Trust in Lending*

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Abstract

We develop a theory of trust in lending that distinguishes between reputation and trust in a model uncertainty framework. Banks emerge as more trusted lenders than non-banks. We show that trust removes the link between performance and the cost and availability of financing for lenders, but trust can be lost and is difficult to re-gain. When trust is lost, it generates discontinuities in pricing and credit availability, but banks are better able to survive such an erosion of trust than non-banks. This trust advantage for banks arises from the lower cost of funding for banks due to insured deposits and an endogenous belief revision channel that complements the effect of the funding cost advantage. The results also have novel policy relevance for the optimal size and scope of deposit insurance.

Keywords: Trust, Banks, Non-banks, Fintech, Lending, Financial Intermediation, Credit Market, Financial Crisis

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1 Introduction

Trust in financial products and institutions is often essential for financial markets to function efficiently. Arrow (1972) highlighted the importance of trust by stating: "Virtually every commercial transaction has within it an element of trust, certainly any transaction conducted over a period of time." For banks and credit markets in general, trust seems especially important as a lubricant of economic exchange—it has always played a foundational role, with "my word is my bond" defining the essence of banks in their safekeeping and depository functions. In line with this, trust has been part of the policy discussions regarding the potential credit market impact of shadow banks and non-intermediated credit, both of which have exhibited rapid growth (see He et al. (2017)).[1] Furthermore, many financial crises are attributed to risk taking and accompanied by serious damage to the creditworthiness reputation of institutions and a loss of trust that deepens the crisis (e.g. Guiso (2010), Fungacova, Kerola, and Weill (2019), and Knell and Stix (2015)).[2]

This paper develops a theory of trust in lending that permits a distinction between loss of trust and loss of reputation, and captures many features commonly observed in crises. We make the point that bank deposits—which are protected by deposit insurance—can contribute to the trust agents have in banks and make banks more trusted lenders than the non-depository lenders they compete with. This contrasts with the standard view since Merton (1977) that deposit insurance, which is isomorphic to a put option, can cause elevated risk taking by insured banks (e.g. Calomiris and Haber (2014) and McCoy (2000)). Thus, trust plays an important role in mediating the nature and effect of credit market competition

[1] Shadow banking experienced significant growth before the 2007-2009 financial crisis, and since then peer-to-peer (P2P) lending and other non-bank lending has been growing rapidly. Buchak et al. (2018) report that more than half of new U.S. residential mortgage lending is now done by shadow banks. This non-bank lending growth has coincided with a concomitant lack of growth in the lending capacity of depository institutions (see Fenwick, McCahery, and Vermeulen (2017)). This has been observed not only in the U.S. but also in Europe, causing many to debate the future of banks in lending (e.g. Sorkin (2016), de Roure, Pelizzon, and Thakor (2022)).

[2] Guiso (2010) uses survey evidence to document the collapse of trust in banks after the 2007-2009 crisis. Fungacova et al. (2019) examine crises during 1970-2014 in 52 countries, and find that experiencing a banking crisis diminishes a person's trust in banks.

between banks and non-banks.[3] In establishing this result, we show that the effect of deposit insurance on lending behavior depends on the distinction between the related notions of lender trust and reputation.

To explore these issues, we develop a two-period model in which competing lenders make loans in both periods. Lenders are intermediaries that raise short-term funding in each period from investors and use it to make loans. A lender can be a bank or a non-bank. From a functional perspective (e.g. Merton (1990, 1993, 1995)), they both perform the same lending function, so we focus on an important institutional difference—banks raise most of their funding through insured deposits, whereas non-banks do not. From a trust standpoint, this distinction seems key in light of the evidence in Knell and Stix (2015). Following Donaldson, Piacentino, and Thakor (2021) and Merton and Thakor (2019), this implies a lower cost of funding for banks than for non-banks, *ceteris paribus*.[4]

In each period, single-period loans are made. There is moral hazard at the lender level—the lender can unobservably make a bad loan instead of a good loan. The propensity to do this varies across lender types, which are *a priori* privately known to lenders. Lenders who remain solvent after the first period and can acquire funding are able to continue in the second period. In each period, borrower defaults are affected by the realization of a publicly-observed macroeconomic state. Investors revise their beliefs about each lender's type by observing both the macro state and whether the loan made by that lender repaid. The cost and availability of second-period funding for the lender depend on this belief revision.

This belief revision is at the core of how we define and model trust relative to credit

[3]For example, Rhydian Lewis, co-founder and chief executive of RateSetter, says "Banks can currently access money more cheaply than marketplace lenders and, in order to be truly competitive, this gap must reduce. The route to this for lending platforms is to build trust and acceptance, which comes with a strong track record" (see Green (2016)). Consistent with this, international data reveal that private credit provision goes down as trust declines. For example, there is a negative relationship between the credit-to-GDP ratio (from World Development Indicators) and the lack of trust indicator (from the Findex dataset) in 2017. We thank Nicola Limodio for providing this data. Along similar lines, Guiso (2010) provides evidence that trust is procyclical, and argues that the collapse of trust can cause investors to move towards safer portfolios, with adverse effects on the cost and availability of financing.

[4]Chretien and Lyonnet (2017) show that banks' access to insured deposits leads to an equilibrium in which banks and non-banks co-exist but the shadow banking sector is larger than optimal.

market reputation. We take our cue from the literature than emphasizes the distinction between trust and reputation (e.g. Morrison and Wilhelm (2015) and Mui, Muhtashemi, and Halberstadt (2002)). Broadly speaking, reputational enforcement can be viewed as involving agents' beliefs about someone's future behavior, when the behavior cannot be legally enforced but is driven by the anticipated future consequences of the behavior. Trust is different. Morrison and Wilhelm (2015) state: "A person is trusted only when his action promises are intrinsic to that person, rather than supplied by extrinsic motivation such as money or social approbation."[5] Thus, in contrast to reputation, trust does not depend on a threat of future "punishment" to achieve commitment. Indeed, as Fehr and Rockenbach (2003) point out, the threat of punishment can actually generate untrustworthy behavior.

In our model trust is the likelihood that the lender will engage in prudent lending, and this is linked to the lender's privately-known lender type—one type is completely trustworthy, and one is self-interested, meaning that it is trustworthy only when that is in its best interest and there is heterogeneity in the degree of self interest.[6] We analyze trust and reputation for prudent lending from two perspectives. One is a standard career-concerns type model in which the bank's reputation for prudent lending evolves via Bayesian updating based on observed performance. With assume standard preferences and Bayesian rational beliefs, investors' trust in the lender and the lender's reputation for prudent lending are indistinguishable.

The other perspective models trust and distinguishes it from reputation using Ortoleva's (2012) "model uncertainty" framework. Agents face uncertainty both about the correct

[5]Somewhat similarly, Gambetta (1988) states: "...trust is a particular level of the subjective probability with which an agent will perform a particular action, both before [it] can monitor such action (or independently of his capacity of ever to be able to monitor it) and in a context in which it affects (the agent's) own action."

[6]Our focus is on trustworthiness; another dimension of trust is competence. Trustworthiness is about intent, whereas competence is about skills. A trustworthy but incompetent entity can make decisions as poorly as an untrustworthy entity. A potential third dimension of trust is reliability, as noted by the work of Onora O'Neill (see, e.g., O'Neill (2002)). Reliability may refer to people or systems—for example, a mistake made by an unreliable system may be viewed as a lack of trust in that system. Reliability can be incorporated in the competence dimension of trust, although there may be circumstances in which a distinction between the two can be informative.

model of the world ("is the lender unconditionally trustworthy or self-interested?") as well as about the lender's "type" within a given model ("if self-interested, is the lender still worth financing?"), and belief revision is Bayesian in some states and non-Bayesian in others. Agents first choose the model of the world they believe in and then take expectations over the set of types in that model. A lender is trusted if agents adopt a model of the world that the lender will never make a bad loan. But sufficiently strong ex post evidence that this model is incorrect causes trust to be lost (via non-Bayesian belief updating), so lenders are viewed as self-interested, and there is Bayesian revision of post-model-shift beliefs.[7] Uncertainty about the true model reflects trust and is captured by a *prior over priors*, while within-model uncertainty reflects reputation and is captured by the usual prior beliefs. Trust in this setting has a 0-1 property—you either trust someone or you do not.[8] The non-Bayesian belief revision is necessary because with Savage rationality, model uncertainty cannot be distinguished from uncertainty in the value of the relevant asset.

Analysis of the model generates the following main results. First, as long as financial institutions are trusted, they can raise financing at the lowest possible cost regardless of their prior loan default experience and market conditions.[9] This sheds possible light on the insensitivity of funding availability to performance for banks documented by Martin,

[7] In our model, a loss of trust involves only a discontinuous change in beliefs. If we also modeled "betrayal costs" (Bohnet and Zeckhauser (2004)), our results about the impact of loss of trust on the cost and availability of financing would be even stronger. Our modeling of within-model uncertainty is somewhat similar to Hartman-Glaser (2017), where there is asymmetric information about issuer preferences for honestly revealing quality. Ordonez (2013) models fragile reputation in credit markets that results in correlated risk-taking by reputable firms in response to small changes in aggregate conditions. A similar idea appears in Ordonez (2018) wherein the viability of securitization depends on the confidence the parties to a contract have that counterparties will behave as expected, even absent explicit contractual provisions. In our model, there is no securitization or loan retention decision, and uncertainty about the true model plays a central role.

[8] The trust we focus on is personalized trust, as opposed to generalized trust. In the trust literature, there is a debate about whether trust should be measured along a continuum or as a dichotomous variable (an entity is trusted or not). This is the "scale-length" debate; see Baner and Freitag (2018). We believe this debate pertains mainly to generalized trust, and that an action-specific allocation of personalized trust has a 0-1 property—you either trust an entity or you do not.

[9] Nicolas and Taraz (2020) provide evidence that trust matters for lending growth. Recently, Gurun, Stoffman, and Yonker (2018) provide evidence that communities exposed to the Madoff Ponzi scheme withdrew assets from investment advisers and increased deposits at banks, and provide evidence that services which built up more trust experienced fewer withdrawals.

Puri, and Ufier (2018). Although trusted banks have a funding-cost advantage over trusted non-banks, trust minimizes the difference between banks and non-banks in terms of their prudent-lending incentives.

Second, lenders may lose trust when they experience loan defaults that would be sufficiently unlikely if they were making prudent loans, and we show that trust is easier to lose than to gain, a result that arises *only* with model uncertainty. Loss of trust forces reliance on credit reputation, with sharp discontinuities in pricing and credit availability, both of which now depend on the *perceived* prudent lending incentives of self-interested lenders. This explains pricing and funding discontinuities during the 2007-09 crisis (e.g. Gorton and Metrick (2012), Iyer, Peydro, da-Rocha-Lopes, and Schoar (2013)).[10]

Third, banks survive a loss of trust and have continued funding access when non-bank lenders face drying up of funding, i.e. banks are more trusted lenders than non-banks (Knell and Stix (2015)).[11] Even if both banks and non-banks lose trust, the funding-cost advantage banks have over non-banks *increases* relative to when both are trusted, i.e., a loss of trust *magnifies* the difference between banks and non-banks. Moreover, the loss of trust has real consequences—expected loan defaults increase, implying that a loss of trust leads to less trustworthy behavior, consistent with experimental evidence on "trust responsiveness" (see Bacharach, Guerra, and Zizzo (2007)).

In our model, the bank's funding cost advantage affects the bank's profit only for the good loan since the bad loan produces no pledgeable cash flow and generates only private benefits for the bank. This highlights a benefit of insured deposits for banks in terms of making them more trusted lenders. Moreover, our main analysis does not have the risk-shifting moral hazard commonly associated with deposit insurance (Merton (1977)). However, it is informative to consider how our analysis would be affected by alternative assumptions on the

[10]This can also rationalize features like the pricing of credit seemingly disassociated from risk during some periods (e.g. Coval, Jurek, and Stafford (2009), Min (2015), Stephanou (2010), and Lee, Miller, and Yeager (2015)).

[11]Thus, deposit insurance helps to make the bank's depositors "liability insulators" in the sense of Chodorow-Reich, Ghent, and Haddad (2018)—the cost of the bank's liabilities (and hence the value of the bank's equity) is insulated from fluctuations in asset "market values".

pledgeable payoff and private benefits of the bad loan, as well as moral hazard surrounding deposit insurance. To examine this, in a section on extensions of the analysis, we assume that the bad loan has a pledgeable payoff and lender private benefits with some positive probability that is lower than that of the good loan, i.e., we introduce risk-shifting moral hazard. Additionally, we introduce a deposit franchise value for the bank (e.g. Dreschler, Savov, and Schnabl (2023)). Analysis of this case uncovers a condition that must hold for all of the results in the base model to go through. This condition ensures that the cost-of-funding advantage of the bank is strong enough to offset the disadvantage of deposit-insurance-related moral hazard.

The analysis has policy implications. First, the analysis highlights the positive contribution deposit insurance makes to prudent lending incentives, in contrast to the standard view, and hence the policy implications of that. Second, the results show that trust in banks complements tools of prudential regulation, like capital requirements. Third, the analysis has implications for other regulatory tools such as the disclosure of stress test results.

Our paper is related to the vast literature on deposit insurance (see, e.g., reviews by Calomiris and Jaremski (2016) and Demirgüç-Kunt and Kane (2003)). While this literature focuses on the moral hazard and potential loss of trust that deposit insurance engenders (one that we also consider in our extension), we highlight a novel aspect of deposit insurance, namely its role in making banks more trusted as lenders than non-banks. Furthermore, while this literature asserts that deposit insurance dilutes market discipline on banks, in our model it facilitates market discipline.

Our paper is also related to the literature on trust in financial markets, e.g. Guiso, Sapienza, and Zingales (2008), Sapienza and Zingales (2011), and Gennaioli, Shleifer, and Vishny (2015a). These papers provide the insight that trust can lower perceptions of risk and increase investor participation.[12] Our work is complementary in that investors' willingness

[12] Our paper is also related to the literature that examines the interaction between reputation and trust. See, for example, Bohnet, Frey, and Huck (2001) and Bohnet and Huck (2004). These papers examine how short-term reputational incentives affect the development of trust. Also related is the relational contracting literature in which contracting parties engage in mutually-beneficial behavior due to their relationship, even

to fund lenders depends on trust. However, the focus of our analysis is different.

Also related are papers that depart from Savage rationality to explain some crisis-related events, including those that feature model uncertainty like we do (e.g. Hong, Stein, and Yu (2007)). These papers use either non-Bayesian belief revision assuming extrapolative expectations (e.g. Gennaioli, Shleifer, and Vishny (2012, 2015b)) or the availability heuristic (e.g. Thakor (2015)), or depart from standard preference assumptions and introduce uncertainty aversion (e.g. Routledge and Zin (2009)). Contrary to Bayesian updating, some of these papers introduce learning in which new information does not monotonically increase the information known to the decision-maker. Specifically, both under-reaction and over-reaction to new information are well-known features of this class of models, and these prediction are consistent with documented behavior in financial markets (e.g. De Bondt, Werner, and Thaler (1985, 1987)). Unlike these papers, we use standard preferences and permit both Bayesian and non-Bayesian belief revision. Moreover, besides explaining crisis-related stylized facts, our paper addresses a host of other issues discussed below.

In summary, the intended marginal contribution of our paper is twofold. First, we provide a framework within which the role of deposits in generating implications for trust in lending across banks and non-banks can be examined. Specifically, our result that a *single* difference between banks and non-banks—namely the funding cost advantage that deposits give banks—can lead to banks being the "trusted lenders" in the economy has significant novel policy relevance. Second, we analyze trust and reputation within the same model, showing that they are indistinguishable in a standard Bayesian rational setting but can be distinguished in a model uncertainty setting. With this we show the effect of competition among lenders on trust and reputation, and *how* this varies across banks and non-banks.

The rest of the paper is organized as follows. Section 2 develops the formal model. Section 3 discusses the Reputation model. It also provides an analysis of the first best. Section 4

when reneging is possible (see Baker, Gibbons, and Murphy (2002), and Kukharsky and Pflüger (2010)). Macaulay (1963) first wrote about how relational contracting is based on trust. Our model differs from this literature in that our notion of trust is different and we focus on developing a model that distinguishes between trust and reputation in a credit market setting.

analyzes the Trust model. Section 5 provides an analysis of the choices of lenders and a juxtaposition of the Reputation and Trust models, and an analysis of extensions of the base model, including allowing lender types to be in a continuum. Section 6 has a discussion of the policy implications of the analysis. Section 7 concludes.

2 The Model

There are two time periods, the first from $t = 0$ to $t = 1$, and the second from $t = 1$ to $t = 2$. All agents are risk neutral, and the one-period riskless rate is $r > 0$. All agents can invest in the riskless asset, so the reservation return on providing financing is r for lenders as well as the financiers of lenders. There are individual agents who can be borrowers or savers (or both), banks that intermediate between borrowers and savers by raising money from depositors and shareholders at $t = 0$ to fund loans, and non-bank lenders that provide both intermediated (shadow banks) and non-intermediated financing (e.g. P2P lending). While lenders exist for both periods, each borrower, depositor, and shareholder lives for one period. Thus, there are first-period borrowers and financiers and second-period borrowers and financiers. This means all claims are settled at the end of each period and the only "long-lived" entity is the lender. Later, we will permit borrowers to operate in both periods.

2.1 Agents and Contracts

Borrowers: Each borrower has a project requiring L at the start of the period and paying off at the end of the period. Borrowers are penniless and need loans to finance these projects. There are two types of borrowers: good (G) and bad (B). Each G borrower has a good (socially efficient) project that pays off $x \in \mathbb{R}_+$ with some "success" probability at the end of the period and 0 with the complement of that probability; a loan to such a borrower is a "G loan". The success probability is a function of an idiosyncratic project-specific probability $q \in (0, 1)$ and a macroeconomic variable $\tilde{m}$ (described below).

There is macroeconomic uncertainty—representing the state of the overall economy—whose realization is publicly observed at the end of each period. This uncertainty is represented by the random variable $\tilde{m}$ (realization m) with density function η and support $\eta \in [\underline{m}, \overline{m}]$. The repayment probability, $F(m, q) \in (0, 1)$ is a function of both q and m, with $\partial F / \partial m > 0$. Let

$$\overline{q} \equiv \int_{\underline{m}}^{\overline{m}} F(m, q)\eta \, dm \tag{1}$$

We assume $F\left(\overline{m}, q\right)$ is very close to 1, so in the most favorable macroeconomic state, the G loan has a very high repayment probability. Let ω be the observed outcome at $t = 1$, where

$$\omega = \{\text{borrower defaults or repays}, m\} \tag{2}$$

Let Ω be the set of all ω's.

We assume that the G project has an expected payoff with

$$F\left(\underline{m}, q\right) x > L[1 + r] \tag{3}$$

so the lowest m has positive NPV.

There are also (inefficient) loans, each of size L, to bad (B) borrowers that default with probability 1. These inefficient loans generate non-pledgeable payoffs for the B borrowers. Lenders, who can privately distinguish between B and G borrowers, may make loans to B borrowers due to lender private benefits, as explained later, but the sum of the borrower's non-pledgeable payoff and the lender's private benefit is less than $L[1 + r]$, i.e., the loans are inefficient. We refer to this as a "PB" loan.

Zero Lower Bound: We assume that all interest rates have a zero lower bound. This assumption helps to simplify the analysis, but is not crucial.

The Loan Contract: Each first-period borrower receives L at $t = 0$ and promises to repay the lender some amount R at $t = 1$. Since this amount can be repaid only if the borrower's project pays off x, a higher q for any m (and hence higher F) means lower default risk. Similarly, each second-period borrower takes a loan of L and promises to repay some R at $t = 2$.

Depositors: These agents have liquidity at the start of each period that they can either deposit in a bank or invest in a riskless asset for a return of r. If D is deposited in the bank at $t = 0$, it produces liquidity, safekeeping, and transaction services that depositors value.[13] We assume that the value of the bank's services is high enough, so depositors' participation constraint is satisfied with a deposit interest rate of zero. Appendix A provides a microfoundation for this and also shows that complete deposit insurance has a welfare benefit that arises in part from depositors' aversion to the bank's credit risk.

The idea that depositors do not wish to be exposed to the bank's credit risk builds on the insights of Merton (1989, 1993, 1995, 1997), and most recently, Dang, Gorton, Holmstrom, and Ordonez (2017) and Merton and Thakor (2019). The deposit interest rate is zero because depositors receive bank services that, conditional on bank solvency, are valued higher than the riskless rate r; this makes complete deposit insurance socially efficient. Absent the zero lower bound on interest rates, depositors would even accept a negative interest rate. With a zero interest rate, depositors' participation constraint is slack.

Investors: These are agents who, like depositors, have liquidity at the start of the period, but do not value the bank's liquidity services. Thus, they expect the instrument they invest in to provide a pure financial return of r.

[13] There is a vast literature in banking that rationalizes the value depositors attach to bank deposits, including the literature on the "safe asset premium". Thus, depositors play two roles—they provide financing and they consume services provided by the bank. As in Merton and Thakor (2019), we refer to them as "customers" of the bank, in contrast to shareholders and other investors who are pure financiers. This feature distinguishes banks from non-banks—banks receive substantial financing from customers.

Banks: There are regulated entities operating in a competitive credit market and designing loan contracts that maximize the expected utilities of borrowers subject to the participation constraints of depositors and investors. Each bank is operated by a (penniless) insider who maximizes his own expected utility, raising $L-D$ at the start of each period from shareholders who require an expected return of r. Shareholders who provide funding at $t=0$ are paid off fully at $t=1$, conditional on the bank being solvent, at which time funds are raised from new shareholders. Deposits are completely insured.[14] If the bank is insolvent, the claims of the bank's shareholders are worthless, and after the depositors are paid off by the deposit insurer, equity financing for the second period is raised from a new group of shareholders.[15] Without loss of generality, we set the deposit insurance premium at zero.[16]

We distinguish between deposits and funds provided by investors, but there is no difference between the expected returns demanded by shareholders and subordinated debtholders, so the bank's financing mix of equity and "sub" debt is irrelevant. Financing to each bank is in perfectly elastic supply, and the return to each group of financiers satisfies the participation constraints of that group, i.e., gives that group an expected return of at least r.[17]

Non-bank Lenders: As noted earlier, these lenders may be non-banks such as shadow banks or P2P lenders, that provide no depository services to customers. All financing is raised from investors and loaned to borrowers. In the case of shadow banks, this would be non-depository debt, and in the case of P2P platforms it would be equity (Philippon (2016)).[18] Each non-bank is also operated to maximize the expected utility of the insider

[14]This is for simplicity; our results are unchanged if we assume partial deposit insurance.

[15]That is, the previous shareholders of the failed bank no longer have any claim on the bank's cash flows. This assumption is for simplicity, and does not affect our conclusions.

[16]This is consistent with the institutional reality for U.S. banks over long periods of time. Moreover, as long as the premium is risk-insensitive, it reduces to a constant and does not affect the analysis.

[17]We will show later that the participation constraint of shareholders will hold tightly in equilibrium, whereas depositors' participation constraint will be slack. This is because depositors value the bank's liquidity services. Non-depositor investors will not covet deposits since they do not value these liquidity services.

[18]Given the equivalence between non-deposit debt and equity, no generality is lost in assuming that non-banks are all-equity financed. This is because we have no bankruptcy costs.

owner (residual claimant after investors are paid off).[19] In line with our previous discussion of focusing on trustworthiness, we assume that non-banks have access to the same information technology that banks have access to, and are just as skilled at processing information.

In our context, note that investors (who do not care about the bank's liquidity services) are indifferent between funding banks and non-banks *ceteris paribus*, so both banks and non-banks must compete to offer borrowers the same terms. Thus, in equilibrium the liquidity services provided by banks to depositors end up making banks more profitable than non-banks, but both still co-exist.[20] We do not model a cost of intermediation for banks, but in a general equilibrium model, one can assume that this cost is high enough to equal the expected profit of the marginal bank (which would be declining in the number of banks). This would determine the equilibrium number of banks and non-banks.

2.2 Agent Types and Models of the World

Lender Types: Whether a lender is a bank or a non-bank is publicly observable. However, either a bank or a non-bank can be one of three unobservable types: τ_A, τ_B, and τ_C. Each lender privately knows its own type, but this is not observed by others. there is a common

[19] Investors who provide a fintech platform, such as a P2P lender, with funding for the loan must receive an expected rate of return commensurate with the usual no-arbitrage market pricing conditions. As the collector of fees and servicing revenues, the platform owner is the residual claimant. A standard compensation agreement is for the platform owner to collect part of the loan repayment as a fee and pass along the rest to investors, so its objective is to maximize the expected loan repayment, similar to a shadow bank. In addition, the platform owner also typically collects a fee that is increasing in loan volume. This may create additional incentive problems, but these exist similarly for banks as well.

[20] This is true empirically as well. Chernenko, Erel, and Prilmeier (2018) document that 32% of all loans to publicly-traded middle-market firms during 2010-2015 were provided by non-banks. In our model, the co-existence is possible—despite banks being more profitable than non-banks—because no lender will offer a loan that gives it an expected return below r, so borrowers are indifferent between banks and non-banks that will offer the same terms in competitive bidding. Thus, banks do not capture the entire market. An alternative argument for why banks—with a funding-cost advantage—co-exist with non-banks in general equilibrium appears in Donaldson, Piacentino, and Thakor (2021).

prior belief distribution over types at $t = 0$:

$$\Pr(\tau_A) = \zeta_0 \in (0,1),\ \Pr(\tau_B \text{ or } \tau_C) = 1 - \zeta_0$$
$$\Pr(\tau_B \mid \tau_B \text{ or } \tau_C) = \gamma \in (0,1),\ \Pr(\tau_C \mid \tau_B \text{ or } \tau_C) = 1 - \gamma \tag{4}$$

where ζ_t is the probability at date t. The type τ_A lender does not have access to any private-benefit loan, so it always invests in a good borrower, but like any lender, it will need to monitor the borrower to limit its access to inefficient private-benefit projects. The type τ_B can choose between making a good loan and a private-benefit loan that yields it a private benefit of $\beta_B \in \mathbb{R}_+$. The type τ_C has *no* access to a good borrower and thus can make only a private-benefit loan yielding $\beta_C > \beta_B$.[21] While the good loan yields the lender no private benefits (an innocuous assumption), private benefit loans are inefficient:

$$\beta_C < L[1 + r] \tag{5}$$

The Notion of Trust: Our focus is on the trust that the financiers of lenders have in the lender making a good loan. Trust is influenced by beliefs about the lender's type τ. As a matter of expositional convenience, we will refer to beliefs about τ as "trustworthiness".

We assume that τ is privately known to the lender. Thus, our analysis revolves largely around how beliefs about τ are revised.

Two Approaches: We will analyze two models. The first is a straightforward model of Bayesian updating in which agents have prior beliefs over the lender's type and use these beliefs to price the financing they provide at $t = 0$. They then update using Bayes' Rule at $t = 1$, based on the observed outcome at $t = 1$, and then determine whether to renew funding for the lender, and if so, at what terms. We call this the "Reputation Model"; this leads to

[21] There are many ways to interpret lender private benefits. One is that it is a private cost of monitoring the good loan which pays the lender nothing if it is not monitored. The other is that it is literally a rent that accrues to the lender because it is a (bad) loan made to a friend or relative of the manager of the lender.

a standard career concerns analysis in which the lender's first-period choice anticipates the future reputational consequences for second-period funding.

The second approach is one in which there is model uncertainty in Ortoleva's (2012) framework. In this setting, there are two models of the world that investors and depositors can have: (1) lenders are completely trustworthy (Model I), and (2) lenders are not completely trustworthy, and may choose private benefit loans (Model II). In Model I, the lender is only of type τ_A. In Model II, the lender can be either type τ_B or τ_C.

With model uncertainty, the common prior belief of borrowers and financiers at $t = 0$ is that the probability is $\zeta_0 \in (0, 1)$ that the true model of the world is Model I, and $1 - \zeta_0$ that it is Model II. The model of the world adopted by borrowers and financiers ("agents" henceforth when referred to collectively as a group) applies to individual banks as well as non-banks. Unlike the Reputation Model, in the Trust Model we will be able to analyze loss of trust, which occurs when agents switch from Model I to Model II.

Lender Maximization Programs and Information: Let $l_t^i(\tau_j) \in \{G, PB\}$ be the choice of loan in period t by type $\tau_j \in \{\tau_A, \tau_B, \tau_C\}$ of lender $i \in \{b, n\}$, where b represents banks and n represents non-banks. Then in the second period:

$$l_2^i(\tau_j) \in \arg\max_{\{G,PB\}} u_2^i(\tau_j) \tag{6}$$

and in the first period:

$$l_1^i(\tau_j) \in \arg\max_{\{G,PB\}} U_0^i(\tau_j) \tag{7}$$

where

$$U_0^i(\tau_j) = u_1^i(\tau_j) + \mathbb{E}\left[u_2^i \mid l_2^i(\tau_j)\right] \tag{8}$$

is the expected utility of the bank decision-maker over two periods, and it takes as a given the (subgame perfect) choice $l_2^i(\tau_j)$ in the second period. The maximizations above are subject to the participation constraints of the financiers of the lenders and borrowers. Note that the upper case utility notation $U_0^i(\tau_j)$ represents expected utility over two periods, whereas the lower case utility notation $u_t^i(\tau_j)$ represents utility in period t.

Here the lender's preference function in each period is

$$u_t^i(\tau_j) = \left[1 - \alpha_t^i\right] z_t^i(\tau_j) + \beta_j \tag{9}$$

where t is the time period, $\tau_j \in \{\tau_A, \tau_B, \tau_C\}$ and $i \in \{b, n\}$. Further, $z_t^i(\tau_j)$ is the expected payoff to the lender's shareholders, and α_t^i is the share of the payoff that lender i must sell to raise equity in period t. While each lender can observe the borrowers' type, the lender's financiers cannot tell whether the lender made a G or a PB loan.

2.3 Competitive Structure of the Credit Market

We model imperfect competition among lenders through a process in which borrowers search for lenders. The total number of borrowers is M and this remains the same in both periods. There are bank and non-bank lenders and the total number of lenders exceeds the total number of borrowers, but lender-borrower matching is subject to frictions, so with probability $\theta \in (0, 1)$, the borrower will be faced with two or more lenders, and with probability $1-\theta$ the borrower will face only one lender. When a borrower is paired with two lenders, the lenders engage in Bertrand competition, loan pricing is competitive, and the lender's participation constraint holds tightly. When there is only one lender, the pricing is monopolistic. Thus, θ can be viewed as a measure of credit market competitiveness. The microfoundations of this are provided in Appendix A.

Bank Regulator: There is a regulator who provides complete deposit insurance. Although we take this as given, we also provide a microfoundation for it. We ignore regulatory compliance costs for now, but discuss their implications later. Non-banks do not have access to deposits, and are not subject to regulation.

Figure 1 summarizes the sequence of events in the two periods of the model.

Figure 1: **Time Line**

$t = 0$	$t = 1$	$t = 2$
► Borrowers and financiers share common prior beliefs about lender types. With model uncertainty, the true model of the world (i.e. the probability that lenders are trustworthy) and the lender's type within each model. ► These beliefs determine the prices at which bank and non-bank lenders raise financing. ► Each lender decides whether to make a good loan or a private benefit loan.	► The macro uncertainty $\tilde{m}$ is realized and it affects first-period success probabilities. ► Borrowers pay off or default on first-period loans. Lenders settle claims with financiers. If the lender collects a profit, it is paid off to shareholders as a dividend. In the case of banks that fail, the deposit insurer covers part of the claim. ► Economic agents revise their beliefs about lender types in the Reputation Model, and about the true model of the world as well as about lender types within the Trust Model. Lenders may lose trust. ► Second period begins with new borrowers and new depositors. Shareholders may or may not choose to provide more financing.	► Second-period claims are settled after second-period $\tilde{m}$ is realized and loans are repaid or default.

3 First Best and Analysis of Reputation Model

In this section, we begin to analyze the model. We start with the first best, and then analyze the second best equilibrium in the Reputation Model. The focus here is on some general results and second-period lender strategies. In Section 5, we will analyze the Trust Model, followed by an analysis of both Models and a comparison in Section 6.

3.1 First Best

This is the case in which the bank's loan choice is observable. The first-best outcome is the bank making the good loan. This outcome for a single period is the same as the single-period outcome with trustworthy lenders. Next we have:

Lemma 1: *The borrower's repayment obligation when faced with only one lender is:*

$$R_{FB}(1) = x \tag{10}$$

and when faced with two or more lenders, it is:

$$R_{FB}(2) = \{L[1 + r]\} \{\overline{q}\}^{-1} < x. \tag{11}$$

The repayment obligation is independent of whether the lender is a bank or a non-bank.

This result follows from the fact that the lender fully extracts all project surplus when it is a monopolist, but offers a price to the borrower at which the loan yields an expected return of r to the lender when there are two or more competing lenders. The reason why no lender prices the loan lower is that r is each lender's reservation expected return on lending, since this is the return that can be obtained by investing in the riskless asset.

3.2 Reputation Model in the Second Best: Equilibrium Concept

In the reputation model, agents initially believe that lenders can be of any type, τ_A, τ_B, or τ_C. That is, the prior belief at date 0 is a probability distribution over all three types for lender $i \in \{b, n\}$:

$$\pi_0^i = \{\Pr(\tau_A) = \zeta_0,\ \Pr(\tau_B) = [1-\zeta_0]\,\gamma,\ \Pr(\tau_C) = [1-\zeta_0]\,[1-\gamma]\} \tag{12}$$

Subsequent to this prior, new information will arrive and at date t the information set is ω, so the posterior belief will be:

$$\mu_t^i(\tau_j \mid \omega) = \Pr\left(\text{lender } i \text{ is type } \tau_j \mid \pi_0^i, \omega, j \in \{A, B, C\}\right) \tag{13}$$

Recall that $\omega \in \Omega$ is the composite information set that includes the realized $\tilde{m}$ and whether the first-period borrower repaid the loan or defaulted. The superscript i will sometimes be dropped if the context demands.

We now introduce additional notation that is useful in the subsequent analysis. Let λ^i (with $i \in \{b, n\}$) be the net payoff to the lender's shareholders when the G loan repays, and define an indicator function related to the choice of the G loan:[22]

$$I_t^i(\tau_j) = \begin{cases} 1 & \text{if the strategy } \phi_t^i(\tau_j) \text{ chooses the } G \text{ loan} \\ 0 & \text{otherwise} \end{cases} \tag{14}$$

Note that

$$\lambda^b = \theta R_{FB}(2) + [1-\theta]x - D \tag{15}$$

$$\lambda^n = \theta R_{FB}(2) + [1-\theta]x \tag{16}$$

[22] Note that $\phi_t^i(\tau_A) = 1$ always, $\phi_t^i(\tau_C) = 0$ always, so it is only for the τ_B lender that the strategy is endogenous. We use the more general strategy notation rather than stipulating it only holds for τ_B because it eases the expressions in the proofs.

where $R_{FB}(2)$ is available in (11). Both the bank and the non-bank need to raise equity financing to fund the loan. It is clear that $\lambda^b > 0$ and $\lambda^n > L$. Let $\alpha_t^i(\omega)$, $i \in \{b, n\}$, be the share of ownership that a type-i lender must sell in order to raise the financing needed at $t \in \{0, 1\}$ when the state ω is observed (this observation is only relevant for $t = 1$).

Definition of Competitive Equilibrium: A competitive Bayesian Perfect Nash equilibrium (BPNE) in the Reputation Model is a vector of beliefs, prices, and strategies at $t = 0$ and $t = 1$ such that:

1. At $t = 0$, the equilibrium consists of $\langle \pi_0^i, R_0(1), R_0(2), \phi_0^i(\tau_j) \rangle$ where it is common knowledge that $\pi_0^i = \langle \zeta_0, [1 - \zeta_0]\gamma, [1 - \zeta_0][1 - \gamma] \rangle$ is the vector of prior beliefs over the three lender types τ_A, τ_B, and τ_C for $i \in \{b, n\}$. $R_0(1)$ and $R_0(2)$ are the borrower's repayment obligations when faced with a single lender and when faced with two lenders, respectively, and $\phi_0^i(\tau_j)$ is the strategy of lender $i \in \{b, n\}$ of type τ_j, $j \in \{0, 1, 2\}$, where the lender's strategy is a loan choice from $\{G, PB\}$, conditional on making a loan and the decision of whether to lend. Each lender chooses ϕ_0 to maximize its expected utility over two periods, given π_0^i and $\mu_t^i(\tau_j \mid \omega)$ in each future $\omega \in \Omega$.[23]

2. At $t = 1$, for each $\omega \in \Omega$ the equilibrium consists of $\langle \pi_1^i(\omega), R_1(1), R_1(2), \phi_1^i(\tau_j) \rangle$ where $\mu_1^i(\tau_j \mid \omega)$ is the updated posterior belief over lenders' types chosen by agents at $t = 1$, $R_1(1)$ and $R_1(2)$ are the repayment obligations of the borrower in the second period when finding only one lender and when it finds two or more lenders, respectively; and $\phi_1^i(\tau_j)$ is the strategy of a lender in the second period, defined in a manner similar to $\phi_0^i(\tau_j)$. Note that $\phi_t^i(\tau_j)$ also includes not extending a loan because the lender may be unable to raise financing at $t = 1$. All strategies are privately optimal for all agents in every subgame in the sense that the lender's choice of loan solves (6) and the loan prices is determined as in Lemma 1, subject to the participation constraints of lenders' second-period financiers, taking $\mu_1^i(\tau_j \mid \omega)$ as given.

[23] Agents here are all financiers of lenders and those who borrow from the lenders.

3.3 Analysis of the Second Best: Some General Results

3.3.1 Borrower's Repayment Obligation and Number of Lenders

Lemma 2: *$R_t(1) \equiv R(1) \equiv R_{FB}(1) = x \; \forall \; t \in \{0,1\}$, and $R_t(2) \equiv R(2) = R_{FB}(2) = \{L[1+r]\} [\overline{q}]^{-1} \; \forall \; t \in \{0,1\}$. Moreover, for any set of beliefs about the lender's type, in each period we have:*

$$\alpha_t^b(\omega) = \frac{[L-D][1+r]}{\left[\sum_j \mu_t^b(\tau_j \mid \omega) I_t^b(\tau_j) \overline{q}\right] \lambda^b}, \; j \in \{A, B, C\} \tag{17}$$

$$\alpha_t^n(\omega) = \frac{L[1+r]}{\sum_j [\mu_t^n(\tau_j \mid \omega) I_t^n(\tau_j) \overline{q}] \lambda_n}, \; j \in \{A, B, C\} \tag{18}$$

This lemma says that the borrower's repayment obligation depends on the number of competing lenders, *not* beliefs about each lender's type. This is because investors' beliefs about the bank's type affect the cost and availability of funds as well as the lender's participation constraint, but not loan pricing, which is set to either give the lender all of the borrower's pledgeable cash flow (with only one lender) or just let the lender break even (multiple lenders).

The smallest fraction of ownership the lender can sell is when the probability of the lender choosing G, as perceived (rationally) by investors, is 1. That is,

$$\alpha_t^b(\min) = \frac{[L-D][1+r]}{\overline{q}\lambda^b} \, \forall \, t \tag{19}$$

$$\alpha_t^n(\min) = \frac{L[1+r]}{\overline{q}\lambda^n} \, \forall \, t \tag{20}$$

We will assume that both the bank and the non-bank type τ_1 will choose G when the minimum-cost financing is available. That is, in the second period, the following incentive compatibility (IC) conditions hold:

$$\overline{q}\left[1-\alpha_t^b(\min)\right]\lambda^b \geq \beta_B \tag{21}$$

$$\overline{q}\left[1-\alpha_t^n(\min)\right]\lambda^n \geq \beta_B \tag{22}$$

3.3.2 Bank's and Non-bank's Incentives to Make Good Loans

Theorem 1: *Conditional on being funded, for any set of beliefs of investors about the lender's type, a bank always has a stronger incentive to make (higher profitability from making) the G loan than does a non-bank, conditional on both being type τ_B. The bank and non-bank have the same incentive to make the G loan if both are either type τ_A or type τ_B.*

This result says that a bank always has a stronger incentive than a non-bank to make the G loan, as long as it is type τ_B (the only type with a strategic choice). The result holds for both the Trust and Reputation models and for any state $\omega \in \Omega$. The reason is the access banks have to insured deposits and the associated surplus that strengthens the bank's incentive to make the G loan. While this result relies on deposit insurance not having the usual risk-shifting disadvantage, we show in Section 5 that, with an additional condition, it also holds with risk-shifting moral hazard.

3.3.3 Second-period Lender Strategies in Reputation Model

We now analyze the second-period strategies of lenders.

Theorem 2: *Conditional on default at $t = 1$, the set of states (i.e. set of values of m) in which lenders can continue in the second period is larger for banks than for non-banks.*

While this result relies on Theorem 1, it is more circumstance-specific, applying to the Reputation Model and referring to the state following borrower default. This result is important because it shows that banks are inherently less fragile than non-banks, even conditional on loan default, in the sense that even *uninsured* investors are more willing to provide them with continuation funding. The intuition comes from Theorem 1, which applies to both the Reputation and Trust models. Since a bank has a stronger incentive than a non-bank to invest in a G loan in some states of the world and at least as strong an incentive in other states, there are more states of the world in which investors are willing to fund the bank in the second period.

The practical importance of this result is that it suggests that funding disruptions for lenders following borrower defaults are going to be larger for the economy as a whole when more credit is being provided by non-banks relative to banks, as has been observed in recent years (e.g., Buchak et al. (2018)).

We can now prove the following result.

Lemma 3: *Conditional on loan repayment at $t = 1$, the lender will choose G in equilibrium for every realization of m at $t = 1$.*

At a high level, the economic intuition is that observing loan repayment at $t = 1$ implies that a good loan was made at $t = 0$, so the lender enhances its reputation for making a good loan. Given that its reputation was good enough to enable it to obtain financing at $t = 0$, this puts it in an even stronger position to obtain financing at $t = 1$. This is consistent with the empirical evidence in Gambacorta and Mistrulli (2004), given that loan defaults deplete bank capital and repayments replenish it, and our result highlights that this also happens through a reputation channel that complements the capital effect.

The model-specific intuition is a bit more involved because it must account for the lenders' equilibrium strategies. First, suppose the type τ_B lender's equilibrium strategy is to choose G in the first period. Then at $t = 1$, loan repayment means the probability of the lender being either type τ_A or τ_B is 1. Thus, if investors assume the type τ_B lender will choose G in the second period, the financing will be provided at $\alpha_t^i(\text{min})$. Given (21) and (22), the lender will indeed choose G, so this is a Nash equilibrium in the second-period subgame.

Now suppose the type τ_B lender's equilibrium strategy is to choose the PB loan in the first period. Then successful repayment at $t = 1$ means that the posterior probability that the lender is type τ_A is 1. Consequently, the probability of G being chosen in the second period is 1 and minimum-cost financing is available.

4 The Trust Model

4.1 Model Uncertainty

The reputation model of the previous section did not pick a model of the world, but simply spread the probability distribution over all three lender types. In contract, the trustworthiness aspect of trust relates to uncertainty about whether the correct model is Model I or Model II, so agents first pick the model.

Model uncertainty allows loss of trust in lenders to be viewed as a *discontinuous* shift in beliefs about their type or motives. Since trust is typically all-or-nothing—one either trusts an agent or does not—observing an outcome that seems incompatible with the trust initially placed in a lender is essentially observation of a zero-probability event, and Bayes rule for belief revision cannot be used. *Within-model* uncertainty captures a reputational effect (even in the Trust model) through the normal Bayesian revision of beliefs about types (τ) that occurs once agents have (re)selected their model of the world based on their posterior beliefs about the lender's type. Since banks and non-banks are observationally distinct, belief revision occurs for each as a distinct entity. To model such behavior and its implications for the strategies of lenders, we rely on Ortoleva's (2012) *Hypothesis Testing Representation* (henceforth HTR).

More formally, at $t = 0$, all financiers and borrowers ("agents" henceforth) have common prior beliefs that if Model I is the true model of the world, then all lenders are trustworthy, and if Model II is the true model of the world, then there is a probability $\gamma \in (0, 1)$ that the lender is of type τ_B, and a probability $1 - \gamma$ that the lender is of type τ_C. All financiers also have a prior over priors and believe that $\zeta_0 \in (0, 1)$ is the probability that Model I is the correct model and $1 - \zeta_0$ is the probability that Model II is the correct model. In Step 1, at $t = 0$ the agents choose the model to which the prior over priors assigns the highest likelihood, i.e., they adopt Model I for their beliefs if $\zeta_0 \geq 0.5$ and Model II if $\zeta_0 < 0.5$. They also choose the threshold probability $\varepsilon \in (0, 1)$ for a future revision of their prior over priors. Given these beliefs, agents determine the price at which lenders will be financed so financiers earn an expected return of at least r, with the expectation taken over the beliefs adopted in Step 1.

At $t = 1$, everybody observes the macro state realization and whether the borrower repaid or defaulted on the first-period loan. Based on this, in Step 2 agents test their priors to determine if they used the correct model of the world in Step 1. If the probability that the agents' prior assigned to the observed repayment/default outcome at $t = 1$ is *above* the threshold ε, then the prior belief chosen in Step 1 is *not* rejected, and beliefs are now updated using Bayes rule, thereby determining the second-period financing costs for lenders and the terms at which the lenders will make second-period loans to borrowers.

If, however, the probability that the agents' prior assigned to the new information observed at $t = 1$ is below the threshold ε, then the prior is *rejected* and agents go back to their prior over priors ζ_0, update it with Bayes' rule using the information at $t = 1$, and then in Step 3 chooses the model to which the *updated* prior over priors assigns the highest likelihood. With these new beliefs, financiers determine the cost of financing for lenders, and lenders determine the loan terms for second-period borrowers.

This means that if the prior "chosen" at $t = 0$ is rejected by the data, agents reconsider the prior to use by choosing the new maximum likelihood prior, which is extracted by examining the prior over priors after its updating using Bayes' rule. The idea is that ε is a small positive number, and we will assume throughout that this is the case. In particular, consistent with the notation in (3) that $F(\underline{m}, q)$ is high enough, we assume $\varepsilon < \gamma F(\underline{m}, q)$.

As Ortoleva (2012) points out, when $\varepsilon = 0$, belief revision follows Bayes' rule.[24]

In our setting, a model is itself a prior belief over the lender's type, and ζ_0 is the prior over these prior beliefs. Following Ortoleva (2012), and using the notation of Section 3.2 which we now modify slightly, we can write:

$$\pi_0^i = \left\{\pi_0^i(k) \mid k \in \{\mathrm{I}, \mathrm{II}\}\right\} \tag{23}$$

as the vector of prior beliefs that consists of two model-specific probability distributions over types, with $i \in \{b, n\}$. So we see that

$$\pi_0^i(\mathrm{I}) = \langle \Pr(\tau_A) = 1,\, \Pr(\tau_B) = 0,\, \Pr(\tau_C) = 0 \rangle\,, \tag{24}$$

$$\pi_0^i(\mathrm{II}) = \langle \Pr(\tau_A) = 0,\, \Pr(\tau_B) = \gamma \in (0,1),\, \Pr(\tau_C) = 1-\gamma \rangle\,, \tag{25}$$

where τ_A denotes that the lender is completely trustworthy, and τ_B and τ_C denote that the lender is self-interested and of the respective type. Then the prior over priors says that ζ_0 is the prior belief that the correct prior is $\pi_0(\mathrm{I})$ and $1 - \zeta_0$ is the prior belief that the correct prior is $\pi_0(\mathrm{II})$. A visualization of this process is provided in Appendix B. Also to distinguish posterior belief formation with model uncertainty from that in the reputation model, we now refer top the posteriors at date t by π_t instead of μ_t

Note that all lenders start out with the same prior beliefs about whether they are trustworthy or self-interested, and the same prior beliefs over types conditional on being self-interested. Hence, if Model I prevails, then *all* lenders are trusted at $t = 0$, and if Model II prevails, then *all* lenders are considered self-interested at $t = 0$. However, at $t = 1$, whether an initially-trusted lender continues to be trusted depends on the information set at $t = 1$, so some lenders may be trusted at $t = 1$ and others may not be.

[24]See Ortoleva (2012) for an analysis of the uniqueness properties of this representation.

4.2 Definition of Competitive Equilibrium

A competitive equilibrium is a vector of beliefs, prices, and strategies at $t = 0$ and at $t = 1$:

(i) At $t = 0$, the equilibrium consists of $\langle \varepsilon, \pi_0^i, R_0(1), R_0(2), \phi_0^i(\tau_j) \rangle$ where ε is common knowledge, $\pi_0^i = \{\pi_0^i(\mathrm{I}), \pi_0^i(\mathrm{II})\}$ is the prior belief chosen by agents over lenders' types, $R_0(1)$ and $R_0(2)$ are the repayment obligations of the borrower when faced with a single lender and when faced with two or more lenders, respectively, $\phi_0^i(\tau_j)$ is the strategy of a lender $i \in \{b, n\}$ of type τ_j, $j \in \{A, B, C\}$, where the lender's strategy is a choice of loan from $\{G,\ PB\}$, conditional on making a loan, as well as the decision of whether to make a loan. Here $\pi_0^i(k)$, $k \in \{\mathrm{I}, \mathrm{II}\}$, is chosen by agents using the HTR; and ϕ_0^i is chosen by each lender to maximize its expected utility over two periods, given π_0^i and $\pi_1^i(k \mid \omega)$ in each future $\omega \in \Omega$.[25]

(ii) At $t = 1$, for each $\omega \in \Omega$, the equilibrium consists of $\langle \pi_1^i(k \mid \omega), R_1(1), R_1(2), \phi_1^i(\tau_j) \rangle$, where $\pi_1^i(k), k \in \{\mathrm{I}, \mathrm{II}\}$ is the updated posterior belief over lenders' types chosen by agents at $t = 1$ based on the HTR; $R_1(1)$ and $R_1(2)$ are the repayment obligations of the borrower in the second period when finding only one lender and when it finds two or more lenders, respectively; and $\phi_1^i(\tau_j)$ is the strategy of a lender in the second period, defined in a manner similar to $\phi_0^i(\tau_j)$. Note that $\phi_1^i(\tau_j)$ also includes not extending a loan because the lender may be unable to raise financing at $t = 1$. All strategies are privately optimal for all agents in every subgame in the sense that: the lender's choice of loan solves (6) and the loan price is determined as in Lemma 2, subject to the participation constraints of lenders' second-period financiers, taking $\pi_1^i(k \mid \omega)$ as given.

Our focus will be on a situation in which agents use the HTR and at $t = 0$ choose the prior that lenders are trustworthy. We will then examine the behavior of banks and non-banks in

[25] Agents here are all financiers of lenders and those who borrow from the lenders.

the first period when they are trusted. Then we characterize conditions under which trust can be lost in the second period, which leads to an analysis of how the potential to lose trust in the future influences lender behavior at $t = 0$.

For further analysis, we drop the superscript $i \in \{b, n\}$ to reduce notational clutter, and we introduce some additional notation. Recall that ζ_1 is the prior over priors at $t = 1$ and $\pi_1(k \mid \omega)$, $k \in \{\mathrm{I}, \mathrm{II}\}$, is the prior belief chosen by agents at $t = 1$ using the HTR. Thus:

$$\pi_0^i(k \mid \omega) = \begin{cases} \pi_1(\mathrm{I} \mid \omega) & \text{if agents believe lender is trusted} \\ \pi_1(\mathrm{II} \mid \omega) & \text{if agents believe at } t = 1 \\ & \quad \text{that lender is self interested} \end{cases} \tag{26}$$

where

$$\pi_1(\mathrm{I} \mid \omega) = \{\Pr(\tau_A) = 1\} \tag{27}$$

$$\pi_1(\mathrm{II} \mid \omega) = \{\Pr(\tau_A) = 0,\ \Pr(\tau_j) = \mu_1(\tau_j \mid \omega, \pi_0(\mathrm{II}))\} \tag{28}$$

and $\mu_1(\tau_j \mid \omega, \pi_0(\mathrm{II}))$ is the posterior belief at $t = 1$ that the lender is type τ_j, given the prior belief, $\pi_0(\mathrm{II})$, over types for Model II, i.e., the prior belief that $\Pr(\tau_B) = \gamma$ and $\Pr(\tau_C) = 1 - \gamma$.

Define an indicator function indicating that Model I is chosen:

$$I_t(\mathrm{I}) = \begin{cases} 1 & \text{if } \pi_t(k \mid \omega) = \pi_t(\mathrm{I} \mid \omega),\ t \in \{0, 1\} \\ 0 & \text{otherwise} \end{cases} \tag{29}$$

Lemmas 1, 2, and 3 and Theorems 1 and 2 hold in the Trust model as well. The precise expressions in Lemma 4 are slightly different here because lender strategies are different; we skip those expressions here since they are qualitatively similar to Lemma 3.

4.3 Initial Trust of Investors and its Possible Loss

In what follows, the notation $\overline{\mu}(\tau_j \mid \overline{m})$ denotes the posterior belief that the lender is type τ_j, conditional on $m = \overline{m}$, lender default, and the prior being $\pi_0(\text{II})$, i.e. $j \in \{B, C\}$.

Theorem 3: *Suppose that lenders start out at $t = 0$ with agents choosing*

$$\zeta_0 \in \left(0.5, \left[1 - \overline{\mu}(\tau_B \mid \overline{m}) F(\overline{m}, q)\right]\left[2 - \overline{\mu}(\tau_B \mid \overline{m}) F(\overline{m}, q) - F(\overline{m}, q)\right]^{-1}\right) \tag{30}$$

where

$$\overline{\mu}(\tau_B \mid \overline{m}) \equiv \frac{\left[1 - F(\overline{m}, q)\right]\gamma}{\left[1 - F(\overline{m}, q)\right]\gamma + 1 - \gamma} \tag{31}$$

Then lenders will be viewed as trustworthy at $t = 0$ under the HTR. Whether they lose this trust at $t = 1$ is sensitive to the realization of $\tilde{m}$ and whether the lender experiences default. Trust will not be lost if the borrower repays the lender at $t = 1$, but it may be lost if the lender experiences default, depending on $\tilde{m}$. If

$$1 - F(\overline{m}, q) < \varepsilon < 1 - F(\underline{m}, q) \tag{32}$$

then $\exists\, m^* \in (\underline{m}, \overline{m})$ such that a lender that experiences borrower default at $t = 1$ will lose trust in the second period if $m > m^*$ and not lose trust if $m \leq m^*$.

This result shows that a loss of trust due to failure is more likely if the failure occurs when the macroeconomic state is better.[26] This is because even a good loan is more likely to default in a recession than in a boom, so loan default in a boom is more informative about a bad loan having been made than if the same loan had defaulted in a recession. The very low likelihood of a good loan defaulting in a boom causes agents (under the HTR) at $t = 1$ to reject the initial prior over priors that the lender is trustworthy in the first period. However,

[26] Note that (32) is not an overly restrictive condition. It simply states that $\left[C(\underline{m}, q), C(\overline{m}, q)\right]$ is a sufficiently large subset of [0,1]. Specifically, because epsilon is a very small, positive number, the repayment probability $C(\overline{m}, q)$ must be sufficiently close to 1.

they may continue to believe the lender is trustworthy if the default occurs in a recession.

Corollary 1: *Suppose ζ_0 is as in (30)–(32). Then, conditional upon experiencing borrower default at $t = 1$: (i) in states $m > m^*$, all lenders experiencing default lose trust; and (ii) in states $m \leq m^*$, no lender experiencing default loses trust.*

The intuition is that if agents believe that lenders are trustworthy in the first period, then they are believed to have made G loans in the first period. The probability of failure with the G loan is the same for every lender. Hence, the HTR either rejects the initial prior over priors for all lenders experiencing default or for none. Note that since the G loans have outcomes that are not perfectly correlated, at $t = 1$ there are lenders who experienced default and lenders that did not. Hence, at $t = 1$, it is possible to have some lenders who are trusted and some who are not. Henceforth, we will assume that (30) and (32) hold. The result that trust is lost following bad outcomes is consistent with the empirical evidence in Knell and Stix (2015).

4.4 Trust is Easier to Lose than to Gain

Theorem 4: *Consider parameter values such that in equilibrium, lenders start out being trusted at $t = 0$ and lose trust at $t = 1$. Then, for the same parameter values, lenders can never gain trust at $t = 1$ if they start out being considered self-interested at $t = 0$.*

The result that trust is easier to lose than to gain echoes the psychology-based explanations for trust asymmetry based on behavioral biases. For example, as Eiser and White (2005) note, according to the "negativity bias account", trust is easier to lose than gain because negative information grabs attention.[27] Our result does not depend on such behavioral biases. Rather, it arises from model uncertainty, as we explain below. From a policy standpoint, it underscores the importance of prudential regulation in ensuring the minimization of

[27]Haselhuhn, Schweitzer, Kray, and Kennedy (2016) cite Mr. Darcy from *Pride and Prejudice* when he states, "My good opinion once lost is lost forever." They then go on to observe: "Plenty of people would agree with Mr. Darcy on matters of trust: that trust is difficult to gain and tough to repair once broken."

outcomes that erode trust in banks, since regulators will find it more challenging to maintain trust than to rebuild it.

To see the intuition for the asymmetric nature of trust with the context of our model, suppose lenders do not have trust at $t = 0$, and the equilibrium at $t = 0$ is one in which the type-τ_B lenders make good loans for all realizations of its private benefit from the PB loan. Then if the lender experiences loan repayment at $t = 0$, it may merely "confirm" that the lender is a type-τ_B lender, especially if the prior probability attached to the lender being type-τ_B was high, i.e., if it had a strong reputation ex ante. And of course this reputation must be high enough or else the lender would not have been able to raise financing at $t = 0$. In other words, the HTR will not reject the initial model II based on the repayment outcome. Thus, a lender with a strong reputation but no trust is unable to become trusted by experiencing good outcomes. However, if it starts out with trust and experiences borrower default, the HTR may reject the initial Model I and trust will be lost. This result depends on model uncertainty and would not be available without it.

5 Analysis of Equilibria for Reputation and Trust Model

5.1 First-period Equilibria

The lender's first period strategy maximizes (7). To ensure that the type τ_B lender is trustworthy in the first period, the incentive compatibility condition ensuring a choice of G by type τ_B must be satisfied:

$$\begin{aligned}\left[1-\alpha_0^i\right]\overline{q}\lambda^i + \int_{\underline{m}}^{\overline{m}} q(m)\left[1-\alpha_1^i\left(\min\right)\right]\lambda^i\eta\, dm + \int_{\underline{m}}^{\widehat{m}_i}\left[1-q(m)\right]\left[1-\alpha_1^i\left(m,f\right)\right]\lambda^i\eta\, dm \\ \geq \beta_B + \int_{\underline{m}}^{\widehat{m}_i}\left[1-\alpha_1^i\left(m,f\right)\right]\lambda^i\eta\, dm\end{aligned} \tag{33}$$

where $\widehat{m}_i$ is the maximum value of m consistent with the lender being able to get second-period funding to continue, and $\alpha_1^i(m, f)$ is the ownership share that must be surrendered to financiers in state m after failure to get funding. Here we are relying on the earlier analysis which showed that funding is more probable when failure occurs at a lower value of m, and using Lemma 3 which showed that, conditional on first-period loan repayment, the lender secures minimum-cost second-period funding, since in this case the second-period strategy of the type τ_B lender is to choose G and the probability is zero the lender is type τ_C.

Recall that "trustworthiness" is measured by the measure of the set of exogenous parameter values for which the type τ_B lender chooses G at $t = 0$. We can now prove:

Theorem 5: *In both the Reputation Model as well as the Trust Model, trustworthiness is greater for banks than non-banks.*

The intuition for trustworthiness being greater for banks than for non-banks is similar to what was discussed earlier. It stems from the deposit-related rents banks enjoy relative to non-banks. These rents arise both from the fact that deposits are cheaper than other types of finance due to deposit insurance and liquidity services, and more interestingly, from the *beliefs of investors* that—as a consequence of this cost advantage—banks will make more prudent asset choices. This (equilibrium) belief generates an *endogenous* funding cost advantage that *complements* the exogenous advantage associated with insured deposits. Thus, this result is more subtle than simply arising from the higher profitability banks enjoy on G loans than non-banks do. Moreover, this result is consistent with the evidence provided by Knell and Stix (2015) that banks are more trusted than non-banks.

Our next result establishes equilibrium existence and shows that trust has a *feedback effect* on the behavior of lenders.

Theorem 6: *Suppose ζ_0 is high enough that in the Trust Model, Model I is chosen. Then there exist exogenous parameter values such that there exists a unique equilibrium in the Trust Model in which both banks and non-banks of type τ_B choose G at $t = 0$. For the same* *exogenous parameter values, there exists a BPNE in the Reputation Model in which all type τ_A lenders choose G, all type τ_C lenders choose the PB loan, type τ_B banks choose G, and type τ_B non-banks choose PB. Any lender pursuing the out-of-equilibrium strategy of not making a loan offer to a borrower despite being able to raise the financing to do so is believed to be type τ_C with probability 1.*

This result shows that when lenders are trusted, they behave in a more trustworthy manner. It provides a theoretical foundation for experiment-based evidence that trust begets trustworthiness (e.g. Cohen and Isaac (2021)). The intuition is that in the Trust Model, funding costs for trusted lenders are lower than they are in the Reputation Model. Thus, trust generates higher profitability for the lender from making the G loan relative to the PB loan. Model uncertainty consequently has real effects in the sense that, in the case of non-banks, it leads to less default on average at $t = 1$, compared to the Reputation Model. Moreover, in the Reputation Model, banks show a stronger propensity than non-banks for prudent lending.

Corollary 2: *Conditional on banks and non-banks choosing the same lending strategies at $t = 0$, default at $t = 1$ leads to funding for the second period being cut off for a larger measure of m values for non-banks than for banks in both the Reputation Model and in the Trust Model.*

The intuition is familiar from the earlier results. For the Reputation Model, since both the bank and the non-bank adopt the same first-period strategies, posterior beliefs about their types conditional on first-period default are identical for every m. Thus, in the Reputation Model, the measure of values of m for which banks get funded in the second period is larger than the corresponding measure for non-banks because banks have a stronger incentive than non-banks to make G leans in the second period (see Theorem 1). This implies that there are values of m for which it is a rational belief on the part of investors that if second-period financing is priced under the assumption that both the bank and the non-bank will choose

G, the bank will choose G and the non-bank will choose PB. Thus, in the second-period subgame, the equilibrium involves banks getting funded and non-banks not getting funded.

In the Trust Model, first-period default will lead to trust being lost when $m > m^*$. The result now follows from the fact that banks have a stronger incentive to make G loans in the second period. This shows that banks are innately more trusted lenders than non-banks. From a policy standpoint, this is important since it suggests that financial stability—in terms of continued borrower access to credit—is enhanced by having a greater proportion of credit being provided by banks.[28] Since deposit insurance plays a role in providing banks this trust advantage, it highlights the positive aspect of deposit insurance from a novel perspective.

Corollary 3: *Suppose the equilibria in the Trust Model and in the Reputation Model both involve the type τ_B lender making the G loan at $t = 0$. Then in some states, the lender's funding cost is unresponsive to its performance in the Trust Model, but responds to its performance in the Reputation Model. If there are realizations of m at $t = 1$ for which loan default causes a loss of trust, then in these states the lender's funding cost responds more to its performance than in the Reputation Model.*

This result says that in some states, model uncertainty leads to a complete unresponsiveness of funding cost to the lender's performance. This is consistent with the empirical evidence in Martin, Puri, and Ufier (2018) who show that following bad news about the bank, total deposits at the distressed bank did not change much. However, while such insensitivity of funding availability to bank performance is typically interpreted as a lack of market discipline, our analysis shows that it can be encountered even when there is market discipline and banks are trusted.

The result also says that in the Trust Model, the funding cost reaction to lender performance can also be greater than in the Reputation Model.

[28] For empirical evidence that welfare is higher when a higher proportion of credit is provided by banks than by non-banks, albeit in the context of secured loans, see Cerqueiro, Ongena, and Roszbach (2020).

5.2 Extensions and Robustness

In this subsection, we examine some extensions that shed light on the robustness of the model.

5.2.1 Continuum of Types

Suppose that instead of three lender types, we have a continuum $\tau \in [\tau_A, \tau_C]$, where each τ is rank-ordered based on the private benefits from the PB loan, so τ_A has zero private benefit from making a PB loan and τ_C has the maximum private benefit, β_C. For all other types, the private benefit is $\beta(\tau)$, with $\beta'(\tau) > 0$.

With this specification, we will have the following partitioning of types based on their equilibrium lending choices, with $\tau_A < \tau_k < \tau_j < \tau_C$ (for simplicity, we focus on banks in the Reputation Model):

$[\tau_A, \tau_k]$: Bank types τ in this range will always choose G.

$(\tau_k, \tau_j]$: Bank types τ in this range will behave like the type τ_B banks, choosing G or PB depending on the circumstances. For any ω at date t, the type τ_{k+1} bank will have an incentive to choose G that is as strong as or stronger than the incentive to choose G that the type τ_{k+2} bank has, where $\tau_{k+2} > \tau_{k+1}$.

$(\tau_j, \tau_C]$: Bank types τ in this range will behave like the type τ_C bank, always choosing PB.

Comparing banks and non-banks, the measure $[\tau_A, \tau_k]$ will be smaller and the measure of $(\tau_j, \tau_C]$ will be larger for non-banks.[29] Thus, we expect that the basic insights of our analysis will be sustained with a continuum of types, albeit with more notational and analytical complexity.

[29]Formal proofs of these claims are available upon request.

5.2.2 Risk-shifting Moral Hazard and Alternative Specification of Bad Project

We have assumed that the bank's funding cost advantage affects only the profitability of the good loan and not the bad loan, so the costs/benefits of the bad loan are the same across banks and non-banks. An alternative assumption is for the bank's funding cost advantage to also make the bank's profitability from the bad loan higher than the non-bank's. In other words, what if the bad loan has a positive success probability and the bank's private benefit from the loan is only realized conditional on success?

A related issue is whether the results would hold up with the standard risk-shifting moral hazard associated with deposit insurance (e.g. Merton (1977)). This issue is important because it creates a disadvantage for banks *vis a vis* non-banks when it comes to being viewed as a lender that is more trusted to make prudent lending decisions. So, while the lower cost of funding due to access to deposits boosts banks' profitability on prudent lending and makes them more likely than non-banks to make good loans, the risk-shifting moral hazard associated with deposit funding makes them less likely to make good loans. These two forces pull in opposite directions, so we will analyze how these effects play out.

To deal with these issues, we introduce a modified specification of the PB loan. Suppose the PB loan succeeds with probability $\delta \in (0,1)$ and defaults with probability $1-\delta$. We assume:

$$\delta < F\left(\underline{m}, q\right) \tag{34}$$

so this loan has a lower success probability than the G loan for any m. When the project of the borrower to whom this PB loan is made succeeds, it generates a pledgeable payoff of $y \in \mathbb{R}_+$ and a private benefit of β_i for the type-i lender, where $i \in \{B, C\}$. That is, *both* y and β_i are available only if the borrower's project succeeds, i.e., only with probability δ. We continue to assume that β_C is so large that the type-τ_C lender will always prefer the PB loan to the G loan. We assume that $y > x$, so this is a classic risk-shifting problem.

The third issue is that we have modeled the difference between banks and non-banks through a lower funding cost for banks due to the value that (insured) deposits provide to the bank's depositors. A somewhat different way to think about this is to stipulate that the bank's deposit franchise has value, say $\Lambda > 0$, and this value would be lost upon failure; see Demsetz, Saidenberg, and Strahan (1996), and Dreschler, Savov, and Schnabl (2021). Of course, more generally, we could think of Λ as the present value of the additional profits the bank generates through its lower deposit funding cost. There is empirical evidence that the deposit franchise value deters risk-shifting moral hazard on the part of banks (e.g. Keeley (1990)), so this specification works nicely with our altered specification of the PB loan. We will assume that, even with Λ, the type τ_C bank will always choose the PB loan.

Our plan is to first examine whether in this setting banks still have stronger incentives than non-banks to make G loans. Next, we will examine whether banks are more likely than non-banks to be able to continue in the second period following first-period failure in a reputation setting. These two issues provide the basic building blocks for our analyses in the preceding sections, so examining them is key to understanding the robustness of that analysis.

The bank's profit from a G loan is

$$\left[1-\alpha_t^b\right]\lambda^b\overline{q} \tag{35}$$

where

$$\alpha_t^b = \frac{[L-D][1+r]}{\sum_j \mu_t^b\left(\tau_j\right) I_t^b \overline{q}\lambda^b} \tag{36}$$

with $j \in \{A, B, C\}$, $\mu_t^b\left(\tau_j\right)$ given by (13) (with ω suppressed), $I_t^b = I_t^b\left(\tau_j\right)$ given by (14), and

$$\lambda^b = \theta R_{FB}(2) + [1-\theta]x - D + \Lambda \tag{37}$$

The bank's utility from making this loan is

$$\left[1-\alpha_t^b\right]\lambda^b \tag{38}$$

The τ_B bank's profit from the PB loan is

$$\hat{\lambda}^b = \theta R_{FB}(2) + [1-\theta]y - D + \Lambda \tag{39}$$

and the bank's utility from making this loan is

$$\delta \left\{ \left[1 - \alpha_t^b\right] \hat{\lambda}^b + \beta_B \right\} \tag{40}$$

For the non-bank, the expressions are similar, except that

$$\lambda^n = \theta R_{FB}(2) + [1-\theta]x \tag{41}$$

and

$$\hat{\lambda}^n = \theta R_{FB}(2) + [1-\theta]y \tag{42}$$

We now have the following analog of Theorem 1.

Theorem 7: *For any ω, a bank has a stronger incentive than a non-bank to make a G loan as long as both are type τ_B and $\overline{q}$ is sufficiently larger than δ. Incentives to make a G loan are the same for banks and non-banks for type τ_A and τ_C.*

In contrast to Theorem 1, we need a condition for the type-τ_B bank to have a stronger preference than the type-τ_B non-bank to make a G loan. The economic intuition is as follows. Because the bank's lower funding cost gives it higher profits on *both* the G and the PB loans, it finds *both* loans more attractive than the non-bank does. This weakens the "incentive compatibility" advantage the bank has over the non-bank in choosing G. Moreover, the risk-shifting problem is worse for the deposit-insured bank than the non-bank. However, since the G loan pays off with probability $\overline{q}$ and the PB loan pays off with probability δ, the bank's incentive to make the G loan due to its funding cost advantage gets stronger *relative to* the non-bank's incentive as the wedge between $\overline{q}$ and δ gets larger. In addition, the smaller

δ is, the stronger are the influences of the bank's funding cost and deposit franchise value on diminishing its proclivity to invest in the PB loan. Thus, when $\overline{q}$ is sufficiently larger than δ, the effect of the deposit-funding-cost advantage and the deposit franchise value dominates that of the risk-shifting moral hazard that is exacerbated by deposit insurance.[30]

The next result is an analog of Theorem 2.

Theorem 8: *Conditional on default at $t = 1$, the set of states (values of m) in which lenders can continue in the second period is larger for banks than for non-banks in the Reputation Model.*

This result uses the result from Theorem 1 that the type τ_B banks have a stronger incentive than the type τ_B non-banks to choose G, so it relies on the same condition that Theorem 1 relies on. The economic intuition is that, because the bank has a stronger incentive to make a G loan for any state ω, it also has this incentive following default at $t = 1$, given admissible lending strategies for banks and non-banks at $t = 0$ and the associated beliefs of investors. Thus, the set of states in which continuation financing is forthcoming at $t = 1$ is larger for banks than for non-banks.

These results suggest that, given the condition in Theorem 1, all of our results in the previous sections will go through with the model modifications introduced in this sub-section.

6 Discussion and Policy Implications

6.1 Deposit Insurance and Prudent Lending Incentives

Because insured deposits are cheaper than other short-term uninsured debt, banks have a lower funding cost than non-banks, and this generates incentives for prudent lending along

[30] This sufficiency condition is likely to be weaker if we enriched the model with transactions costs and random regulatory auditing. Merton (1978) shows that in such a setting, there are circumstances in which risk shifting does not occur because the capitalized cost of the insurance paid in advance enables deposit rates to be below the riskless rate, generating ex post rents for banks that would be lost if the bank is detected to have acted badly.

with a relative trust advantage for banks.[31] There are two complementary channels through which this effect arises. First, investors' beliefs have *no* impact on the behavior of the innately trustworthy (type τ_A) lenders, but they do affect the behavior of the type τ_B lenders. Because investors know that deposits carry a lower cost of funds than the uninsured funding available to non-banks, they believe a type-τ_B bank will find the benefit of investing in a G loan to be greater than a type-τ_B non-bank will. This belief endogenously leads to a lower cost of funding for banks even on the *uninsured* portion of its funding (equity). This then further reinforces the advantage of investing in G loans relative to private benefit loans, and it is a Nash equilibrium for investors to view banks as "trusted" lenders in the economy.

The second channel is created by the presence of the type-τ_A lenders. Having these lenders in the mix lowers the cost of funding for *all* lenders, thus creating a positive externality that makes it more attractive for all lenders—banks and non-banks—of type τ_B to invest in G loans. So while this effect complements the deposit insurance effect, it also narrows the trust gap between banks and non-banks. This shows that the relative advantage that a bank has in the personalized trust that it enjoys over a non-bank is diminished as the trust in all lenders increases.

While our base model has moral hazard at the lender level, it is moral hazard that adversely affects *all* of the bank's financiers. Thus, in the case of banks, this moral hazard adversely impacts not only the deposit insurer—as in the standard approach to modeling deposit-insurance-related moral hazard—but also its equityholders. This is why the lowering the cost of funding via deposit insurance generates asset-choice incentives that benefit all of the bank's financiers. This is in contrast to the standard approach wherein deposit insurance generates risk-shifting incentives that benefit the bank's shareholders at the expense of the deposit insurer and subordinated debtholders (see, for example, Calomiris and Haber (2014) and McCoy (2006)). Thus, when we introduce this standard risk-shifting moral hazard in an extension of the model, we need an additional condition for our results to go through.

[31] See the more extensive discussion of funding cost differences between banks and non-banks in Donaldson, Piacentino, and Thakor (2021).

6.2 Deposit Insurance, Trust, and Prudential Regulation

To the extent that deposit insurance might generate risk-shifting incentives, it is well known that increasing bank capital can counteract these incentives (e.g. Merton (1977), Holmstrom and Tirole (1997)), as will regulatory auditing that results in a loss of charter value if auditing reveals risk-shifting behavior (Merton (1978)). Thus, a policy implication suggested by our analysis is that having sufficiently high regulatory capital requirements, coupled with effective regulatory monitoring, for banks can *amplify* the positive impact of deposit insurance on the role of banks as trusted lenders. Moreover, somewhat surprisingly in light of the previous literature, more extensive deposit insurance coverage will strengthen the incentives of banks to engage in trustworthy behavior, as long as any accompanying rise in risk-shifting incentives is controlled through higher capital requirements.[32] Our analysis shows that deposit insurance not only helps to lower the cost of equity capital for banks—thereby making it easier for them to raise the equity needed to satisfy the higher capital requirements—but also gives them a trust advantage over non-banks that requires high capital to sustain. That is, trust induced by deposit insurance complements the tools of prudential regulation.

It is also believed that deposit insurance weakens market discipline on banks because the cost of funding for the bank becomes less sensitive to the risk it takes. This has led some to advocate against adopting deposit insurance. For example, Demirgüç-Kunt and Kane (2003) state: "This evidence challenges the wisdom of encouraging countries to adopt explicit deposit insurance without first stopping to assess and remedy weaknesses in their informational and supervisory environments." In our model, because deposit insurance lowers the bank's cost of funding, it provides stronger prudent lending incentives for banks that the market recognizes and this is reflected in a lower cost of *uninsured* funding for banks which further strengthens prudent lending incentives. This highlights a novel aspect of the relationship between deposit insurance and market discipline.

[32]For example, in Merton (1977), higher risk shifting by the bank is achieved through an increase in its asset volatility. We do not consider an increase in risk-shifting incentives explicitly in our analysis.

6.3 Trust and Information Disclosure by Banks

The Dodd-Frank Act instituted stress tests for banks, but there is an active debate about how much disclosure of these test results there should be (e.g. Berlin (2015)). Regulators and some researchers have argued that the public disclosure of examination results could diminish the incentives of banks to disclose confidential information to examiners. Thakor and Merton (2023) have recently developed a theory in which more trusted firms optimally disclose less information. Based on that, it follows that there will be a lesser need to disclose stress test results if banks are trusted. This suggests that an important focus of bank regulation should be to ensure trust in banks.

7 Conclusion

This paper has developed a theory in which the trust investors have in lenders enables lenders to have access to financing at rates that are insulated from the adverse reputational consequences of prior loan defaults as well as market conditions. However, trust can be broken. It is most likely to be eroded when the lender experiences high borrower defaults during an economic boom. Trust is asymmetric—it is easier to lose it than to gain it. The importance of trust varies across banks and non-banks. The responsiveness of the lender's funding cost to the lender's performance differs across the reputation model and the one with model uncertainty. Many of these results cannot be obtained with a standard reputation model. That is, model uncertainty matters.

From a functional perspective, banks and non-banks perform similar lending functions. Our analysis of trust and a characterization of the difference between banks and non-banks relies on an essential institutional difference between these lenders—banks have access to insured deposits and they provide valuable depository services to their customers, whereas non-banks are entirely investor-financed. This single distinction makes banks innately more trustworthy than non-banks, and provides them with a competitive advantage over non-depository lenders on the trust dimension.[33]

Our result that the funding cost advantage that deposits give banks can lead to banks being the "trusted lenders" in the economy has significant novel policy relevance. In much of the deposit insurance literature, while it is acknowledged that such insurance is necessary to minimize the threat of banking panics, the focus is largely on the risk-shifting moral hazard deposit insurance creates, and this is often used as a rationale for limiting the size and scope of deposit insurance. While risk-shifting moral hazard is certainly an important friction, our analysis surfaces another aspect of deposit insurance—its role as a "trust insulator"—and establishes a condition under which this trust insulator effect more than offsets the risk-shifting moral hazard effect. The novel aspect of deposit insurance that we highlight should thus be featured in future discussions about the size and scope of deposit insurance.

[33]A distinction that does not appear in our analysis is that banks are also more regulated and face higher regulatory compliance costs. This, however, may not just be a disadvantage for banks as regulation may itself contribute to greater trust in banks—this is analogous to the role played by the FDA for drug makers and the FAA for airlines in this regard.

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Appendix A: Additional Results

A.1 Microfoundations for Deposit Insurance

Suppose depositors value the bank's liquidity safekeeping and transaction services as $\varphi(D) > 0\ \forall D > 0$ at $t = 1$ if the bank fully repays depositors. Here, $\varphi' > r$, and $\varphi(0) = 0$. The same assumptions apply to second-period deposits that arrive at $t = 1$ and are paid off at $t = 2$. Deposit supply is exogenously fixed at $D < L$.

Lemma: *The deposit interest rate is zero if we assume that depositors' financial claims are completely insulated from the bank's credit risk, i.e., deposits are riskfree. The social welfare benefit of complete deposit insurance relative to no insurance is*

$$[1-\overline{q}]\,[\hat{\varphi}(D) - D] > 0. \tag{A.1}$$

Proof: Since $\varphi' > r$, it follows that

$$\int_0^D \varphi'(y)\,dy > \int_0^D r\,dy \tag{A.2}$$

which means that $\varphi(D) > rD$. The depositors' participation constraint (with riskless deposits) is:

$$D\,[1 + r_D] + \varphi(D) \geq D[1 + r] \tag{A.3}$$

Since the zero-lower-bound assumption implies that $r_D \geq 0$, if (A.3) holds for $r_D = 0$, then the competitive equilibrium solution must be $r_D = 0$ because maximizing the lender's utility implies minimizing the left-hand side of (A.3) while satisfying (A.3). At $r_D = 0$, (A.3) becomes:

$$\varphi(D) \geq rD \tag{A.4}$$

which clearly holds.

Now, if deposits are riskless, the value of the bank's depository services to its customers is $\varphi(D)$. If the bank is unable to fully pay off depositors when the borrower defaults, the value of the bank's depository services to its customers is:

$$\overline{q}\,\varphi(D) \tag{A.5}$$

Thus, the welfare gain due to making deposits riskless is:

$$[1-\overline{q}]\,\varphi(D) \tag{A.6}$$

Now by providing deposit insurance, relative to not providing it, the deposit insurer increases the expected payoff to depositors by

$$[1-\overline{q}]\,[\varphi(D)+D] \tag{A.7}$$

The expected cost of providing deposit insurance is

$$[1-\overline{q}]\,D[1+r] \tag{A.8}$$

Thus, the net welfare benefit of complete deposit insurance provision is the difference between (A.7) and (A.8):

$$\triangle \equiv [1-\overline{q}]\,[\varphi(D)-rD] \tag{A.9}$$

From the proof of Lemma 1, we know that $\varphi(D) > rD$, which means

$$\triangle > 0 \tag{A.10}$$

This completes the proof. ■

A.2 Microfoundations for Competition Among Lenders

We model imperfect competition among lenders in the following way. At $t = 0$, there are N_0^b banks and N_0^n non-bank lenders, so the total number of lenders is $N_0 = N_0^b + N_0^n$. There are $M < N_0 < 2M$ borrowers. For simplicity, we assume that M is intertemporally invariant; this assumption can be relaxed without changing the analysis as long as $M_t < N_t \ \forall t$. At $t = 1$, suppose n lenders fail and cannot raise second-period financing, so they exit. Here n_b is the number of exiting banks and n_n the number of exiting non-banks, so $n = n_b + n_n$. This means that, absent new entry, the number of second-period lenders at $t = 1$ will be $N_1 = N_0 - n$. For simplicity, we rule out entry of new lenders at $t = 1$. This makes no difference to the analysis as long as the number of lenders at $t = 1$ remains below $2M$.

Borrowers search for lenders. We simplify the search process by stipulating that nature randomly initially matches M lenders with M borrowers, so each borrower is matched with one lender. Then nature matches the remaining $N_0 - M$ lenders with $N_0 - M$ borrowers, so that each of those borrowers will have two lenders competing for it. Thus, $N_0 - M$ borrowers will each face two lenders, and $2M - N_0$ borrowers will each face one lender. No borrower will be without at least one lender at $t = 0$. Let

$$\theta_0 \equiv \frac{N_0 - M}{M} \tag{A.11}$$

as the probability that a borrower will be faced with two or more lenders at $t = 0$. Since $M < N_0 < 2M$, we know that $\theta \in (0, 1)$. Thus, $1 - \theta$ is the probability that the borrower will be paired with only one lender.

At $t = 1$, we have

$$\theta_1 \equiv \frac{N_0 - n - M}{M} \leq \theta_0 \tag{A.12}$$

When the borrower is paired with two lenders, these lenders engage in Bertrand competition and the pricing of the loan is competitive, in that the lender's participation constraint holds tightly. When the borrower faces only one lender, the pricing is monopolistic, so the repayment obligation on the loan is set at the maximum pledgeable cash flow on the borrower's project, x. Thus θ is a measure of credit market competitiveness.[34]

[34] This specification is a way to provide for an ex ante sharing of the project surplus between the bank and the borrower. An alternative specification would be a Nash bargaining game.

Appendix B: Additional Figures and Tables

Figure A1: Hypothesis Testing Representation

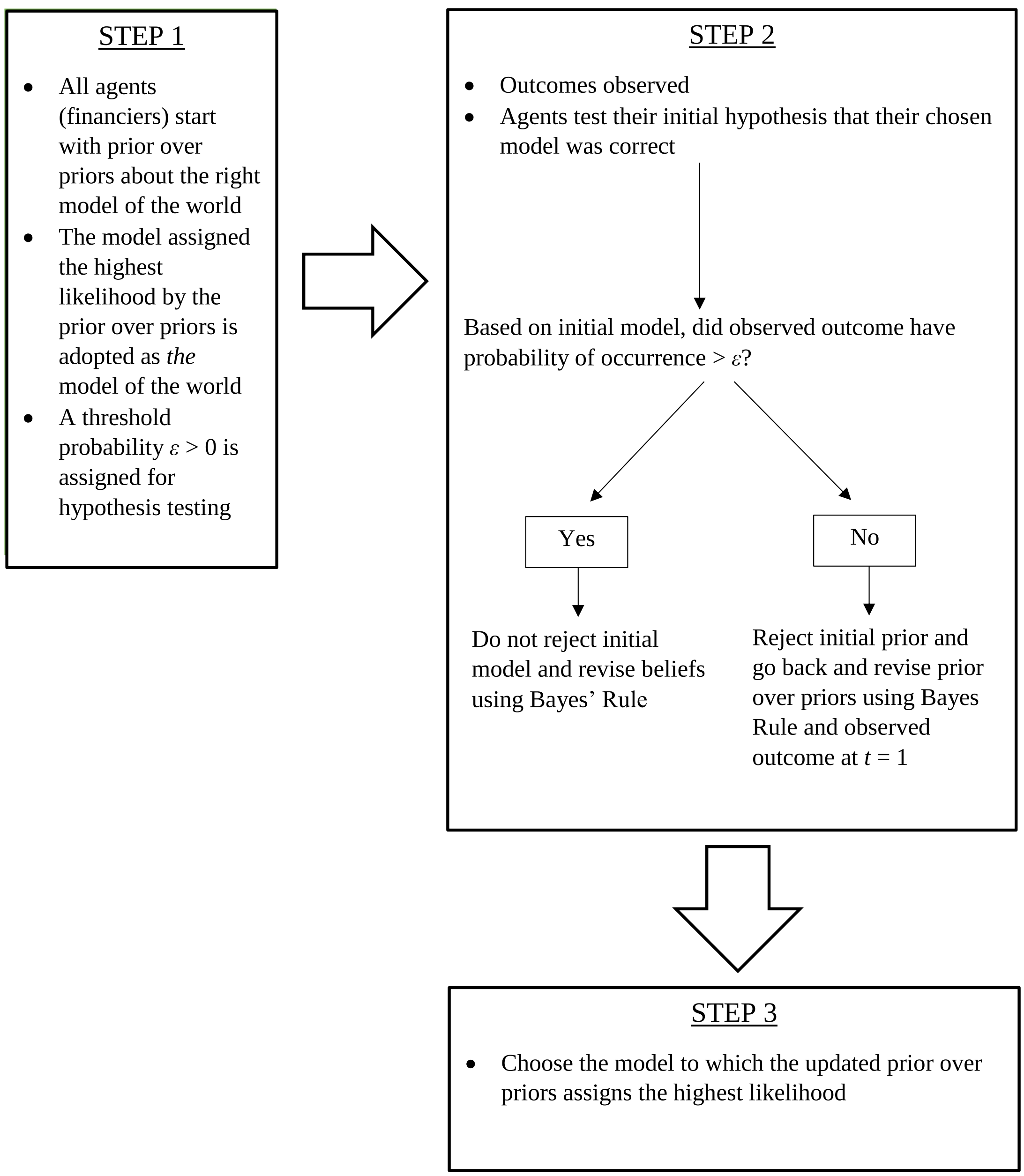

Table A1: List of Notation and Definitions in the Text

Notation	Definition
D	Amount of deposits at the bank
$R_{FB}(k)$	First-best repayment obligation of borrower when faced with k lenders
π_t^i	Posterior probability distribution of agents' beliefs over lender types τ_j when lender is $i \in \{\text{bank}, \text{non-bank}\}$
$\mu_t^i(\tau_j \mid \omega)$	Agents' posterior beliefs at date t that lender $i \in \{\text{bank}, \text{non-bank}\}$ is type τ_j, given information ω
$I_t^i(\tau_j)$	Indicator function that equals 1 if the strategy of lender $i \in \{\text{bank}, \text{non-bank}\}$ of type τ_j chooses G loan at date t
$\phi_t^i(\tau_j)$	Lending strategy at date t chosen by lender $i \in \{\text{bank}, \text{non-bank}\}$
λ^i	Expected profit of lender $i \in \{b, n\}$, where $b =$ bank and $n =$ non-bank
$\alpha_t^i(\omega)$	Ownership fraction sold by lender $i \in \{b, n\}$ at date-t, given information ω, to raise financing
$\alpha_t^i(\min)$	Smallest value of $\alpha_t^i(\omega)$ that is feasible
ε	Threshold probability in Trust model
$\pi_t(k \mid \omega)$	Vector of beliefs $\{\pi_t(\text{I} \mid \omega), \pi_t(\text{II} \mid \omega)\}$ at date t over whether agents believe in Model I or II
y	Pledgeable payoff on risk-shifting project in Model extension
δ	Probability of success of risk-shifting project
Λ	Bank's deposit franchise value
τ_A, τ_B, τ_C	Lender types: A, B, C
ζ_t	$\Pr(\tau_A)$ at date t
$1 - \zeta_t$	$\Pr(\tau_A \text{ or } \tau_C)$ at date t
γ	$\Pr(\tau_B \mid \tau_A \text{ or } \tau_C)$
β_i, $i \in \{A, B, C\}$	Private benefit to lender from bad (PB) loan
L	Loan size
r	Riskless interest rate
$l_t^i(\tau_j)$	Choice of loan in period t by lender i (where $i \in \{\text{bank}, \text{non-bank}\}$) of type τ_j
$u_t^i(\tau_j)$	Utility of lender of τ_j at date t when lender is i (where $i \in \{\text{bank}, \text{non-bank}\}$)
B	Bad loan
G	Good loan
θ	Measure of competition among lenders
q	Idiosyncratic factor affecting borrower repayment probability
m	Systematic factor affecting borrower repayment probability
$F(m, q)$	Borrower repayment probability
η	Probability density function of m
$\overline{q}$	Expected borrower repayment probability
ω	State of information = {borrower repays or defaults, m}
Ω	Set of all ω's
$[\underline{m}, \overline{m}]$	Support of η
x	Payoff of borrower's project when it succeeds
R	Repayment on loan promised by borrower

Appendix C: Proofs

Proof of Lemma 1: When there is only one lender, it can act as a monopolist with respect to the borrower, so the repayment obligation is set at the maximum pledgeable cash flow, x. When there are two or more lenders, the repayment obligation must be set to yield the lender an expected return of r on the loan, which is the minimum return the lender will accept, given its ability to invest its funds at r. Thus, $R_{FB}(2)$ solves:

$$\overline{q}R_{FB}(2) = L[1+r] \tag{A.13}$$

which yields (11). ■

Proof of Lemma 2: The result that $R_t(1) \equiv R(1) = R_{FB}(1) = x \, \forall \, t \in \{0,1\}$ and $R_t(2) \equiv R(2) = R_{FB}(2) = \{L[1+r]\} \{\overline{q}\}^{-1} \, \forall \, t \in \{0,1\}$ follows from the fact that the lender's loan pricing depends only on whether lenders are competing and the lender's participation constraint (minimum return of r) and not on the beliefs of investors about the lender's type.

Now $\alpha_t^b(\omega)$ will be determined to satisfy the outside shareholders' participation constraint, which holds tightly in equilibrium:

$$\alpha_t^b(\omega) \left\{ \sum_{j=0}^{2} \overline{q}\mu_t^b \left(\tau_j \mid \omega\right) I_t^b \left(\tau_j\right) \right\} \lambda_b = [L-D][1+r] \tag{A.14}$$

where the bank's strategy is restricted to lending (since financing is needed only if the bank decides to make a loan). Solving (A.14) yields (15). Similarly, for the non-bank lender, $\alpha_t^n(\omega)$ solves:

$$\alpha_t^n(\omega) \left\{ \sum_{j=0}^{2} \overline{q}\mu_t^n \left(\tau_j \mid \omega\right) I_t^n \left(\tau_j\right) \right\} \lambda_n = L[1+r] \tag{A.15}$$

Solving (A.15) yields (16). ■

Proof of Theorem 1: Note that the expected utility of the insider of a type-τ_B bank from making the G loan is

$$\left[1-\alpha_t^b\right]\lambda^b\overline{q} \tag{A.16}$$

where ω, the argument of α_t^b, is suppressed. The expected utility from a PB loan is β_B. Thus, the incentive compatibility (IC) constraint for the bank to prefer the G loan to the PB loan is:

$$\lambda^b\left[1-\alpha_t^b\right]\overline{q} > \beta_B \tag{A.17}$$

The analogous IC constraint for the non-bank lender is:

$$\lambda^n\left[1-\alpha_t^n\right]\overline{q} > \beta_B \tag{A.18}$$

Thus, to show that the bank has a stronger incentive to make the G loan than a comparable non-bank lender, we need to show that:

$$\left[1-\alpha_t^b\right]\overline{q}\lambda^b > \left[1-\alpha_t^n\right]\overline{q}\lambda^n \tag{A.19}$$

For this comparison, we need to have the same posterior belief about the lender's type for both the bank and the non-bank lender. That is, let

$$\xi \equiv \sum_{j=0}^{2}\overline{q}\mu_t^b\left(\tau_j \mid \omega\right)I_t^b\left(\tau_j\right) \tag{A.20}$$

Then using (15) and (16) we can write:

$$\alpha_t^b = \frac{L[1+r]-D[1+r]}{\lambda^b\xi} \tag{A.21}$$

$$\alpha_t^n = \frac{L[1+r]}{\lambda^n\xi} \tag{A.22}$$

with:

$$\lambda^b = \lambda^n - D \tag{A.23}$$

(A.19) thus requires showing that:

$$\left[1-\alpha_t^b\right]\lambda^b > \left[1-\alpha_t^n\right]\lambda^n \tag{A.24}$$

Substituting in (A.24) from (A.21) and (A.22):

$$\frac{\left\{\xi\lambda^b - L[1+r] + D[1+r]\right\}}{\lambda^b\xi}\lambda^b > \frac{\left\{\xi\lambda^n - L[1+r]\right\}}{\lambda^n\xi}\lambda^n \tag{A.25}$$

or, re-writing this:

$$\xi\lambda^b - L[1+r] + D[1+r] > \xi\lambda^n - L[1+r] \tag{A.26}$$

And substituting in (A.26) from (A.23) we have:

$$\xi\left[\lambda^n - D\right] + D[1+r] > \xi\lambda^n \tag{A.27}$$

which requires:

$$D\{1+r-\xi\} > 0 \tag{A.28}$$

which is true since ξ is a probability. ■

Proof of Theorem 2: Take a given $\omega \in \Omega$. A type τ_B bank's expected profit from a G loan is

$$\left[1-\alpha_1^b(\omega)\right]\overline{q}\lambda^b \geq \beta_B \tag{A.29}$$

where

$$1-\alpha_1^b(\omega) = \frac{\left[\mu_1^b\left(\tau_A \mid \omega\right) + \mu_1^b\left(\tau_B \mid \omega\right)\right]\overline{q}\lambda^b - [L-D][1+r]}{\left[\mu_1^b\left(\tau_A \mid \omega\right) + \mu_1^b\left(\tau_B \mid \omega\right)\right]\overline{q}\lambda^b} \tag{A.30}$$

Substituting (A.30) and for λ^b in (A.29) and defining $H_1^b(\omega) \equiv \mu_1^b\left(\tau_A \mid \omega\right) + \mu_1^b\left(\tau_B \mid \omega\right)$, we can write (A.29) as:

$$\frac{H_1^b\overline{q}\left[\theta R_{FB}(2) + [1-\theta]x\right] - L[1+r] + D\left\{1+r-\overline{q}A^b\right\}}{H_1^b} \geq \beta_B \tag{A.31}$$

Similarly, the IC constraint for the non-bank is:

$$\frac{A^n \overline{q}\left[\theta R_{FB}(2) + [1-\theta]x\right] - L[1+r]}{H_1^b} \geq \beta_B \tag{A.32}$$

where $H_1^n(\omega) \equiv H_1^n \equiv \mu_1^n(\tau_A \mid \omega) + \mu_1^n(\tau_B \mid \omega)$.

Now, if $H_1^b = H_1^n$, then a comparison of (A.31) and (A.32) shows that the left-hand side (LHS) of (A.31) exceeds the LHS of (A.32). Thus, conditional on investors having the same beliefs about the strategies of banks and non-banks, banks have a stronger incentive to make a G loan. What H_1^b and H_1^n will be after default depends on what lender strategies were in the first period. There are three possibilities: (i) both the bank and non-bank of type τ_B chose G in the first period; (ii) neither the bank nor the non-bank chose G; and (iii) the bank of type τ_B chose G and non-bank of type τ_B chose PB. Note that the bank of type τ_B choosing PB and the non-bank of type τ_1 choosing G is not possible, given Theorem 1 and the earlier part of this proof.

In case (i), $H_1^b \geq H_1^n$ since the bank has a stronger incentive to choose G in the second period. So it is sufficient to show that $\alpha_t^n(\omega) > \alpha_t^b(\omega)$. That is, we want to show

$$\frac{[L-D][1+r]}{\lambda^b} < \frac{L[1+r]}{\lambda^n} \tag{A.33}$$

Substituting for λ^b and λ^n, we see that this reduces to showing

$$\theta R_{FB}(2) + [1-\theta]x > L \tag{A.34}$$

which is the case.

In case (ii), the analysis is identical to that for case (i).

In case (iii), if the type τ_B bank chose G in the first period, then default will put more probability weight on τ_C in the posterior and less on τ_A and τ_B. With a non-bank, if τ_B chose PB in the first period, then the posterior will put more weight on τ_B and τ_C and less on τ_A. Moreover, since first-period incentives to choose G are always stronger than second-period incentives, we know that greater weight on τ_B and τ_C with a non-bank means a lower probability of G in the second period (because τ_1 will choose PB in the second period). The type τ_B bank will either choose G or PB

in the second period. Thus, $H_1^b \geq H_1^n$ again. ■

Proof of Lemma 3: Follows from the arguments in the main text. ■

Proof of Theorem 3: By the HTR, since $\zeta_0 > 0.5$, the agents' prior over priors will select $\pi_0(I \mid \omega)$ and lenders will be viewed as trustworthy in the first period. Since $1 - F(\overline{m}, q) < \varepsilon$, it follows that if the lender experiences default and $\tilde{m} = \overline{m}$, then by the HTR agents will *reject* their initial prior $\pi_0(I \mid \omega)$ and go back to their prior over priors to update using Bayes' rule. They will compute the posterior belief

$$\zeta_1 = \frac{[1 - F(\overline{m}, q)]\,\zeta_0}{[1 - F(\overline{m}, q)]\,\zeta_0 + q^f(\overline{m})\,[1 - \zeta^0]} \tag{A.35}$$

where $q^f(\overline{m})$ is the expected failure probability in macro state $\overline{m}$ if the lender is type τ_B or τ_C, given the optimal strategies untrustworthy lenders would have chosen in the first period (with the expectation taken over lender types in Model II) when faced with agents believing them to be trustworthy.

Note that ζ_1 is decreasing in $q^f(\overline{m})$. The higher the probability that a type-τ_j ($j \in \{B, C\}$) lender makes the G loan in the first period, the lower is $q^f(\overline{m})$ and hence the higher is ζ_1. The maximum probability that a type-τ_j lender will make the G loan is 1. Thus, if we can establish that $\zeta_1 < 0.5$ with this conjectured first-period strategy chosen by type τ_j, then $\zeta_1 < 0.5$ with *any* first-period strategy chosen by the type-τ_j lender.

Now if the type-τ_B makes the G loan with probability 1 in the first period, then

$$q^f(\overline{m}) = [1 - F(\overline{m}, q)]\,\overline{\mu}(\tau_B \mid \overline{m}) + \overline{\mu}(\tau_C \mid \overline{m}) \tag{A.36}$$

where $\overline{\mu}(\tau_B \mid \overline{m})$ is defined in (31). Substituting (31) in (A.36), the condition for $\zeta_1 < 0.5$ becomes:

$$\frac{[1 - F(\overline{m}, q)]\,\zeta_0}{[1 - F(\overline{m}, q)]\,\zeta_0 + \{[1 - F(\overline{m}, q)]\,\overline{\mu}(\tau_B \mid \overline{m}) + 1 - \overline{\mu}(\tau_B \mid \overline{m})\}\,[1 - \zeta_0]} < 0.5 \tag{A.37}$$

Simplifying this yields

$$\zeta_0 < \frac{1 - F(\overline{m}, q)\,\overline{\mu}(\tau_B \mid \overline{m})}{2 - F(\overline{m}, q)\,[1 + \overline{\mu}(\tau_B \mid \overline{m})]} \tag{A.38}$$

Note that since $\overline{\mu}(\tau_B \mid \overline{m}) < 1$, the quantity on the right-hand side of (A.38) is bigger than 0.5. Thus, the interval defined in (30) has positive Lebesgue measure.

So we have proven that at $\tilde{m} = \overline{m}$, if the lender experiences borrower default, by HTR the prior over priors will reject the initially chosen Model I as the correct belief and the revised prior over priors at $t = 1$ will choose Model II as the correct prior for the second period. This holds for any first-period strategy chosen by the lender. By continuity, $\exists\, m^*$ in the neighborhood of $\overline{m}$ for which this will be true as well. Further, given $\varepsilon < 1 - F(\underline{m}, q)$ in (32), it also follows that the initial prior is not rejected if $\tilde{m} = \underline{m}$. Thus, $m^* \in (\underline{m}, \overline{m})$.

It is straightforward that the initial prior will not be rejected for any $\tilde{m}$ if the lender experiences success (borrower-repayment) at $t = 1$. ■

Proof of Corollary 1: At $t = 0$, agents believe that all lenders are trustworthy. Thus, all make G loans and the probability of failure for every lender is $1 - F(m, q)$ in every $m \in [\underline{m}, \overline{m}]$. By Theorem 1, if $m > m^*$, then the HTR will reject the initial hypothesis that the lender is trustworthy if default is experienced, and if $m \leq m^*$, the HTR will not reject the initial hypothesis. Moreover, since every trustworthy lender had the same strategy in the first period, ζ_1 (see (A.35)) is also the same for every lender. The result now follows from Theorem 1. ■

Proof of Theorem 4: Assume (32) holds. Then we have already established in Corollary 1 that a lender who starts out being trusted can lose trust if default is experienced at $t = 1$ at $m > m^*$. So what we need to prove is that, for the *same* set of parameter values, a lender who starts out not being trusted can never gain trust in the future.

So suppose agents start out at $t = 0$ with Model II. The only way for lenders to gain trust at $t = 1$ is if they experience first-period loan repayment. Suppose this happens when $m = \underline{m}$, so the repayment probability of the G loan is $F(\underline{m}, q)$. Clearly, if trust cannot be regained with loan repayment when $m = \underline{m}$, it cannot be regained with $m > \underline{m}$. The HTR will reject the initially-adopted Model II if

$$\gamma F\left(\underline{m}, q\right) > \varepsilon \tag{A.39}$$

where it is recognized that with Model II only the type-τ_B lenders choose loan G, so γ is the probability measure of lenders choosing loan G. Given our assumption on ε, (A.39) holds. Thus, trust will never be gained at $t = 1$. ■

Proof of Theorem 5: Consider first the Reputation Model. Letting α_0^i, $\alpha_1^i(m, s)$, and $\alpha_1^i(m, f)$ be the ownership fractions an $i \in \{b, n\}$ lender must sell to raise financing at $t = 0$, at $t = 1$ when the macro state is m and there is first-period repayment, and at $t = 1$ when the macro state is m and there is first-period default, respectively. Then for lender $i \in \{b, n\}$, the IC constraint to choose G in the first period is given by (33). We want to prove that the LHS of (33) for a bank exceeds the LHS of (33) for a non-bank. Substituting for α_0^b and α_0^n and using the notation H_1^b and H_1^n developed in the proof of Theorem 2, we see that

$$\left[1 - \alpha_0^b\right] \overline{q}\lambda^b = \frac{\overline{q}\left\{\left[\theta R_{FB}(2) + [1-\theta]x\right] H_1^b - L[1+r] + D\left[1 + r - H_1^b\right]\right\}}{H_1^b} \tag{A.40}$$

$$\left[1 - \alpha_0^n\right] \overline{q}\lambda^n = \frac{\overline{q}\left\{\left[\theta R_{FB}(2) + [1-\theta]x\right] H_1^n - L[1+r]\right\}}{H_1^n} \tag{A.41}$$

If both the bank and the non-bank of type τ_1 choose G in the first period, then $H_1^n = H_1^b$. Now a comparison of (A.40) and (A.41) reveals that

$$\left[1 - \alpha_0^b\right] \overline{q}\lambda^b > \left[1 - \alpha_0^n\right] \overline{q}\lambda^n \tag{A.42}$$

Next we prove that the second and third terms on the LHS of (33) add up to a quantity that is higher for banks than for non-banks. First note that

$$\int_{\widehat{m}}^{\overline{m}} q(m)\left[1 - \alpha_1^b(\min)\right] \lambda^b \eta \, dm > \int_{\widehat{m}_n}^{\overline{m}} q(m)\left[1 - \alpha_1^n(\min)\right] \lambda^n \eta \, dm \tag{A.43}$$

This follows from Lemma 3, which shows that, when faced with minimum-cost financing, all lenders choose G in the second period for every $m \in [\underline{m}, \overline{m}]$, and the fact that $\lambda^b > \lambda^n$. Next we will prove that

$$\int_{\underline{m}}^{\widehat{m}_b} q(m)\left\{\left[1-\alpha_1^b(\min)\right]-\left[1-\alpha_1^b(m,f)\right]\right\}\lambda^b\eta\,dm > \int_{\underline{m}}^{\widehat{m}_n} q(m)\left\{\left[1-\alpha_1^n(\min)\right]-\left[1-\alpha_1^n(m,f)\right]\right\}\lambda^n\eta\,dm \tag{A.44}$$

We know that $\widehat{m}_b > \widehat{m}_n$ (see Theorem 2), so we have

$$\int_{\underline{m}}^{\widehat{m}_b} q(m)\left\{\left[1-\alpha_1^b(\min)\right]-\left[1-\alpha_1^b(m,f)\right]\right\}\lambda_b\eta\,dm > \int_{\underline{m}}^{\widehat{m}_n} q(m)\left\{\left[1-\alpha_1^b(\min)\right]-\left[1-\alpha_1^b(m,f)\right]\right\}\lambda^n\eta\,dm \tag{A.45}$$

Replacing the left-hand side (LHS) of (A.44) with the right-hand side of (A.45) means it is sufficient to prove that:

$$\int_{\underline{m}}^{\widehat{m}_n} q(m)\left\{\left[1-\alpha_1^b(\min)\right]-\left[1-\alpha_1^b(m,f)\right]\right\}\lambda^n\eta\,dm > \int_{\underline{m}}^{\widehat{m}_n} q(m)\left\{\left[1-\alpha_1^n(\min)\right]-\left[1-\alpha_1^n(m,f)\right]\right\}\lambda^n\eta\,dm \tag{A.46}$$

It is clear that (A.46) will hold if

$$\alpha_1^n(\min)-\alpha_1^b(\min) < \alpha_1^n(m,f)-\alpha_1^b(m,f) \tag{A.47}$$

Now using (17), (18), (19), and (20), we see that

$$\alpha_1^n(\min)-\alpha_1^b(\min) = \frac{\lambda^b L[1+r]-\lambda^n[L-D][1+r]}{\overline{q}\lambda^n\lambda^b} \tag{A.48}$$

$$\alpha_1^n(m,f)-\alpha_1^b(m,f) = \frac{Q^b\lambda^b L[1+r]-Q^n\lambda^n[L-D[1+r]]}{Q^bQ^n\overline{q}\lambda^n\lambda^b} \tag{A.49}$$

where

$$Q^b = \sum_{j=0}^{2}\mu_1^b\left(\tau_j \mid \omega\right)I_1^b\left(\tau_j\right)\overline{q} \tag{A.50}$$

$$Q^n = \sum_{j=0}^{2}\mu_1^n\left(\tau_j \mid \omega\right)I_1^n\left(\tau_j\right)\overline{q} \tag{A.51}$$

$\mu_1^b\left(\tau_j \mid \omega\right)$ and $\mu_1^n\left(\tau_j \mid \omega\right)$ are posterior beliefs defined in (13), and $I_1^b\left(\tau_j\right)$ and $I_1^n\left(\tau_j\right)$ are defined in

(14) as (for $i \in \{b, n\}$):

$$I_1^i(\tau_j) = \begin{cases} 1 & \text{if the lender's strategy } \phi_1^i(\tau_j) \text{ choose the } G \text{ loan} \\ 0 & \text{otherwise} \end{cases} \tag{A.52}$$

Thus, Q^b and Q^n correspond to beliefs about lender repayment probabilities related to $\omega = (m, f)$ for f and a given m. Now, since the range of integration on both sides of (A.46) is $[\underline{m}, \hat{m}_n]$, we know that $Q^n = Q^b$ over this range. Since $Q^n = Q^b$,it follows from (A.48) that (A.47) holds.

Now turn to the Trust Model. The IC condition for lender i to choose G in the first period is

$$\left[1-\alpha_0^i(\min)\right]\overline{q}\lambda^i + \int_{\underline{m}}^{\overline{m}} q(m)\left[1-\alpha_0^i(\min)\right]\lambda^i\eta\, dm + \int_{\underline{m}}^{m_i^*}\left[1-q(m)\right]\left[1-\alpha_0^i(\min)\right]\lambda^i\eta\, dm$$
$$+\int_{m_i^*}^{\hat{m}_i}\left[1-q(m)\right]\left[1-\alpha_1^i(m,f)\right]\lambda_i\eta\, dm \geq \beta_B + \int_{\underline{m}}^{m_i^*}\left[1-\alpha_0^i(\min)\right]\lambda_i\eta\, dm + \int_{m_i^*}^{\hat{m}_i}\left[1-\alpha_1^i(m,f)\right]\lambda^i\eta\, dm \tag{A.53}$$

where $i \in \{b, n\}$, $\alpha_0^i(\min)$ is defined in (19) and (20), $\alpha_1^i(m, f)$ is the ownership fraction the type i lender must sell when the macro state is m and there is first-period default. We also recognize that if Model I is initially adopted, it will continue to be adopted if there is repayment in the first-period loan, in states $[\underline{m}, m_i^*]$ trust is retained despite default, and in states $[m_i^*, \hat{m}_i]$ trust is lost upon default but the lender is able to continue in the second period. The proof that (A.53) holds is similar to that for the Reputation Model. ■

Proof of Theorem 6: Existence and uniqueness of the equilibrium in the Trust Model are guaranteed by Theorem 1 and Proposition 2 in Ortoleva (2012). As for the existence of the BPNE in the Reputation Model, note that the maximization programs of lenders are well defined (see (6)-(8)) and have unique solutions, given a set of exogenous parameter values, the realized competition and the equilibrium beliefs and strategies of borrowers and lenders. Utility-maximizing borrowers extract all the project surplus when they face two or more lenders and the lender extracts all the project surplus when there is only one lender. Thus, the borrower-lender maximization program has a a unique solution in each state ω at $t = 1$, and a unique solution for the overall maximization at $t = 0$. The existence and uniqueness of the BPNE is now guaranteed by the out-of-equilibrium belief specified in the theorem. The rest of the proof follows from Theorem 1, which states that a bank of type τ_B has a stronger incentive to make a G loan than a non-bank of type τ_B. Thus, it is always possible to find exogenous parameter values that yield the equilibrium in this Theorem. ■

Proof of Corollary 2: Follows directly from the arguments in the text. ■

Proof of Corollary 3: This follows directly from Theorem 3. Conditional on loan repayment at $t = 1$ and on default for $m \leq m^*$, trust is retained, so the lender's funding cost in the second period is the same across all of these states. However, across these states, a lender faces different second-period funding costs. If there is default at $t = 1$ and $m > m^*$, the lender will lost trust and the change in funding costs will exceed that in the Reputation Model. ■

Proof of Theorem 7: The IC constraint for the type-τ_B bank to prefer the G loan to the PB loan is

$$\left[1-\alpha_t^b\right]\lambda^b\overline{q} \geq \left\{\left[1-\alpha_t^b\right]\hat{\lambda}^b + \beta_B\right\}\delta \tag{A.54}$$

and for the non-bank the analogous IC constraint is

$$\left[1-\alpha_t^n\right]\lambda^n\overline{q} \geq \left\{\left[1-\alpha_t^n\right]\hat{\lambda}^n + \beta_B\right\}\delta \tag{A.55}$$

To prove the theorem, we need to show that:

$$\left[1-\alpha_t^b\right]\left[\lambda^b\overline{q} - \hat{\lambda}^b\delta\right] + \delta\beta_B \geq \left[1-\alpha_t^n\right]\left[\lambda^n\overline{q} - \hat{\lambda}^n\delta\right] + \delta\beta_B \tag{A.56}$$

Noting that

$$\lambda^b - \lambda^n = \hat{\lambda}^b - \hat{\lambda}^n = \Lambda - D \tag{A.57}$$

we see that (A.56) can be written as:

$$\overline{q} \geq \delta\left\{\frac{1-\alpha_t^b}{1-\alpha_t^n}\right\} \tag{A.58}$$

Conditional on identical investor beliefs about the types of the bank and the non-bank, we know $\alpha_1^t > \alpha_t^n$. Thus, if δ is sufficiently small and $\overline{q}$ is sufficiently greater than δ, (A.58) will hold. ■

Proof of Theorem 8: Given that Theorem 8 follows closely to that of Theorem 7. ■