Trust in Lending*

Richard T. Thakor† and Robert C. Merton‡

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Abstract

We develop a theory of trust in lending that distinguishes between reputation and trust using a model uncertainty framework. 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 deposits and has 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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†University of Minnesota and MIT LFE. E-mail: rthakor@umn.edu

‡MIT and NBER. E-mail: rmerton@mit.edu

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. Many also believe that financial crises are 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)).[1] 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. In examining this issue, we make the point that bank deposits—which provide valuable services to depositors and are protected by deposit insurance—can cause agents to trust banks more than non-banks, and this generates predictions regarding how the structure of the credit market may change due to trust.

We build on two key ideas. First, lenders—both banks and non-banks—compete with each other, and trust plays an important role in mediating the nature and effect of this competition.[2] 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

[1] 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.

[2] 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.

have exhibited rapid growth (see He et al. (2017)).[3]

Second, there is a distinction between the notion of trust and the closely-related notion of lender reputation. Fehr and Zehnder (2009) provide experimental evidence that reputation formation in credit markets is important for proper market functioning, and may matter even more than legal enforcement of repayments. While reputation enforcement is frequently conflated with trust-based commitments, many have emphasized the importance of distinguishing between them (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 the anticipated future consequences of the behavior. The competitive structure of the credit market affects the profitability of each reputational consequence and thus affects reputational incentives. 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."[4] 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.

This distinction between trust and reputation allows a better understanding of stylized facts in credit markets during events where trust has been eroded. For example, it has been argued that the 2007-2009 financial crisis was concomitant with a collapse in trust in financial markets (e.g. Guiso (2010)). Knell and Stix (2015) document that trust in

[3]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)).

[4]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."

financial institutions declines during crises, but banks are nonetheless more trusted than non-banks, and banks' access to (insured) deposits acts as a "trust stabilizer". Our theory formalizes this notion. Furthermore, crises are often associated with sharp discontinuities in pricing and liquidity, including cessation of trade that leads to funding dry-ups for financial institutions and reduced lending (e.g. Gorton and Metrick (2012), Iyer, Lopez, Peydro, and Schoar (2013)). There is also evidence that these problems were less severe for banks than for non-banks (e.g. Brunnermeier (2009) and Ivashina and Scharfstein (2010)). Our theory of lender reputation and trust helps to shed light on these stylized facts and how they are connected.

To address these issues, we develop a two-period model in which competing lenders make loans in both periods. There is moral hazard at the lender level. The lender can unobservably make a bad loan instead of making a good loan. The propensity to do this varies across lender types, which are *a priori* privately known to lenders. Lenders are intermediaries that raise short-term funding in each period from investors and use it to make loans. A lender can be either a bank or a non-bank, and deposit insurance is the difference between a bank and a non-bank in the model. In each period, single-period loans are made. 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 depends on this belief revision.

This belief revision is at the core of how we define and model trust relative to credit market reputation. We view trust as the likelihood that the lender will engage in prudent lending, as we link this to privately-known lender types—one type is completely trustworthy, and one is self-interested (trustworthy only when it is in its own best interest), with heterogeneity in the degree of self interest.[5] We analyze trust and reputation for prudent lending from two

[5]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

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.[6] In this perspective, since we 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 utilizes a "model uncertainty" framework in which trust and reputation can be distinguished. Our modeling of trust follows Fehr (2009), who proposes a behavioral definition and argues that trust is more than just inferring *a priori* unknown types from observations.[7] Indeed, trust often has a 0-1 property—you either trust someone or you do not.[8] More specifically, we formalize this notion of trust using Ortoleva's (2012) theory of (partly) non-Bayesian belief revision in which agents face uncertainty both about the correct 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?"). The departure from the standard model is thus that belief revision is Bayesian in some states and non-Bayesian in other states. 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. 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.

We call the smooth Bayesian revision model the "Reputation model", and the model

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.

[6]Similar to Diamond (1989).

[7]Fehr (2009, p. 238) notes: "An individual...trusts if she voluntarily places resources at the disposal of another party (the trustee) without any legal commitment from the latter. In addition, the act of trust is associated with an expectation that the act will pay off in terms of the investor's goals. In particular, if the trustee is trustworthy the investor is better off than if trust were not placed, whereas if the trustee is not trustworthy the investor is worse off than if trust were not placed." See also Morrison and Wilhelm (2015).

[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.

uncertainty framework as the “Trust model”. In the Reputation model, agents take expectations over all possible lender types and revise their beliefs using Bayes rule. In the Trust model, the set of all types is divided into two subsets, with each subset representing a “model of the world”. Thus, agents first choose the model of the world they believe in and then take expectations over the set of types in that model. Belief revision with model uncertainty is thus non-Bayesian in some states and Bayesian in others, providing an ideal framework for analyzing lender reputation and trust simultaneously. 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)—lenders are viewed as self-interested, and there is Bayesian revision of post-model-shift beliefs.[9]

Lenders are banks and non-banks. 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*.[10]

Analysis of the model generates two main results. First, greater trust or a stronger reputation for prudent lending improves the lender’s ability to have continued access to

[9] 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. In that model, asset retention by an issuer selling the asset acts as a signal of asset quality, and reputation induces pooling, in contrast to the static case in which the equilibrium is separating. 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.

[10] 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.

financing. Model uncertainty (in the Trust model) matters and has real consequences—there are circumstances in which the same lenders would make inefficient loans in the Reputation model, but efficient loans in the Trust model. Consequently, the lender's financing cost always responds to lender performance in the Reputation model, but in the Trust model lenders can raise financing at the lowest possible cost regardless of their prior loan default experience and market conditions.[11] This sheds possible light on the insensitivity of funding availability to performance for banks documented by Martin, Puri, and Ufier (2018). Further, 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. When trust is lost, the Reputation model prevails, with sharp discontinuities in pricing and credit availability, both of which now depend on the *perceived* prudent lending incentives of self-interested lenders. Some lenders may find second-period funding completely drying up. 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)), and 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)).

Second, we show that banks survive a loss of trust and have continued funding access when non-bank lenders face cessation of trade and are shut down, i.e. *banks are more trusted lenders* than non-banks (Knell and Stix (2015)).[12] That is, the manner in which crisis events impact lender trust varies across banks and non-banks. This result is rooted in banks' access to insured deposits. This access generates beliefs and rents that induce even self-interested banks to behavior more often like trustworthy banks when investors cannot

[11] In a sense, when there is trust, depositors are "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".

[12] 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.

distinguish between the two types of banks. That is, deposit insurance contributes to the trust agents have in banks, in contrast to the usual argument that, deposit insurance makes banks less trustworthy by generating moral hazard. Moreover, trust begets trustworthy behavior, consistent with experimental evidence on "trust responsiveness" (see Bacharach, Guerra, and Zizzo (2007)).

Although our results shed light on numerous crisis-related stylized facts, the analysis turns on only one main friction: asymmetric information about the lender's type. The intuition underlying our results is driven by one main economic force, which is that the *lender's* trustworthiness as well as competition among lenders affect lender profitability and prudent-lending incentives.

Our paper is 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.[13] Our work is complementary in that investors' willingness to fund lenders depends on trust. However, the focus of our analysis is completely different, so we obtain numerous results not previously encountered.

Also related are papers that depart from Savage rationality to explain some crisis-related events. 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)). 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.

[13]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 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.

In summary, the intended marginal contribution of our paper relative to the previous literature 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, as we discuss later. We also explain how this sheds light on pricing and trading discontinuities during financial crises. 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 analyzes the Trust model. Section 5 provides an analysis of the choices of lenders and a juxtaposition of the Reputation and Trust models, and a discussion of the policy implications of the analysis. Section 6 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

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 $y \in \mathbb{R}_+$ with probability $q \in (0,1)$ at the end of the period and 0 with probability $1-q$; a loan to such a borrower is a "G loan". The good project therefore has an expected payoff of:

$$qy > L[1+r] \tag{1}$$

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

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 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 at

$\varphi(D) > 0 \; \forall D > 0$ at $t = 1$ if the bank fully repays depositors.[14] 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 $D < L$.

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.

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.[15] 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.[16] Without loss of generality, we set the deposit insurance premium at zero.[17]

Our model distinguishes between deposits and funds provided by investors, but there is no difference between the expected returns demanded by shareholders and subordinated debtholders, so the mix of equity and "sub" debt in the bank's capital structure is irrelevant. Financing to each bank is in perfectly elastic supply, and the return to each group of financiers

[14] 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.

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

[16] 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.

[17] 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.

satisfies the participation constraints of that group, i.e., gives that group an expected return of at least r.[18]

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)).[19] Each non-bank is also operated to maximize the expected utility of the insider owner (residual claimant after investors are paid off).[20] 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.[21] 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).

[18]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.

[19]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.

[20]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.

[21]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 co-existence argument appears in Donaldson, Piacentino, and Thakor (2021).

This would determine the equilibrium number of banks and non-banks.

2.2 Agent Types, Models of the World, and Uncertainties

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_0, τ_1, and τ_2. Each lender privately knows its own type, but this is not observed by others. there is a common prior belief distribution over types:

$$\begin{aligned}
&\Pr(\tau_0) = \zeta^0 \in (0,1),\ \Pr(\tau_1 \text{ or } \tau_2) = 1 - \zeta^0 \\
&\Pr(\tau_1 \mid \tau_1 \text{ or } \tau_2) = \gamma \in (0,1),\ \Pr(\tau_2 \mid \tau_1 \text{ or } \tau_2) = 1 - \gamma
\end{aligned} \tag{2}$$

The type τ_0 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_1 can choose between making a good loan and a private-benefit loan that yields it a private benefit of $\beta_1 \in \mathbb{R}_+$. The type τ_2 has no access to a good borrower and thus can make only a private-benefit loan yielding $\beta_2 > \beta_1$.[22] While the good loan yields the lender no private benefits,[23] private benefit loans are inefficient:

$$\beta_2 < L[1 + r] \tag{3}$$

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.

[22] 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.

[23] This is an innocuous assumption.

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 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_0. In Model II, the lender can be either type τ_1 or τ_2.

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 $l_{ij}^t \in \{G, PB\}$ be the choice of loan in period t by type $j \in \{\tau_0, \tau_1, \tau_2\}$ of lender $i \in \{b, n\}$, where b represents banks and n represents non-banks. Then in the second period:

$$l_{ij}^2 \in \arg \max_{\{G,PB\}} u_{ij}^2 \tag{4}$$

and in the first period:

$$l_{ij}^1 \in \arg \max_{\{G,PB\}} U_{ij}^0 \tag{5}$$

where

$$U_{ij}^{0} = u_{ij}^{1} + \mathbb{E}\left[u_{ij}^{2}\left(l_{ij}^{2}\right)\right] \tag{6}$$

is the expected utility of the bank decision-maker over two periods, and it takes as a given the (subgame perfect) choice l_{ij}^2 in the second period. The maximizations above are subject to the participation constraints of the financiers of the lenders and borrowers. Here the lender's preference function in each period is

$$u_{ij}^{t} = \left[1 - \alpha_i^t\right] z_{ij}^t + \beta_j \tag{7}$$

where t is the time period, $j \in \{0, 1, 2\}$ with $j = 0$ designating τ_0, $j = 1$ designating τ_1, and $j = 2$ designating τ_2, and $i \in \{b, n\}$. Further, z_{ij}^t is the payoff to the lender's shareholders, and α_i^t 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.

Macro Uncertainty: There is macro uncertainty—representing the state of the overall economy—whose realization is observed at the end of each period. It is represented by a random variable $\tilde{m}$ with probability density function η. Let supp $\eta = [\underline{m}, \overline{m}]$. The realization of $\tilde{m}$ is publicly observed, and there exists a function:

$$C : [\underline{m}, \overline{m}] \times (0, 1) \to (0, 1) \tag{8}$$

such that for a $q \in (0, 1)$ and a realized $m \in [\underline{m}, \overline{m}]$, the repayment probability of the good loan becomes $C(m, q) \in (0, 1)$, with higher m values representing a higher repayment probability, i.e., $\partial C / \partial m > 0$.

Let

$$\overline{q} \equiv \int_{\underline{m}}^{\overline{m}} C(m, q)\eta \, dm \tag{9}$$

Let ω be the observed outcome at $t = 1$, where ω is the realization of a pair of random variables: $\omega = \{\text{borrower defaults or repays}, m\}$. Let Ω be the set of ω's for all lenders.

2.3 Competitive Structure of the Credit Market

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

$$\theta_0 \equiv \frac{N_0 - M}{M} \tag{10}$$

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

$$\theta_1 \equiv \frac{N_0 - n - M}{M} \leq \theta_0 \tag{11}$$

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.[24]

Bank Regulator: There is a regulator who provides complete deposit insurance.[25] 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.

Zero Lower Bound: We assume that all interest rates have a zero lower bound.[26]

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

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 and 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

[24] 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.

[25] The justification for this specification is that depositor insurance is provided to enhance social welfare by insulating the bank's depository customers from the bank's credit risk (see Merton and Thakor (2019)).

[26] This assumption helps to simplify the algebra, but is not crucial to the analysis. Essentially, it leads to depositors receiving a zero interest rate on deposits in equilibrium.

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.

outcome with trustworthy lenders. Next we have:

Lemma 1: *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*

$$[1-\overline{q}]\,[\hat{\varphi}(D)-D]>0. \tag{12}$$

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.

Lemma 2: *The borrower's repayment obligation when faced with only one lender is:*

$$R_1^{FB}=x \tag{13}$$

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

$$R_2^{FB}=\{L[1+r]\}\,\{\overline{q}\}^{-1}<x. \tag{14}$$

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

The posterior belief at date t is:

$$\mu_{\omega}^{i}(j) \equiv \Pr(\text{lender } i \text{ is type } \tau_j \mid \pi^2 = \pi_N, \omega, j = 1, 2) \tag{15}$$

where $i \in \{b, n\}$, and recall that $\omega \in \Omega$ is the composite state 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:

$$I_i^t(j) = \begin{cases} 1 & \text{if the strategy } \phi_i^t(\tau_j) \text{ chooses the } G \text{ loan} \\ 0 & \text{otherwise} \end{cases} \tag{16}$$

Note that

$$\lambda_b = \theta R_2^{FB} + [1 - \theta]x - D \tag{17}$$

$$\lambda_n = \theta R_2^{FB} + [1 - \theta]x \tag{18}$$

where R_2^{FB} is available in (14). 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 $\alpha_i^t(\omega)$, $i \in \{b, n\}$, 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 $\left\langle \pi^0_{rep}, R^0_1, R^0_2, \phi^0_i(\tau_j) \right\rangle$ where it is common knowledge that $\pi^0_{rep} = \langle \zeta^0, [1-\zeta^0]\,\gamma, [1-\zeta^0]\,[1-\gamma] \rangle$ is the vector of prior beliefs over the three lender types τ_0, τ_1, and τ_2 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_i to maximize its expected utility over two periods, given π^0_{rep} and $\pi^1_{rep}(\omega)$ in each future $\omega \in \Omega$.[27]

2. At $t = 1$, for each $\omega \in \Omega$ the equilibrium consists of $\left\langle \pi^1_{rep}, R^1_1, R^1_2, \phi^1_i(\tau_j) \right\rangle$ where $\pi^1_{rep}(\omega) \in \langle \mu_\omega(j) \mid j \in \{0, 1, 2\}, \omega \rangle$ is the updated 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 $\phi^1_i(\tau_j)$ 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 (4) and the loan prices is determined as in Lemma 2, subject to the participation constraints of lenders' second-period financiers, taking $\pi^1_{rep}(\omega)$ as given.

[27] 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 3: $R_1^t \equiv R_1 \equiv R_1^{FB} = x(\kappa)\ \forall\ t \in \{0,1\}$, *and* $R_2^t \equiv R_2 = R_2^{FB} = \{L[1+r]\}\,[\overline{q}]^{-1}\ \forall\ t \in \{0,1\}$. *Moreover, for any set of beliefs about the lender's type, in each period we have:*

$$\alpha_b^t(\omega) = \frac{[L-D][1+r]}{\left[\sum_{j=0}^{2} \mu_\omega^b(j) I_b^t(j)\overline{q}\right]\lambda_b} \tag{19}$$

$$\alpha_n^t(\omega) = \frac{L[1+r]}{\sum_{j=0}^{2} \left[\mu_\omega^n(j) I_n^t(j)\overline{q}\right]\lambda_n} \tag{20}$$

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,

$$\alpha_{b,\min}^t = \frac{[L-D][1+r]}{\overline{q}\lambda_b}\ \forall\, t \tag{21}$$

$$\alpha_{n,\min}^t = \frac{L[1+r]}{\overline{q}\lambda_n}\ \forall\, t \tag{22}$$

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:

$$\overline{q}\left[1-\alpha_{b,\min}^{t}\right]\lambda_b \geq \beta_1 \tag{23}$$

$$\overline{q}\left[1-\alpha_{n,\min}^{t}\right]\lambda_n \geq \beta_1 \tag{24}$$

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:*

(i) A bank and a non-bank lender have the same incentive to choose loan G if both are type τ_0; and

(ii) 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_1, and have the same incentive if both are type τ_2.

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_1 (the only type with a strategic choice). 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.

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.*

The intuition comes from Theorem 1. Since a bank has a stronger incentive than a non-bank to invest in a G loan, there are more states of the world in which investors are willing to fund the bank in the second period.

We can now prove the following result.

Lemma 4: *Conditional on loan repayment at $t = 1$, the lender will choose G in equilibrium for every realization of m at $t = 1$.*

The intuition is as follows. First, suppose the type τ_1 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_0 or τ_1 is 1. Thus, if investors assume the type τ_1 lender will choose G in the second period, the financing will be provided at $\alpha^t_{i,\min}$. Given (23) and (24), the lender will indeed choose G, so this is a Nash equilibrium in the second-period subgame. Now suppose the type τ_1 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_0 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 trustworthiness aspect of trust relates to uncertainty about whether the correct model is Model I or Model II, and reputation refers to uncertainty about type given a 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 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_1, and a probability $1 - \gamma$ that the lender is of type τ_2. 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.[28] 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

[28]This is merely a parameter and not an object of choice.

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. As Ortoleva (2012) points out, when $\varepsilon = 0$, belief revision follows Bayes' rule.[29]

In our setting, a model is itself a prior belief over the lender's type, and ζ is the prior over these prior beliefs. Following Ortoleva (2012), we define $\pi^t(\omega)$ as the prior belief at date t given information ω, which is a vector of two probability distributions over lender types, $\pi = \{\pi_T, \pi_N\}$, where

$$\pi_T = \langle \Pr(\tau_0) = 1,\, \Pr(\tau_1) = 0,\, \Pr(\tau_2) = 0 \rangle, \tag{25}$$

$$\pi_N = \langle \Pr(\tau_0) = 0,\, \Pr(\tau_1) = \gamma \in (0,1),\, \Pr(\tau_2) = 1 - \gamma \in (0,1) \rangle, \tag{26}$$

where τ_0 denotes that the lender is completely trustworthy, τ_i denotes that the lender is self-interested and of type τ_i, with $i \in \{1, 2\}$. Then the prior over priors says that ζ^0 is the prior belief that the correct prior is π_T and $1 - \zeta^0$ is the prior belief that the correct prior is π_N. A visualization of this process is provided in the Appendix.

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.

[29] 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 $\langle \varepsilon, \pi^0, R_1^0, R_2^0, \phi_i^0(\tau_j) \rangle$ where ε is common knowledge, $\pi^0 \in \{\pi_T, \pi_N\}$ is the prior belief chosen by agents over lenders' types, R_1^0 and R_2^0 are the repayment obligations of the borrower when faced with a single lender and when faced with two or more lenders, respectively, $\phi_i^0(\tau_j)$ is the strategy of a lender $i \in \{b, n\}$ of type τ_j, $j \in \{0, 1, 2\}$, where the lender's strategy is a choice of loan from $\{G, \text{PB}\}$, conditional on making a loan, as well as the decision of whether to make a loan. Here π^0 is chosen by agents using the HTR; and ϕ_i^0 is chosen by each lender to maximize its expected utility over two periods, given π^0 and $\pi^1(\omega)$ in each future $\omega \in \Omega$.[30]

(ii) At $t = 1$, for each $\omega \in \Omega$, the equilibrium consists of $\langle \pi^1(\omega), R_1^1, R_2^1, \phi_i^1(\tau_j) \rangle$, where $\pi^1(\omega) \in \{\pi_T, \pi_N\}$ is the updated prior belief over lenders' types chosen by agents at $t = 1$ based on the HTR; R_1^1 and R_2^1 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 $\phi_i^1(\tau_j)$ is the strategy of a lender in the second period, defined in a manner similar to $\phi_i^0(\tau_j)$. Note that $\phi_i^1(\tau_j)$ 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 (4) and the loan price is determined as in Lemma 2, subject to the participation constraints of lenders' second-period financiers, taking $\pi^1(\omega)$ 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.[31] We will then examine the behavior of banks and non-banks

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

[31] In a sense, we can think of this as corresponding to the current credit market situation in which lenders are trusted by financiers to make good loans.

in 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 introduce some notation. Recall that ζ^1 is the prior over priors at $t = 1$ and $\pi^1(\omega)$ is the prior belief chosen by agents at $t = 1$ using the HTR. Thus:

$$\pi^1(\omega) = \begin{cases} \pi_T & \text{if agents believe lender is trusted} \\ \pi_N = \langle \mu^i_\omega(1), \mu^i_\omega(2) \rangle & \text{if agents believe at } t = 1 \\ & \text{ that lender is self interested} \end{cases} \tag{27}$$

Define an indicator function indicating that Model I is chosen:

$$I^t_{\{\pi_T\}} = \begin{cases} 1 & \text{if } \pi^t(\omega) = \pi_T,\ t \in \{0, 1\} \\ 0 & \text{otherwise} \end{cases} \tag{28}$$

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

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

$$\zeta^0 \in \left(0.5, \left[1 - \overline{\mu}_{\overline{m}}(1) C\left(\overline{m}, q\right)\right]\left[2 - \overline{\mu}_{\overline{m}}(1) C\left(\overline{m}, q\right) - C\left(\overline{m}, q\right)\right]^{-1}\right) \tag{29}$$

where

$$\overline{\mu}_{\overline{m}}(1) \equiv \frac{\left[1 - C\left(\overline{m}, q\right)\right]\gamma}{\left[1 - C\left(\overline{m}, q\right)\right]\gamma + 1 - \gamma} \tag{30}$$

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

$$1 - C(\overline{m}, q) < \varepsilon < 1 - C(\underline{m}, q) \tag{31}$$

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.[32] This is because even a good loan is more likely to default in a recession than in a boom, so the HTR at $t = 1$ will reject the initial prior over priors that led agents to view the lender as trustworthy in the first period when the bank fails in a boom, but may not do so in a recession.

Corollary 1: *Suppose ζ^0 is as in (29)–(31) holds. 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 (29) and (31) hold.

[32] Note that (31) is not an overly restrictive condition. It simply states that $[C(\underline{m}, q), C(\overline{m}, q)]$ 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.

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 intuition for the asymmetric nature of trust is as follows. Suppose lenders do not have trust at $t = 0$, and the equilibrium at $t = 0$ is one in which the type-τ_1 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_1 lender, especially if the prior probability attached to the lender being type-τ_1 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 (5). To ensure that the type τ_1 lender is trustworthy in the first period, the incentive compatibility condition ensuring a choice of G by type τ_1 must be satisfied:

$$\left[1-\alpha_i^0\right]\overline{q}\lambda_i + \int_{\underline{m}}^{\overline{m}} q(m)\left[1-\alpha_{i,\min}^1\right]\lambda_i\eta\, dm + \int_{\underline{m}}^{\widehat{m}_i}\left[1-q(m)\right]\left[1-\alpha_i^1(m,f)\right]\lambda_i\eta\, dm$$
$$\geq \beta_1 + \int_{\underline{m}}^{\widehat{m}_i}\left[1-\alpha_i^1(m,f)\right]\lambda_i\eta\, dm \quad (32)$$

where $\widehat{m}_i$ is the maximum value of m consistent with the lender being able to get second-period funding to continue. 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 4 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_1 lender is to choose G and the probability is zero the lender is type τ_2.

Recall that "trustworthiness" is measured by the measure of the set of exogenous parameter values for which the type τ_1 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 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.

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_1 choose G at $t = 0$. For the same exogenous parameter values, there exists a BPNE in the Reputation Model in which all type τ_0 lenders choose G, all type τ_2 lenders choose the PB loan, type τ_1 banks choose G, and type τ_1 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_2 with probability 1.

This result shows that when lenders are trusted, they behave in a more trustworthy manner. 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 thus 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.

Corollary 3: *Suppose the equilibria in the Trust Model and in the Reputation Model both involve the type τ_1 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.

5.2 Discussion and Policy Implications

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 with a relative trust advantage for banks.[33] There are two complementary channels through which this effect arises. First, investors' beliefs have *no* impact on the behavior of the

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

innately trustworthy (type τ_0) lenders, but they do affect the behavior of the type τ_1 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_1 bank will find the benefit of investing in a G loan to be greater than a type-τ_1 non-bank will. This belief 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_0 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_1 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 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)).

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)). Thus, a policy implication suggested by our analysis is that having sufficiently high regulatory capital requirements 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.[34] 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.

6 Conclusion

This paper has developed a theory in which the trust investors have in lenders has two dimensions: trustworthiness and competence. We show that these dimensions interact—greater lender competence increases trustworthiness and hence trust. However the impact of competence on trustworthiness diminishes with competition. We analyze trust using both a Bayesian reputation model as well as one with model uncertainty and non-Bayesian belief revision. In the latter model, trust 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

[34] For example, in Merton (1977), this is done by the bank increasing its asset volatility. We do not consider an increase in risk-shifting incentives explicitly in our analysis.

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.[35]

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 in such a setting, our analysis surfaces another aspect of deposit insurance—its role as a "trust insulator"—that should be featured in this discussion.

[35] 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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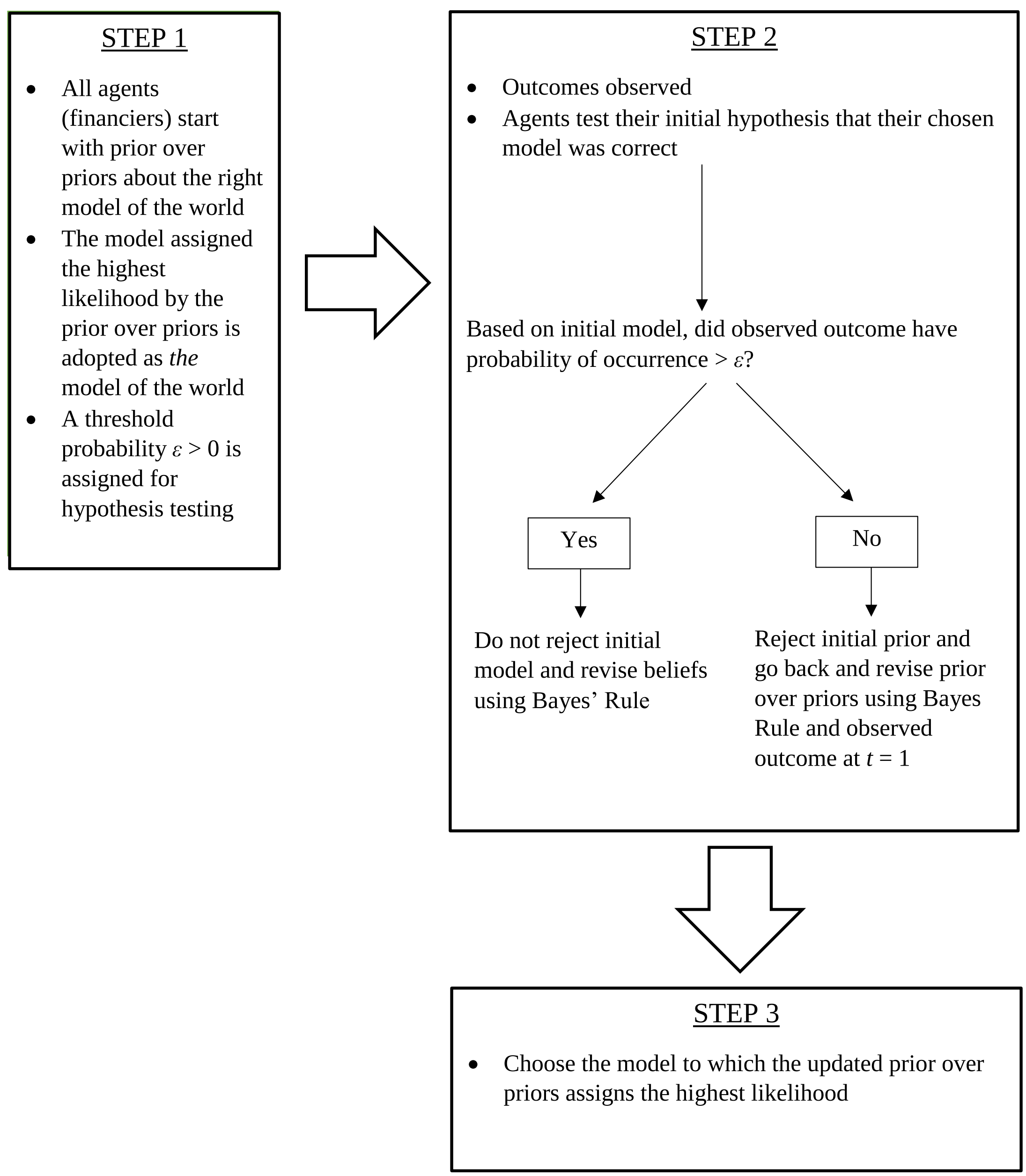
Appendix

A. Additional Figures

Figure A1: Hypothesis Testing Representation



B. Proofs

Proof of Lemma 1: Since $\varphi' > r$, it follows that

$$\int_0^D \varphi'(y)\,dy > \int_0^D r\,dy \tag{A.1}$$

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

$$D\,[1 + r_D] + \varphi(D) \geq D[1 + r] \tag{A.2}$$

Since the zero-lower-bound assumption implies that $r_D \geq 0$, if (A.2) 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.2) while satisfying (A.2). At $r_D = 0$, (A.2) becomes:

$$\varphi(D) \geq rD \tag{A.3}$$

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:

$$\overline{q}\,\varphi(D) \tag{A.4}$$

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

$$[1 - \overline{q}]\,\varphi(D) \tag{A.5}$$

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

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

The expected cost of providing deposit insurance is

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

Thus, the net welfare benefit of complete deposit insurance provision is the difference between (A.6) and (A.7):

$$\triangle \equiv [1-\overline{q}]\,[\varphi(D) - rD] \tag{A.8}$$

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

$$\triangle > 0 \tag{A.9}$$

This completes the proof. ■

Proof of Lemma 2: 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_2^{FB} solves:

$$\overline{q}R_2^{FB} = L[1+r] \tag{A.10}$$

which yields (14). ■

Proof of Lemma 3: The result that $R_1^t \equiv R_1 = R_1^{FB} = x\,\forall\, t \in \{0,1\}$ and $R_2^t \equiv R_2 = R_2^{FB} = \{L[1+r]\}\,\{\overline{q}\}^{-1}\,\forall\, t \in \{0,1\}$ 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 $s_b^t(\omega)$ will be determined to satisfy the outside shareholders' participation constraint, which holds tightly in equilibrium:

$$\alpha_b^t(\omega)\left\{\sum_{j=0}^{2}\overline{q}\mu_\omega^b(j)I_b^t(j)\right\}\lambda_b = [L-D][1+r] \tag{A.11}$$

where the bank's strategy is restricted to lending (since financing is needed only if the bank decides to make a loan). Solving (A.11) yields (17). Similarly, for the non-bank lender, $\alpha_n^t(\omega)$ solves:

$$\alpha_n^t(\omega)\left\{\sum_{j=0}^{2}\overline{q}\mu_\omega^n(j)I_n^t(j)\right\}\lambda_n = L[1+r] \tag{A.12}$$

Solving (A.12) yields (18). ■

Proof of Theorem 1: Part (i) of the theorem is clear, given that the type-τ_0 lenders always choose G. To prove part (ii), note that the expected utility of the insider of a type-τ_1 bank from making the G loan is

$$\left[1-\alpha_b^t\right]\lambda_b\overline{q} \tag{A.13}$$

where ω, the argument of α_b^t, is suppressed. The expected utility from a PB loan is β_1. Thus, the incentive compatibility (IC) constraint for the bank to prefer the G loan to the PB loan is:

$$\lambda_b\left[1-\alpha_b^t\right]\overline{q} > \beta_1 \tag{A.14}$$

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

$$\lambda_n\left[1-\alpha_n^t\right]\overline{q} > \beta_1 \tag{A.15}$$

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:

$$\left[1-\alpha_b^t\right]\overline{q}\lambda_b > \left[1-\alpha_n^t\right]\overline{q}\lambda_n \tag{A.16}$$

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

$$\xi \equiv \sum_{j=0}^{2} \overline{q}\mu_{\omega}^{b}(j)I_{b}^{t}(j)$$
$$= \sum_{j=0}^{2} \overline{q}\mu_{\omega}^{n}(j)I_{b}^{t}(j) \tag{A.17}$$

Then using (17) and (18) we can write:

$$\alpha_b^t = \frac{L[1+r] - D[1+r]}{\lambda_b \xi} \tag{A.18}$$

$$\alpha_n^t = \frac{L[1+r]}{\lambda_n \xi} \tag{A.19}$$

with:

$$\lambda_b = \lambda_n - D \tag{A.20}$$

(A.16) thus requires showing that:

$$\left[1 - \alpha_b^t\right] \lambda_b > \left[1 - \alpha_n^t\right] \lambda_n \tag{A.21}$$

Substituting in (A.21) from (A.18) and (A.19):

$$\frac{\{\xi\lambda_b - L[1+r] + D[1+r]\}}{\lambda_b \xi}\lambda_b > \frac{\{\xi\lambda_n - L[1+r]\}}{\lambda_n \xi}\lambda_n \tag{A.22}$$

or, re-writing this:

$$\xi\lambda_b - L[1+r] + D[1+r] > \xi\lambda_n - L[1+r] \tag{A.23}$$

And substituting in (A.23) from (A.20) we have:

$$\xi\left[\lambda_n - D\right] + D[1+r] > \xi\lambda_n \tag{A.24}$$

which requires:

$$D\{1 + r - \xi\} > 0 \tag{A.25}$$

which is true since ξ is a probability. ■

Proof of Theorem 2: Take a given $\omega \in \Omega$. A type τ_1 bank's expected profit from a G loan is

$$\left[1 - \alpha_b^1(\omega)\right] \overline{q}\lambda_b \geq \beta_1 \tag{A.26}$$

where

$$1 - \alpha_b^1(\omega) = \frac{\left[\mu_\omega^b(0) + \mu_\omega^b(1)\right] \overline{q}\lambda_b - [L - D][1 + r]}{\left[\mu_\omega^b(0) + \mu_\omega^b(1)\right] \overline{q}\lambda_b} \tag{A.27}$$

Substituting (A.27) and for λ_b in (A.26) and defining $A^b(\omega) \equiv \mu_\omega^b(0) + \mu_\omega^b(1)$, we can write (A.26) as:

$$\frac{A^b\overline{q}\left[\theta R_2^{FB} + [1-\theta]x\right] - L[1+r] + D\left\{1 + r - \overline{q}A^b\right\}}{A^b} \geq \beta_1 \tag{A.28}$$

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

$$\frac{A^n\overline{q}\left[\theta R_2^{FB} + [1-\theta]x\right] - L[1+r]}{A^n} \geq \beta_1 \tag{A.29}$$

where $A^n(\omega) \equiv A^n \equiv \mu_\omega^n(0) + \mu_\omega^n(1)$.

Now, if $A^b = A^n$, then a comparison of (A.28) and (A.29) shows that the left-hand side (LHS) of (A.28) exceeds the LHS of (A.29). 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 A^b and A^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_1 chose G in the first period; (ii) neither the bank nor the non-bank chose G; and (iii) the bank of type τ_1 chose G and non-bank of type τ_1 chose PB. Note that the bank of type τ_1 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), $A^b \geq A^n$ since the bank has a stronger incentive to choose G in the second period. So it is sufficient to show that $\alpha_n^t(\omega) > \alpha_b^t(\omega)$. That is, we want to show

$$\frac{[L-D][1+r]}{\lambda_b} < \frac{L[1+r]}{\lambda_n} \tag{A.30}$$

Substituting for λ_b and λ_n, we see that this reduces to showing

$$\theta R_2^{FB} + [1-\theta]x > L \tag{A.31}$$

which is the case.

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

In case (iii), if the type τ_1 bank chose G in the first period, then default will put more probability weight on τ_2 in the posterior and less on τ_0 and τ_1.With a non-bank, if τ_1 chose PB in the first period, then the posterior will put more weight on τ_1 and τ_2 and less on τ_0. Moreover, since first-period incentives to choose G are always stronger than second-period incentives, we know that greater weight on τ_1 and τ_2 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_1 bank will either choose G or PB in the second period. Thus, $A^b \geq A^n$ again.

Now, to prove the part about lender competence and the effect of competition, we need to show $\partial\alpha_b^t(\omega)/\partial\theta > 0$ and $\partial\alpha_n^t(\omega)/\partial\theta > 0$. Now

$$\partial\alpha_b^t(\omega)/\partial\theta = \frac{[L-D][1+r]}{A^b}\left\{-\lambda_b^{-2}\right\}[\partial\lambda_b/\partial\theta] \tag{A.32}$$

where

$$\partial\lambda_b/\partial\theta = R_2^{FB} - x < 0 \tag{A.33}$$

Thus, $\partial\alpha_b^t(\omega)/\partial\theta > 0$, and similarly $\partial\alpha_n^t(\omega)/\partial\theta > 0$. ■

Proof of Lemma 4: 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 $\pi^0 = \pi_T$ and lenders will be viewed as trustworthy in the first period. Since $1 - C(\overline{m}, q) < \varepsilon$, it follows that if the lender experiences default and $\tilde{m} = \overline{m}$, then by the HTR agents will *reject* their initial prior π_T and go back to their prior over priors to update using Bayes' rule. They will compute the posterior belief

$$\zeta^1 = \frac{[1 - C(\overline{m}, q)]\,\zeta^0}{[1 - C(\overline{m}, q)]\,\zeta^0 + q_F(\overline{m})\,[1 - \zeta^0]} \tag{A.34}$$

where $q_F(\overline{m})$ is the expected failure probability in macro state $\overline{m}$ if the lender is type τ_1 or τ_2, 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 ($j \in \{1, 2\}$) 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_1 makes the G loan with probability 1 in the first period, then

$$q_F(\overline{m}) = [1 - C(\overline{m}, q)]\,\mu_{\overline{m}}(1) + \mu_{\overline{m}}(2) \tag{A.35}$$

where $\mu_{\overline{m}}(1)$ is defined in (30), with the superscript i dropped, $\omega = \overline{m}$, and recognizing that the posterior is after observing default at $t = 1$, it can be written as:

$$\mu_{\overline{m}}(1) = \frac{[1 - C(\overline{m}, q)]\,\gamma}{[1 - C(\overline{m}, q)]\,\gamma + 1 - \gamma} \tag{A.36}$$

Substituting this in (A.35), the condition for $\zeta^1 < 0.5$ becomes:

$$\frac{[1 - C(\overline{m}, q)]\,\zeta^0}{[1 - C(\overline{m}, q)]\,\zeta^0 + \{[1 - C(\overline{m}, q)]\,\mu_{\overline{m}}(1) + 1 - \mu_{\overline{m}}(1)\}\,[1 - \zeta^0]} < 0.5 \tag{A.37}$$

Simplifying this yields

$$\zeta^0 < \frac{1 - C(\overline{m}, q)\,\mu_{\overline{m}}(1)}{2 - C(\overline{m}, q)\,[1 + \mu_{\overline{m}}(1)]} \tag{A.38}$$

Note that since $\mu_{\overline{m}}(1) < 1$, the quantity on the right-hand side of (A.38) is bigger than 0.5. Thus, the interval defined in (29) 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 $\varepsilon < 1 - C\left(\underline{m}, q\right)$ in (31), 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 $1 - C\left(m, q\right)$ 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.34)) is also the same for every lender. The result now follows from Theorem 1. ■

Proof of Theorem 4: Assume (31) 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 $C\left(\underline{m}, q\right)$. 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

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

where it is recognized that with Model II only the type-τ_1 lenders and type-τ_2 lenders with $\tilde{\beta}_2 = \beta_2^l$ choose loan G, so γ is the probability measure of lenders choosing loan G. Since ε is arbitrarily small, (A.39) holds. Thus, trust will never be gained at $t = 1$. ■

Proof of Theorem 5: Consider first the Reputation Model. Letting α_i^0, $\alpha_i^1(m,s)$, and $\alpha_i^1(m,f)$ 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 (32). We want to prove that the LHS of (32) for a bank exceeds the LHS of (32) for a non-bank. Substituting for α_b^0 and α_n^0 and using the notation A^b and A^n developed in the proof of Theorem 2, we see that

$$\left[1-\alpha_b^0\right]\overline{q}\lambda_b = \frac{\overline{q}\left\{\left[\theta R_{FB}^2 + [1-\theta]x\right]A^b - L[1+r] + D[1+r-A^b]\right\}}{A^b} \tag{A.40}$$

$$\left[1-\alpha_n^0\right]\overline{q}\lambda_n = \frac{\overline{q}\left\{\left[\theta R_{FB}^2 + [1-\theta]x\right]A^n - L[1+r]\right\}}{A^n} \tag{A.41}$$

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

$$\left[1-\alpha_b^0\right]\overline{q}\lambda_b > \left[1-\alpha_n^0\right]\overline{q}\lambda_n \tag{A.42}$$

Next we prove that the second and third terms on the LHS of (32) add up to a quantity that is higher for banks than for non-banks. First note that

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

This follows from Lemma 4, 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

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

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 (19), (20), (21), and (22), we see that

$$\alpha^1_{n,\min}-\alpha^1_{b,\min} = \frac{\lambda_b L[1+r]-\lambda_n[L-D][1+r]}{\overline{q}\lambda_n\lambda_b} \tag{A.48}$$

$$\alpha^1_n(m,f)-\alpha^1_b(m,f) = \frac{Q_b\lambda_b L[1+r]-Q_n\lambda_n[L-D][1+r]}{Q_nQ_b\overline{q}\lambda_n\lambda_b} \tag{A.49}$$

where $Q_b \equiv \sum_{j=0}^{2}\mu^b_\omega(j)I^t_b(j)\overline{q}$ and $Q_n \equiv \sum_{j=0}^{n}\mu^n_\omega(j)I^t_n(j)\overline{q}$ correspond to beliefs related to $\omega = (m,f)$ for f and a given m. Now, since the range of integration on both sides of (A.46) is $[\underline{m},\widehat{m}_n]$, we know that $Q_n = Q_b$ over this range. Since $Q_n = Q_b < 1$, it follows from (A.48) and (A.49) that (A.47) holds.

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

$$\begin{aligned}
&\left[1-\alpha^T_i\right]\overline{q}\lambda_b + \int_{\underline{m}}^{\overline{m}} q(m)\left[1-\alpha^T_i\right]\lambda_i\eta\,dm + \int_{\underline{m}}^{m^*_i}\left[1-q(m)\right]\left[1-\alpha^T_i\right]\lambda_i\eta\,dm \\
&+\int_{m^*_i}^{\hat{m}_i}\left[1-q(m)\right]\left[1-\alpha^1_b(m,f)\right]\lambda_i\eta\,dm \geq \beta_1 + \int_{\underline{m}}^{m^*_i}\left[1-\alpha^T_b\right]\lambda_i\eta\,dm + \int_{m^*_i}^{\hat{m}_i}\left[1-\alpha^1_i(m,f)\right]\lambda_i\eta\,dm
\end{aligned} \tag{A.50}$$

where we 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.50) holds is similar to that for the Reputation Model.

Now to prove that higher competence leads to greater trustworthiness, note that the satisfaction of the IC constraint for choosing G at $t = 0$ is easier when λ_i is higher, and $\partial\lambda_i/\partial\kappa > 0 \; \forall \, i \in \{b, n\}$. The proof that the effect of competence on trustworthiness is stronger in the Trust Model than in the Reputation Model follows from the fact that α_i^T is lower in the Trust Model (when the lender is trusted) than in 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 (4)-(6)) 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_1 has a stronger incentive to make a G loan than a non-bank of type τ_1. 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. ■