Ignorant Experts and Financial Fragility*

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Abstract

We study debt funding 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 expertise and creating fear of illiquidity. In this case, as information about collateral decays over time, there is growth in credit and expertise acquisition, making the economy more vulnerable to an aggregate shock. This result suggests that the growth in the financial sector is associated with the prevalence of opaque assets and a subsequent crisis.

JEL Classification: D83, E44, G01.

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

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1 Introduction

The financial industry has aggressively acquired financial expertise. 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.1 The expertise allows financial firms to gather and process information about complex assets more easily and provide their services more efficiently. However, given that financial firms played a major role in the 2007–09 financial crisis, the social value of their expertise has been questioned.2 Therefore, it has become imperative to investigate under what conditions and why the trend of an increasing expertise acquisition has occurred within the financial industry.

In this study, we examine expertise acquisition incentives in a model of debt funding 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 are willing to acquire expertise to threaten firms with the fears of information acquisition and improve bargaining positions with firms, which allows for the emergence of ignorant experts—investors that acquire expertise but do not use it to produce information. Moreover, in this case, the depreciation of information

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1See 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.

2Adair 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).
about collateral over time leads to both a credit boom and a growth in expertise acquisition, leaving financial markets vulnerable to an aggregate shock. This finding offers an explanation about the linkage between the prevalence of opaque assets, the growth in the financial sector, and the financial crisis.

We build on the idea that symmetric ignorance can enhance liquidity in markets and that its breakdown can lead to a crisis, as advocated by Gorton and Ordoñez (2014), Dang et al. (2015), and Holmström (2015). 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. However, when the debt becomes information-sensitive in response to a shock, private information production ensues, and liquidity dries up. We explore the relationship between the information sensitivity of debt and expertise acquisition for a better understanding of recent developments in the financial sector.

In our environment, 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. We interpret the assets as preexisting financial securities (e.g., asset- and mortgage-backed securities) that are so complex and opaque that agents find it difficult to evaluate their fundamental values 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

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3The idea that information can destroy economic value goes back to Hirschleifer (1971), who shows that public information restricts risk sharing. See also Gorton and Pennacchi (1990).
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 acquire expertise to use it as a threat to extract rents from firms rather than to use it for information production. This implies that overinvestment in expertise arises.

In a dynamic model, we demonstrate how the decay of information about collateral over time leads to financial fragility. As in Gorton and Ordoñez (2014), we introduce idiosyncratic shocks that transform collateral with known quality into opaque collateral with high perceived quality. The firms with collateral known as low quality can obtain financing through uninformed lending after the shock hits; accordingly, information about collateral decays and credit expands over time. The rise in lending without information acquisition increases the opportunities for investors to extract rents, encouraging their expertise acquisition. However, booms do not last indefinitely. As a boom continues and expertise acquisition grows, investors are more likely to produce information about opaque collateral in response to aggregate shocks that reduce the collateral’s average quality. The informational regime change, from a state in which no one acquires information about collateral’s true quality to a state in which investors start to produce information, leads to a deterioration in funding liquidity and a decline in aggregate output. Thus, as opaque
assets circulates more widely in markets, credit and the level of expertise will grow, and the likelihood that a subsequent crisis will occur increases.

This offers a coherent explanation for the recent financial crisis. Prior to the financial crisis, securitization, or the process of pooling and tranching a set of assets, created large quantities of AAA-rated asset- and mortgage-backed securities from risky assets such as subprime mortgages (Coval et al., 2009). Although these securitized products were complex and opaque, they were considered by investors to be safe and were regularly used as collateral in the repo markets. Indeed, the overall size of reverse repo markets was roughly $4 trillion (Copeland et al., 2014). During this time period, we also observe the growth in finance; the financial sector share of GDP increased from about 5 percent in 1980 to about 8 percent in 2006 (Greenwood and Scharfstein, 2013, Philippon, 2015).

Subsequently, the repo markets collapsed during the crisis and were recognized as a major source of financial instability (Gorton and Metrick, 2012). Gorton and Metrick (2010) demonstrate that haircuts on subprime-related assets were zero before the crisis but then increased to 100 percent by 2009. By contrast, haircuts on non-subprime-related products increased from zero percent to approximately 20 percent. Our model implies that the growth in securitization that produces opaque assets and fuels a credit boom encourages an active acquisition of expertise for rent extraction, which increases the likelihood of information production and a subsequent collapse in markets.

**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

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4 Reverse repo markets comprise repo transactions in which dealers lend to their clients (e.g., hedge funds) or to other dealers. About 92 percent of this activity consists of bilateral reverse repo.

5 A significant rise in margins in bilateral repos is observed in a market wherein dealers lend to clients (Copeland et al., 2014). Copeland et al. (2014) and Krishnamurthy et al. (2014) document that, in contrast to bilateral repo markets, the tri-party repo markets, in which dealers mainly borrowed funds from cash providers (such as money market funds and security lenders) were relatively stable.
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 and relate the setup to a repo market. 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) and Acharya et al. (2016) 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 (2015), high financial sector compensation arises from the moral hazard problem. In our study, however, greater compensation is related to expertise in the evaluation of financial claims.

This line of work is related to the literature on the optimal level of financial expertise. 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, so that information decay can go hand-in-hand with increasing expertise acquisition and lead to a boom and bust cycle. Moreover, in contrast to earlier works, we show that investment in expertise can be inefficiently high with high pledgeability but inefficiently low with low pledgeability. This suggests that policy implications should differ depending on pledge-
Finally, our paper is also related to the literature on the relationship between adverse selection and financial crises. Although this literature primarily treats information asymmetry as exogenous (e.g., Kurlat, 2013; Chari et al., 2014; Guerrieri and Shimer, 2014; Bigio, 2015), a model of endogenous information asymmetry is presented by Gorton and Ordoñez (2014). As in our study, a depletion of information about collateral generates a credit boom followed by a crisis at the point of informational regime change. However, in contrast to us, Gorton and Ordoñez (2014) assume that the level of expertise (i.e., the cost of information acquisition) is exogenously given and thus do not explore inefficiencies in expertise acquisition. Moreover, our approach to include expertise acquisition clarifies how the growth in expertise plays an important role in generating a financial crisis.

Outline: The remainder of the paper is organized as follows. Section 2 describes the setting of the static 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 financial contracts. Section 4 characterizes the equilibrium of the static model. Section 5 extends the static model into the dynamic setting in which there is a depreciation of information about collateral over time. Section 6 presents our conclusions.

2 Static 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. We view these assets as preexisting financial securities, such as mortgage-related securities, and consider that the complexity of their design makes it difficult to estimate their real value.

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 assumptions of random matching and bilateral contract are intended to capture the fact that the new complex securities are mainly traded in an over-the-counter market (e.g., Duffie et al., 2005). 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 $x \in [0,1]$. We discuss more general contracts in Section 4.5.
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 $\gamma \in [0, \gamma_{\text{max}}]$ units of goods, each investor knows the true quality of collateral perfectly. The cost of information acquisition $\gamma$ can be interpreted as an inverse measure of the investor’s financial expertise, that is, investors with lower $\gamma$ have more expertise. The underlying idea is that investors who have more financial expertise find it easier to gather and process information about complex assets. The important feature of our model is that the level of expertise $\gamma$ is an endogenous variable. Before financial contracts are offered, each investor chooses $\gamma$, incurring a cost $\psi(\gamma_{\text{max}} - \gamma)$, with $\psi \geq 0$ and $\psi' \geq 0$. While $\gamma$ is publicly observable, the acquisition of information is unobservable.

The timing of events is as follows. Each investor chooses the level of financial expertise $\gamma$. 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 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 (Equilibrium)** A perfect Bayesian equilibrium is given by the firms’ contracts

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7In 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.
\((R^i, x)\), their choice between behaving and misbehaving, investors’ expertise \(\gamma\), 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 \(\gamma\), 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 (or expertise). 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:

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

(1)
subject to

\[ pR^i + (1 - p)x\tilde{\phi}C \geq 1, \tag{2} \]
\[ p(R - R^i) - (1 - p)x\tilde{\phi}C \geq 0, \tag{3} \]
\[ p(R - R^i) - (1 - p)x\tilde{\phi}C \geq (p - \Delta p)(R - R^i) - (1 - p + \Delta p)x\tilde{\phi}C + B, \tag{4} \]
\[ 0 \leq x \leq 1. \tag{5} \]

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 (\( \rho \)) 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 (Information and financial contract) 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 $\rho$ 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 $\phi$ but not with $\tilde{\phi} = 0$. This means that with full information, firms whose collateral is 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
Figure 2: Financial contract in each information regime

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 analyze the case of high pledgeability, $\rho \geq I - \phi C$, in which information about collateral reduces liquidity from Proposition 1. Then, Section 4.3 analyzes the case of low pledgeability, $\rho < I - \phi C$, in which information about collateral enhances liquidity. Section 4.4 analyzes efficiency in both cases and shows that investors overinvest in expertise in the case of high pledgeability and underinvest in expertise in the case of low pledgeability. Section 4.5 discusses assumptions.

4.1 Optimal Contract

Given that investors can acquire information about collateral at a cost of $\gamma$, 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 $(R_{II}^i, x_{II})$. Firms choose the contract $(R_{II}^i, x_{II})$ to maximize

$$p(R - R_{II}^i) - (1 - p)x_{II}\phi C$$

(8)
subject to

\[ pR^i_{II} + (1 - p)x_{II}pC \geq I, \]  
\( p(R - R^i_{II}) - (1 - p)x_{II}pC \geq 0, \]  
\[ R - R^i_{II} + x_{II}pC \geq \frac{B}{\Delta p}, \]  
\[ 0 \leq x_{II} \leq 1, \]  
\[ pR^i_{II} + (1 - p)x_{II}pC - I \geq \phi \left[pR^i_{II} + (1 - p)x_{II}pC - I\right] - \gamma. \]

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

\[ (1 - \phi) \left( I - pR^i_{II} \right) \leq \gamma. \]  

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 \( \gamma \), the investors choose not to acquire information.

Firms have incentives to reduce a repayment \( R^i_{II} \) to increase their payoff. When \( \gamma \) 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 \( \gamma \) is low, \( R^i_{II} \) is determined at
which (14) binds because a lower $R_{II}^i$ strengthens the investors’ incentives to acquire information. This means that for investors with lower $\gamma$, firms must lower the benefit of information production by increasing repayment $R_{II}^i$ and reducing the expected loss that informed investors are able to avoid.

The mechanism through which the lower-$\gamma$ investors require higher compensation $R_{II}^i$ 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 $R_{II}^i$ reduces firms’ stake $R - R_{II}^i$ and weakens their commitment to behave, firms must choose $x_{II}$ to satisfy the IC constraint (11) rather than the IR constraint (9) if $\gamma$ 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 $\gamma \geq \gamma_{II} \equiv (1 - \phi) (I - \rho - p \min \{pR - \rho, \phi C\})$, then firms can borrow funds by offering information-insensitive debt contracts, which yield the firms’ net payoff,

\[
U_{II}^f = \begin{cases} 
  pR - I & \text{if } \gamma_{II} \leq \gamma, \\
  pR - I - \frac{(1 - p)(1 - \phi)(I - \rho) - \gamma}{p(1 - \phi)} & \text{if } \gamma_{II} \leq \gamma < \gamma_{II}, 
\end{cases}
\]

(15)

where $\gamma_{II} \equiv (1 - p)(1 - \phi)(I - \rho) \geq \max \{0, \gamma\}$, and the investors’ net payoff,

\[
U_{II}^i = \begin{cases} 
  0 & \text{if } \gamma_{II} \leq \gamma, \\
  \frac{(1 - p)(1 - \phi)(I - \rho) - \gamma}{p(1 - \phi)} & \text{if } \gamma_{II} \leq \gamma < \gamma_{II}.
\end{cases}
\]

(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 \( \gamma_{II} \leq \gamma < \gamma_{III} \), 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 \( (U^f_{II} \text{ is increasing in } \gamma \text{ and } U^i_{II} \text{ is decreasing in } \gamma) \). 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 \( (\gamma < \gamma_{II}) \), firms do not obtain funds through information-insensitive contracts because firms lose money if they obtain financing \((10) \text{ is violated}\) or because they cannot pose more collateral \((12) \text{ is violated}\).

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

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

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

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

\[
0 \leq x_{IS} \leq 1, \tag{21}
\]

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

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 con-
straint (21), and the constraint that triggers information acquisition (22).

It is straightforward to characterize the optimal contract inducing information acquisition. A lower $R_{IS}^i$ increases the firms’ profit (17) and relaxes the constraints (20) and (22). Thus, the firms decrease $R_{IS}^i$ until (18) binds, and they obtain the entire social surplus $\phi(pR-I) - \gamma$, where they have to incur the cost of information acquisition $\gamma$. This implies that any financial contract $(R_{IS}^i, x_{IS})$ that satisfies (18) with equality and the remaining constraints is optimal. A higher $x_{IS}$ and a lower $R_{IS}^i$ 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

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

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

$$U_{IS}^f = \phi(pR-I) - \gamma,$$

and the investors’ net payoff, $U_{IS}^i = 0$. 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 ($U_{IS}^f$ is decreasing in $\gamma$). 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.

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
Figure 3: The comparison of payoffs between information-insensitive contracts and information-sensitive contracts when $\gamma_{II} = (1 - \phi) \left[ I - (1 - p) \rho - p^2 R \right]$ and $\gamma_{IS} = \phi(pR - I)$ payoff depends on $\gamma$. $U_{II}^f$ is nondecreasing in $\gamma$ from (15), whereas $U_{IS}^f$ is decreasing in $\gamma$ from (23). Thus, the firm chooses to offer information-insensitive contracts if $U_{II}^f \geq U_{IS}^f$, that is, $\gamma \geq \gamma^c$ given by

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

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

Whether firms with good collateral secure financing when $\gamma < \max\{\gamma_{II}, \gamma^c\}$ 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 $\gamma$, either information-insensitive or information-sensitive contracts are chosen, Figure 3b shows the situation in which for some $\gamma$, financial markets collapse.

The following proposition summarizes the result of the equilibrium contract.

**Proposition 2 (Optimal financial contract)** Suppose that Assumptions 1 and 2 hold and that $I - \rho \leq \phi C$. 

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Figure 4: Investors’ payoff

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

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

(iii) Otherwise, they cannot secure financing.

4.2 Acquisition of Financial Expertise

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

$$U^i(\gamma) = \begin{cases} 
(1-p)(1-\phi)(1-\rho) - \frac{\gamma}{p(1-\phi)} & \text{if } \max\{\gamma_{II}, \gamma^c\} \leq \gamma < \gamma_{II}, \\
0 & \text{otherwise},
\end{cases}$$

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

$$\gamma^* \equiv \arg\max_{\gamma \in [0, \gamma_{\text{max}}]} U^i(\gamma) - \psi(\gamma_{\text{max}} - \gamma).$$  \hspace{1cm} (26)$$

To guarantee that investors acquire expertise in equilibrium, i.e., $\gamma^* < \gamma_{\text{max}}$, and $\gamma^*$ is unique, we make the following assumption:

**Assumption 3** $\gamma_{\text{max}}$ and the function $\psi(\gamma_{\text{max}} - \gamma)$ are such that

1. $\gamma_{\text{II}} < \gamma_{\text{max}} \leq \gamma_{\text{II}}$,

2. $\psi(0) = 0, \psi' > 0, \psi'' > 0, \text{and } \lim_{\gamma \to \gamma_{\text{max}}} \psi'(\gamma_{\text{max}} - \gamma) < \frac{1}{p(1-\phi)}$.

The cost function $\psi(\gamma_{\text{max}} - \gamma)$ that satisfies this assumption is illustrated in Figure 4.

Under Assumption 3, it immediately follows that

$$\gamma^* = \begin{cases} 
\gamma_{\text{max}} - \psi'^{-1}\left(\frac{1}{p(1-\phi)}\right) & \text{if } \frac{1}{p(1-\phi)} < \psi' \left(\gamma_{\text{max}} - \max\{0, \gamma_{\text{II}}, \gamma^c\}\right) \\
\max\{0, \gamma_{\text{II}}, \gamma^c\} & \text{otherwise.}
\end{cases}$$  \hspace{1cm} (27)$$

When $\psi' \left(\gamma_{\text{max}} - \max\{0, \gamma_{\text{II}}, \gamma^c\}\right)$ is sufficiently high, investors choose the level of expertise that equates marginal benefit and marginal cost. When $\psi' \left(\gamma_{\text{max}} - \max\{0, \gamma_{\text{II}}, \gamma^c\}\right)$ is sufficiently low, investors acquire expertise to the point at which additional acquisition of expertise either stops firms from offering information-insensitive contracts: $\gamma^* = \max\{0, \gamma_{\text{II}}, \gamma^c\}$. In both cases, there is expertise acquisition but never information acquisition in equilibrium.

**Proposition 3 (Emergence of ignorant experts)** Suppose that Assumptions 1–3 hold and that $1 - \rho \leq \phi C$. Then, in equilibrium, the level of financial expertise $\gamma^*$ is given by (27) and all firms obtain financing without inducing information acquisition.
4.3 Low Pledgeability

To highlight the effect of pledgeability $\rho$ 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 $\gamma$ have a zero payoff, $U^i(\gamma) = 0$. As a result, (26) implies that 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 $1 - \rho > \phi C$. 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.
4.4 Efficiency

We now turn to efficiency. 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 $(R_{II}^i, x_{II}, \gamma)$ 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,

$$pR_{II}^i + (1 - p)x_{II}\phi C - I - \psi(\gamma_{\text{max}} - \gamma) \geq 0. \tag{28}$$

(28) is different from (9) because the investment in expertise is not sunk. In this optimization problem, an increase in $\gamma$ relaxes (14) and (28), thereby increasing the firm’s payoff. The socially optimal level of $\gamma$ is given by $\gamma^S = \gamma_{\text{max}}$. Then, since (28) becomes the same as (9), the financial contract $(R_{II}^i, x_{II})$ that the planner designs is the same as in the solution for the optimization problem (8)-(13) with $\gamma = \gamma_{\text{max}}$. 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 $(R_{IS}^i, x_{IS}, \gamma)$ 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,

$$\phi \left[ pR_{IS}^i + (1 - p)x_{IS}\phi C - I \right] - \gamma - \psi(\gamma_{\text{max}} - \gamma) \geq 0. \tag{29}$$
Since (29) is binding, the firm’s payoff becomes $\phi(pR - I) - \gamma - \psi(\gamma_{\text{max}} - \gamma)$. The planner chooses $\gamma$ to maximize this payoff without taking into account the remaining constraints because a lower $\gamma$ merely relaxes (20) and (22). Thus, the socially optimal level of $\gamma$ is given by $\gamma^S = \max\{\gamma_{\text{max}} - \psi'/\psi(1), 0\}$. The planner is indifferent to any contract $(R_{IS}', x_{IS})$ that satisfies (29) with equality and the remaining constraints.

**Proposition 5 (Inefficiency of expertise acquisition)** Suppose that Assumptions 1–3 hold. If $1 - \rho \leq \phi C$, the socially optimal level of expertise satisfies $\gamma^S = \gamma_{\text{max}} > \gamma^*$. If $1 - \rho > \phi C$, it satisfies $\gamma^S = \max\{\gamma_{\text{max}} - \psi'/\psi(1), 0\} < \gamma^*$.

**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.

**Proposition 5** suggests that policy implications will differ depending on the pledgeability. On the one hand, in an economy with well-developed financial markets, investors acquire excessive expertise, implying that the government can improve social welfare by discouraging the acquisition of expertise. One measure that the government can implement would be to introduce a cap on investors’ compensation $R'$. Since this prevents firms from promising a large compensation for investors to deter their information acquisition, rents extracted by investors reduce. Thus, bonus limits discourage investors’ incentives to acquire expertise. On the other hand, in an economy with underdeveloped financial
markets, the government can increase social welfare by encouraging investors to acquire expertise and screen collateral at a low cost. This could justify subsidies for the financial firms that play a role in examining the quality of collateral.

4.5 Discussion about Assumptions

Here, several assumptions are worth emphasizing.

**Financial contracts:** We could consider a more general contract \((T, R', x)\) 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.

**Search frictions:** We thus far assume that once a firm meets an investor and fails to borrow funds, the firm will not be able to find another investor. This eliminates competition between investors and allows them to extract rents from firms. If firms are on the short side of the market and can search for investors without costs, firms will try to borrow funds from investors with a level of expertise that gives the firms the highest payoff. Because a lower level of expertise decreases investors’ compensation and increases firms’ payoffs, investors have an incentive to slightly reduce their levels of expertise compared to other investors. Thus, competition among investors discourages expertise acquisition.
5 Dynamics

This section extends the static model of Section 2 into a dynamic setting. Section 5.1 describes the setup of the dynamic model. Following Gorton and Ordoñez (2014), the distribution of beliefs about collateral value is the unique state variable. Section 5.2 shows how investors’ compensation and levels of expertise grow and credit expands as information about collateral decays over time. Section 5.3 introduces a negative aggregate shock on asset quality that can lead to a crisis.

5.1 Setting

Time is discrete and continues forever: $t = 0, 1, 2, \ldots$. The model is populated by overlapping generations of a continuum of agents with unit mass who live for two periods as young and old. They are risk-neutral with no discounting between periods and their preferences over consumption streams are represented by $c^y + c^o$. When young, each agent becomes an investor and is endowed with a sufficient amount of goods. When old, each agent becomes a firm and is endowed with a project but no goods. We assume that goods are perishable and there is no storage technology. This means that firms need external financing.

One unit of asset, which has two types of quality, is distributed only to each agent of the initial generation; a fraction $\phi$ of the initial agents receive a good asset, and a fraction $1 - \phi$ of the initial agents receive a bad asset. The intrinsic value of a good (bad) asset is $C(0)$, and when the owner of the asset extracts its intrinsic value, it disappears. This means that an asset is storable and can be transferred to the next generation and used as collateral unless its owner consumes its intrinsic value. We also assume that an asset is indivisible.

Every period, the quality of the asset may change because of idiosyncratic shocks. For each asset, the idiosyncratic shock does not hit with probability $\lambda \in (0, 1)$ and hits with
probability $1 - \lambda$, regardless of the quality of the asset. While the quality of the asset that does not receive the shock remains unchanged, the quality of the asset that receives the shock becomes good with probability $\phi$ and bad with probability $1 - \phi$. While the shock is observable, whether the asset becomes good or bad after the shock is unobservable. The structure of idiosyncratic shocks is depicted in Figure 5. With this specific structure, when the true quality of collateral is identified and the beliefs about the probability of good collateral are given by $\hat{\phi} = 0$ or $\hat{\phi} = 1$, the shock makes the quality unknown and changes the associated belief to $\hat{\phi} = \phi$. When collateral with the belief $\hat{\phi} = \phi$ receives the shock, the belief does not change.

Figure 6 shows the sequence of events within a period. Each investor (or young agent) acquires expertise and then, idiosyncratic shocks occur. Each firm (or old agent) is matched with an investor and offers financial contracts $(R^i, x)$. The investor decides whether to acquire information and whether to accept the offer. If the investor accepts the offer, the firm chooses between behaving and misbehaving. Then, all outcomes are realized. At the end of the period, the owner of each asset decides whether to consume its intrinsic value, to hold the asset, or to sell it to the owner’s counterpart. For simplicity, we assume that when assets are traded, a buyer makes a take-it-or-leave-it offer to a seller.

We assume that when the investor acquires private information, the information becomes public. This assumption simplifies the analysis by allowing all agents to share beliefs on collateral and restores information symmetry at the end of the period.
5.2 Credit Boom and Escalating Levels of Expertise

We begin by analyzing asset markets. Because investors use an asset as collateral in the next period, they evaluate the asset more highly than do the firms. This implies that a firm that holds an asset becomes a seller, whereas an investor that does not hold the asset becomes a buyer. Since both the investor and the firm have common beliefs about collateral, $\tilde{\phi}$, the investor offers the transfer price $\tilde{\phi}C$ that makes the firm indifferent between selling the asset and consuming the intrinsic value.

This price setting allows us to apply the result of the static model directly to the dynamic model, in which the beliefs $\tilde{\phi}$ take three values (0, $\phi$, and 1) and the distribution of beliefs $\tilde{\phi}$ is the unique state variable. When firms have collateral with $\tilde{\phi} = 0$ or $\tilde{\phi} = 1$, they offer the optimal contract while ignoring investors’ information acquisition, as analyzed in Section 3. While firms with collateral $\tilde{\phi} = 1$ offer a financial contract that solves the optimization problem (1)-(5), firms with collateral $\tilde{\phi} = 0$ cannot secure financing. When firms have collateral with $\tilde{\phi} = \phi$, they choose between contracts that induce information acquisition and contracts that do not induce information acquisition, as analyzed in Section 4. Hereafter, we assume that pledgeable cash flows $\rho$ are sufficiently high that information about collateral reduces liquidity:

**Assumption 4** $0 < I - \rho \leq \phi C$. 
This is a stronger assumption than Assumption 2 and ensures that on the equilibrium path, firms with collateral $\tilde{\phi} = \phi$ offer information-insensitive contracts from Proposition 3.

We assume that at the initial period ($t = 0$), all agents are fully informed about the true value of assets. This means that at $t = 0$, there is no opaque collateral (i.e., collateral with belief $\tilde{\phi} = \phi$) and only firms that have collateral with belief $\tilde{\phi} = 1$ obtain funds. Figure 7 illustrates the transitional dynamics with a numerical example. In every period, some firms receive a shock and have collateral with belief $\tilde{\phi} = \phi$, which allows them to secure financing by offering information-insensitive contracts. Correspondingly, the fraction of opaque collateral increases over time (upper-left panel); after $t$ period, the distribution of beliefs concerning the probability of good collateral, $f(\tilde{\phi})$, is given by $f(0) = \lambda^t(1 - \phi)$, $f(\phi) = 1 - \lambda^t$, and $f(1) = \lambda^t \phi$. Because firms with bad collateral are able to invest in projects after receiving the shock, net aggregate output, given by $(1 - \lambda^t + \lambda^t \phi)(pR - I)$, rises over time (upper-right panel).

The opportunity of information-insensitive lending allows investors to increase their compensation by acquiring expertise. The equilibrium level of expertise is determined to maximize investors’ payoff:

$$\gamma^*_t \equiv \arg\max_{\gamma \in [0, \gamma_{max}]} (1 - \lambda^t)U^i(\gamma) - \psi(\gamma_{max} - \gamma). \quad (30)$$

In contrast to (26), investors meet firms with collateral $\tilde{\phi} = \phi$ with probability $f(\phi)$. This implies that as a fraction of opaque collateral increases, investors have a greater opportunity to extract rents by information-insensitive lending and are more willing to acquire expertise. Thus, as time goes by, the cost of information acquisition, $\gamma^*_t$, decreases (lower-left panel) and investors’ expected profits, $(1 - \lambda^t)U^i(\gamma^*_t) - \psi(\gamma_{max} - \gamma^*_t)$, increase (lower-right panel).

**Proposition 6** Suppose that Assumptions 1, 3, and 4 hold and that at the initial period, there is
Figure 7: Dynamics

Notes: The horizontal axis represents periods from $t = 0$ to $t = 100$. We assume

$$\psi(\gamma_{\text{max}} - \gamma) = \frac{1}{\Delta} (\gamma_{\text{max}} - \gamma)^2$$

and $\gamma_{\text{max}} = \frac{\gamma}{1 + \Delta}$. The parameters used are $p = 0.7$, $R = 2.5$, $\Delta p = 0.3$, $I = 1.5$, $B = 0.45$, $C = 1.3$, $\phi = 0.8$, $\lambda = 0.93$, and $d = 0.01$. 

full information about asset quality. A fraction of opaque collateral, net aggregate output, levels of expertise, and expected profits for investors grow over time.

Proposition 6 highlights the linkage between the prevalence of opaque assets, a credit boom, and growth in the financial sector. This captures the important aspects during the run-up to the financial crisis. Before the crisis, dramatic growth in securitization produced opaque financial securities and fueled a credit boom. During this time period, the financial industry grew; the financial sector share of GDP increased from about 5 percent in 1980 to about 8 percent in 2006 (Greenwood and Scharfstein, 2013, Philippon, 2015). Our model suggests that an increase in the use of securitized products in financial transactions leads the financial sector to invest more in expertise and extract larger rents from the corporate sector of the economy.

5.3 Financial Fragility

Next, we introduce negative aggregate shocks on asset quality. We assume that a negative aggregate shock makes the fraction \((1 - \eta)\), with \(\eta \in (0, 1)\), of good assets become bad assets. Agents can observe whether the aggregate shock hits but cannot observe who receives the shock. Thus, the aggregate shock changes beliefs \(\phi = \phi\) into \(\phi = \eta \phi\) and beliefs \(\phi = 1\) into \(\phi = \eta\), while \(\phi = 0\) remains unchanged. Suppose that the aggregate shock hits unexpectedly after the acquisition of expertise by investors but before the offering of financial contracts.\(^9\) This implies that when the aggregate shock hits, investors cannot adjust levels of expertise, but firms that have collateral with belief \(\phi = \eta \phi\) or \(\phi = \eta\) can design financial contracts given these beliefs.

Figure 8 illustrates the impact of aggregate shocks on the payoff of firms with collateral \(\phi = \phi\) and the financial contracts when \(\gamma_H \leq \gamma^c\). After the belief is reduced to \(\phi = \eta \phi\), the expected payoff of the firm that offers information-sensitive contracts

\(^9\)We consider only the unexpected aggregate shock for simplicity. Even if investors anticipate that the aggregate shock hits, as long as the probability that the shock hits is sufficiently small, they do not refrain from acquiring expertise and our result remains unchanged.
Figure 8: Effect of an aggregate shock on financial contracts when $\gamma_{III} \leq \gamma^c$ decreases because the probability of financing decreases. The expected payoff of firms that offer information-insensitive contracts also decreases because the increased probability that an investor meets a firm with bad collateral strengthens information acquisition incentives and leads to greater rents for the investor. If the aggregate shock $1 - \eta$ is sufficiently small, the latter effect dominates the former, implying that the information-sensitive region widens and the information-insensitive region narrows.

In this case, whether the aggregate shock induces an informational regime change depends on the level of expertise. When investors have a low level of expertise (for example, $\gamma'$ in Figure 8), the firms with collateral $\tilde{\phi} = \eta \phi$ choose information-insensitive contracts. However, when investors acquire a high level of expertise (for example, $\gamma''$), the shock induces the firms with collateral $\tilde{\phi} = \eta \phi$ to choose information-sensitive rather than information-insensitive contracts.$^{10}$

Figure 9 shows how the economy fluctuates in response to aggregate shocks. To simplify the explanation, we assume that the aggregate shock $1 - \eta$ is sufficiently small, such

$^{10}$When $\gamma_{III} \leq \gamma^c$, both the information-sensitive and information-insensitive regions would narrow and the region of no financing would widen, if the aggregate shock $1 - \eta$ is sufficiently large. When $\gamma_{III} > \gamma^c$, the aggregate shock necessarily narrows the information-sensitive and information-insensitive regions and widens the region of no financing. In these situations, the aggregate shock can prevent firms with collateral $\tilde{\phi} = \eta \phi$ from obtaining funds. However, since this possibility does not change our qualitative result, we focus on the situation in which the firms can issue either information-insensitive or information-sensitive debt even after the aggregate shock hits.
that firms with collateral $\tilde{\phi} = \eta$ offer information-insensitive contracts in the equilibrium path. After the first shock is realized (in period 5), the fraction of good assets decreases from $\phi$ to $\eta\phi$ and then moves back to the original level, $\phi$, because of idiosyncratic mean-reverting shocks, as displayed in the left panel. Despite the negative aggregate shock, the credit boom continues (the right panel). As shown in the lower-left panel of Figure 7, when the fraction of the opaque collateral is small, investors have not acquired enough expertise and thus, firms with opaque collateral can continue to choose information-insensitive contracts. However, when the increase in opaque collateral and the corresponding credit boom continue for a long enough period, investors acquire a high level of expertise. In this case, as shown in Figure 8, the aggregate shock induces the firms with opaque collateral to select information-sensitive contracts. As a result, if their collateral is identified as bad, they cannot obtain financing, and net aggregate output must decrease. Indeed, when an aggregate shock hits in period 50, it causes a sharp drop in aggregate output. Then, the economy begins to recover, and net aggregate output grows again.

Proposition 7 Suppose that Assumptions 1, 3, and 4 hold and that at the initial period, there is
full information about asset quality. Assume that $\eta \phi \geq \phi^c$, where

$$\phi^c \equiv 1 + \frac{1}{p} - \frac{1}{p} + \frac{(1 - p)B}{\Delta p} < 1. \quad (31)$$

There exists a time $t^c$ such that if $t < t^c$, a negative aggregate shock on collateral does not affect aggregate output, and if $t \geq t^c$, the shock generates a crisis.

**Proof.** See Appendix B. ■

Proposition 7 has a different implication from that in Gorton and Ordoñez (2014). In their setup, in which the level of expertise is exogenously given, the possibility that an aggregate shock causes a decline in output is independent of a fraction of opaque collateral. By contrast, our model predicts that the possibility that the shock generates a drop in output rises as a fraction of opaque collateral increases because it encourages the acquisition of expertise and leaves the financial market more vulnerable to a shock. This difference implies that a credit boom with growth in expertise tends to cause a large crash compared to the one without growth in expertise.

### 6 Conclusion

This study analyzes inefficiencies in expertise acquisition in a model of debt funding 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. The emergence of such ignorant experts
leads to a credit boom, due to their ignorance, and a subsequent crisis, due to their expertise. Our theory proposes a novel explanation that links the prevalence of opaque assets with growth in the financial sector and the financial crisis.

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 $R_{iI}$ increases the firm’s profit and makes (11) more likely to hold. The firm decreases $R_{iI}$ until (9) or (14) hold as equality.

First, suppose that (9) is binding. In this case, firms that secure financing obtain the payoff $U_{iI}^f = pR - I$, so that (10) is not binding. Thus, they are indifferent to $R_{iI}$ and $x_{II}$ if they obtain financing. Since a lower $R_{iI}$ 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

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

(32)

(9) is binding and firms’ payoff is given by $U_{iI}^f = pR - I$.

Next, suppose that (32) does not hold, that is, $\gamma_{II} > \gamma$. This implies that (14) binds but (9) holds with strict inequality. Since $R_{iI}$ is determined by (14) holding with equality, the firm’s profit (8) becomes $U_{iI}^f = pR - I - (1-p)x_{II}\phi C + \gamma/(1 - \phi)$. Because $U_{iI}^f$ 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, \( \gamma_{II} \leq \gamma \).

Note that

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

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

**Appendix B  Proof of Proposition 7**

**Proof.** Proposition 2 suggests that the information-insensitive region is \( \gamma \geq \max \{ \underline{\gamma_{II}}, \gamma^c \} \). \( \overline{\gamma_{II}} = (1 - \phi) [I - \rho - p \min \{ pR - \rho, \phi C \}] \) is decreasing in \( \phi \), while \( \gamma^c \) is decreasing in \( \phi \) when \( \phi \geq \phi^c \) because the total differentiation of (24) with respect to \( \gamma^c \) and \( \phi \) yields

\[
\frac{d \gamma^c}{d \phi} = \frac{(pR - I)\left([p(1 - \phi) + 1]^2 - p\right) - p(1 - p)B/\Delta p}{[p(1 - \phi) + 1]^2},
\]

where the numerator is decreasing in \( \phi \) and negative when \( \phi = 1 \) from Assumption 4. After an aggregate shock that reduces the belief \( \tilde{\phi} = \phi \) to \( \tilde{\phi} = \eta \phi \), \( \overline{\gamma_{II}} \) increases to

\[
\hat{\gamma}_{II} = (1 - \eta \phi) [I - \rho - p \min \{ pR - \rho, \eta \phi C \}] , \quad (33)
\]

and, if \( \eta \phi \geq \phi^c \), \( \gamma^c \) also increases to

\[
\hat{\gamma}^c = \frac{1 - \eta \phi}{p(1 - \eta \phi) + 1} \left[ p(1 - p) \frac{B}{\Delta p} - (1 - p \eta \phi)(pR - I) \right] . \quad (34)
\]

Thus, \( \max \{ \underline{\gamma_{II}}, \gamma^c \} < \max \{ \hat{\gamma}_{II}, \hat{\gamma}^c \} \), implying that the aggregate shock makes the information-insensitive region narrower.

Suppose that the first aggregate shock hits in period \( t \). If \( \gamma^*_t \geq \max \{ \hat{\gamma}_{II}, \hat{\gamma}^c \} \), firms that have collateral with belief \( \tilde{\phi} = \eta \phi \) issue information-insensitive debt, and the shock does not affect aggregate output given by \((1 - \lambda^t + \lambda^t \phi)(pR - I)\). If \( \gamma^*_t < \max \{ \hat{\gamma}_{II}, \hat{\gamma}^c \} \),
firms with collateral $\tilde{\phi} = \eta \phi$ issue information-sensitive debt or cannot receive financing. In either case, aggregate output declines.

From (30), the equilibrium level of expertise is given by

$$
\gamma^*_t = \begin{cases} 
\gamma_{\max} - \psi' \left( \frac{1 - \lambda^t}{\rho (1 - \phi)} \right) & \text{if } \frac{1 - \lambda^t}{\rho (1 - \phi)} < \psi' \left( \gamma_{\max} - \max \{0, \gamma_{\II}, \gamma^c\} \right) \\
\max \{0, \gamma_{\II}, \gamma^c\} & \text{otherwise,}
\end{cases}
$$

(35)

where $\gamma^*_t$ is nonincreasing in time $t$. Thus, if $\lim_{t \to \infty} \gamma^*_t < \max \{\hat{\gamma}_{\II}, \hat{\gamma}^c\}$, there exists a threshold $t^* \in [0, \infty)$ such that for $t < t^*$, an aggregate shock does not affect output, and for $t \geq t^*$, the shock causes a drop in output; otherwise, for any $t$, the aggregate shock does not affect output. ■

**References**


