceeds the expected payoff from not investing at the pooling stake \( \beta \), i.e., \((1-\beta)(\eta Y+G) \geq G \) and \((1-\beta)(\xi Z+B) \geq B \). Both types of firms consequently seek equity financing and invest. If \( \theta < \theta_E \) however, it can be shown that \((1-\beta)(\eta Y+G) < G \), or \( \eta Y-1 < \beta(G+\eta Y)-1 \). The type G firm thus does not want to invest, since the wealth transfer from the current shareholders of the firm to the new shareholders exceeds the NPV of the project. In this case only type B borrowers would possibly seek equity financing. Equityholders who rationally anticipate this would then demand a stake \( 1/[B+\xi Z] \) in a firm seeking external financing. Since \( \xi Z < 1 \), however, the type B firm does not want to invest at these terms, and the equity market fails. Note finally that \( \theta_E \in (0,1) \), since \( \eta Y > 1 > \xi Z \).

Result 2 shows that a type G borrower can only obtain external financing in order to invest in a good project if the quality of the pool of firms seeking equity financing is sufficiently high. Otherwise, the loss to the type G firm's current shareholders from selling shares at a 'bargain price' exceeds the positive NPV of the firm's investment project. The shareholders of type G would then be worse off if the project is undertaken. If the type G firm retreats from the equity market, the type B firm can no longer benefit from favorable (pooling) financing terms, and the equity market breaks down. We next consider the moral hazard problems which may be caused by the existence of ex ante and/or ex post information asymmetry.

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\( \text{financing, see Myers and Majluf (1984) and Noe (1988).} \)

\( ^7 \) In the remainder of this chapter we will primarily focus on debt financing, since debt contracts are central in subsequent chapters of this dissertation (see Chapter 3 and Chapter 4).
Adverse Selection and Moral Hazard in the Debt Market

We now assume that the type G borrower can choose between two projects, the project described earlier in this section (from now on denoted as the 'safer' project) and a 'riskier' project, which generates a (partially contractible) end-of-period cash flow $X$ with a probability $\alpha \in [0,1]$, and 0 with a probability $(1-\alpha)$, with $\xi > Z > X > \alpha > Y$ and $0 < \xi < \alpha < \eta$.

Both projects have a positive expected NPV. The safer project has a higher expected NPV than the riskier project. Type B's investment opportunity set is unchanged. The firm's project choice is either non-observable or non-contractible. Let $\eta^1 = \frac{[\eta Y - \alpha X]}{[\eta - \alpha]} < Y$.

Under these parametric conditions the following result can be derived in the case of debt financing.

**Result 3:** There exists a $\theta_A \in (0,1)$ and a $\theta_D \in (0,\theta_A]$ such that both types of firms seek debt financing and the type G borrower invests in the safer project if $\theta > \theta_A$. If $\theta_D < \theta < \theta_A$, both types of firms seek debt financing and the type G firm invests in the riskier project. If $\theta < \theta_D$, neither type of firm seeks financing and the debt market fails.

**Proof:** Define $\theta_A = \frac{[\eta(Y - \alpha X)\xi]}{[(\eta Y - \alpha X)(\eta - \xi)]}$ and $\theta_D = \frac{[X - \xi]}{[\alpha - \xi]}$. If $\theta > \theta_A$, the pooled interest factor $r$ charged by the lender under the assumption that the type G borrower chooses the safer project equals $[(\theta \eta + (1-\theta)\xi) ]^{\frac{1}{\theta}}$. At this rate, the expected payoff to the type G firm from choosing the safer project exceeds the payoff from choosing the riskier project, i.e. $\eta(Y - r) > \alpha(X - r)$. Furthermore, $Y > r$. Since $Z > Y$, both borrower types then would seek debt funding at the pooling rate $r$ and invest. If $\theta > \theta_A$, the expected payoff to type G of choosing the riskier project is higher than the payoff of the safer project at the pooling rate $[(\theta \eta + (1-\theta)\xi) ]^{\frac{1}{\theta}}$. The type G firm therefore wants to switch to the riskier project, and the market, rationally anticipating this, consequently charges an interest factor $[(\theta \alpha + (1-\theta)\xi) ]^{\frac{1}{\theta}}$. Both borrower types then choose to invest if $X > [(\theta \alpha + (1-\theta)\xi) ]^{\frac{1}{\theta}}$, i.e. if $\theta \in [\theta_D, \theta_A]$. If $\theta < \theta_D$ however, $X < [(\theta \alpha + (1-\theta)\xi) ]^{\frac{1}{\theta}}$, and the type G borrower does not want to invest. In this case underinvestment occurs, and the market fails (see Result 1). Finally, under the parametric conditions stated above, it can easily be seen that $\theta_A \in (0,1)$ and $\theta_D < \theta_A$.

From Result 3 it is clear that adverse selection may result in 'risk shifting' moral hazard.

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8 Observe that in this example $\xi Z < 1$ and $\alpha X > 1$, i.e. the type B borrower's project has a negative expected NPV and the type G borrower's riskier project has a positive expected NPV. Later in this chapter we vary the attractiveness of the respective borrower types' investment opportunities (see the parametric conditions that are stated for each model structure).
and overinvestment moral hazard and/or in underinvestment moral hazard, dependent on the quality of the pool of borrowers and the investment opportunities that are available in the economy. If the quality of the borrower pool is relatively high, the type G borrower chooses the better, safer project at the pooling interest rate r. Observe that the type B borrower invests in a negative NPV project (overinvestment). If the adverse selection premium in the interest rate increases, however, the riskier project becomes relatively more attractive. For a sufficiently high interest rate the type G borrower switches to the riskier project (risk shifting or 'asset substitution'). Since the lender rationally anticipates this, the pooling interest rate that he charges the borrower will increase. For intermediate quality of the borrower pool both borrower types would still seek financing at this higher interest rate. If the quality of the borrower pool is too low, however, the type G borrower will not find it worthwhile to invest, because the payoff from investing would completely accrue to the debtholders. In this case underinvestment occurs due to a debt overhang problem (see later). A lender who rationally anticipates that in this case only lower quality firms would seek financing will then adjust the interest rate even further. This makes financing also unattractive for the lower quality firms, and ultimately results in a total market breakdown.

Another moral hazard problem on the side of a firm which will be aggravated by adverse selection is 'effort aversion' moral hazard. Effort aversion moral hazard occurs if a firm’s manager has lower than first best incentives to exert effort in order to improve firm performance, since he only partially shares in the benefits from doing so, but fully bears the (private) costs. This type of moral hazard can be illustrated by endogenizing the success probability of the borrower’s project. For example, assume that the type G firm has to make an unobservable effort choice in case of investment in the safer project. We assume that the choice of an effort level e results in a success probability η(e) for the project, with η(0)=η, η'(e)>0 and η''(e)<0, and incurs (private) costs equal to e. In the case of complete selffinancing, the firm’s manager optimizes his expected net payoff η(e)Y-e, and the optimal (first best) effort level satisfies η'(e)=Y. With outside debt financing at an interest rate r, the manager maximizes η(e)(Y-r)-e. Observe that in this case the manager only benefits from effort exertion if Y>r. Given the interest rate r set by the lender, the effort level chosen now satisfies η'(e)=(Y-r)'>Y', and consequently is lower than first

9 Effort aversion moral hazard therefore is the mirror image of 'perquisites consumption'. In the case of perquisites consumption a firm’s manager enjoys excessive perks, because he benefits fully from these perks, but only partially bears the costs (see e.g. Jensen and Meckling (1976)). Both agency problems increase with the proportion of outside financing.
best. Since $\eta'(e)$ decreases in $e$, it can easily be seen that a higher (pooled) interest rate $r$ results in a higher deviation from the first best effort level which is chosen in the case of selffinancing.

Finally, reporting moral hazard may occur. This problem is relevant if the cash flow generated by a firm’s project is unobservable and/or non-verifiable, and thus cannot be contracted upon. In this case, a firm’s manager always has an incentive to report low cash flows and to forego repayments to the capital supplier. As a consequence, capital suppliers are not willing to extend financing. It is obvious that this again results in underinvestment.

From the exposition given above it is clear that informational problems may distort investment efficiency on the side of the firm, and thus may frustrate an efficient allocation of capital in the economy. Table 1 in Section 3 classifies the informational problems discussed in this section. Different types of firms differ in the informational problems they pose for their financiers, both in the initial stage of financing and in the post funding stage. Informational problems may also fluctuate over the life-cycle of the firm. Informational problems tend to be particularly severe for small (and young) firms with firm-specific assets (e.g. R&D firms). Such firms are generally characterized by a lack of track record and a low visibility (i.e. these firms have a low $\theta$ and/or show a high variability of $\theta$’s in the industry). These firms also tend to be riskier and have a wider scope for discretionary behavior (i.e. moral hazard).

The informational problems which arise in conjunction with external financing are affected by the type of financial contract chosen (debt, equity or mezzanine financing) and the contract features (e.g. collateral, different types of covenants). Furthermore, the type of capital supplier (banks, venture capitalists, or the financial market) is important. Different capital suppliers serve a potentially different role in dealing with these informational problems, and as a consequence may have a different impact on a firm’s cost of funding and its investment behavior. Below we will describe how each of the two dimensions 'contract type and features' and 'type of capital supplier' could mitigate the adverse effects of asymmetric information on a firm’s investment decisions (e.g. by increasing the availability of capital and/or by lowering its price). The Tables 1 through 4 later in this chapter give an overview of these arguments and will link them to specific characteristics of the firms seeking (external) financing.
3 Solutions to Informational Problems: Financial Contracting

3.1 Solutions to Adverse Selection

In order to mitigate the adverse effects of ex ante information asymmetry in the financial market and the mispricing of financial claims by financiers, firms may follow a 'pecking order' or financing hierarchy in the funding of their investment projects (see Myers and Majluf (1984)). This is particularly relevant if firms cannot directly and credibly signal the quality of their assets and investment projects to outside financiers (see later). Firms then may prefer to finance their projects internally by retained earnings or other forms of financial slack. If a firm's financing needs cannot completely be satisfied by internal sources of funds and external financing is required, the firm prefers debt to equity, since debt is less informationally sensitive (and thus is less subject to mispricing). Hence, a better quality firm would subsequently issue riskless debt, risky debt, mezzanine financing, and - only as a last resort - equity. The choice of the type of financial claim used by the firm thus can serve as a signalling device with respect to the quality of the firm's investment projects. Since higher quality firms do not want to issue underpriced shares, and lower quality firms have an incentive to issue overpriced securities, an equity issue could be interpreted by the market as a signal that the issuing firm is of low quality. Higher quality firms therefore prefer internal financing or outside debt. In the context of the model structure presented in Section 2 this argument can be illustrated as follows.

Choice of Contract Type as a Solution to Adverse Selection Problems (Pecking Order Theory)

We again assume that the type \( G \) firm can invest in a project with a success probability \( \eta \) and a (partially contractible) end-of-period cash flow \( Y \) and has assets with a market value equal to \( G \). The type \( B \) firm's project has a success probability \( \xi \), a (partially contractible) end-of-period cash flow \( Z > Y \) and assets with a market value equal to \( B < G \). The amount of financial slack present in the firm is denoted by \( S \geq 0 \). We assume that both types of firms are currently all-equity financed. Let \( \eta Y > \xi Z > 1 \), i.e. both types of firms have an investment

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10 A very interesting new strand of literature has emerged which focuses on the benefits of internal financing and internal capital markets in mitigating informational problems and investment distortions within (one-divisional or multi-divisional) firms. This literature will be discussed in Chapter 4.
project with a positive expected NPV\textsuperscript{11}. The following result then can be derived.

**Result 4:** In the case of equity financing, there exists a separating equilibrium in which a type G firm does not want to issue equity and invest (underinvestment), whereas the type B firm wants to issue equity and invest if $\theta<\theta_{E}$. In the case of debt financing, underinvestment occurs if $\theta<\theta_{D}$, with $\theta_{D}<\theta_{E}$. Both $\theta_{D}$ and $\theta_{E}$ decrease with the amount of financial slack $S$ available to the firm before investing in the new project.

**Proof:** Define $\theta_{D}$ and $\theta_{E}$ as in Result 1 respectively Result 2 of Section 2. Then it can easily be seen that $(1-\beta)(G+\eta Y)<G$ for $\theta<\theta_{E}$ and $\beta$ equal to $[\theta(G+\eta Y)+(1-\theta)(B+\xi Z)]^{-1}$. The type G firm thus does not want to invest in the positive NPV project if $\theta<\theta_{E}$ (underinvestment). Since only the type B firm would be willing to seek external equity financing at the pooling terms $\beta$, the market would adjust its financing terms and require a stake equal to $1/(B+\xi Z)$ in a firm which issues equity. Since $(1-1/[B+\xi Z])(B+\xi Z)>B$ for $\xi Z>1$, the type B firm then wants to issue equity and invest. The proof in the case of debt financing is analogous. By comparing $\theta_{D}$ and $\theta_{E}$ for the parametric conditions imposed in this example, it can easily be shown that $\theta_{D}<\theta_{E}$ if $G>B$. The underinvestment problem therefore is less severe in the case of debt financing. If a firm has a positive amount of financial slack $S$, the capital supplier's zero profit constraints in the case of debt and equity financing rewrite to $[\theta \eta+(1-\theta)\xi]r = (1-S)$ and $[\theta(G+\eta Y)+(1-\theta)(B+\xi Z)]\beta = (1-S)$ respectively. From rearranging terms and taking the partial derivatives of $r$ and $\beta$ with respect to $S$, it can easily be seen that $\theta_{D}$ and $\theta_{E}$ decrease monotonically in $S$. Finally, observe that for $S=1$ the region of $\theta$ for which underinvestment occurs is empty. That is, if a firm has sufficient internal slack, all projects with a positive expected NPV would be undertaken.

The opportunities for using internal equity as a financing source depend on the stage in a firm's life-cycle and on the firm's possibilities to build up financial slack. New and information-problematic start-up firms which generate low cash flows in the beginning of their life-cycle and investment activities (e.g. R&D-firms), as well as growth firms, will be more restricted in this respect than more mature firms which generate more stable cash flow patterns.

In the case of debt financing, adverse selection problems (and credit rationing) may

\textsuperscript{11} Observe that we now assume (in the spirit of Myers and Majluf (1984)) that a type B borrower has a positive NPV project, i.e. $\xi Z>1$. 

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be reduced by firms posting collateral (see e.g. Bester (1985)). Since a lender can seize collateralized assets in the case of default, the use of collateral reduces the competitive nominal interest rate charged by the lender (note that collateralization therefore may also mitigate moral hazard (see e.g. Boot, Thakor and Udell (1989)). Furthermore, by posting collateral firms may credibly signal their quality to the market. That is, by choosing a secured loan viable borrowers can separate themselves from lemons, since the latter would suffer too much from the more likely loss of their collateral. This intuition can be illustrated as follows.

The Use of Collateral as a Solution to Adverse Selection in the Debt Market

We now assume that the borrower's assets have an end-of-period market value of \( C > 0 \). A lender can offer two types of lending contracts to a borrower: uni-dimensional (unsecured) contracts, which are characterized by an interest rate only, and two-dimensional (secured) contracts, which specify both an interest rate and a collateral amount \( C \). In the case of a secured loan the lender can seize the borrower's (project) assets if default occurs, and subsequently can sell these assets for an amount equal to \( cC \), with \( c \leq 1 \). Let \( \eta > 0 \).

Result 5: There exists a separating equilibrium in which a type \( G \) borrower chooses a secured loan and the type \( B \) borrower chooses an unsecured loan if

\[
\frac{[\eta - \xi]}{[\eta - \xi(\eta + (1-\eta)c)]} \leq C \leq \frac{[\eta - \xi]}/[(1-\eta)(1-c)\xi].
\]

Proof: Observe first that the pooling interest factor of a secured loan in a competitive market equals \([1-(\theta(1-\eta)+(1-\theta)(1-\xi)]cC)/[\theta(\eta+(1-\theta)\xi)]\), and is smaller than \([\theta(\eta+(1-\theta)\xi)]\), the pooling rate for an unsecured loan, for all \( C > 0 \). The full information rate for an unsecured loan to a type \( B \) borrower would equal \( \xi \), whereas the full information rate for a secured loan to a type \( G \) borrower equals \([1-(1-\eta)c]/\eta\). The conjectured separating equilibrium then exists if the two borrower types do not envy each other's contract choices in equilibrium. A type \( G \) borrower (weakly) prefers a secured debt contract over an unsecured contract if \( \eta(Y-[1-(1-\eta)c]/\eta) - (1-\eta)C \geq \eta(Y-\xi) \), i.e. if \( C \leq [\eta - \xi]/[(1-\eta)(1-c)\xi] \). A type \( B \) borrower prefers an unsecured contract over a secured contract if \( \xi(Z-\xi) \geq \xi(Z-[1-(1-\eta)c]/\eta) - (1-\xi)C \), i.e. if \( C \geq [\eta - \xi]/[\eta - \xi(\eta + (1-\eta)c)] \). Observe that in this equilibrium the type \( B \) borrower does not mimic the type \( G \) borrower's contract choice, since he would lose his assets with a higher probability. Finally, observe that the existence of a separating equilibrium becomes more likely if the value of the borrower's assets to the lender is
sufficiently high, i.e. if $c$ is sufficiently large. Otherwise, both borrower types issue an unsecured loan at the pooling rate $[\theta \eta + (1-\theta) \xi]^1$.

The possibilities for pledging collateral depend on the specificity of a firm’s assets and on the industry in which the firm operates, since both will affect the value of $c$. It may not always be possible for borrowers to collateralize loans, especially for start-up firms with intangible assets. Furthermore, the liquidation value of the firm’s assets (i.e. $cC$) may depend on industry conditions, i.e. the price resulting from sale of (collateralized) assets may be lower during industry- and/or economy-wide recessions (see e.g. Shleifer and Vishny (1992)).

Another potential self-selection device in the case of debt financing is the choice of the loan maturity by a firm (see e.g. Flannery (1986) and Diamond (1993)). High quality firms could separate themselves from lower quality firms by choosing and repaying shorter maturity loans. The possibility to use this self-selection device again depends on the cash flow pattern associated with a firm’s investment projects. The following model structure demonstrates the function of loan maturity as a signalling mechanism.

**Loan Maturity Choice as a Solution to Adverse Selection in the Debt Market**

In order to address the borrower’s loan maturity choice, we extend the basic model structure presented in the previous section to two periods. We assume that the type $G$ borrower can invest in the safer project in the first period, and contingent upon success, can invest another $S_1$ in a project which generates a second period cash flow of $R > 1$ with a probability $\frac{1}{2}$. The type $B$’s investment project generates an end-of-period cash flow 0 in both periods\(^{13}\). The lender can offer two types of contracts: a long-term (two-period)

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\(^{12}\) We assume here that the cash flow $Y > 1$ will be (partially) consumed at $t=1$, and thus is not sufficient to finance the type $G$ borrower’s second period investment project. An amount of $S_1$ of external financing is therefore needed at $t=1$. Another way of modeling this is by assuming that the second period investment outlay $I$ is larger than $Y$, and that $R > I$ (see also Petersen and Rajan (1995) and Section 4.1 of this chapter).

\(^{13}\) That is, we assume that $\xi = 0$. This assumption is made for simplicity reasons only, and ensures a perfect revelation of the borrower type after one repayment period. In the more general case with $\xi > 0$, Bayesian updating takes place more gradually. In that case the posterior probability assessment of the lender that a borrower which repays his debt after one period is of type $G$ equals $\frac{\theta \eta}{\theta \eta + (1-\theta) \xi} > \theta$. For details, see e.g. Diamond (1989) and Diamond (1991). Observe that under the assumption that $\xi = 0$, a type $B$ borrower will always want to mimic the type $G$ borrower’s contract maturity choice, since the firm otherwise perfectly reveals itself as a type $B$ borrower, and thus will not be able to obtain financing at $t=0$.  

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contract and short-term (one-period) contracts. With a long-term contract the repayment on the loan needs to be made at the end of the second period (at t=2). The lender therefore cannot learn from the repayment behavior of the borrower at t=1. Short-term contracts need to be repaid and renewed after each period. Since with short-term contracts a lender can observe whether repayment on the loan is made or not, he can update his beliefs with respect to the borrower’s type at the end of the first period, using Bayes’ Rule. This information then can be used in determining the second-period interest rate. At t=0 each borrower type decides how much to borrow and chooses the maturity of the loan. The following result now can be derived.

**Result 6:** Both borrower types will prefer to borrow $1 using a short-term debt contract at t=0. At t=1 the type G borrower will receive $1 of short-term financing at the riskfree rate, and the type B borrower will not be financed.

**Proof:** Given both borrower types’ maturity choices, the first period pooling rate charged by the lender for a short-term contract in a competitive capital market equals $(\theta \eta)^{-1}$. Since only a type G borrower can repay this loan at t=1, the lender has a posterior probability assessment that a repaying borrower is of type G with a probability 1. The interest rate charged for the second period short-term contract, conditional on first period repayment, then equals 1. If no repayment occurs at the end of the first period, the lender would deny the borrower a second-period loan. We now need to verify that both borrower types prefer a short-term contract at t=0 over a long-term contract at the pooling rate $r$. For a type B borrower this is obvious (see footnote 13). Since with long-term debt financing the lender doesn’t learn about the borrower’s type at the intermediate date, and the riskfree interest rate equals 0, borrowing $1 long-term at t=0 and subsequently $1 short-term at t=1 is equivalent to borrowing $2 long-term at t=0 (see also Rajan (1992)). The pooling interest

We furthermore assume that, although type B’s t=1 cash flow equals 0 with a probability 1, a type B borrower will still (weakly) prefer to receive the $1 of external financing at t=0 over no financing, for example because he can divert (part of) this cash flow for private consumption (this is similar to the approach taken in e.g. Petersen and Rajan (1995)) or because the type B borrower derives (non-modeled) private control rents from investing (see e.g. Boot and Thakor (1997)).

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14 As indicated above, the focus in this setup is on a pooling equilibrium with respect to the borrower’s maturity choice. Information revelation thus takes place through a borrower’s repayment behavior. We could also construct a model setup where the borrower types separate in the beginning (at t=0) through their contract choices. In that case (which for our purpose is less instructive) both borrower types would borrow at the full information rate corresponding to their type. See e.g. Diamond (1991) for details.
factor for a long-term debt contract then equals $2(\theta \eta)^{-1}$. A type G borrower then prefers short-term financing over long-term financing if $\eta(Y+(\theta \eta)^{-1}+R-1) \geq \eta(Y+R-2(\theta \eta)^{-1})$. It can easily be seen that this condition is satisfied for all $\theta$ and $\eta \in [0,1]$.

In the case of equity financing, (risk averse) firm managers could attempt to credibly signal the quality of their firms' assets to less informed outside investors by retaining a substantial stake in their own firm (and thereby giving up diversification benefits in their own investment portfolios; see Leland and Pyle (1977)).

In the solutions to the adverse selection problems discussed so far, better quality firms try to credibly communicate their private information by their choice of contract type and/or contract features. It may however not always be possible (or desirable) for firms to signal this information, for example because the revelation of proprietary information may benefit their competitors (see e.g. Myers and Majluf (1984), Bhattacharya and Chiesa (1995) and Yosha (1995)). In this case information production by the capital supplier may be necessary to resolve informational problems and to prevent market failure (see Section 4).

3.2 Solutions to Moral Hazard

Potential agency problems associated with the use of debt financing that have an impact on the investment behavior of a firm are underinvestment moral hazard (in projects and/or managerial effort), excessive risk taking (risk shifting or asset substitution moral hazard) and overinvestment moral hazard (see Jensen and Meckling (1976), Jensen (1986) and Myers (1977)). Underinvestment moral hazard occurs if a firm is relatively highly levered (i.e. has a debt overhang). If a firm’s manager acts in the interest of the firm’s current shareholders, he may then forego favorable investment projects, because the returns generated by these projects would mainly be captured by the lenders. Similarly, high leverage may induce risk shifting. That is, the manager of the firm may have an incentive to change the firm’s investment strategy towards riskier projects, thereby diluting the value of the firm’s debt (this is due to limited liability and the residual claim nature of equity). Overinvestment occurs in this context if these risk shifting incentives result in the acceptance of projects with a negative expected NPV.

These conflicts of interest between shareholders and debtholders may be mitigated by the use of collateral and covenants in debt contracts. Both contract features can reduce the borrowing firm’s nominal funding rate in a competitive market, and as such improve
(ex post) incentives (see also Result 3). The benefits of collateral have been discussed in Section 3.1. Covenants may be either negative or affirmative. Negative covenants restrain the borrower from certain actions, such as spending more than a specified amount on capital expenditures or dividends, or stipulate that measurable financial variables satisfy certain criteria (e.g. minimum levels of capital). Affirmative covenants require a borrower to meet certain standards, such as discharging contractual obligations and providing information at regular intervals (see Carey, Prowse, Rea and Udell (1993)). Observe however that, although covenants can be value-enhancing in resolving debtholder-shareholder conflicts, they could also be value-reducing, since they may limit a borrower’s flexibility in future decision making (see e.g. Berlin and Mester (1992)). The effectiveness of the use of specific covenants therefore depends on the type of industry in which the firm operates. The constraints in flexibility imposed by covenants may be relaxed through implicit and explicit provisions for contract renegotiation between borrowers and lenders. Information production by lenders and the potential renegotiability of debt contracts therefore can reduce the drawbacks of covenants. We will come back to this later (see Section 4.1 and Chapter 3).

Risk shifting and/or overinvestment problems associated with risky debt financing can also be reduced through the use of conversion features in debt contracts and/or warrants. These instruments give the debtholders the option to convert (part of) their claim on the firm into newly issued shares (mezzanine financing). Warrants and convertibles change the structure of the equity holders’ residual claim, and as a consequence alter their incentives to take risk (see e.g. Green (1984) and Stein (1992))\(^\text{15}\). The reason for this is twofold. First, the option premium implicit in the terms of the debt reduces the nominal interest rate required by lenders. Second, by issuing convertible debt or warrants the current shareholders (partly) give away the benefits from risk-taking; if conversion occurs, the debtholders get a fraction of the firm’s equity, and the fraction of equity in the hands of the current stockholders decreases. This dilution makes excess risk-taking less attractive.

\(^{15}\) Note the analogy between the equity of a levered firm and a call option, i.e. the equity claim in a levered firm can be interpreted as a European call option on the value of the firm, with an exercise price equal to the face value of the debt outstanding, and a maturity equal to the maturity of the debt (see e.g. Merton (1977)). The value of this call option increases with an increase in risk. The difference between warrants and convertibles is that the exercise of warrants results in a provision of new funds to the firm, whereas a conversion of bonds into equity only changes the structure of the investor’s claim on the firm. Both contract types however will make the equityholder’s claim on the firm more ‘concave’, and thus mitigate excess risk-taking incentives on the side of the manager.
The following calibration of the basic model structure illustrates this argument.

The Use of Convertible Debt as a Solution to Asset Substitution (and Overinvestment)

Moral Hazard

We again assume that a type $G$ borrower can choose between two investment projects: a safer project which generates a (partially contractible) end-of-period payoff of $X$ with a probability $\eta \delta$, a (partially contractible) end-of-period payoff $Y$ with a probability $\eta (1-\delta)$, and a payoff of 0 with a probability $(1-\eta)$, and a riskier project which generates $X$ with a probability $\alpha$, and 0 with a probability $(1-\alpha)$. Let $\eta Y > 1 > \alpha X$, $\alpha > \eta \delta$, with $\delta \in [0,1]$, and furthermore let $\eta^1 > [\eta \delta X + \eta (1-\delta) Y - \alpha X]/[\eta - \alpha]$.$^{16}$ The latter condition guarantees that the type $G$ borrower would invest in the riskier, negative NPV project in the case of straight debt financing.$^{17}$ We again consider a two-period setting. At $t=0$ the firm seeks financing and makes its investment decision, and the capital supplier sets the financing terms. At $t=1$ the capital supplier learns the end-of-period ($t=2$) cash flow (project value) to be generated by the firm. At $t=2$ cash flows are realized and the capital suppliers are paid, if possible. The type $G$ firm can choose between issuing long-term straight debt and convertible debt. With long-term straight debt, the firm pays the capital supplier the interest factor $r$ at $t=2$, conditional on project success. In the case of convertible debt the capital supplier has the option to give up his debt claim $r$ in return for a fraction $\gamma \in [0,1]$ of the firm’s equity, after learning the end-of-period value of the investment project at $t=1$. We assume that the current assets of the firm are completely equity financed. The following result shows that the use of convertible debt can solve the asset substitution problem that is present in the case of straight debt financing.

Result 7: If $\max[(\eta X)^1, [\eta \delta X + \eta (1-\delta) Y - \alpha X]/[\alpha X]] \leq \gamma \leq [\eta Y + \eta \delta (X-Y)]^1$, the type $G$ borrower prefers to issue convertible debt and invests in the safer, positive NPV project. With straight debt financing investment efficiency cannot be obtained.

Proof: Observe first that the parametric condition $\eta^1 > [\eta \delta X + \eta (1-\delta) Y - \alpha X]/[\eta - \alpha]$ guara-

$^{16}$ It can be shown that the set of parameter values of $\alpha$, $\eta$, $\delta$, $X$ and $Y$ which satisfies these parametric conditions simultaneously is non-empty. Furthermore, observe that the returns of the safer project still have a higher expected value and a lower variance than the returns of the riskier project.

$^{17}$ This assumption allows us to present the main argument without incorporating an adverse selection premium in the type $G$ firm’s funding cost, and is made for simplicity reasons only.
tees that the type $G$ firm would choose to invest in the negative NPV project with straight
debt financing, even if the financier sets the interest factor based on the belief that the type
$G$ firm chooses the safer project and charges $\eta^*$. That is, $\eta \delta(X-\eta^*) + \eta(1-\delta)(Y-\eta^*) < \alpha(X-\eta^*)$. This results in asset substitution (and overinvestment) moral hazard. Since
financiers rationally anticipate this, the competitive interest factor that the firm could obtain
with straight debt financing equals $\alpha^*$. In the case of convertible debt financing, we
conjecture that the convertible debtholder only wants to convert his debt into equity if he
learns that a high cash flow (project value) of $X$ will be realized at $t=2$ (we will verify this
conjecture later on). This implies that $\gamma X \geq r \geq \gamma Y$. The interest factor $r$ at which the financier
then would break even in a competitive market satisfies $\eta \delta \gamma X + \eta(1-\delta) r = 1$, with $r \leq \eta^*$. The
debtholder’s conjectured conversion strategy then is feasible if and only if $[\eta X]^1 \leq \gamma \leq [\eta Y + \eta \delta(X-Y)]^1$. Under these conditions the type $G$ firm (weakly) prefers the safer project
over the riskier project with convertible debt if $\eta \delta(1-\gamma)X + \eta(1-\delta)(Y-r) \geq \alpha(1-\gamma)X$, i.e. if
$\gamma \geq [1-(\eta \delta X + \eta(1-\delta)Y-\alpha X)]/\alpha X$. Since $[1-(\eta \delta X + \eta(1-\delta)Y-\alpha X)]/\alpha X < [\eta Y + \eta \delta(X-Y)]^1 < 1$, the firm’s investment strategy and the debtholder’s conversion strategies are consistent for
$\gamma \geq \max[(\eta X)^1, (\eta \delta X + \eta(1-\delta)Y-\alpha X)/\alpha X]$. Finally, it can easily be seen that the type $G$
firm prefers to issue convertible debt over straight debt, since $\eta \delta(1-\gamma)X + \eta(1-\delta)(Y-r) > \alpha X - 1$ under these conditions.

The intuition behind Result 7 is that the use of convertible debt allows the financier to
(partially) share in the upside potential of project returns. This lowers the break-even
interest rate charged by the convertible debtholder as compared to the case of straight debt
financing, and thus mitigates the firm’s incentives to engage in risk shifting. If the equity
stake that convertible bondholders receive upon conversion is sufficiently high, asset
substitution can generally be ruled out completely\(^\text{18}\). The use of subordinated debt can be
rationalized analogously. Using a similar type of argument, the combination of debt and
warrants can be shown to reduce underinvestment moral hazard (see Chiesa (1992)). Firms
that are subject to potentially severe moral hazard problems due to unfavorable lending

\(^{18}\) Observe that in our example the stake $\gamma$ that convertible debtholders receive cannot be too high. This
is due to the stylized nature of our model (in particular, the discrete 'three-state distribution' setting). The
reason is that for a relatively high value of $\gamma$ the convertible debtholders would always want to convert their
debt into equity in the case of a positive project value, i.e. $\gamma Y > r$. In that case, the claim that the convertible
debtholder gets is essentially equivalent to an equity claim, and the riskier project will always be preferred.
For an exposition of the benefits of debt and warrants in a setting with a continuous cash flow distribution,
see Green (1984).
terms thus may prefer mezzanine-financing, or may need to be financed through equity-type of financial claims.

Another contracting solution to moral hazard problems associated with debt financing is the use of long-term loan commitments (see e.g. Boot, Thakor and Udell (1987) and Boot, Greenbaum and Thakor (1993)). Loan commitments are contracts which give the borrower an option to borrow up to a certain loan amount in the future at a predetermined interest rate. With a loan commitment, a lender can promise to lend at an interest rate that is low enough to deter moral hazard on the side of the borrower. The lender's compensation for this promise is a commitment fee, which is generally paid upfront by the borrower. Since the borrower treats this fee as a sunk cost at the time the investment decision is made, this fee does not adversely affect a borrower's investment incentives. Loan commitments often need to be customized to a borrower's specific needs. These contracts therefore are most effectively offered by banks (see Section 4.1 and also Chapter 3). The following example illustrates the beneficial incentive effects of the use of loan commitments.

The Use of Loan Commitments as a Solution to Asset Substitution (and Underinvestment) Moral Hazard

We again consider a two-period model structure. At \( t=0 \) a type \( G \) borrower knows that he has the opportunity to invest in either the safer project or the riskier project at \( t=1 \). The type \( B \) borrower's investment opportunity generates a (partially contractible) cash flow \( Z \) with a probability \( \xi \), and 0 otherwise, with \( \xi Z > 1 \). We assume that the lender does not know the fraction of type \( G \) borrowers in the borrower pool at \( t=1 \) at the outset. The realization of this fraction at \( t=1 \) can either be \( \theta \) or \( \tilde{\theta} > \theta \), both with an equal probability. The lender can offer the borrower either a spot loan at \( t=1 \), or a loan commitment contract at \( t=0 \). With a loan commitment contract, the borrower pays an initial fee \( f \) at \( t=0 \) in exchange for the option to borrow \( S \) at \( t=1 \) at a predetermined interest rate. The borrower chooses between these two financing options and makes his investment decision at \( t=1 \). We assume that \( \theta \) and \( \tilde{\theta} \) satisfy \( Z > \xi^{-1} \left[ \theta \alpha + (1-\theta) \xi \right] > X > [\eta \alpha + (1-\theta) \xi] > Y > [\eta Y - \alpha X]/[\eta - \alpha] > [\tilde{\eta} \alpha + (1-\tilde{\theta}) \alpha] \). Under this condition the following result can be derived.

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19 The quality of the borrower pool at \( t=1 \) could for example depend on some exogenous factor (or an exogenous 'shock'), which for simplicity reasons has not been modeled. This approach is equivalent to assuming that the future spot interest rate is stochastic (see e.g. Boot, Thakor and Udell (1989), Boot, Thakor and Udell (1991) and Boot, Greenbaum and Thakor (1993)).
Result 8: In the case of spot contracting at $t=1$, the type G borrower invests in the safer project only if $\theta=\bar{\theta}$. If $\theta=\underline{\theta}$, underinvestment occurs. With a loan commitment contract, investment efficiency occurs both for $\theta=\bar{\theta}$ and $\theta=\underline{\theta}$.

Proof: First, consider the case of spot contracting at $t=1$. If $\theta=\bar{\theta}$, the pooling interest rate charged by the lender under the assumption that the type G firm chooses the safer project equals $[\eta\eta+(1-\bar{\theta})\xi]\uparrow$. Under the parametric condition stated above, however, the type G borrower would prefer the riskier project at this pooling rate. Since the market anticipates this, the competitive interest rate charged if $\theta=\bar{\theta}$ would equal $[\eta\alpha+(1-\bar{\theta})\xi]\uparrow$. Since this interest rate is larger than $X$, the type G borrower then would refrain from financing and forego investment. In this case, only the type B borrower would invest, and underinvestment occurs. If $\theta=\bar{\theta}>0$, the pooling rate $[\bar{\theta}\eta+(1-\bar{\theta})\xi]\uparrow$ would be sufficiently low to induce the type G borrower to invest in the safer project. In order to prevent underinvestment for $\theta=\bar{\theta}$, the lender could offer the borrower a loan commitment which enables the borrower to borrow $1$ at an interest factor $[\eta\gamma+(1-\bar{\theta})\xi]\downarrow\uparrow$. At this interest factor the type G borrower is indifferent between the safer and the riskier project. The type G borrower would exercise this option if $\theta=\bar{\theta}$, and thus would (weakly) prefer the safer project. If $\theta=\bar{\theta}$, the borrower leaves the loan commitment unexercised, and borrows at the $t=1$ spot interest rate of $[\bar{\theta}\eta+(1-\bar{\theta})\xi]\downarrow<[\eta\gamma+(1-\bar{\theta})\xi]\downarrow\uparrow$. With a loan commitment, investment efficiency thus can be completely restored. In order to break even in a competitive market, the lender needs to charge a fee $f$ at $t=0$ to recoup the expected loss from 'subsidizing' the borrower if $\theta=\bar{\theta}$. It is straightforward to derive that this fee $f$ equals $\frac{1}{2}[1-\eta\eta+(1-\bar{\theta})\xi]\downarrow[\eta\gamma+(1-\bar{\theta})\xi]\downarrow\uparrow$. Observe finally that, since the type G borrower would treat the commitment fee as a sunk cost when he makes his investment decision, this fee does not affect the borrower's project choice.

Underinvestment problems stemming from a debt overhang, finally, can be reduced if a firm can issue debt with a shorter maturity and/or a higher seniority (priority) than its existing debt claims (see Myers (1977) and Boot and Verheyen (1997) for an exposition). Whether this is possible, however, depends on the stringency of the covenants present in the firm's existing debt contracts.

Agency problems associated with equity financing are overinvestment (or 'empire building'), reporting moral hazard, effort aversion moral hazard and perquisites consumption. The latter two types of moral hazard have been discussed in Section 2. Overinvestment moral hazard generally occurs in larger, more mature corporations, which generate high free cash flows (financial slack), but have few value-enhancing investment opportuni-
<table>
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<tr>
<th>Type of Information Asymmetry and Consequences</th>
<th>Financial Contracting Solution (Contract Type and Features)</th>
<th>Applicability (Type of Corporations)</th>
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<td>'Ex ante information asymmetry' ('Adverse selection')&lt;br&gt;→ May cause 'moral hazard' (see below)</td>
<td>(Debt) market failure → 'Credit rationing' ('underinvestment')&lt;br&gt;Use of collateral → Multi-dimensional loan contracts&lt;br&gt;Choice of maturity structure&lt;br&gt;Inside owner's stake in firm</td>
<td>Depends on industry and asset specificity&lt;br&gt;- yes: firms with tangible non-specific assets&lt;br&gt;- no: start-up firms with intangible assets in cyclical industry&lt;br&gt;Depends on cash flow pattern&lt;br&gt;Depends on external financing needs</td>
</tr>
<tr>
<td>'Ex post information asymmetry' ('Moral hazard')&lt;br&gt;Manager-Shareholder Conflict&lt;br&gt;* 'Effort aversion/underinvestment'&lt;br&gt;* 'Perquisites consumption'&lt;br&gt;* 'Empire building/overinvestment'&lt;br&gt;Shareholder-Debtholder Conflict&lt;br&gt;* 'Underinvestment' ('Debt overhang')&lt;br&gt;* 'Risk shifting/asset substitution' 'Overinvestment'</td>
<td>Increase equity stake manager (by debt financing)&lt;br&gt;Choose debt contracts&lt;br&gt;Use of collateral and covenants&lt;br&gt;Use of multi-period commitments&lt;br&gt;Choice of maturity and seniority&lt;br&gt;Use of collateral and covenants&lt;br&gt;Use of conversion features and warrants in debt or subordinated debt (mezzanine financing)&lt;br&gt;Use of multi-period commitments</td>
<td>Depends on external financing needs and degree of managerial discretion&lt;br&gt;(Mature) firms with large free cash flows&lt;br&gt;Depends on asset specificity, covenants and flexibility needs for decision making&lt;br&gt;Depends on the severity of adverse selection and moral hazard problems and on the degree of managerial discretion</td>
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Table 1: Overview of Financial Contracting Solutions to Informational Problems in Capital Markets
ties. In this case managers may prefer to increase their private benefits from controlling the firm by investing the free cash flows in negative NPV projects, instead of paying them out to the shareholders. This problem may be mitigated by reducing the free cash flows at the manager's discretion, for example through issuing debt claims. By issuing debt the manager commits to service the debt whenever possible, since he loses his control benefits in the case of default. In addition, debt financing forces the manager to increase his efficiency in managing the firm ('control hypothesis of debt', see Jensen (1986)). The agency costs of equity increase with the fraction of outside equity financing. Investment inefficiencies arising from conflicts of interest between shareholders and managers therefore can be reduced by increasing the amount of debt, or by the managers otherwise committing to behaving in the interest of the shareholders\textsuperscript{20}. Furthermore, firms which suffer from these types of moral hazard problems may prefer to be monitored by outsiders (see Section 4). A firm's incentives to engage in reporting moral hazard in the case of outside financing finally may also be curbed by the use of debt contracts (see e.g. Townsend (1979) and Diamond (1984)). The intuition here is that a manager may lose substantial private benefits of control, or the firm's assets are liquidated, if the firm is detected to unjustifiably (or strategically) default on its debt.

In the exposition of the financial contracting solutions given above, we have shown that financial contracts may be designed to mitigate specific informational problems and investment distortions, and hence can reduce a firm's cost of funding and/or increase the availability of capital (by making market failure less likely). Table 1 briefly summarizes these arguments and links them to the characteristics of a firm's assets and the different types of incentive problems.

4 Solutions to Informational Problems: The Firm's Funding Source Choice

In our discussion so far, the focus has been on the firm's manager trying to either reveal his private information to the financier, or to commit to desired behavior ex ante ('bonding') by his choice of financial contract. Information asymmetry can also be reduced if the capital supplier produces information on the borrower. Different capital suppliers perform different roles in dealing with informational problems, and therefore may have a

\textsuperscript{20} A large strand of literature analyzes how incentive problems between managers and shareholders can be attenuated through the use of managerial compensation mechanisms, see e.g. Harris and Raviv (1979), Holmström (1979), Holmström and Milgrom (1993) and Milbourn (1997). We will discuss this literature in some detail in Chapter 4.
different impact on a firm’s cost of capital and on the availability of financing to firms in the economy. In this section we will concentrate on the informational role of the capital supplier and discuss the interactions between firms and three different types of financiers: banks, investors in the financial market and venture capital firms.

4.1 Bank financing

The existence of banks (and other financial intermediaries) can be viewed as an institutional response to the inability of market-mediated mechanisms to efficiently resolve informational problems (see e.g. Bhattacharya and Thakor (1993)). Banks invest in information production in order to screen prospective borrowers ex ante and/or to monitor them ex post (see Leland and Pyle (1977), Diamond (1984) and Ramakrishnan and Thakor (1984)). By constructing large and well-diversified portfolios, banks can perform these activities in a more cost-efficient way than individual investors in the financial market by preventing free-riding problems and a wasteful duplication of information production. The information produced by banks furthermore may be cross-sectionally and/or intertemporally reusable (see Chan, Greenbaum and Thakor (1986)). The bank’s screening and monitoring role is particularly beneficial for relatively new borrowers without well-established reputations in the credit market, and for firms with a wide scope for discretionary behavior. Since these firms would face unfavorable financing terms in the market, loan monitoring may be needed to prevent risk shifting, overinvestment and/or underinvestment moral hazard. Firms with a good public track record on the other hand would prefer to issue debt in the financial market. Since such firms can obtain financial market financing at favorable terms, they are less inclined to engage in moral hazard. These firms therefore do not want to compensate a bank for the costs of (ex post) information production, and prefer ‘cheaper’ financial market financing (see e.g. Diamond (1991)).

An important feature of bank financing is that it may allow for the development of long-term customer relationships and commitments between borrowers and lenders. This may mitigate information asymmetries along several dimensions. A borrower may be prepared to reveal proprietary information to his bank, while he would never disseminate this information to the financial market, and hence to his competitors (see e.g. Bhattacharya and Chiesa (1995) and Yosha (1995)). Furthermore, a borrower’s main bank may gain unique information on a borrower through the observation of his checking accounts. A bank might also be more receptive to information because of its role as enduring and dominant lender, and thus may have better incentives to invest in information acquisition.
While this is costly, the substantial stake that the bank has in the funding of the borrower, and its enduring relationship - with the possibility of information reusability over time - increase the value of information to banks (see e.g. Chan, Greenbaum and Thakor (1986) and Boot and Thakor (1998)).

A frequently mentioned benefit of the development of bank-firm relationships is that such relationships enable the bank and the borrowing firm to intertemporally share surplus by 'smoothing' interest rates. This may increase a bank’s willingness to finance credit-constrained (in particular young and distressed) firms, since the bank may be able to capture the benefits from funding or 'subsidizing' a firm in an early stage of the relationship in a later stage of the lending process (see e.g. Petersen and Rajan (1995) and Allen and Gale (1996)). This argument can be illustrated as follows.

**Multi-Period Bank-Firm Relationships and Intertemporal Smoothing of Interest Rates**

We again consider a two-period version of the basic model of Section 2. In the first period the type G borrower can choose between the safer and the riskier project presented earlier. Conditional upon first period success, the type G borrower has a project in the second period which requires an investment outlay of $I > X > Y = \frac{\theta \eta + (1-\theta) \xi}{\xi}$, and generates a payoff of $R > I$ with a probability 1. The second period investment project therefore requires new outside financing at $t=1$. The type B borrower’s first period investment opportunity set is unchanged. Type B thus has a project which generates a cash flow of $Z$ with a probability $\xi$, with $\xi Z < 1$. The type B borrower’s second period investment project generates a payoff of $0$ with a probability 1. The borrower can enter into a one-period or a two-period lending relationship with an outside capital supplier. For now, we assume that this outside capital supplier is a bank which invests in monitoring and therefore will learn the borrower’s type at $t=1$. If the borrower doesn’t repay his first period loan at $t=1$, the bank can liquidate the borrower’s assets. For simplicity, we assume that the liquidation value $L$ of the assets equals 0. The bank has some market power over the future project (see later), and thus has the possibility to extract some rents $M \in (0, (\theta \eta)^{1-\xi})$ in the second

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21 Observe that this choice is not equivalent to the choice between short-term and long-term contracts. In fact, analogous to the proof of Result 8 it can be shown that both borrower types would choose short-term contracts in a pooling equilibrium at $t=0$. The decision that the borrower needs to make is whether to borrow from the same lender in both periods or not.
period. All cash flows are assumed to be partially contractible (see footnote 4). The following result now can be derived.

**Result 9:** In the case of a one-period bank-firm relationship credit rationing occurs for \( \theta < \theta^D \) (see Result 3). In the case of a two-period bank-firm relationship, the bank can also accommodate borrowers with \( \theta \in [\theta^R, \theta^A] \). Furthermore, there exists a \( \theta^R \in [\theta^R, \theta^A] \) such that asset substitution moral hazard is prevented for \( \theta \in [\theta^R, \theta^A] \) (see Result 3). Both \( \theta^D \) and \( \theta^R \) decrease monotonically in \( M \).

**Proof:** For the first part of Result 9 see the proof of Result 3 in Section 2 (with \( \theta^D \) and \( \theta^A \) as defined there). Since the bank needs to break even in each period, the first period pooling interest rate charged by the bank for \( \theta < \theta^D \) induces moral hazard on the side of the type \( G \) borrower, which in turn causes the debt market to fail. For the second part of the proof, define \( \theta^D = \left[ \frac{1 - \xi}{(\alpha - \xi)X + \alpha M} \right] \) and \( \theta^A = \left[ \frac{(\eta - \alpha) - (\eta Y - \alpha X)\xi}{(\eta - \xi)(\eta Y - \alpha X) + (\eta - \alpha)\eta M} \right] \). In the case of a two-period bank-firm relationship, the bank needs to break even over a two-period time span, i.e. the bank’s zero profit constraint can be written as \( [\theta \eta + (1 - 0)\xi]r + \theta M(1 + M - 1) = 1 \). The first period pooling interest rate charged by the bank thus is equal to \( [1 - \theta M][\theta \eta + (1 - 0)\xi]^{-1} \). For \( \theta \geq \theta^D \) this interest rate is smaller than \( [\eta Y - \alpha X]/[\eta - \alpha] \), the interest rate for which the type \( G \) borrower would be indifferent between the safer and the riskier project, and the type \( G \) borrower consequently would invest in the safer project. Since \( \theta^D < \theta_A \), asset substitution moral hazard is reduced in comparison with the one-period relationship case. For \( \theta < \theta_A \) the type \( G \) borrower prefers the risky, but still positive NPV project, and the bank charges a pooling rate \( [1 - \theta \alpha M][\theta \alpha + (1 - 0)\xi]^{-1} \). If \( \theta < \theta^D \), this interest rate is larger than \( X \), and the type \( G \) borrower consequently does not want to invest. Analogous to Result 3 in Section 2 it can be shown that in this case the debt market breaks down. Finally, by differentiating \( \theta^D \) and \( \theta^A \) with respect to \( M \), it can be shown that both are monotonically decreasing in \( M \).

The intuition behind Result 9 is that in a two-period bank-firm relationship the bank has the possibility to overcome incentive problems (risk shifting and/or underinvestment moral hazard) on the side of the borrower by offering a lower interest rate in the beginning of the relationship. The benefits from doing so can then be internalized at a later stage.

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22 In general, these rents could be the outcome of a bargaining game, which is not specified here (see Rajan (1992)). For an illustrative numerical example, see Greenbaum and Thakor (1995), pp. 280-282.
Consequently, the bank may be more willing to offer credit to new (or low \( \theta \)) borrowers. The higher the rents \( M \) that the bank can extract from future projects, the more the bank can relax borrowers’ credit constraints in the beginning of a bank-firm relationship.

A bank’s financing terms can thus be tailored to the borrower’s specific needs. Analogously, the advancement of funds can be staggered or delayed, while confidentiality concerning the borrower’s financial condition and business operations can be maintained. Firms that generate low actual cash flows, but have a high potential for future cash flows (e.g. due to growth opportunities), may benefit from these long-term interactions. Since the uncertainty about these firms’ prospects may be high, investors in the financial market may be forced to charge a high interest rate until this uncertainty is resolved. This could be extremely distortionary to the firms’ incentives and hence might result in the firm not receiving credit at all (adverse selection causes moral hazard, which in turn may lead to credit rationing; see Result 3 in Section 2).

The beneficial impact of the development of long-term customer relationships on the provision of funding to viable corporations depends on the extent of concentration and competition in credit markets. Creditors in concentrated markets will be able to extract future rents from a borrower, and consequently may accept lower returns upfront. This allows more firms to be financed, and increases the availability of credit in the economy. Competition in the credit market, on the other hand, may force banks to break even on a period by period basis, and hence may be inimical to the formation of mutually beneficial relationships between firms and lenders (in our model structure this is the case for \( M=0 \)). During the lending process, however, competition between lenders may be reduced if a lender develops an informational monopoly (see e.g. Sharpe (1990)). In the context of the model presented above this can be seen as follows. Assume that the bank learns the borrower’s type at \( t=1 \), whereas an outside capital supplier can only observe whether repayment on the first-period loan has occurred or not. Conditional on the borrower’s

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In this case the parameter \( M>0 \) represents ‘monopolistic’ rents that could be captured by the bank, even if information with respect to the borrower’s quality is perfectly revealed to other, outside capital suppliers at \( t=1 \) (see Petersen and Rajan (1995) for an exposition of the case with \( \xi=0 \)).

Note that we constructed the model in such a way that repayment on the first period loan would not result in a perfect revelation of the borrower’s type. This is the case if \( \xi>0 \). Since we assume that the lenders can liquidate the borrower’s assets in the case of default - and under the assumption that liquidation is observable - the absence of liquidation would be perfectly revealing in the case where \( \xi=0 \). This would rule out the development of an informational monopoly on the side of the bank at \( t=1 \).
first period repayment behavior the outside capital supplier then updates its beliefs with respect to the borrower’s type, using Bayes’ Rule, and assigns a posterior probability $\mu$ equal to $[\theta \eta][\theta \eta+(1-\theta)\xi]^{-1} > \theta$ that a repaying borrower is of type $G$. The competitive second-period interest rate that the outside capital supplier then can charge equals $\mu^2$. The inside bank now can also charge this interest rate in the second period, without losing the borrower to a competing ‘outside’ lender, and thus can extract rents $M$ equal to $\mu^2 - 1 = (1 - \theta)\xi(\theta \eta)^{-1} > 0$ from a type $G$ borrower at $t=1$, even in a perfectly competitive credit market.

A potential drawback of (ex post) rent extraction by the bank however is that such rent extraction may distort the ex ante allocation of credit in the economy and/or ex ante investment incentives on the side of the borrower (see e.g. Sharpe (1990) and Rajan (1992)). In fact, the former already occurs in the model described above (and therefore is implicit in Result 9), since the type $B$ borrower’s investment project has a negative expected NPV and thus should not be financed. Since $\theta \rho > \rho$, the probability that a type $B$ borrower’s project would get financed is higher in the case of a multi-period bank-firm relationship than in a one-period bank-firm interaction. In order to explore the effect of ex post rent extraction on the borrower’s ex ante incentives, assume that the type $G$’s investment opportunity set is stochastic at $t=0$. That is, the borrower can either have a safer (good) project which generates a certain payoff of $Y$ at $t=2$ or a riskier (bad) project, which pays off $X$ with a probability $\alpha$ and 0 otherwise, with $\alpha X < 1$. The type $G$ borrower can influence the quality of his investment opportunity by exerting costly effort. The choice of an effort level $e$ incurs (private) costs equal to $e$ and generates a good project with a probability $\eta(e)$, with $\eta(0) = \eta$, $\eta'(e) > 0$ and $\eta''(e) < 0$ (see also Section 2). With a probability $1-\eta(e)$ the type $G$ borrower finds a bad project. In the case of bank financing, both the borrower and the bank learn the quality of the borrower’s investment project at $t=1$. Outside capital suppliers, on the other hand, do not invest in information production and, as a consequence, do not learn project quality. At $t=1$ the type $G$ borrower’s investment project can be liquidated for an amount $L \in (\alpha X, 1)$, irrespective of its quality. This assumption ensures that it is first best optimal to liquidate a bad project at $t=1$ and to continue a good project. Since the type $G$ borrower receives nothing in the case of liquidation, it is obvious that he always wants to continue the investment project at $t=1$. We focus on short-term debt contracts which are renewed at $t=1$. Let $\eta Y + (1-\eta)\alpha X > L$. In this case, an outside capital supplier would never liquidate the project at $t=1$. The interest

25 This adjustment of our basic model structure is similar to Rajan (1992).
factor $r$ charged by an outside capital supplier then has to compensate the capital supplier for the inefficient continuation of a bad project, and satisfies $\eta(e)r + (1-\eta(e))\alpha r = 1$. The borrower's effort choice in this case satisfies $\eta'(e)(Y-r) = 1$. With bank financing, the bad project would be liquidated at $t=1$. Since $L > \alpha X$ this would in itself decrease the interest rate charged by the bank. However, the bank can also threaten to liquidate a good investment project at $t=1$ by not refinancing the first period loan, and thus can extract rents equal to $\lambda (Y-L)$ from the borrower in the case he has a good project, with $\lambda \in (0,1)$\textsuperscript{26}. The type $G$ borrower's optimal effort choice in case of bank financing then maximizes $\eta(e)(1-\lambda)(Y-L)-e$, and satisfies $\eta'(e)=1/[(1-\lambda)(Y-L)]$. It can now easily be seen that for $\lambda$ sufficiently large the ex ante effort level chosen by the borrower is low, and may be lower than in case of financing by an outside capital supplier. In choosing his financing source, the borrower then trades off the benefit of ex post investment efficiency in the case of bank financing with the adverse effect on the firm's effort decision. Some implications for the firm's funding source choices following from these insights are that borrowers who anticipate a sequence of very profitable future projects would abstain from bank financing in order to prevent future rent extraction by the bank, whereas borrowers with poorer projects would benefit from monitoring and thus would prefer bank loans. Observe finally that some of the incentives distortions described above could be prevented by the use of loan commitments in a multi-period bank-firm relationship (see Section 3). Furthermore, reputational mechanisms in the financial market may curb the bank's incentives to engage in excessive rent extraction (see e.g. Sharpe (1990) and Boot, Greenbaum and Thakor (1993)).

Another distinctive feature of bank-borrower relationships is that such relationships are generally less rigid than those normally encountered in the financial market. This facilitates more informative decisions based on a better information flow between borrower and lender. Bank-firm relationships can be viewed as mutual commitments based on trust and respect. This would allow for the use of implicit (non-enforceable) long-term contracts and commitments. Reputational mechanisms and information production are important for sustaining such commitments (see Sharpe (1990) and Boot, Greenbaum and Thakor (1993)).

\textsuperscript{26} The calculation of these rents relies on the implicit assumption that the type $G$ borrower will not switch to an outside capital supplier at $t=1$. This could for example be the case because the interest rate charged by the outside capital supplier is relatively high. For an explicit analysis of competition between informed and uninformed lenders at the intermediate date see Rajan (1992). The parameter $\lambda$ can be interpreted as the degree of the bank's bargaining power.
and also Chapter 3). Information asymmetries in the financial market, and also the non-contractibility of various pieces of information on the borrower could rule out the use of alternative long-term capital market funding sources, as well as explicit long-term commitments by banks, in some circumstances.

The concentrated nature of bank financing furthermore facilitates renegotiations between banks and borrowers. This allows for a qualitative use of flexibility, for example in dealing with the arrival of new (potentially 'soft' or non-verifiable) information in the post-contracting stage, and thus may enhance investment efficiency (see e.g. Berlin and Mester (1992) and Chapter 3). Borrowers who are relatively high credit risks and about whom information is more volatile therefore may prefer bank loans with stringent covenants, since such loans more easily trigger mutually beneficial renegotiation, and these borrower types are furthermore closely monitored by banks27.

In addition, bank loans are less subject to 'free-riding'-problems than bond issues or other public capital market funding vehicles. This facilitates timely intervention in the case of financial distress (see e.g. Gertner, Scharfstein and Stein (1991))28. The following model structure demonstrates this argument.

**Renegotiation and Timely Intervention with Bank Financing**

Consider the following simple two-period model structure. We assume that a borrower can invest $1 in a project which generates a (partially contractible) $t=1$ cash flow of $Y$ with a probability $\eta$ (i.e. if a good state occurs) and $1-\eta$ with a probability $1-\eta$ (i.e. in the bad or 'distressed' state). In the distressed state this cash flow needs to be reinvested in the firm at $t=1$ in order to continue the project. Continuation of the project in the good state requires

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27 The combination of covenants, monitoring and renegotiation may explain which types of borrowers fund in different markets under different contract terms. In Carey, Prowse, Rea and Udell (1993) this is denoted as the 'CMR'- or 'Covenants-Monitoring-Renegotiation'-paradigm, based on which the authors present an outline for a theory of specialization of financial intermediaries.

28 An example of timely intervention has already been given in the model structure presented above, since a bank could liquidate a negative NPV project at an intermediate date, whereas an outside (less informed) capital supplier wouldn't. In the model structure that follows, we focus on the differences in the possibilities for renegotiation between banks and investors in the financial market when both types of financiers are equally informed about the quality of the borrower's investment projects.
no additional financing at \( t=1 \). If the project is continued at \( t=1 \), it generates a certain payoff (or value) of \( R > 1 \) at \( t=2 \). Liquidation of the project at \( t=1 \) yields the lender a payoff of \( 0 < L < R - I \). Continuation of the project in the distressed state would therefore be optimal. The project can either be financed by a bank, or by a large number of investors in the financial market. In the case of financial market financing, we assume that each bondholder holds an infinitesimally small fraction of the bonds issued by the firm. We furthermore assume that the firm is financed with long-term (renegotiable) debt contracts. At \( t=1 \) each type of capital supplier needs to decide whether to reinvest the borrower’s first period interest payment in the distressed state in order to continue the project, or not. In this context we can derive the following result.

**Result 10:** With bank financing the project will be (efficiently) continued in both states. In the case of financial market financing the project will be liquidated in the distressed state.

**Proof:** If the good state occurs, the borrower makes his first period interest payment to the lender, and the project is therefore continued. In the distressed state, the borrower cannot fully pay his first period interest obligation. In this case the lender has the option to either liquidate the project, or to forgive the first period debt repayment and reinvest \( I \) in the firm in order to continue the project. With bank financing, debt forgiveness will occur and the project will be continued, since \( R > L + I \). In the case of financial market financing, however, a holdout (or coordination) problem arises. That is, since each bondholder holds an infinitesimally small fraction of the total number of bonds issued by the firm, he neglects his influence on the probability that the borrower’s first period debt obligation will be forgiven. An individual bondholder who expects that the other bondholders will forgive the borrower’s first period interest payment will then not be willing to forgive debt and reinvest his \( t=1 \) debt claim, since holding out from reinvesting will yield him a higher expected payoff conditional on project continuation. Since each bondholder will make this tradeoff, debt forgiveness will be prevented, and the project will be inefficiently liquidated. Finally, observe the analogy between this holdout problem and the free-riding problem in the context of hostile takeovers (see Grossman and Hart (1980)).

A potential drawback of the concentrated nature of bank financing could be that

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29 We assume here that the firm cannot obtain the amount \( I \) of financing needed at \( t=1 \) from a new capital supplier. A possible reason for this could be that a new capital supplier generally requires priority, which may be prohibited by the current debt contract’s covenants (see e.g. Boot and Verheugen (1997)).
banks may suffer from a 'soft budget constraint' problem, i.e. borrowers may realize that they can renegotiate with the bank ex post, which could give them perverse ex ante incentives (see e.g. Dewatripont and Maskin (1995)). For example, borrowers that anticipate that it is ex post efficient for a bank to refinance a loan in a bad state (e.g. in order to (re)capture some of the payoffs from its original loan) may exert less effort ex ante to prevent such a bad state from occurring. Decentralization of credit through financial market funding then may be beneficial, because it creates coordination problems in renegotiation. To see this, assume that the borrower in the model structure described above can influence the probability of a good or a bad state occurring by exerting costly effort \( e \) (as before). We assume that in the distressed state the t=1 cash flow generated by the project equals 0, and that continuation of the project will generate a cash flow of \( X>Y \) with a probability \( \alpha \) and 0 with a probability \( 1-\alpha \) at t=2, with \( \eta(Y+R) > \alpha X > 1 \). As before, the project generates a t=1 cash flow of \( Y \) in the good state, and an additional t=2 cash flow of \( R \) upon continuation. In addition, we assume that at t=1 an additional $1 of external financing is needed to continue the project, and that \( 0<L<\alpha X-1 \). Continuation of the project in the bad state thus is socially efficient. We again focus on long-term debt contracts. Then with bank financing, the bank will forgive the borrower’s first period interest payment and refinance the project in the distressed state, since this allows the bank at least a partial expected repayment on its original debt at t=2. With financial market financing, renegotiation will fail (see Result 10), and the project would be liquidated in the bad state. Since the borrower’s payoff in the case of liquidation is 0, the borrower would consequently choose a higher effort level with financial market financing in order to prevent the bad state from occurring. That is, in the case of financial market financing the effort level chosen by the borrower maximizes \( \eta(e)[Y+R-(r+1)]-e \) and satisfies \( \eta'(e)=[Y+R-(r+1)]^{-1} \). In the case of bank financing, the optimal effort level maximizes \( \eta(e)[Y+R-(r+1)]+(1-\eta(e))\alpha(X-(r+\alpha^{-1})) \) \( -e \), i.e. \( \eta'(e)=[Y+R-(r+1)-\alpha(X-(r+\alpha^{-1}))]^{-1} \). Since \( \eta''(e)<0 \) the borrower therefore chooses a lower effort level in case of bank financing\(^ {30} \). The borrower’s anticipation of (ex post) renegotiation in the distressed state makes this state relatively more attractive, and therefore distorts (ex ante) effort incentives. Using a similar idea, Wilson (1994) argues that the

\(^{30}\) Observe that in these expressions \( r \) represents the total interest payments made on the original \( t=0 \) loan (i.e. the first and second period coupon payments plus the repayment of the face value of $1). In order to prevent underinvestment we assume that \( Y+R>(1+r) \), i.e. the total cash flows realized by the project are sufficiently high to make investment worthwhile for the borrowing firm’s shareholders. Also observe that the second period interest rate that the bank would charge on the amount of refinancing in the distressed state equals \( \alpha^{-1} \).
### Main (Informational) Features of Bank Financing

<table>
<thead>
<tr>
<th><strong>Cost-Efficient Information Production</strong></th>
<th><strong>Applicability to Borrower Type</strong></th>
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</thead>
<tbody>
<tr>
<td>* Benefit: Ex ante screening and ex post monitoring</td>
<td>New borrowers without credit reputation ('track record'), R&amp;D-firms with scope for discretionary behavior, firms in 'traditional' industries with scope for moral hazard</td>
</tr>
</tbody>
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<table>
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<tr>
<th><strong>Development of Long-Term Relationships and Commitments</strong></th>
<th><strong>Applicability to Borrower Type</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>* Benefit: Possibility to intertemporally share surplus ('intertemporal smoothing')</td>
<td>Credit-constrained firms (start-up or distressed firms), firms with high growth opportunities</td>
</tr>
<tr>
<td>* Benefit: Credibility in offering long-term loan commitments</td>
<td>Credit-constrained firms which are potentially subject to moral hazard problems</td>
</tr>
<tr>
<td>* Benefit: Confidentiality</td>
<td>R&amp;D-firms with proprietary information</td>
</tr>
<tr>
<td>* Drawback: Rent extraction due to informational monopoly at intermediate date</td>
<td>Firms with poorer prospects for future profits</td>
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<tr>
<th><strong>Concentrated Nature Bank Financing Facilitates Renegotiation and Refinancing</strong></th>
<th><strong>Applicability to Borrower Type</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>* Benefit: Flexibility in dealing with new information in post-contracting stage and timely intervention</td>
<td>Firms with relatively high credit risks (and volatile information), firms with need for flexibility, financially distressed firms, firms with small intra-firm incentive problems</td>
</tr>
<tr>
<td>* Drawback: 'Soft budget constraint' problem</td>
<td>Firms with small ex ante incentive problems</td>
</tr>
</tbody>
</table>

Table 2: Overview of Benefits and Drawbacks of Bank Financing
resolution of severe intrafirm incentive problems in large corporations would call for 'hard budget constraints', and thus financial market funding, in order to guarantee ex ante efficient project selections. Smaller firms that are less subject to such incentive problems would prefer bank financing to benefit from the flexibility of renegotiation.

The arguments described above also have implications for the seniority and maturity structure of loan contracts offered by banks. A bank's incentives to produce information on borrowers could be enhanced by giving the bank a more junior claim on the firm, whereas the possibilities for timely intervention and efficient renegotiation would speak for seniority and a short maturity of bank debt (see e.g. Gorton and Kahn (1996)). Banks with senior claims are less likely to be subject to soft budget constraint problems (in comparison with junior claims, such as subordinated debt and/or equity) and therefore may impose more credible threats on the borrower to cut off credit or to change the terms of financing in the course of time. This has a disciplinary effect on the borrower.

Summarizing, bank loans are relatively short-term, possibly collateralized loans, which in general are heavily restricted by covenants, or may embody longer-term implicit commitments supported by reputational considerations. Bank financing is likely to be preferred when asset substitution moral hazard is severe and borrowers do not have sufficient credit reputations, so that bank monitoring is valuable (Diamond (1989) and Rajan (1992)), when long-term financing commitments that banks can make are effective in attenuating underinvestment and other forms of moral hazard (Berkovitch and Greenbaum (1990), Boot, Thakor and Udell (1991) and Petersen and Rajan (1995)), and when contract renegotiation is likely, and the flexibility offered by bank financing thus is valuable (Berlin and Mester (1992)). On the other hand, capital market financing may be preferred when intrafirm incentive problems and soft budget constraint problems in borrowing firms are severe (Wilson (1994)), and when banks are likely to develop monopoly power that could distort credit allocations and ex ante incentives (Rajan (1992) and Sharpe (1990)). Table 2 summarizes the benefits and drawbacks of bank financing that have been discussed in this section, and gives an overview of their applicability to specific types of firms.

4.2 Financial Market Financing

Financial market financing (i.e. public debt and/or equity financing) is generally provided by a large number of widely dispersed, competing and anonymous investors, which due to coordination- and free-rider problems neither engage in monitoring activities nor in renegotiation. As such, financial market financing imposes a 'hard' budget constraint
on a firm and thus may improve a firm’s ex ante investment incentives (see Section 4.1). A potential drawback of the coordination problems associated with decentralized financing is that they may induce borrowers to engage in 'myopic' investment behavior. That is, firms which anticipate difficulties in renegotiation may prefer to invest in safer projects which generate cash flows (or resolve uncertainty with respect to cash flows) earlier, at the expense of riskier, but potentially more innovative projects which pay off in the longer run (see e.g. Dewatripont and Maskin (1995)). As a consequence, financial market financing may be less beneficial for firms with riskier projects that have a long-term horizon.

Financial markets may however provide investors with incentives to gather (costly) information on firms and/or market conditions if it is possible for those investors to beneficially trade on this information. If this is the case, the information produced by investors becomes reflected in the prices of financial claims, and the prices of these claims consequently can provide signals for the efficient allocation of investment (see Allen (1993) and Boot and Thakor (1997)). A key attribute of the financial market therefore is that there is a valuable information feedback loop from the equilibrium market prices of securities to the real decisions of firms that impact those market prices. This information loop provides a propagation mechanism by which the effects of financial market trading are felt in the real sector. With bank financing such an information loop is absent. The potentially beneficial impact of information acquisition in the financial market on a firm’s investment decisions will be illustrated below.

Information Aggregation in Financial Markets

We again consider a type $G$ borrower who needs $1 of external financing in order to finance a project that generates a (partially contractible) end-of-period cash flow of $Y$ with a probability $\eta$, and 0 otherwise. We assume that the firm can possibly enhance the return of the project by making an (unobservable) investment at a (private) cost $K$ at the time of investment in the project. This investment increases the project’s return by an amount $\kappa > K$ at $t=1$, with $\kappa \in (0,1)$, conditional on a favorable realization of an 'environmental' or 'market' variable $v \in \{0,1\}$. If $v=1$, the project pays off $Y+\kappa$ in case of success and $\kappa$ otherwise. If $v=0$, the project improvement pays off 0 with a probability 1. We assume that

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31 This mechanism works stronger for more information-sensitive securities (see e.g. Boot and Thakor (1993) and Fulghieri and Lukin (1999)).

32 The model structure described here is similar to that in Boot and Thakor (1997).
the realization of $v$ can only be observed by investors who become informed at a cost $M>0$. Neither the borrower nor uninformed investors in the market can observe $v$. Both only know the commonly known prior probability $\pi \in [0, 1]$ that $v=1$. Let $\pi < K < \eta K$. The financial market is characterized by many agents and a rational price formation process that noisily aggregates information contained in the order flow of securities. The structure of the financial market is as follows. There are two types of investors (traders) in the market: liquidity traders and discretionary traders. The aggregate asset demand $\ell$ (in dollars) of liquidity traders is random and exogenously specified by a probability density function $f(\ell) = A^{-1/2} A^2 \ell$ with a support $[0, 2/A]$ and $A>0$. A discretionary trader can become an informed trader by investing an amount $M$ in information production. This investment generates a signal that perfectly reveals $v$. An informed trader tries to exploit his informational advantage by trading on this information. We assume that informed traders submit a demand order for the firm’s security if $v=1$ (this will be verified later on). At $t=0$ each potential investor must determine whether the expected benefit from investing in information outweighs his information production costs. Let $\Omega \in [0, 1]$ represent the (Lebesgue) measure of discretionary traders in the market that choose to become informed. Then the total demand $D_t$ by the informed traders equals either 0 (if $v=0$) or $\Omega$ (if $v=1$). All demand orders are submitted to an uninformed market maker who only observes the total demand $D = D_t + \ell$ for the firm’s security, but cannot distinguish between the different components of the order flow. We assume that there is a sufficient number of market makers, so that the market is competitive. The market maker receives all the orders for a given security and takes the position in the security required to clear the market at a price that yields him zero profit, conditional on the information in the order flow. The debt security that we focus on is a bond issued at par, and the price set by the market maker is the interest factor $r$ (as before). After observing the terms offered on the bond the borrower makes his inference about $v$ and decides whether to invest in the project enhancement or not. In this model

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33 The basic idea here is that traders in the capital market may acquire valuable information that the managers of a firm may not possess. For example, traders may be industry specialists who develop special skills in assessing shifts in customer preferences, changes in the competitive structure of the industry. For a more elaborate discussion, see Boot and Thakor (1997).

34 Liquidity traders (or noise traders) are in the market for liquidity or diversification purposes. They do not trade on the basis of information. The (plausible) presence of these traders in the market creates the necessary noise in the price aggregation process which allows informed traders to make positive profits on their trades (see Grossman and Stiglitz (1980) and Kyle (1985)).
structure the following result can be derived.

**Result 11:** There exists a noisy rational expectations Nash equilibrium in which the borrower invests in the project enhancement with financial market financing and the measure of informed traders equals $\Omega_d \in (0,1)$. The borrower would not invest in the project improvement in the absence of information production. Information aggregation in the financial market thus reduces underinvestment.

**Proof:** Observe first that the parametric condition $\pi\kappa < \kappa < \eta\kappa$ dictates that in the absence of information production in the market the investment in the project improvement will not be undertaken. Since $\eta\kappa > \kappa$ this results in underinvestment in the case where $\nu = 1$. A borrower only wants to invest in the project improvement if the probability that he assigns to the occurrence of $\nu = 1$ is sufficiently large. Since $\nu$ can only be observed through the total order flow submitted to the market maker, this implies that the borrower wants to invest $K$ if

$$\text{Prob}(\nu = 1 \mid D)\eta\kappa > \kappa,$$

with $\text{Prob}(\nu = 1 \mid D)$ defined as the posterior probability that the borrower (or the market maker) assigns to the event that $\nu = 1$, conditional on observing a total demand of $D$ for the borrower’s security. Observe that, since investment in the project improvement is socially optimal if $\text{Prob}(\nu = 1 \mid D)\kappa > \kappa$, underinvestment will still occur in the case where $\nu = 1$. This is due to the fact that the borrower will only benefit from the project improvement if the project turns out to be successful (i.e. the borrower faces a debt overhang problem). The aggregation of information in the financial market however reduces the likelihood of underinvestment. Using Bayes’ Rule, we can easily derive that

$$\text{Prob}(\nu = 1 \mid D) = \frac{\{f(D-\Omega_\pi)\pi\} + \{f(D\pi) + f(D)(1-\pi)\}}{\{f(D-\Omega_\pi)\pi\} + \{f(D\pi) + f(D)(1-\pi)\}}$$

and from substituting $f(\ell) = A - \frac{1}{2}A\ell$ it follows that $\text{Prob}(\nu = 1 \mid D)$ increases monotonically with $D$ (and thus with the number of informed traders in the market). Define $D_d$ as the level of $D$ for which $\text{Prob}(\nu = 1 \mid D)\eta\kappa = \kappa$ and $\Omega_d$ as the measure of discretionary traders that will become informed by investing $M$. Furthermore, let $D_d = \Omega_d$. A discretionary trader wants to become informed if the expected net gain from doing so is positive. An informed trader can only make a profit on his investment in information production if $\nu = 1$ and if the total demand $D$ satisfies $\Omega_d < D < 2/A$. Observe that in this case the borrower chooses the value-enhancing investment and revelation about $\nu = 1$ is noisy. This allows an informed trader who observes that $\nu = 1$ to charge the borrower an interest factor $r(D)$ which satisfies $\text{Prob}(\nu = 1 \mid D)\eta\kappa = \kappa$, i.e. $r(D) = \frac{1 - \text{Prob}(\nu = 1 \mid D)(1-\eta)}{\eta}$, whereas his breakeven rate $r$ equals $\frac{1 - (1-\eta)}{\eta}$. The expected profit that an informed traded can realize then is given
by -M + ηπ ∫ [r(D) - r]f(β)dβ. The measure Ω_D of informed traders in equilibrium is endogenously determined in the model by a marginal investor condition which states that for the marginal informed investor the expected net gain from becoming informed is zero (and the first order derivative of this expected profit with respect to Ω is negative at Ω_D).

Analogous to the proof in Boot and Thakor (1997) then it can be shown that this condition is satisfied for D = Ω_D.

The key to the information-feedback role of prices is that the informed traders will attempt to profit from their information by taking positions in the securities issued by the firms about which they have superior information. Although the presence of liquidity-motivated trades will mask the trades of the informed traders, the total order flow will at least noisily reveal the presence of informed traders in the market. The firm thus may be able to infer some of the information possessed by the informed traders. This may induce the firm to make value-enhancing real decisions.

An important role of the financial market is thus to provide decision makers in firms with information that they otherwise would not have possessed. In this context, financial markets can be viewed as a mechanism for aggregating many diverse opinions among investors about a firm’s optimal actions, which can provide information about optimal decision rules in corporations that is superior to that attainable through bank funding (see Allen (1993) and Allen and Gale (1999)). Furthermore, the market provides continuous and repeated evaluations of a firm’s behavior. From these arguments it follows that financial markets (in particular stock markets) may be the preferred capital allocation mechanism when optimal decision rules are hard to formulate; e.g. when information decays rapidly and new information arrives almost constantly. This would be the case for firms in highly competitive industries with constantly changing market conditions, or for firms in industries where technologies evolve at a fast pace. Banks on the other hand are desirable institutions for allocating resources in situations where there is consensus on the technology (i.e. in ‘traditional industries’), and the main problem is monitoring firms.

In addition, information production in the financial market may allow for the design of more effective managerial incentive schemes by investors in the market, since a firm’s stock price may incorporate performance information that cannot be gleaned from the
Financial market financing (e.g. the issuance of public debt) may also relieve the financing constraints of borrowers with large financing needs, which face high interest rates or even credit rationing due to informational problems. Firms can furthermore increase their bargaining power vis-à-vis banks by gaining access to the stock or bond market, and by disseminating information to a generality of investors. This elicits outside competition to their lender, and guarantees a lower cost of capital and/or a larger supply of external finance (see e.g. Rajan (1992)). In this respect, it should be noted that bank financing and capital market funding are complementary. Prioritized bank debt, for example, facilitates timely intervention, and the resulting decrease in moral hazard on the side of the firm may benefit a firm’s bondholders as well. Bondholders therefore may find it optimal to grant bank debt priority over their own claims, and in doing so delegate the timely intervention activity to the bank. Consequently, the borrower may reduce his total funding cost by accessing both the bank-credit market and the financial market.

Finally, investors may benefit from the higher liquidity of financial market claims, which offers better opportunities for risk sharing and portfolio diversification. Table 3 summarizes these arguments and links their applicability to specific types of firms.

<table>
<thead>
<tr>
<th>Main (Informational) Features of Financial Market Financing</th>
<th>Applicability to Firm Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Decentralized Financing; No Renegotiation (due to Coordination Failure)</td>
<td>Firms with low credit risk, firms which are not subject to 'investment myopia', large firms subject to severe intra-firm incentive problems</td>
</tr>
<tr>
<td>No Monitoring (due to Coordination Failure)</td>
<td>Firms with well-established management skills and good credit reputations, firms with good prospects for future profits</td>
</tr>
<tr>
<td>Efficient Risk Sharing; High(er) Liquidity</td>
<td>Firms with higher degrees of technological uncertainty</td>
</tr>
<tr>
<td>Information Aggregation; Feedback Role of (Stock) Prices to the Real Sector</td>
<td>Firms in highly competitive industries with constantly changing market conditions, technological firms and R&amp;D-firms</td>
</tr>
</tbody>
</table>

Table 3: Overview of Benefits and Drawbacks of Financial Market Financing
4.3 Venture Capital Financing

Small, new and extremely information-problematic firms that require a prohibitive amount of evaluation and monitoring and have little or no collateral to offer prospective lenders, must either use internally generated funds or obtain outside equity financing, potentially from venture capital firms. For these firms the adverse selection and moral hazard problems associated with debt or equity financing may result in credit rationing and/or market failure in the equity market (see Section 2).\(^\text{35}\)

Venture capital firms can be viewed as financial intermediaries that produce information about the prospects of new firms, and invest extensively in monitoring. As intermediaries and inside investors, venture capital suppliers can facilitate the search of good investment projects (by solving adverse selection), and mitigate potential moral hazard problems. This improves the quality of projects financed in the economy (see Chan (1983) and Chan, Siegel and Thakor (1987)). The benefits of venture capital financing in this respect primarily arise due to scale economies in information production and information reusability. The benefits of information reusability may depend on the intertemporal fluctuations in the firm’s credit risk; a higher variance in credit risk makes information less durable, and thus may reduce the venture capitalist’s incentives for information production. This then could reduce the quality of the venture capitalist’s assets and as a consequence could result in inefficient allocations of capital (see Chan, Greenbaum and Thakor (1986)).

Venture capitalists provide both the capital and the expertise (i.e. assistance) that allow entrepreneurs to convert ideas into commercial ventures. The fact that the venture capitalist combines the role of financier and 'controlling manager' furthermore implies that potential agency conflicts between owners and managers are internalized; this may increase the venture capitalist’s incentives for information production (and managing effort). In settings where entrepreneurial skill is highly uncertain and the role of a 'backup manager' with expertise in the industry is significant, venture capitalists therefore may have an advantage over banks in providing financing.

Venture capital arrangements generally combine a risky claim on the firm’s cash flows (e.g. (convertible) preferred stock or convertible debt) for the venture capitalist with disproportionate control, and moreover contain explicit covenants permitting passage of control to the venture capitalist following a poor performance by firms (see Chan, Siegel

\(^{35}\) In Chapter 5 we will discuss the (informational) role of the venture capitalist and the distinct characteristics of venture capital arrangements in more detail.
and Thakor (1990) and Sahlman (1990)). These control aspects increase the venture capitalist’s incentives to search for a professional management team for the firm in later stages of the firm-venture capitalist relationship (see e.g. Hellmann (1998)), and may also make it easier for the venture capitalist to exit his investment through an IPO or through the liquidation of his stake in the firm at more favorable terms (see Berglöf (1994)). Both benefits will lower an entrepreneur’s initial cost of funding. The use of convertible preferred stock and/or convertible debt instead of straight equity furthermore shifts risk from the venture capitalist to the entrepreneur. This may allow the venture capitalist to ’smoke out’ good entrepreneurs, and furthermore improves an entrepreneur’s (ex ante) incentives to exert effort (Sahlman (1990)).

An important feature of venture capital financing is the staging of the commitment of capital in different phases. This gives the venture capitalist the opportunity to exit the project (abandonment option) after the initial phase and thus improves an entrepreneur’s ex ante incentives. Stage financing also allows a successful entrepreneur to attract future financing at more favorable terms (see Sahlman (1990)). Although the staging of financing may potentially create incentives for ‘short-termism’ or ‘myopic’ investment behavior on the side of the firm, these incentives are (partly) curbed through the use of conversion features in venture capital contracts (see Cornelli and Yosha (1997)). As before (see Section 3) the intuition is that a firm’s bias towards projects which perform well in the short-term (in order to increase the probability of refinancing) may induce the venture capitalist to convert debt into equity, and thus reduces the entrepreneur’s stake in the future profits of the firm.

As with bank financing, the presence of an inside investor may also create (investment) inefficiencies. For example, the inside investor may refrain from providing additional financing in later stages if he only captures part of the returns, or he may exploit an informational monopoly in later financing stages at the expense of outside investors. Such incentive problems on the side of the venture capitalist would reduce the benefits of venture capital. Admati and Pfleiderer (1994) however show that these incentive problems could be mitigated by using specific financial contracts, and rationalize ’fixed fraction’ contracts in which the entrepreneur receives a fixed fraction of the project’s payoff and

\[36\] Note that this feature of venture capital financing may facilitate timely intervention, but on the other hand may also induce soft budget constraint problems (analogous to bank financing, see Section 4.1). The ex ante incentive distortions stemming from these problems may however be mitigated by monitoring (and control) by the venture capitalist.
finances that same fraction of any future investment) in multi-stage financing arrangements in this context. Such contracts can also be shown to reduce overinvestment incentives on the side of the entrepreneur (see Chapter 5).

Finally, the information acquired by venture capitalists may be valuable in later stages of the project, since venture capitalists are typically involved in obtaining capital from outside investors, due to their certification role in IPOs.

Summarizing, the most inexperienced borrowers, which are unsure of their management skills and pose particularly onerous moral hazards, are expected to choose venture capital financing, whereas those with better established skills but without a credit reputation approach banks. Larger firms with both skilled management and a reputation for creditworthiness are expected to choose capital market financing (see Bhattacharya and Thakor (1993)). Table 4 summarizes the main features of venture capital financing and their applicability to specific types of firms.

<table>
<thead>
<tr>
<th>Main (Informational) Features of Financing with Venture Capital</th>
<th>Applicability to Firm Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Information Production (and Information Reusability) Search for projects and monitoring</td>
<td>Small and information-problematic firms without collateral and/or track records, firms with growth opportunities</td>
</tr>
<tr>
<td>Combination of Risky Financing (Convertible Debt and/or Convertible Preferred Stock) and Control (Governance Aspects)</td>
<td>Firms with uncertain entrepreneurial skills which are potentially subject to managerial discretion</td>
</tr>
<tr>
<td>Staging of Commitment of Capital (in Phases)</td>
<td>Firms with need for flexibility and firms with scope for managerial discretion, firms which are less susceptible to 'short-termism'</td>
</tr>
</tbody>
</table>

Table 4: Overview of Benefits and Drawbacks of Venture Capital Financing

5 Concluding Remarks

The overview of the corporate finance and financial intermediation theories presented above suggests that the severity and the type of informational problems that firms face are important determinants of the market (segment) in which firms obtain financing and the capital supplier and the types of contracts they choose, and hence have a significant
impact on the terms under which capital is available. Different types of capital suppliers have different comparative advantages in dealing with informational problems, and therefore could be more or less effective in offering specific financial contracts to different types of firms.

Our analysis implies that informational problems are most severe for small, new firms with highly specific - and potentially intangible - assets, which are in need of risk capital and flexibility in financing terms. These firms may face substantial problems in obtaining external financing, due to both significant adverse selection and moral hazard problems, and therefore are potentially subject to market failure and underinvestment problems\textsuperscript{37}.

The Tables 1 through 4 have given a comprehensive overview of the financing alternatives available to different types of firms, and indicate the main determinants of a firm's financing and funding source choices, both cross-sectionally and intertemporally. The efficiency with which firms can be financed, however, does not only depend on firm characteristics, but is also determined by the efficiency and expertise on the side of the (external) capital suppliers. That is, the financing of viable corporations and the realization of allocative efficiency in the economy can only be guaranteed sufficiently if the existing financing forms and 'institutional arrangements', i.e. the supply channels of capital (banks, the financial market and venture capital firms), are developed and function at a satisfying level. This again points at the crucial importance of a simultaneous consideration of economic-theoretic arguments and the institutional setting in which firms seek financing (see Chapter 1), and links our insights to issues of financial system design. For example, a lack of liquidity in the financial market may frustrate the exit possibilities for venture capitalists, and thus may discourage the initial financing of entrepreneurial firms. Or, the supply of risk capital in an economy may be restricted due to a risk averse investment attitude on the side of suppliers of private capital, such as institutional investors (pension funds) and banks. This may be particularly problematic in economies where public (equity) markets have no significant role in the funding of corporations, and private financing - for example, bank financing - would be dominant. In Chapter 5 of this dissertation we will address some of these issues.

From a theoretical perspective, finally, we can conclude that, although the existing

\textsuperscript{37} In Chapter 5 we will discuss how government intervention in the capital market may stimulate the availability of risk financing for these firms at reasonable terms.
literature has increased our understanding of the links between firm characteristics and a firm’s financing choices, a lot of questions remain. For example, what determines the simultaneous use of public and private debt by corporations? What is the exact difference between the informational role of inside investors like banks and venture capitalists? What types of investment projects are more likely to be financed by banks and venture capitalists respectively? These and other questions provide an interesting agenda for future research in this area.