Managing Financial Expertise

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Abstract

We study credit markets in which lenders can invest in financial expertise to reduce the cost of acquiring information about underlying collateral. If the pledgeability of corporate income is low, information acquisition enhances liquidity, but lenders reduce expertise acquisition because of the hold-up problem. By contrast, if the pledgeability is high, information acquisition reduces liquidity so that lenders can extract rents from firms by investing in financial expertise and creating fear of illiquidity. Optimal policy involves subsidizing investment in financial expertise when the pledgeability is low and taxing investment in financial expertise when the pledgeability is high.

JEL Classification: D82, G20.

Keywords: financial expertise, collateral, information acquisition, liquidity.

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1 Introduction

The financial sector plays an important role in fostering economic development, and it has been therefore recognized that boosting the overall level of the financial sector is essential in developing economies. However, in recent years, the financial sector in developed economies, especially in the US, has often been criticized for engaging in rent-seeking behavior and becoming too large.[1] [2] Philippon and Reshef (2012) demonstrate that in recent decades, the US financial sector has increased information technology spending and attracted highly talented workers compared to other sectors of the economy and that these investments in financial expertise are strongly associated with rising remuneration in the sector.[3] Therefore, it is imperative to investigate the role of financial expertise at different stages of financial development in order to consider desirable government intervention in the financial sector.

In this study, we examine expertise acquisition incentives in a model of credit markets in which expertise reduces the cost of acquiring information about the quality of the collateral. We show that equilibrium investment in expertise is inefficient but for different reasons depending on the degree of cash flow pledgeability. On the one hand, if the pledgeability is low, information acquisition enhances liquidity so that investing in expertise is socially beneficial. However, investors do not have incentives to acquire expertise because of a hold-up problem. On the other hand, if the pledgeability is high, information acquisition causes illiquidity, implying that costly expertise acquisition is socially wasteful. However, investors acquire expertise to use it as a threat to extract rents from firms rather than to use it for information production. Our results suggest that optimal policy

[1] Adair Turner, a former chairman of the UK's Financial Services Authority, comments that: "There is no clear evidence that the growth in the scale and complexity of the financial system in the rich developed world over the last 20 to 30 years has driven increased growth or stability, and it is possible for financial activity to extract rents from the real economy rather than to deliver economic value" (Turner, 2010).

[2] See Levine (2005) and Popov (2018) for the literature on the relationship between finance and economic growth.

[3] See also Goldin and Katz (2008) for an increase in talented workers in the financial industry and Kaplan and Rauh (2010) for their increasing representation among top income earners. For similar evidence for some European countries, see Boustanifar et al. (2017).

intervention in the financial sector depends on the degree of financial development: subsidies on expertise acquisition in countries with a low level of financial development and taxes on expertise acquisition in counties with a high level of financial development.

We consider an environment in which firms borrow funds from investors by offering short-term contracts to finance a project requiring a fixed investment. Because the pledgeability of cash flow from an investment project is imperfect, as in Holmström and Tirole (1997, 1998), a firm needs to pose an asset as collateral to make up for the lack of pledgeability. The assets used as collateral have a heterogeneous quality, high or low, which is unknown for investors and firms, ex ante. However, after finding a firm, each investor can acquire information about the quality of collateral at a cost for making lending decisions—lending when the collateral is of high quality and refusing to lend when it is of low quality. Collateral can be land or financial securities and their fundamental values are difficult to evaluate without expert due diligence.

The important feature of our model is that before finding a firm, each investor can acquire expertise that reduces the cost of information acquisition. Expertise acquisition incentives depend on the pledgeability, which affects firms' preference for information acquisition about collateral. On the one hand, if the pledgeability is relatively low, the average-quality collateral is insufficient to cover the lack of pledgeability and thus, no firm obtains financing without information acquisition. This motivates firms to design financial contracts that induce information acquisition by investors and makes their expertise acquisition socially desirable. However, trading friction in financial markets creates a hold-up problem for investors' investments in expertise. This results in underinvestment in expertise. On the other hand, if the pledgeability is relatively high, the average-quality collateral allows firms to obtain funds, so that all firms can finance efficient projects by preventing investors from acquiring information. In this case, information acquisition reduces the possibility of funding, thereby rendering expertise acquisition socially undesirable. Nonetheless, investors are willing to acquire expertise to threaten firms with the fears of information acquisition and improve bargaining positions with firms. This implies that overinvestment in expertise arises.

Our results suggest that the role of financial expertise changes depending on pledgeability and thus, policy implications should differ. In economies with low pledgeability, the government can improve welfare by subsidizing investment in financial expertise and encouraging investors to induce more efficient screening. In economies with high pledgeability, however, the government can improve welfare by taxing investment in financial expertise and discouraging rent-seeking behavior.

Related Literature: This study is related to several strands of literature.

Our study builds on the literature on theories of collateral. The existing models of collateral examine its impact on financial contracts in a variety of settings, for example, in the case of adverse selection (Bester, 1985, 1987; Chan and Kanatas, 1985; Besanko and Thakor, 1987) and moral hazard (Chan and Thakor, 1987; Boot et al., 1991; Boot and Thakor, 1994). Recent studies (e.g., Di Maggio and Tahbaz-Salehi, 2015 and Parlatore, 2019) explore models of collateralized loans that incorporate trading friction. These studies typically focus on incentive problems on the borrowers' side, while our focus is on the lenders' side. A few exceptions are Rajan and Winton (1995), Manove et al. (2001), and Inderst and Mueller (2007), who show that collateral influences project screening. Our work, however, focuses on lenders' incentives to screen collateral and expertise acquisition.

Our study also contributes to the growing body of literature on the compensation of employees in the financial sector. Thanassoulis (2012), Acharya et al. (2016), and Célérier and Vallée (2019) show that compensation growth in the financial industry is driven by competition to attract managerial talent that will enable firms to realize high returns. In Myerson (2012), Axelson and Bond (2015), and Biais and Landier (2020), high financial sector compensation arises from the moral hazard problem. In our study, however, greater compensation is related to expertise in the evaluation of collateral.

This line of work is related to the literature on the optimal level of financial expertise.[4] Glode et al. (2012), Biais et al. (2015), Fishman and Parker (2015), and Bolton et al. (2016) develop models in which there is excessive acquisition of expertise. Kurlat (2019) demonstrates that overinvestment in expertise arises in the junk bond underwriting market. In these studies, having more expertise means producing more information. Conversely, our model treats expertise acquisition and information acquisition separately. This setting generates novel insights about the growth of the financial sector. That is, investment in expertise can be inefficiently high with high pledgeability but inefficiently low with low pledgeability.

Finally, our paper is also related to the literature on the information sensitivity of debt. We build on the idea that symmetric ignorance can enhance liquidity, as advocated by Gorton and Ordoñez (2014), Dang et al. (2015), and Holmström (2015).[5] When issuing "information-insensitive debt," in which there is no advantage from acquiring information about the quality of underlying collateral, financial markets are free from adverse selection and highly liquid. These papers also highlight that when the debt becomes information-sensitive in response to a shock, private information production ensues, and a financial crisis happens. However, we explore the relationship between the information sensitivity of debt and expertise acquisition rather than implications for financial crises.

Outline: The remainder of the paper is organized as follows. Section 2 describes the setting of the model. Section 3 analyzes two benchmark cases: in the first one, investors cannot produce private information about the quality of underlying collateral; and in the second, everyone knows the true quality of collateral, ex ante. These exercises allow us to clarify the key mechanism through which information about collateral affects finan-

[4] Philippon (2010), Cahuc and Challe (2012), and Shakhnov (2018) analyze the optimal size of the financial sector by focusing on the allocation of talents between the financial and nonfinancial (productive) sectors. They show that too many agents can enter the financial sector, leading to excessively low levels of entrepreneurship in the economy.

[5] The idea that information can destroy economic value goes back to Hirshleifer (1971), who shows that public information restricts risk sharing. See also Gorton and Pennacchi (1990).

cial contracts. Section 4 characterizes the equilibrium of the model. Section 5 analyzes efficiency. Section 6 presents our conclusions.

2 Model

In this section, we describe the setup of the model.

The economy has a single good that is used for investment and consumption. There is a continuum of firms with unit mass and a continuum of investors with unit mass. Both firms and investors are risk-neutral and derive utility from consumption at the end of the period. While firms are not endowed with goods, investors are endowed with a sufficient amount. Firms are protected by limited liability.

Each firm has a project that requires a fixed investment $I > 0$. It produces nothing in the case of failure and produces returns $R > 0$ in the case of success. The project is subject to moral hazard, as in Holmström and Tirole (1997, 1998). The firm can choose whether to behave or misbehave secretly. In the case of behaving, the project succeeds with probability $p \in (0, 1]$. In the case of misbehaving, the firm enjoys private benefit $B > 0$ but must accept that the probability of success decreases by $\Delta p \in (0, p)$. We assume that the if a firm behaves, project has positive net present value (NPV), whereas if the firm misbehaves, the project has negative NPV, even with the inclusion of private benefit.

Assumption 1 $pR > I > (p - \Delta p)R + B$.

Each firm owns a legacy asset, which has two types of quality: good and bad. The asset is good with probability $\phi \in [0, 1]$ and bad with probability $1 - \phi$. At the end of the period, the owner of an asset receives C units of goods if the asset is good and nothing if it is bad. No one knows the true quality of assets at the beginning of the period.

To run a project, firms need to rely on external financing. Each firm is randomly matched with a single investor, and the firm makes a take-it-or-leave-it offer to the investor. The financial contract has the following structure: (i) the investor contributes I; (ii) when the project succeeds, the investor receives R^i and the firm receives $R - R^i$ from its cash flow; and (iii) when the project fails, both parties receive nothing from the investment return, and the investor seizes the collateral with probability $x \in [0, 1]$.[6]

After receiving a financial contract from a firm but before deciding whether to accept the contract, an investor can produce costly private information about the quality of collateral that the firm pledges. By paying $\gamma \in [0, \gamma_{max}]$ units of goods, each investor knows the true quality of collateral perfectly. The cost of information acquisition γ can be interpreted as an inverse measure of the investor's financial expertise, that is, investors with lower γ have more expertise.[7] The underlying idea is that investors who have more financial expertise find it easier to gather and process information about assets. The important feature of our model is that the level of expertise γ is an endogenous variable. Before financial contracts are offered, each investor chooses γ, incurring a cost $d(\gamma_{max} - \gamma)$. We assume the marginal cost of acquiring expertise d is sufficiently small and close to zero. While γ is publicly observable, the acquisition of information is unobservable.

The timing of events is as follows. Each investor chooses the level of financial expertise γ. Then, each firm is matched with a single investor and offers a financial contract (R^i, x). After receiving the contract, the investor decides whether to acquire costly information about the quality of the pledged collateral and then whether to accept the offered contract. If the investor accepts the contract, the firm starts to run a project and chooses either to behave or misbehave. If the investor rejects the contract, both the firm and the investor keeps holding their own endowments. Finally, all outcomes are realized, outputs are

[6]We could consider a more general contract (T, R^i, x) that allows for flexible up-front payments from the investor to the firm $T \geq I$. However, the firm would not reap any benefits through this additional dimension. If the information-non-acquisition constraint is binding and investors earn a positive payoff, a higher T increases the loss of lending to a firm with bad collateral and requires a higher repayment to deter information acquisition. This makes the IC constraint more difficult to satisfy. Otherwise, since firms that secure financing receive the entire social surplus, a higher T does not affect their payoff, while making it more difficult for them to raise funds. Thus, $T = I$ is the optimal choice for the firms.

[7]In an alternative setup, investors with more expertise receive more accurate signals about the quality of underlying collateral by paying a fixed cost. Although this approach makes the analysis more complicated, the main conclusions remain unchanged.

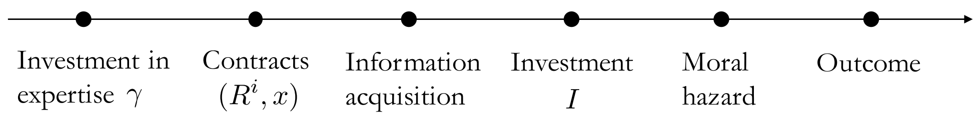


Figure 1: Timing

shared as contracted, and consumption occurs. Figure 1 summarizes the timing of the model.

Finally, we define an equilibrium in the following way.

Definition 1 (Equilibirum) *A perfect Bayesian equilibrium is given by the firms' contracts (R^i, x), their choice between behaving and misbehaving, investors' expertise γ, their decisions on information acquisition and financing, and all agents' beliefs concerning the quality of assets, such that the following conditions are satisfied:*

- *Firms' contracts (R^i, x) and the choice between behaving and misbehaving are optimal, where beliefs and the investors' strategies are taken as given;*
- *The investors' decisions on expertise γ, information acquisition, and financing are optimal, where beliefs and the firms' strategies are taken as given;*
- *Beliefs are consistent with Bayes' rule, given equilibrium strategies, whenever possible.*

3 Symmetric Ignorance versus Full Information

In this section, for the benchmark cases, we suppose that investors cannot acquire information. Instead, we focus on two information regimes: the first is symmetric ignorance, where no one knows the true quality of collateral; and the second is full information, where everyone knows the quality of collateral. By comparing the two cases, we study the key relationship between information about collateral and funding liquidity.

Let $\tilde{\phi}$ be agents' conjecture about the probability that collateral is good. In the case of symmetric ignorance, the conjecture on the probability of good collateral is $\tilde{\phi} = \phi$ for any firm. In the case of full information, $\tilde{\phi} = 1$ for firms with good collateral and $\tilde{\phi} = 0$

for those with bad collateral. A firm designs a contract (R^i, x) by solving the following optimization problem:

$$\max_{R^i, x} p(R - R^i) - (1-p)x\tilde{\phi}C \tag{1}$$

subject to

$$pR^i + (1-p)x\tilde{\phi}C \geq I, \tag{2}$$

$$p(R - R^i) - (1-p)x\tilde{\phi}C \geq 0, \tag{3}$$

$$p(R - R^i) - (1-p)x\tilde{\phi}C \geq (p - \Delta p)(R - R^i) - (1 - p + \Delta p)x\tilde{\phi}C + B, \tag{4}$$

$$0 \leq x \leq 1. \tag{5}$$

The objective function (1) is the firm's net expected payoff. (2) is the individual rationality (IR) constraint for investors, which requires that investors earn non-negative payoff from financial contracts. (3) is the IR constraint for firms. (4) is the incentive compatibility (IC) constraint, which requires that firms prefer behaving to misbehaving. (5) is the feasibility constraint.

A decrease in compensation for an investor R^i increases the firm's payoff (1) and strengthens the incentive to behave from (4). This leads the firm to decrease R^i until the IR constraint (2) is binding. Then, (1) is rewritten as $pR - I$, meaning that the firm that obtains financing receives a payoff equal to the entire social surplus. Since (3) is not binding, any contract (R^i, x) that satisfies (2) with equality, the IC constraint (4), and the feasibility constraint (5) is optimal. Given that a higher x relaxes (4), financing actually occurs if

$$\rho + \tilde{\phi}C \geq I, \tag{6}$$

where

$$\rho \equiv p\left(R - \frac{B}{\Delta p}\right). \tag{7}$$

(6) means that if the sum of the expected pledgeable cash flows from the project (ρ) and collateral value ($\tilde{\phi}C$) exceeds the cost of investment I, the firm secures financing.

The following proposition describes the effect of information about collateral on the investors' financing decision.

Proposition 1 *Suppose that Assumption 1 holds and investors cannot acquire private information about the quality of collateral. Then, there are four cases:*

(i) If $\rho \geq I$, there exists an optimal contract in which collateral pledging is unnecessary ($x = 0$), so that all firms obtain financing regardless of beliefs about collateral $\tilde{\phi}$.

(ii) If $0 < I - \rho \leq \phi C$, then in any optimal contract, collateral pledging is needed ($x > 0$). In the case of symmetric ignorance, all firms secure financing, whereas in the case of full information, only firms with good collateral secure financing.

(iii) If $\phi C < I - \rho \leq C$, then in the case of symmetric ignorance, no firm secures financing, whereas in the case of full information, only firms that pledge good collateral secure financing.

(iv) If $I - \rho > C$, no financing occurs, regardless of $\tilde{\phi}$.

Proposition 1 states that the relationship between information about collateral and the financial contract depends on a firm's level of pledgeable cash ρ compared to the investment I. The result is summarized in Figure 2. If the pledgeability is high enough that investors can recoup their investment from cash flows alone ($\rho \geq I$) or is low enough that firms cannot obtain financing regardless of collateral quality ($\rho < I - C$), there is no role for collateral. If the pledgeability is at the intermediate level ($0 < I - \rho \leq C$), collateral is necessary to fill the gap between the cost of financing and the pledgeable income, and information about collateral quality matters in the financial contract.

When the shortfall $I - \rho$ is relatively small ($0 < I - \rho \leq \phi C$), (6) holds with $\tilde{\phi} = 1$ and ϕ but not with $\tilde{\phi} = 0$. This means that with full information, firms whose collateral is

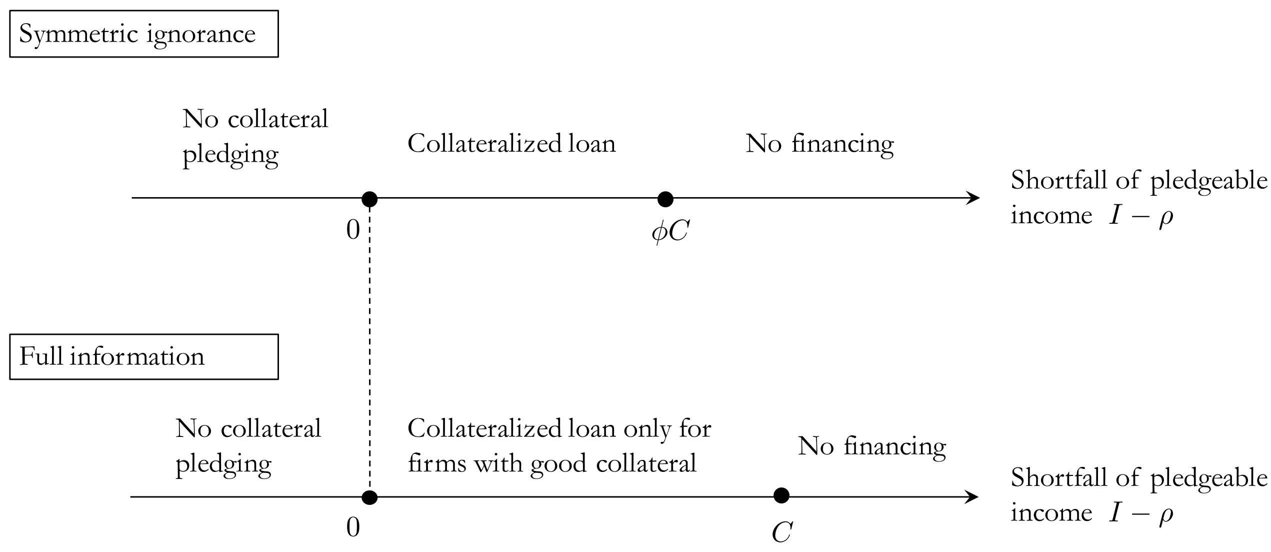


Figure 2: Financial contract in each information regime

identified as bad are not funded, and net aggregate output results in $\phi(pR-I)$. However, with symmetric ignorance, the economy benefits from the cross-subsidization of firms with bad collateral by those with good collateral. Expected collateral value suffices to make up for the lack of pledgeable cash and the economy achieves the first-best level of net aggregate output $pR-I$. Thus, in the case of symmetric ignorance, financial markets are more liquid and the net aggregate output is larger than in the case of full information.

When the shortfall $I-\rho$ is relatively large ($\phi C < I-\rho \leq C$), (6) holds with $\tilde{\phi} = 1$ but not with $\tilde{\phi} = \phi$ and 0. This implies that under symmetric ignorance, collateral is no longer enough to cover the lack of pledgeable cash and financing does not occur. By contrast, under full information, firms whose collateral is known to be good are still able to cover their investment needs. Therefore, full information enhances liquidity and increases output compared to symmetric ignorance.

In the remainder of this paper, to ensure that collateral plays a role in financial contracts, we assume an intermediate level of pledgeability:

Assumption 2 $0 < I-\rho \leq C$.

4 Equilibrium Analysis

In this section, we return to the original model, in which no one knows the true quality of collateral at the beginning of the period, and investors can acquire expertise and private information about collateral. First, Section 4.1 and Section 4.2 characterize the optimal contract that deters information acquisition and the one that induces information acquisition, respectively. Then, Section 4.3 and Section 4.4 analyze the case of high pledgeability, $\rho \geq I - \phi C$, in which information about collateral reduces liquidity from Proposition 1. Section 4.5 analyzes the case of low pledgeability, $\rho < I - \phi C$, in which information about collateral enhances liquidity.

4.1 Information-insensitive contracts

Given that investors can acquire information about collateral at a cost of γ, firms optimally choose between a financial contract that triggers information acquisition (referred to as *information-sensitive debt*) or one that does not trigger information acquisition (referred to as *information-insensitive debt*). We show that when pledgeable cash is high enough ($\rho \geq I - \phi C$), issuing information-insensitive debt enhances liquidity, but this may be costly to firms because they need to promise investors compensation commensurate with the level of their expertise to prevent information acquisition.

First, consider firms offering an information-insensitive debt contract (R^i_{II}, x_{II}). Firms choose the contract (R^i_{II}, x_{II}) to maximize

$$p(R - R^i_{II}) - (1 - p)x_{II}\phi C \tag{8}$$

subject to

$$pR^i_{II} + (1-p)x_{II}\phi C \geq I, \tag{9}$$

$$p(R - R^i_{II}) - (1-p)x_{II}\phi C \geq 0, \tag{10}$$

$$R - R^i_{II} + x_{II}\phi C \geq \frac{B}{\Delta p}, \tag{11}$$

$$0 \leq x_{II} \leq 1, \tag{12}$$

$$pR^i_{II} + (1-p)x_{II}\phi C - I \geq \phi\left[pR^i_{II} + (1-p)x_{II}C - I\right] - \gamma. \tag{13}$$

Similar to the optimization problem (1)-(5) with $\tilde{\phi} = \phi$, the objective function (8) is the firm's net payoff, (9) is the IR constraint for investors, (10) is the IR constraint for firms, (11) is the IC constraint, and (12) is the feasibility constraint.

The additional constraint is (13), which ensures that the investors' payoff without information acquisition (the left-hand side) is larger than the payoff with information acquisition (the right-hand side). When investors acquire information, they accept the offered contract and provide funds if the firm has good collateral and refuse if the firm has bad collateral from Assumption 2. The constraint (13) is rewritten as

$$(1-\phi)\left(I - pR^i_{II}\right) \leq \gamma. \tag{14}$$

The left-hand side of (14) represents the benefit of acquiring information. The investor who encounters a firm with bad collateral with probability $1-\phi$ can avoid a loss of $I - pR^i_{II}$ by not lending. If this benefit is smaller than the cost of acquiring information γ, the investors choose not to acquire information.

Firms have incentives to reduce a repayment R^i_{II} to increase their payoff. When γ is high, we can ignore the constraint (14) so that the optimal contract problem becomes equivalent to the benchmark problem (1)-(5) with $\tilde{\phi} = \phi$; that is, (9) binds, and firms receive the entire social surplus $pR - I$. However, when γ is low, R^i_{II} is determined at which (14) binds because a lower R^i_{II} strengthens the investors' incentives to acquire information. This means that for investors with lower γ, firms must lower the benefit of information production by increasing repayment R^i_{II} and reducing the expected loss that informed investors are able to avoid.

The mechanism through which the lower-γ investors require higher compensation R^i_{II} does not necessarily imply that they earn positive net payoff. If firms can decrease the probability of losing collateral x_{II} until (9) binds, investors will still break even. However, because a higher R^i_{II} reduces firms' stake $R - R^i_{II}$ and weakens their commitment to behave, firms must choose x_{II} to satisfy the IC constraint (11) rather than the IR constraint (9) if γ is sufficiently low. In this case, (9) is not binding and the firm leaves rent for the investor.[8]

Lemma 1 *Suppose that Assumptions 1 and 2 hold. If* $I - \rho \leq \phi C$ *and* $\gamma \geq \underline{\gamma_{II}} \equiv (1 - \phi)\left[I - \rho - p\min\{pR - \rho, \phi C\}\right]$, *then firms can borrow funds by offering information-insensitive debt contracts, which yield the firms' net payoff,*

$$U^f_{II} = \begin{cases} pR - I & \text{if } \overline{\gamma_{II}} \leq \gamma, \\ pR - I - \dfrac{(1-p)(1-\phi)(I-\rho) - \gamma}{p(1-\phi)} & \text{if } \underline{\gamma_{II}} \leq \gamma < \overline{\gamma_{II}}, \end{cases} \tag{15}$$

where $\overline{\gamma_{II}} \equiv (1-p)(1-\phi)\left(I - \rho\right) \geq \max\left\{0, \underline{\gamma_{II}}\right\}$, *and the investors' net payoff,*

$$U^i_{II} = \begin{cases} 0 & \text{if } \overline{\gamma_{II}} \leq \gamma, \\ \dfrac{(1-p)(1-\phi)(I-\rho) - \gamma}{p(1-\phi)} & \text{if } \underline{\gamma_{II}} \leq \gamma < \overline{\gamma_{II}}. \end{cases} \tag{16}$$

Otherwise, firms cannot offer information-insensitive contracts.

Proof. See Appendix A. ■

[8]See Dang (2008), who also shows that in asset markets, a party responding to a take-it-or-leave-it offer can extract some surplus of the transaction when the offer is designed to deter information acquisition.

Lemma 1 implies that if the level of expertise is in the intermediate range ($\underline{\gamma_{II}} \leq \gamma < \overline{\gamma_{II}}$), the investors earn a net positive payoff ($U^i_{II} > 0$). As the level of expertise is higher, investors are able to extract larger rents from firms (U^f_{II} is increasing in γ and U^i_{II} is decreasing in γ). In information-insensitive contracts, financial expertise allows investors to improve their bargaining position with firms that have all the bargaining power by creating the fear of information acquisition. However, if the level of expertise is sufficiently high ($\gamma < \underline{\gamma_{II}}$), firms do not obtain funds through information-insensitive contracts because firms lose money if they obtain financing ((10) is violated) or because they cannot pose more collateral ((12) is violated).

4.2 Information-sensitive contracts

Then, we consider that firms optimally design the information-sensitive debt contract (R^i_{IS}, x_{IS}). An informed investor funds only a firm with good collateral. This implies that once investors accept the contract, firms correctly infer that their collateral is good in equilibrium. The optimal information-sensitive contract is the solution for the following problem:

$$\max_{R^i_{IS}, x_{IS}} \phi \left[p(R - R^i_{IS}) - (1-p)x_{IS}C \right] \tag{17}$$

subject to

$$\phi \left[pR^i_{IS} + (1-p)x_{IS}C - I \right] - \gamma \geq 0, \tag{18}$$

$$\phi \left[p(R - R^i_{IS}) - (1-p)x_{IS}C \right] \geq 0, \tag{19}$$

$$R - R^i_{IS} + x_{IS}C \geq \frac{B}{\Delta p}, \tag{20}$$

$$0 \leq x_{IS} \leq 1, \tag{21}$$

$$(1-\phi)\left(I - pR^i_{IS}\right) > \gamma. \tag{22}$$

The firm maximizes the net expected payoff (17), subject to the IR constraint for the investor (18), the IR constraint for the firm (19), the IC constraint (20), the feasibility constraint (21), and the constraint that triggers information acquisition (22).

It is straightforward to characterize the optimal contract inducing information acquisition. A lower R^i_{IS} increases the firms' profit (17) and relaxes the constraints (20) and (22). Thus, the firms decrease R^i_{IS} until (18) binds, and they obtain the entire social surplus $\phi(pR - I) - \gamma$, where they have to incur the cost of information acquisition γ. This implies that any financial contract (R^i_{IS}, x_{IS}) that satisfies (18) with equality and the remaining constraints is optimal. A higher x_{IS} and a lower R^i_{IS} relaxes the constraints (20) and (22), making financing more likely. The following lemma characterizes the financing condition in the case of information-sensitive contracts.

Lemma 2 *Suppose that Assumptions 1 and 2 hold. If*

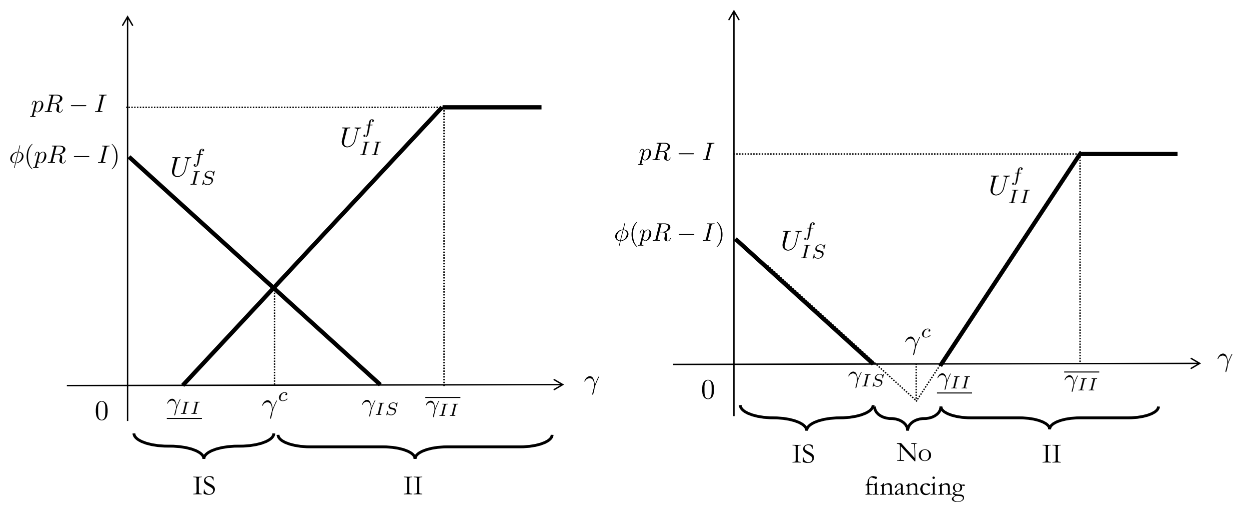
$$\gamma \leq \gamma_{IS} \equiv \phi \min\left\{(1-p)(1-\phi)C, \rho + C - I, pR - I\right\},$$

then firms can borrow funds by offering information-sensitive debt contracts, which yield the firms' net payoff,

$$U^f_{IS} = \phi(pR - I) - \gamma, \tag{23}$$

and the investors' net payoff, $U^i_{IS} = 0$. Otherwise, firms cannot offer information-sensitive contracts.

Lemma 2 implies that if the level of expertise is sufficiently high ($\gamma \leq \gamma_{IS}$), then firms can offer information-sensitive contracts, and a higher level of expertise increases their payoffs (U^f_{IS} is decreasing in γ). In contrast to information-insensitive contracts, financial expertise increases the total surplus from the financial contract and investors always earn a zero payoff. If the level of expertise is sufficiently low ($\gamma > \gamma_{IS}$), at least one of the constraints (19), (20), and (22) is violated, implying that firms cannot obtain financing by offering information-sensitive contracts.



(a) When $\underline{\gamma_{II}} \leq \gamma^c$

(b) When $\underline{\gamma_{II}} > \gamma^c$

Figure 3: The comparison of payoffs between information-insensitive contracts and information-sensitive contracts when $\underline{\gamma_{II}} = (1-\phi)\left[I - (1-p)\rho - p^2 R\right]$ and $\gamma_{IS} = \phi(pR - I)$

4.3 Optimal contract in the case of high pledgeability

Based on Lemma 1 and Lemma 2, a firm chooses between information-insensitive and information-sensitive contracts to maximize its payoff. As shown in Figure 3, the firm's payoff depends on γ. U^f_{II} is nondecreasing in γ from (15), whereas U^f_{IS} is decreasing in γ from (23). Thus, the firm chooses to offer information-insensitive contracts if $U^f_{II} \geq U^f_{IS}$, that is, $\gamma \geq \gamma^c$ given by

$$\gamma^c \equiv \frac{1-\phi}{p(1-\phi)+1}\left[p(1-p)\frac{B}{\Delta p} - (1-p\phi)(pR-I)\right], \tag{24}$$

and if information-insensitive contracts are feasible, that is, $\gamma \geq \underline{\gamma_{II}}$. This implies that if γ is sufficiently high that $\gamma \geq \max\{\underline{\gamma_{II}}, \gamma^c\}$, firms offer information-insensitive contracts.

Whether firms with good collateral secure financing when $\gamma < \max\{\underline{\gamma_{II}}, \gamma^c\}$ depends on the parameters. If $\gamma \leq \gamma_{IS}$, firms can offer information-sensitive contracts. However, if $\gamma > \gamma_{IS}$, no firm secures financing. While Figure 3a illustrates the situation in which for all γ, either information-insensitive or information-sensitive contracts are chosen, Figure 3b shows the situation in which for some γ, financial markets collapse.

The following proposition summarizes the result of the equilibrium contract.

Proposition 2 *Suppose that Assumptions 1 and 2 hold and that $I - \rho \leq \phi C$.*

(i) If $\gamma \geq \max\{\underline{\gamma_{II}}, \gamma^c\}$, firms choose information-insensitive contracts.

(ii) If $\gamma < \max\{\underline{\gamma_{II}}, \gamma^c\}$ and $\gamma \leq \gamma_{IS}$, firms choose information-sensitive contracts.

(iii) Otherwise, they cannot secure financing.

4.4 Acquisition of financial expertise

Anticipating that firms offer a financial contract depending on γ, each investor chooses γ. From Lemma 1, Lemma 2, and Proposition 2, investors' payoffs in the stage of optimal contracting are given by the following:

$$U^i(\gamma) = \begin{cases} \dfrac{(1-p)(1-\phi)(I-\rho)-\gamma}{p(1-\phi)} & \text{if } \max\left\{\underline{\gamma_{II}}, \gamma^c\right\} \leq \gamma < \overline{\gamma_{II}}, \\ 0 & \text{otherwise,} \end{cases} \tag{25}$$

as depicted in Figure 4. If $\max\{\underline{\gamma_{II}}, \gamma^c\} \leq \gamma < \overline{\gamma_{II}}$, investors with lower γ earn higher payoffs by using their expertise as a threat to firms that offer information-insensitive contracts; otherwise, the investors must break even.

Since the cost of expertise acquisition is very small, the equilibrium level of expertise γ^* is determined to maximize the investor's payoff $U^i(\gamma)$. Thus, it immediately follows that

$$\gamma^* = \max\{0, \underline{\gamma_{II}}, \gamma^c\}. \tag{26}$$

Investors acquire expertise to the point at which additional acquisition of expertise either stops firms from offering information-insensitive contracts. There is expertise acquisition but never information acquisition in equilibrium.

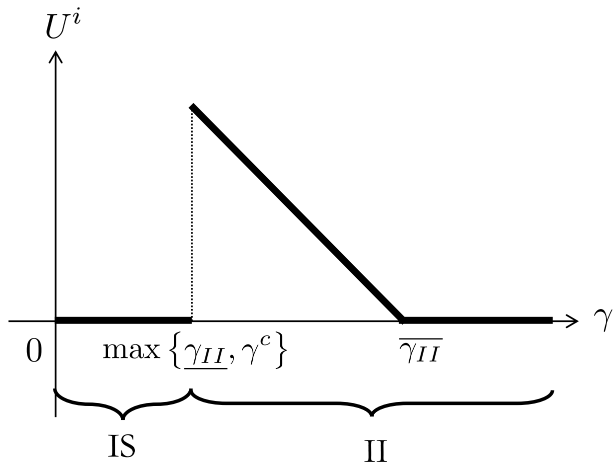


Figure 4: Investors' payoff in the case of high pledgeability

Proposition 3 *Suppose that Assumptions 1 and 2 hold and that $I - \rho \leq \phi C$. Then, in equilibrium, the level of financial expertise γ^* is given by (26) and all firms obtain financing without inducing information acquisition.*

4.5 Low pledgeability

To highlight the effect of pledgeability ρ on expertise acquisition, this section considers the case of low pledgeability $\rho < I - \phi C$, in which information-insensitive contracts are not feasible from Lemma 1. At the stage of optimal contracting, a firm offers information-sensitive contracts for an investor with $\gamma \leq \gamma_{IS}$ and cannot obtain financing from an investor with $\gamma > \gamma_{IS}$ from Lemma 2. In this situation, investors with any γ have a zero payoff, $U^i(\gamma) = 0$. As a result, expertise acquisition does not occur.

The following proposition characterizes the equilibrium in the case of low pledgeability.

Proposition 4 *Suppose that Assumptions 1 and 2 hold and that $I - \rho > \phi C$. Then, the equilibrium level of expertise is given by $\gamma^* = \gamma_{max}$. If $\gamma_{max} \leq \gamma_{IS}$, information acquisition occurs and only firms with good collateral obtain financing. If $\gamma_{max} > \gamma_{IS}$, no firm secures financing.*

The result of an absence of expertise acquisition is due to a hold-up problem. By investing in expertise and reducing the cost of information acquisition, investors allow firms offering information-sensitive contracts to earn higher payoffs. Once the investment has been sunk, however, firms with full bargaining power offer contracts that yield a zero payoff for investors. Because the investors anticipate that they will be unable to recoup the cost of their investments in expertise, there is no incentive to make such an investment.

By comparing Proposition 3 and Proposition 4, we confirm that high pledgeability is associated with a high level of compensation for investors, a high level of expertise, no screening, and a large aggregate output. This suggests that economies with well-developed financial markets achieve a larger financial industry and a higher level of economic development than those with underdeveloped financial markets.

5 Efficiency

This section analyzes efficiency and discusses the role of government. Section 5.1 shows that investors overinvest in expertise in the case of high pledgeability and underinvest in expertise in the case of low pledgeability. Section 5.2 derives policy implications.

5.1 The socially optimal level of expertise

To highlight the inefficiencies of the expertise acquisition, we consider that a social planner chooses the financial contract and the level of expertise to maximize firms' payoff, subject to the same information frictions as in the equilibrium analysis. The planner cannot observe the quality of assets, the firms' choices between behaving and misbehaving, or investors' information acquisition. The key difference compared to the equilibrium analysis is that the planner has the ability to commit to financial contracts.

When pledgeability is high enough that $I - \rho \leq \phi C$, it is socially desirable to prevent investors from acquiring information from Proposition 1. Thus, the planner's problem is to choose $(R^i_{II}, x_{II}, \gamma)$ that maximizes (8), subject to the IR constraint for firms (10), the IC constraint (11), the feasibility constraint (12), the information-non-acquisition constraint (14), and the investors' IR constraint,

$$pR^i_{II} + (1-p)x_{II}\phi C - I \geq 0. \tag{27}$$

(27) is different from (9) because the investment in expertise is not sunk. In this optimization problem, an increase in γ relaxes (14) and (27), thereby increasing the firm's payoff. The socially optimal level of γ is given by $\gamma^S = \gamma_{max}$. Then, since (27) becomes the same as (9), the financial contract (R^i_{II}, x_{II}) that the planner designs is the same as in the solution for the optimization problem (8)-(13) with $\gamma = \gamma_{max}$. As a result, the planner facing information friction achieves the first-best allocation.

By contrast, when pledgeability is low such that $I - \rho > \phi C$, information enhances liquidity from Proposition 1 so that the planner's problem is to choose $(R^i_{IS}, x_{IS}, \gamma)$ that maximizes (17), subject to the IR constraint for the firm (19), the IC constraint (20), the feasibility constraint (21), the information-acquisition constraint (22), and the IR constraint for investors,

$$\phi\left[pR^i_{IS} + (1-p)x_{IS}C - I\right] - \gamma \geq 0. \tag{28}$$

Since (28) is binding, the firm's payoff becomes $\phi(pR - I) - \gamma$. The planner chooses γ to maximize this payoff without taking into account the remaining constraints because a lower γ merely relaxes (22). Thus, the socially optimal level of γ is given by $\gamma^S = 0$. The planner is indifferent to any contract (R^i_{IS}, x_{IS}) that satisfies (28) with equality and the remaining constraints.

Proposition 5 *Suppose that Assumptions 1 and 2 hold. If $I - \rho \leq \phi C$, the socially optimal level of expertise satisfies $\gamma^S = \gamma_{max} > \gamma^*$. If $I - \rho > \phi C$, it satisfies $\gamma^S = 0 < \gamma^*$.*

Proposition 5 emphasizes the importance of commitment. When pledgeability is sufficiently high, information production generates illiquidity and investment in expertise is merely a waste of resources. The planner with the ability to commit to financial contracts refrains from the acquisition of expertise. Without the commitment, however, investors are willing to acquire expertise because they can use it as a threat to improve their bargaining position with firms. Thus, over-investment in expertise arises in equilibrium.

In contrast, when pledgeability is sufficiently low, information production increases the total surplus from the financial contracts and thus, investments in expertise are value-enhancing activities. The social planner with commitment ability can overcome the hold-up problem, whereas investors cannot overcome this problem in equilibrium. Thus, under-investment in expertise arises in equilibrium.

5.2 Policy implications

Proposition 5 implies that the government can improve social welfare by managing investment in financial expertise. We consider the government that uses taxes and subsidies on investment in expertise. If the government with balanced budget sets a linear tax rate $\tau > 0$, the investor with expertise γ must pay $\tau(\gamma_{max} - \gamma)$ and each investor receives lump-sum transfers. If the government provides a subsidy $\tau < 0$, the investor with with expertise γ receives $-\tau(\gamma_{max} - \gamma)$ financed by lump-sum taxes on investors. From Proposition 5, the following result holds:

Proposition 6 *Suppose that Assumptions 1 and 2 hold. If $I - \rho \leq \phi C$, the social optimum is achieved through taxes on expertise acquisition such that $\tau > \frac{1}{p(1-\phi)}$. If $I - \rho > \phi C$, the social optimum is achieved through subsidies on expertise acquisition such that $\tau < 0$.*

Proposition 5 suggests that policy implications will differ depending on the pledgeability. On the one hand, in economies with a high level of financial development, the private marginal benefit of expertise acquisition is $\frac{1}{p(1-\phi)}$ and its social marginal benefit is 0. This implies that the government can improve social welfare by taxing investment in expertise and discouraging investors from investing in expertise. On the other hand, in economies with a low level of financial development, the private marginal benefit of expertise acquisition is 0 and its social marginal benefit is 1. This implies that the government can increase social welfare by subsidizing investment in expertise and encouraging investors to invest in expertise.

6 Conclusion

This study analyzes inefficiencies in expertise acquisition in a model of credit markets in which expertise enables the production of information about the underlying collateral at a low cost. We show that the reasons for inefficient expertise acquisition differ depending on the degree of pledgeability. If the pledgeability is low, information acquisition can enhance liquidity, but investors refrain from the acquisition of expertise because of the hold-up problem. However, if the pledgeability is high, information acquisition generates illiquidity, which allows investors to improve their bargaining position with firms by acquiring expertise. In equilibrium, investors acquire expertise but provide funds to firms without producing information.

In this study, we focus on only one aspect of financial expertise, which is useful to evaluate assets. However, financial expertise could be essential for financial innovations, for example, the creation of financial securities that facilitate better risk-sharing. Analyzing the multiple roles of expertise is an important area for future research.

Appendix A Proof of Lemma 1

Proof. A lower R^i_{II} increases the firm's profit and makes (11) more likely to hold. The firm decreases R^i_{II} until (9) or (14) hold as equality.

First, suppose that (9) is binding. In this case, firms that secure financing obtain the payoff $U^f_{II} = pR - I$, so that (10) is not binding. Thus, they are indifferent to R^i_{II} and x_{II} if they obtain financing. Since a lower R^i_{II} and a higher x_{II} relaxes (11), the financial contract that gives the firms the entire social surplus can be offered, as long as (i) (12) holds with equality ($x_{II} = 1$) and (11) and (14) are satisfied, that is, $I - \rho \leq \phi C \leq \frac{\gamma}{(1-p)(1-\phi)}$ or (ii) (14) holds with equality and (11) and (12) are satisfied, that is, $I - \rho \leq \frac{\gamma}{(1-p)(1-\phi)} \leq \phi C$. Thus, if

$$I - \rho \leq \frac{\gamma}{(1-p)(1-\phi)}, \tag{29}$$

(9) is binding and firms' payoff is given by $U^f_{II} = pR - I$.

Next, suppose that (29) does not hold, that is, $\overline{\gamma_{II}} > \gamma$. This implies that (14) binds but (9) holds with strict inequality. Since R^i_{II} is determined by (14) holding with equality, the firm's profit (8) becomes $U^f_{II} = pR - I - (1-p)x_{II}\phi C + \gamma/(1-\phi)$. Because U^f_{II} is decreasing in x_{II}, the firm decreases x_{II} until (11) binds:

$$x_{II}\phi C = \frac{1}{p}\left[I - \rho - \frac{\gamma}{1-\phi}\right].$$

In this case, the firm secures financing as long as (10) and (12) are satisfied, that is, $\underline{\gamma_{II}} \leq \gamma$. Note that

$$\overline{\gamma_{II}} - \underline{\gamma_{II}} = p(1-\phi)\left[pR - I + \min\left\{\phi C - p\frac{B}{\Delta p}, 0\right\}\right] \geq 0$$

from Assumption 1 and the condition $I - \rho \leq \phi C$. Finally, if γ is so small that $\underline{\gamma_{II}} > \gamma$, financing does not occur. ■

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