Trust and Reputation under Asymmetric Information*

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Abstract

We study the role of information about the multiplier in a finitely repeated investment game. A high multiplier increases the reputational incentives of a trustee, leading to more repayments. Our perfect Bayesian equilibrium analysis shows that if the trustee is privately informed about the multiplier, both the expected frequency of investments and repayments as well as the expected payoffs of both players are higher compared to a situation where the multiplier is public knowledge. We test this result in a laboratory experiment. The data cannot confirm the predicted welfare dominance of private information about the multiplier. We discuss potential reasons for the deviation between theory and experimental data.

Keywords: reputation, trust, incomplete information, experiment

JEL: C73, C92, D82, D83, M13.

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1 Introduction

Trust is an important condition for bilateral and informal trade that cannot be undertaken under formal contracts. For a potentially welfare-improving trade to take place, one party must choose to trust the other by, for example, lending money, delegating tasks, or exerting effort in a project. If the probability that the money lent will be paid back, that tasks will be well executed, or that effort will be rewarded by bonuses is high enough, trusting the other party is part of an equilibrium. In many real-world applications, it seems reasonable to assume that an entrepreneur who receives an investment is better informed about the value of his business than an investor lending money. Given the importance of trust in many bilateral interactions, it is of value to investigate how such informational asymmetries influence the possibility that trust will thrive.

In this paper, we study a finitely repeated investment game (Berg et al., 1995). Typically, in such a game, an investor sends a sum of money to a 'trustee' and, along the way, this money is multiplied by a commonly known factor (henceforth *multiplier*). Out of the money received, the trustee chooses how much to send back to the investor. We assume different types of trustees: a *trustworthy* type who always returns to the investor at least the amount that she sent to him, and a *strategic* type who maximizes his expected payoff. The strategic trustee builds up his reputation by mimicking the behavior of the trustworthy type. Several papers have tested this equilibrium prediction in a laboratory experiment, with varying results (e.g. Camerer and Weigelt, 1988; Neral and Ochs, 1992; Anderhub et al., 2002). A change in information about the value of the multiplier has so far been largely overlooked despite the abundance of economic interactions characterized by asymmetric information.

The value of the multiplier determines whether a strategic trustee has an interest in building up their reputation or whether he is only interested in immediate gains. To study how information about the multiplier affects trust and repayments we compare two versions of the game, one in which the multiplier is common knowledge (Public regime) and another in which it is private information known only to the trustee (Private regime).

We consider the following game between an *Investor* and an *Entrepreneur*. The Investor decides in every period whether or not to trust an Entrepreneur by investing a fixed amount in his project. The Entrepreneur is one of two types, a *good type* who always repays loans, or a *strategic type* who is an expected-payoff maximizer. At the beginning of the game, the strategic type observes the value of a multiplier which tells by how much each unit invested grows in the hands of the Entrepreneur. Hence, the multiplier represents the revenue from one unit of investment. The value of the multiplier remains unchanged throughout the game and, in every equilibrium, the multiplier determines whether or not the Entrepreneur has an incentive to build his reputation by repaying early investments. If the revenue is not high enough to cover the costs of capital, a strategic Entrepreneur is assumed to abandon his project. When the contracted relationship between the Investor and Entrepreneur is informal, this decision would lead him to default on the Investor's loan. Thus, in equilibrium, knowledge of the multiplier allows the Investor to know what the motivations of the strategic Entrepreneur are. When the multiplier is not known to the Investor, there is additional uncertainty. Not only is the type of Entrepreneur unknown, but so is the incentive to invest in their reputation, which is non-observable to the Investor.

Our theoretical analysis shows that there are perfect Bayesian equilibria where there are mixed strategies for a large range of parameters. The mixed strategy perfect Bayesian equilibrium predicts that the ex-ante frequency of investments and repayments is higher when the Investor is uncertain about the motivations of a strategic Entrepreneur (Private regime). The underlying mechanism is that mixing between investing and not investing starts in a later period in the case of additional uncertainty. A direct implication of this result is that in the mixed-strategy equilibrium both the Investor and the strategic Entrepreneur obtain a higher expected payoff under the Private regime.

We run a laboratory experiment to test whether this perfect Bayesian equilibrium is selected by subjects and how subjects behave under the different information regimes. The results do not confirm the Bayesian theoretical prediction of more investments under private information about the multiplier. We discuss potential reasons for the deviations between theoretical prediction and behavior in the experiment. While including risk aversion to the model cannot lead to the observed behavior, a publicly known share of entrepreneurs who repay an investment even though it leads to monetary losses could explain the observed data. We can show that such behavior occurs to a large extent and is highly correlated with a proxy of a subject's cognitive ability.

The remainder of the paper is organized as follows. Section 2 summarizes the related literature. Section 3 formalizes the model. Section 4 outlines the model's perfect Bayesian equilibrium, for public and private knowledge about the payoff multiplier; forms predictions about the numerical example tested in the laboratory; and indicates the welfare implications under the different regimes. Sections 5 and 6 present the experiment, its results and explores on reasons for deviating findings. Section 7 discusses and concludes.

2 Literature

Since Berg et al. (1995), a vast literature in behavioral economics has studied variants of the trust game between a trustor and a trustee in the lab. Camerer (2003) offers a survey of these studies which have consistently found that, against theoretical predictions, people tend to reciprocate trust even in one-shot interactions. More importantly, numerous studies, such as Anderhub et al. (2002); Neral and Ochs (1992); Camerer and Weigelt (1988) and Brandts and Figueras (2003), have investigated the behavior of subjects in trust games with incomplete information about the trustee, under both static and repeated interactions. In the latter case, the focus is on reputation-building in finite games with theoretical foundations borrowed from Kreps and Wilson (1982). A general finding from the lab is that the sequential equilibrium prediction is supported in that trust is maintained for some periods in the beginning of the game but it declines as the game approaches its end. However, the details of the sequential equilibrium, in particular regarding mixed strategies, are met to a varying degree in the lab.

Incomplete information about the multiplier has been studied by Ackert et al. (2011) and Lunawat (2013b, 2016). The former studies a one-shot game, so the interaction between the multiplier and reputation-building is not addressed. Our paper is closest to Lunawat (2013b, 2016) who also analyzes the value of information about the multiplier in a repeated trust game. In her model, the multiplier is drawn anew every period and repayments depend on the multiplier in a linear fashion. As a consequence, if the multiplier is private information and known only to the Entrepreneur, the strategic type returns an amount consistent with the lowest multiplier as often as possible. Observing a low repayment hence leads the Investor to revise her belief downward. In contrast, when the payoff multiplier is public information, the strategic Entrepreneur cannot hide behind a low repayment when a high repayment is warranted and the gradual downward adjustment of the Investor's beliefs does not occur. This reduces the need to use mixed strategies and explains why disclosing the multiplier is ex-ante payoff-dominant. Lunawat (2013a) tests the theoretical framework in the laboratory and finds evidence in support of the theory. While the theoretical assumptions in Lunawat (2013b, 2016) are relevant when repayments are considered as dividends, we consider our model with fixed repayments as especially well-suited for modeling loan-giving in which repayments are determined by some agreed-upon interest rate and not the state of the world.

Our model can be interpreted as a version of the loan model in Sobel (1985). In his stylized game, the Investor's choice is modeled as a continuous variable that directly determines the stage-game payoffs of both players. The payoff uncertainty which is key to our paper is thus not present. Sobel shows that the amount invested in equilibrium increases with each successful loan, which is consistent with findings from other papers studying the phenomenon of *starting small* (e.g. Watson, 1999; Watson et al., 2002). In these models, trust is not an issue because the principal can incentivize the strategic agent to behave well, from the principal's perspective, by offering a valuable enough future through an ascending investment scheme. Kartal (2018) also looks at a repeated trust-game with private information. Similar to assuming a *good* and a *bad* type, she models different types with respect to time preferences. In a repeated trust game with reputational concerns, the time preferences determine whether or not a default occurs on the equilibrium path. Kartal shows that, with the assumption of a contractible fixed contract alongside to the informal one, there is always an 'honest' separating equilibrium where, due to the lack of mixed strategies, a contract is never breached.

Some of the above-mentioned papers are not purely theoretical, but also contain experimental tests. Anderhub et al. (2002) test the usage of mixed strategies for reputation formation in a trust game with type uncertainty. They find evidence for mixing at the aggregate level

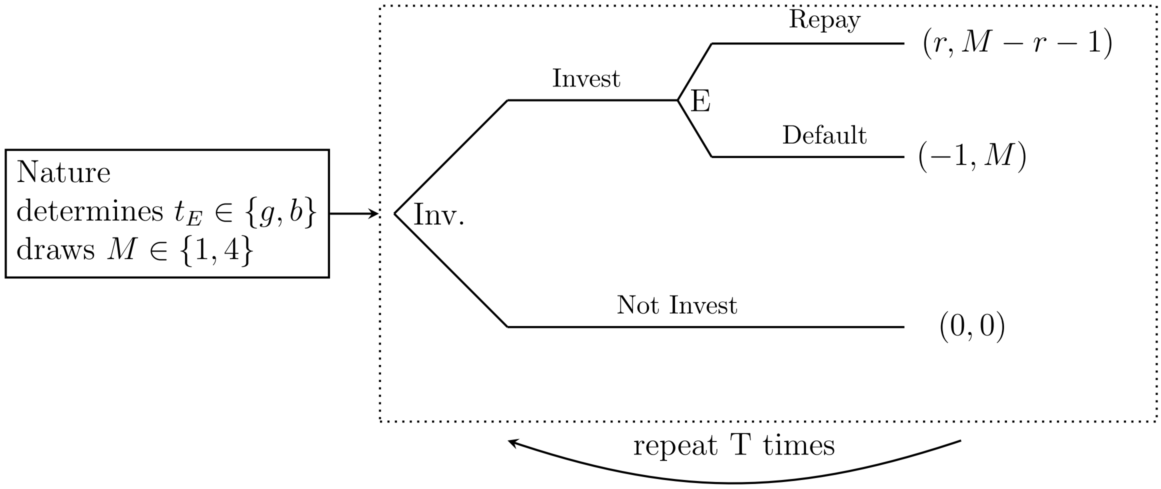


Figure 1: Game sequence.

Notes: $t_E = g$ plays Repay throughout the game. r denotes the interest rate. M is either known to both players (Public regime) or private information of E (Private regime).

of the data, but severe deviations from equilibrium mixed strategies at the individual level. When designing the experiment, if setups with a fixed share of non-strategic individuals are considered, additional problems arise. Anderhub et al. (2002) use computer bots instead of real subjects. Real subjects in the experiment interacted with the bots, and were left uncertain about the existence of bots. Considering the existence of social preferences and non-selfish behavior toward other humans, but not necessarily toward bots, this design is sensitive to noise arising from uncontrolled heterogeneity therein (see e.g. Blount, 1995). Lunawat (2013a) tests whether her theoretical prediction of lower investments with public knowledge about the multiplier is accurate. The experiment reveals that investment levels are higher in such a Public regime. In her experiment, subjects reveal their type by playing a similar game prior to the main experiment. Leaving those subjects free choice in the main experiment, however, does not guarantee a non-strategic behavior. Our paper provides an experimental design that excludes this problem and sets a lower bound on expected repayments.

3 The Game

The structure of the game is shown in Figure 1. Player A (Investor) and Player B (Entrepreneur) interact over a finite and commonly known number of rounds, $T \geq 2$. In every round, an

Investor can choose whether or not to invest the fixed amount $i > 0$.[1] The Entrepreneur E can be one of two types: $t_E \in \{g, b\}$. A *good* Entrepreneur ($t_E = g$) cannot default on an investment at any point in the game. A *bad* Entrepreneur ($t_E = b$) can decide in each round whether to repay or default. The type t_E is private information known only to the Entrepreneur, but the share of good Entrepreneurs is commonly known and is given by $p_1 \in [0, 1]$. The multiplier, $M \in \{1, 4\}$ is drawn at random by nature at the beginning of the game with $Pr(M = 1) = q$ and $Pr(M = 4) = (1 - q)$ and $q \in [0, 1]$.[2]

If an Investor does not invest in a round, both players get a payoff of zero for the round. Repayments R are fixed and equal the investment plus a positive interest rate $r \in (0, 1]$: $R = i(1 + r)$. The payoff of an Investor depends on the investment and repayment decisions. If the Entrepreneur repays an investment in a given round, the Investor's payoff in this round equals the repayment minus the investment. If the Entrepreneur defaults in a round where the Investor invested i, the Investor loses the investment. The payoff of an Entrepreneur depends additionally on M. M determines the value of an investment for the Entrepreneur. We consider two regimes: Private and Public. Under the Public regime, both the Entrepreneur and the Investor are informed about the value of the multiplier. Under the Private regime, only the Entrepreneur is informed about the value of M. We do not include discounting in our model.[3]

4 Equilibrium Predictions

The game is solved theoretically using the concept of perfect Bayesian equilibria (PBE), where the actions and beliefs of the two players correspond and best-react to each other. We define $\sigma_t^{Inv}(h_t)$ the probability of investment, and $\sigma_t^E(h_t)$ the probability of repayment in period t given history of play up to period t, h_t. $p_t(h_t)$ denotes the updated belief of the Investor about the probability that the Entrepreneur is *good* in period t, given history of play, h_t. Hence, p_1

[1] For all calculations, we normalize by setting $i = 1$.

[2] Considering a multiplier drawn from a set $\mathcal{M} \subset \mathbb{R}_+$ with a commonly known continuously increasing distribution F instead does not change the results qualitatively.

[3] Discounting does not add meaningful results, except that by excluding a discount factor we avoid the trivial case in which a bad Entrepreneur's strategy is insensitive to M and our distinction between information regimes would be irrelevant.

denotes the exogenously given prior probability that an Entrepreneur is good.

We now solve for the PBE of a finite game with $T = 3$ rounds, a normalized investment of $i = 1$, an interest rate $r \in (0, 1]$ and the multiplier $M \in \{1, 4\}$ with $Pr(M = 1) = q$ and $Pr(M = 4) = (1 - q)$ with $q \in [0, 1]$ commonly known. The solution of a T-period game, keeping other parameter assumptions unchanged, can be found in Appendix A.

In a one-shot game, as in every last period, the bad Entrepreneur always defaults, as reputation building cannot take place. The good Entrepreneur always repays every investment by design. The best response of the Investor to any strategy of the Entrepreneur is always unique and pinned down by her beliefs.[4] Similarly, along the equilibrium path of play, the best response of the bad Entrepreneur to any strategy of the Investor is also unique. Since the good Entrepreneur is a commitment type who always repays, we focus on the equilibrium strategies and beliefs of the Investor and the bad Entrepreneur.[5] For all interest rates $r \in (0, 1]$, there is a cutoff $\hat{M}$ that determines whether reputation concerns are present or not. This cutoff is strictly between 1 and 4. For both informational treatments, Lemma 1 holds with respect to reputation concerns of the Entrepreneur.

Lemma 1. *In a finite game with $T \geq 2$ periods, the bad Entrepreneur has concerns for his reputation when $M = 4$. That is, he has an incentive to repay in all periods $t < T$. When $M = 1$, bad Entrepreneur does not have reputational concerns and defaults as soon as he can.*

Suppose that the Investor invests with certainty as long as all earlier investments have been repaid. Building up a reputation is optimal for Entrepreneur with multiplier M if and only if the following one-shot deviation condition holds in any non-terminal period t.

$$M \leq [M - (1 + r)](T - t) + M. \tag{1}$$

which holds for any $t < T$ if and only if $M > (1 + r)$. Thus, reputational concerns arise only when $M = 4$ and not when $M = 1$. Intuitively, as M remains constant over time, investing in reputation makes sense for the bad Entrepreneur only if mimicking the good Entrepreneur

[4] In particular, given that the bad Entrepreneur defaults in the last period with certainty, if a default occurs, the unique best response of the Investor is to never invest again during the remainder of the game.

[5] Bad Entrepreneur is sometimes called simply Entrepreneur, or (bad) E.

does not eat away from the payoff of defaulting, which he only gets to do once.

4.1 Public regime

When M is publicly observed, the PBE can be solved for the two possible values of M separately. When $M = 4$, our game and its equilibrium correspond to the repeated trust games studied in previous literature in which the Entrepreneur's reputation concerns are known to always exist (e.g. Camerer and Weigelt, 1988; Anderhub et al., 2002). Thus, when $M = 4$, there exists for every initial belief p_1 a PBE which is unique up to definition of off-the equilibrium beliefs. For prior beliefs above $\frac{1}{1+r}$, the equilibrium is in pure strategies. For an intermediate range of prior beliefs, the equilibrium is in mixed strategies from some period onward.

Lemma 2 states this result when applied to our payoff structure. For better readability, the Lemma and the corresponding proof are relegated to Appendix B.1. For a more detailed discussion of the equilibrium and its construction, we refer to the aforementioned papers.

Suppose now that $M = 1$. Bad Entrepreneur has no reputation concerns and defaults with certainty if an investment is made. Investor invests in period 1 if and only if her prior belief about facing a good Entrepreneur is high enough. An equilibrium with investments can be sustained for some priors lower than $\frac{1}{1+r}$ because in case Entrepreneur is good, Investor obtains a payoff of r from all the three periods. If Entrepreneur is bad, though, Investor incurs a one-time loss of 1. Lemma 3 summarizes the equilibrium strategies for the Public $M = 1$ case and can be found in Appendix B.2.

In the experiment, we set $r = 1$. We consider three treatments that differ in the share of good Entrepreneurs: $p_1 \in \{\frac{1}{5}, \frac{2}{5}, \frac{3}{4}\}$. PBE predicts the following behavior under the Public regime: In the treatment $p_1 = \frac{1}{5}$, if $M = 4$, Investor invests in period 1, and after a repayment randomizes her action in periods 2 and 3 by investing with probability $\frac{1}{2}$ in both periods. After a default, Investor does not invest anymore. If $M = 1$, there are no investments. Entrepreneur with $M = 4$ randomizes his action as follows. In period 1 he repays with probability $\frac{3}{4}$. In period 2, he repays with probability $\frac{1}{3}$. In period 3, Entrepreneur defaults.[6] If $M = 1$, Entrepreneur

[6]For reasons outlined in section 5, in the experiment, we do not allow for repayments by a bad Entrepreneur in the final period.

defaults in period 1. In the treatment $p = \frac{2}{5}$, if $M = 4$, Investor invests in periods 1 and 2, and after a repayment randomizes her action in period 3 by investing with probability $\frac{1}{2}$. If $M = 1$, Investor invests as long as investments are repaid. For all values of M, if a default occurs, Investor does not invest anymore. Entrepreneur with $M = 4$ repays in period 1 and randomizes his action in period 2 by repaying with probability $\frac{2}{3}$. If $M = 1$ Entrepreneur defaults in period 1. In the treatment $p = \frac{3}{4}$, for all values of M, Investor invests as long as investments are repaid. If a default occurs, she does not invest any more. Entrepreneur with $M = 4$ repays in periods 1 and 2. Entrepreneur with $M = 1$ defaults in period 1.

4.2 Private regime

When M is private information of the Entrepreneur, and given that Entrepreneur's reputation concerns depend on the value of M as outlined in Lemma 1, observing a repayment in the first period leads Investor to update her prior belief about the type of the Entrepreneur. Namely, by observing a repayment, Investor is able to exclude the contingency that she is faced with a bad Entrepreneur with $M = 1$ because that type would default immediately.

In an equilibrium in pure strategies, in which a bad Entrepreneur with a high M would repay in periods 1 and 2, and default in period 3, Investor only learns going from period 1 to 2. In general, following a repayment in period t, Investor's posterior belief at the beginning of period $t + 1$ about the Entrepreneur being good is obtained by Bayes Rule:

$$\begin{aligned}\Pr(Good \mid h_{t+1}) = p_{t+1}(h_{t+1}) &= \frac{\Pr(Repay|Good,h_t)}{Pr(Good)\Pr(Repay|Good,h_t)+\Pr(Bad)\Pr(Repay|Bad,h_t)} \\ &= \frac{p_t}{p_t+(1-p_t)\Pr(Repay|Bad,h_t)}\end{aligned}$$

In an equilibrium in pure strategies, $\Pr(Repay|Bad, h_t) = \Pr(M = 4) = (1 - q)$ when $t = 1$. This follows from Lemma 1. In the second period, if Investor observes a repayment, she does not learn anything because $\Pr(Repay|Bad, h_2 = (I, R)) = 1$. However, the fact that there is some learning in the first period allows the bad Entrepreneur to play a pure strategy for some prior beliefs below $\frac{1}{1+r}$, in contrast to the Public regime.

Given Investor's belief-updating rule, the set of prior beliefs for which an equilibrium in pure strategies can be sustained depends on q. Investor's posterior belief in period 2 is increasing in q. That is, the more likely it is that M is low and a bad Entrepreneur defaults immediately, the more confident the Investor is about being faced with a good type after observing a repayment. This extends the range of priors for which a bad Entrepreneur with a high M can resort to a pure strategy.

At the same time, a higher q means that the first Investment is riskier for the Investor since a bad Entrepreneur is more likely to default. This is why the willingness of the Investor to make the first investment is decreasing in q. Therefore, an equilibrium in pure strategies is limited by two belief thresholds, one arising out of Investor's belief updating, and an other arising out of Investor's incentive condition for making the first investment. Nonetheless, for all $r > 0$ and for all $q \in (0, 1)$, both thresholds are below $\frac{1}{1+r}$, implying that the range of priors for which an equilibrium in pure strategies exists is larger under Private than under Public regime.

For lower priors, Entrepreneur's reputation building must consist of mixing - the lower the initial prior the sooner Entrepreneur has to randomize. The structure of the mixed strategy equilibrium is analogous to the Public regime. However, the fact that q enters Investor's posterior beliefs means that the bad Entrepreneur, when randomizing for the first time, can repay with a higher probability than in the Public-regime counterpart. At the same time, the trade-off between incentives to make the first investment (decreasing in q) and belief updating (increasing in q) impose restrictions for the existence of these mixed-strategy equilibria; for high values of q, some mixed-strategy equilibria with investments cannot be sustained.

The equilibrium strategies in the Private regime are summarized formally in Lemma 4. The Lemma and the corresponding proof can be found in Appendix B.3.

For the three treatments that we consider, the following theoretical predictions arise: In the treatment $p_1 = \frac{1}{5}$, Investor invests in period 1 and 2, and after a repayment randomizes her action in periods 3 by investing with probability $\frac{1}{2}$. After a default, Investor does not invest anymore. Entrepreneur with $M = 4$ repays in period 1 with certainty, and repays in period 2 with probability $\frac{1}{2}$. Entrepreneur with $M = 1$ defaults in period 1. In the treatments $p_1 = \frac{2}{5}$ and $p = \frac{3}{4}$, Investor invests as long as investments are repaid. If a default occurs, she does not invest any more. Entrepreneur with $M = 4$ repays in periods 1 and 2. Entrepreneur with

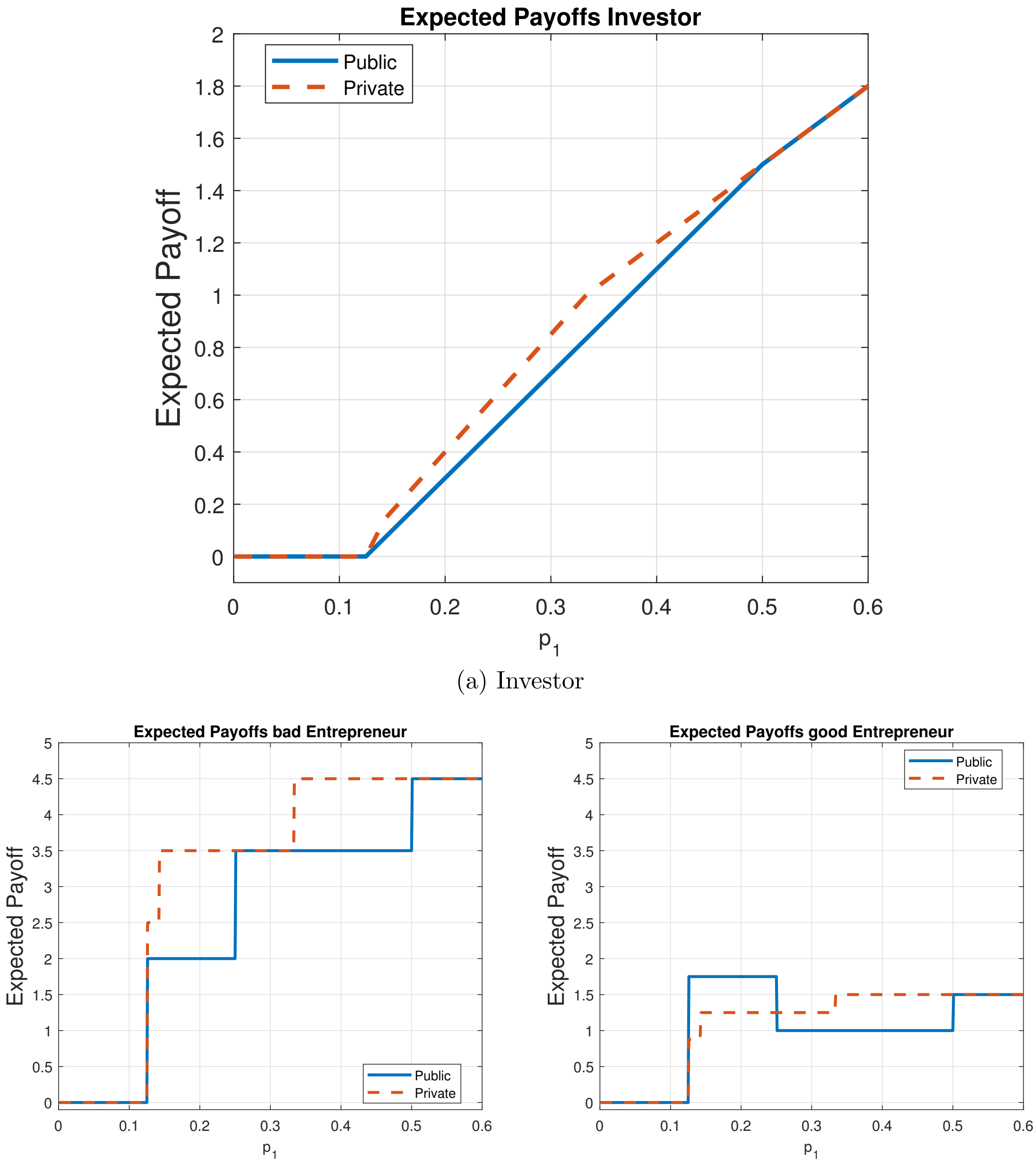
$M = 1$ defaults in period 1.

4.3 Welfare comparison between Public and Private regime

Knowledge of perfect Bayesian equilibria of the game under both information regimes allows one to compare the expected payoffs of the players across regimes. To reduce notation, we fix $r = 1$ and consider Investor's and Entrepreneur's expected payoff as a function of prior beliefs p_1 and probability of M being 1 given by $q \in (0, 1)$.[7] If r was lower, it would shift the thresholds for p and q but since r is a constant, the ranking of regimes would remain unchanged within the given parameter ranges. Expected payoffs are calculated for the point in time when the Entrepreneur knows his type (good or bad) but not yet the value of M.

Figure 2 plots the expected payoffs of each player under both regimes for $r = 1$ and $q = \frac{1}{2}$. For the Investor, investing is not always optimal if M is low. For priors below $\frac{1}{4}$, if M is low, investing yields an expected loss and the Investor should refrain from investing. Conditioning investments on the value of M is not possible under the Private regime, so the Investor, by investing for prior beliefs lower than $\frac{1}{4}$ is hurt by the Private regime if $M = 1$. On the other hand, in the PBE, the benefit of operating under the Private regime is that for high M, the probability of investments and repayments is higher which is reflected in higher expected payoffs as compared to the Public regime. The net effect is that these benefits of the Private regime that occur if $M = 4$ outweigh the expected costs of the Private regime that occur if $M = 1$, making the Private regime (weakly) dominant for the Investor. Propositions 1 and 2 summarize the welfare predictions for Investor and Entrepreneurs.

[7] Only values of q strictly between 0 and 1 are considered since for values 0 and 1 there would be no uncertainty of M and a comparison of information regimes would become obsolete.



(a) Investor

(b) bad Entrepreneur

(c) good Entrepreneur

Figure 2: Expected payoffs for $r = 1$ and $q = \frac{1}{2}$ under the Public (solid line) and the Private regime (dashed line).

Proposition 1 (Investor)**.** *When $r = 1$, then*

- *for all $q \leq \frac{4}{7}$, Investor's expected payoff under Private regime is weakly higher than under Public regime for all prior beliefs $p_1 \in (0, 1)$, and strictly higher for $p_1 \in (\frac{1}{8}, \frac{1}{2})$.*
- *for all $q > \frac{4}{7}$ Investor's expected payoff under Private regime is weakly higher than under Public regime for all prior beliefs $p_1 \geq \frac{1}{4}$, and strictly higher for $p_1 \in (\frac{1}{4}, \frac{1}{2})$.*

Proof. In the appendix. □

Proposition 2 (Entrepreneur)**.** *When $r = 1$, and Entrepreneur is good, then*

- *for all $q \in (0, 1)$, Entrepreneur's expected payoff under Private regime is weakly higher than under Public regime for all prior beliefs $p_1 \geq \frac{1}{4}$, and strictly higher for $p_1 \in (\frac{1}{4}, \frac{1}{2})$*

When $r = 1$, and Entrepreneur is bad, then

- *for all $q \leq \frac{4}{7}$, Entrepreneur's expected payoff under Private regime is weakly higher than under Public regime for all prior beliefs $p_1 \geq \frac{1}{8}$, and strictly higher at least for all prior beliefs $p_1 \in (\frac{1-q}{2-q}, \frac{1}{2})$.*
- *for all $q > \frac{4}{7}$ Entrepreneur's expected payoff under Private regime is weakly higher than under Public regime for all prior beliefs $p_1 \geq \frac{1}{4}$, and strictly higher at least for all prior beliefs $p_1 \in \left(\max\left\{\frac{1-q}{2-q}, \frac{2q-1}{2q+2}\right\}, \frac{1}{2}\right)$.*

Proof. In the appendix. □

4.4 Testable predictions

In the following, we outline the differences between the regimes that we expect to find in the data if the PBE is played by the majority of subjects. A priori it is unclear whether the predicted PBE will be played. Equilibrium play involves some depth of strategic reasoning of Investors and Entrepreneurs. Further, we assumed risk neutral, payoff maximizing players. It is unclear whether these predictions are accurate descriptions of actual behavior.

4.4.1 Investments and Repayments

The experiment serves to find out whether the proposed equilibrium is played and whether the actual behavior is close enough to the theoretical predictions such that the expected payoff differences between the regimes hold. The experiment delivers data on the investment and repayment behavior in each period under the different regimes and for different shares of good Entrepreneurs.

Across all treatments, for all levels of p_1, the bad Entrepreneur is predicted to default whenever $M = 1$, and the Investor is predicted to stop investing after a default occurs. The comparisons of the predicted relative frequencies of investment and repayment (of the bad Entrepreneur) for the treatments $p_1 \in \{\frac{1}{5}, \frac{2}{5}, \frac{3}{4}\}$ are depicted in Table 1 and 2. These predictions are derived by applying the values $r = 1$ and the different levels of p_1 to Lemmas 2, 3 and 4.

	Treatment $p = \frac{1}{5}$	Treatment $p = \frac{2}{5}$	Treatment $p = \frac{3}{4}$
Period 1	*Pr = Pu(M4) > Pu(M1)*	*Pr = Pu(M4) = Pu(M1)*	*Pr = Pu(M4) = Pu(M1)*
Period 2	*Pr > Pu(M4)*	*Pr = Pu(M4) = Pu(M1)*	*Pr = Pu(M4) = Pu(M1)*
Period 3	*Pr = Pu(M4)*	*Pr = Pu(M1) > Pu(M4)*	*Pr = Pu(M4) = Pu(M1)*

Table 1: Predicted equilibrium frequencies of Investments.

Notes: The relative size of the predicted shares of investments conditional on the observation of repayments in all previous periods. If a default is observed, it is predicted that Investors do not invest anymore. *Pr* depicts the investment probability under the *Private* regime, *Pu* under the *Public* regime, where the multiplier is known to the Investor.

	Treatment $p = \frac{1}{5}$	Treatment $p = \frac{2}{5}$	Treatment $p = \frac{3}{4}$
Period 1	*Private > Public*	*Private = Public*	*Private = Public*
Period 2	*Private > Public*	*Private > Public*	*Private = Public*

Table 2: Predicted equilibrium frequencies of Repayments for $M = 4$.

Notes: The relative sizes of the predicted shares of repayments are conditional on an investment in the current and previous period, and, for the second period, on repayment in the first period. For $M = 1$ every bad Entrepreneur is predicted to default in all periods. In the third period, every bad Entrepreneur defaults by design.

4.4.2 Expected payoffs

The results regarding expected payoffs are directly implied by the perfect Bayesian equilibrium strategies. If the subjects play according to the PBE prediction, following Propositions 1 and 2, we should observe no difference in average payoffs in the treatment $p_1 = \frac{3}{4}$. In the treatment $p_1 = \frac{2}{5}$, ex-ante expected payoffs would be higher in the Private treatment for both Investors and Entrepreneurs (of both types). In the treatment $p_1 = \frac{1}{5}$, ex-ante expected payoffs would be higher in the Private treatment for Investors and bad Entrepreneurs, but the reverse would hold for good Entrepreneurs.

5 Experimental Design and Procedure

To test to what extent the perfect Bayesian equilibrium can explain actual behavior we conducted a laboratory experiment.

The multiplier $M \in \{1, 4\}$, the type of Entrepreneur (*good* or *bad*) and the regime (*Public* or *Private*) is varied within subjects. The probability of being a good Entrepreneur, $p_1 \in \{\frac{1}{5}, \frac{2}{5}, \frac{3}{4}\}$ is varied between subjects. At the beginning of each round, this share randomly (and independently of the other Entrepreneurs' outcomes) determines the type of an Entrepreneur. Each round consists of three periods ($T = 3$) and we implement stranger matching out of matching groups of eight between Entrepreneur and Investor between rounds. The role (Entrepreneur or Investor) is randomly determined at the beginning of the experiment – with half the subjects being each type – and is maintained throughout. A *good* Entrepreneur has no choice but to repay every investment made in the three periods within a round.[8] A *bad* Entrepreneur can choose in the first and second period whether to repay an investment.[9] To decrease reciprocal motives, we do not allow bad Entrepreneurs to repay the investment in the last (third) period. This enforcing of the equilibrium play in the third period has the additional advantage that the beliefs we elicit of the investors about a repayment in the third period are a direct test of the PBE. As bad entrepreneurs have no choice but to default in the third period, the investors' beliefs about repayment should directly reflect the beliefs about the type of Entrepreneur. Social preferences or decision-making errors of an Entrepreneur cannot occur in the final period, and the third period beliefs of the investors would need to be exactly 50% in order to set her indifferent between investing or not - as predicted by the PBE. Further, we do not allow Investors to invest in a subsequent period if they did not invest before.[10] The regimes differ in regard to the information given to the Investors, with no information (except the probability distribution) about M under Private, and M being identified under Public.

[8]Instead of using computer-bots for the role of good Entrepreneurs (as in Anderhub et al., 2002), we assign real subjects to these roles. Responding to the understanding in the literature regarding discrepancies in behavior between humans instead of computers, this design allows for clean comparisons between and within the treatments.

[9]The different roles and all the decisions in the experiment are neutrally framed (*Player A* and *Player B*; *send* instead of invest, *colors* instead of good and bad etc.).

[10]Observing an investor who does not invest initially but in a later period would just result in a shorter game, but not add meaningful insights to the reputation building mechanism.

The experiment consists of 17 rounds. The first seven rounds are played under the Private regime, followed by seven rounds under the Public regime.[11] In the 15th round, subjects cast a vote about the regime for their remaining three periods. For every newly formed pair of players in rounds $15 - 17$, the vote of one randomly determined subject is decisive for the respective round. Throughout the experiment we elicit the Investor's choices using the strategy method.[12] In addition to every decision, a subject has to state a belief about the decision of their counterpart. The payoff of the belief is determined with a quadratic scoring rule, guaranteeing an incentive compatible elicitation and delivering point-predictions.[13]

During the experiment, participants earn points dependent on their decisions. Investing translates to sending 10 points and repaying means sending 20 points back. The Entrepreneur receives $(10 \cdot M)$ points for every investment. To ensure the absence of negative payoffs, each subject starts a round with a budget of 30 points. In the end, the investment-repayment decisions of three randomly chosen rounds and one of the entered beliefs in a randomly chosen round are payoff relevant. The beliefs of the three rounds of the last part cannot be determined to be payoff relevant.[14] At the end of each round, every player learns the actions of the player he is matched with and the resulting own payoff for this round. The points are converted to Euro at an exchange rate of 10 points = 1 Euro.

The experiment took place in November and December 2016, when we ran 12 sessions with a total of 280 subjects, in the Lakelab at the University of Konstanz. The recruiting was done from a subject pool of mainly students, using ORSEE (Greiner, 2015), and the experiment was programmed with z-Tree (Fischbacher, 2007). Each session consisted of 24 subjects (except

[11]To control for order effects, half the sessions have a reversed order.

[12]An Investor has the choice whether to invest 10 points initially or not. Afterwards, given that she invested initially, she chooses whether to invest after Repay and after Default by the Entrepreneur. Finally, the Investor chooses for potentially four different combinations of Repay and Default in the previous rounds whether to invest in the last period. As we do not allow the Investor to re-invest after non-investment in a previous period of the same round, not all four options are always available. A bad Entrepreneur chooses whether to Repay a potential initial investment and whether to Repay a potential second investment. In the last period the bad Entrepreneur defaults.

[13]For details see the English translation of the instructions as well as screen-shots of the decision screens in the supplementary materials.

[14]Incentivizing the beliefs in the final part could change the incentives for the vote regarding the preferred regime.

one $p_1 = \frac{1}{5}$ session with 16 subjects), and lasted around 90 minutes including the instruction phase and the payment. On average, each subject earned 20.78 Euro (sd = 5.71), including a show-up fee of 3 Euro.

After handing out the printed instructions for the first part (rounds one to seven), subjects read them and a short summary was read out aloud. Afterwards, subjects answered an unincentivized quiz on their screen and could compare their results with the true answers. Before the real experiment started, subjects had an opportunity to ask the experimenter questions in private. This opportunity was rarely used, however. After finalization of the previous part, the instructions for the second (rounds 8 - 14) and third part (rounds 15 - 17) appeared on the subjects' screens.

6 Results

6.1 Efficiency and Regime Choice

Table 3: Probability of reaching investment in 3^{rd} Period

	(1) all data	(2) $M = 1$	(3) $M = 4$
$p = \frac{1}{5}$	-1.944***	-2.085***	-1.910***
	(0.331)	(0.353)	(0.423)
$p = \frac{2}{5}$	-1.677***	-1.9025***	-1.580***
	(0.288)	(0.297)	(0.416)
Private	0.351	0.418	0.247
	(0.247)	(0.313)	(0.271)
$p = \frac{1}{5} \times Private$	-0.728**	-0.884**	-0.497
	(0.317)	(0.434)	(0.411)
$p = \frac{2}{5} \times Private$	-0.377	-0.131	-0.506
	(0.295)	(0.371)	(0.384)
constant	0.895***	0.667***	1.179***
	(0.220)	(0.231)	(0.280)
Observations	2380	1235	1145
Clusters	35	35	35
Pseudo R^2	0.1586	0.1869	0.1399

Notes: Logistic regressions on dummy variable for third period investment. Observations of $p = \frac{3}{4}$ treatment serve as baseline and are captured in the constant. Standard errors (in parentheses) are clustered at the matching group level.
***(**/*) Significant at the 1 (5/10) percent level.

In the PBE equilibrium, the (theoretical) welfare dominance of Private compared to Public stems from the higher probability of investing up to the last period of a game. Under the Public regime, due to mixing, there is a higher risk that the game will end abruptly, which leads to unrealized expected gains. To test the overall effect of regime, we estimate the probability of having an investment in the third (final) period (Table 3). The regression does not use all data stemming from the strategy method, but uses real occurrences only, taking the conditional investment decisions as well as the conditions (behavior of Entrepreneurs) into account.[15] The regression reveals a significantly higher probability of third period investments for higher p_1. Comparing Public and Private, the probability of reaching a Period 3 investment is significantly lower under Private in the $p_1 = \frac{1}{5}$ treatment, and not significantly different in the other treatments. The actual payoff difference in the game is insignificant between Public and Private in all treatments for good and for bad Entrepreneurs, respectively. For Investors, in the $p_1 = \frac{1}{5}$ treatment, the payoff is significantly lower under Private than under Public (reverse than predicted by PBE). For $p_1 = \frac{2}{5}$ and $p_1 = \frac{3}{4}$, there is no significant difference between Private and Public.[16]

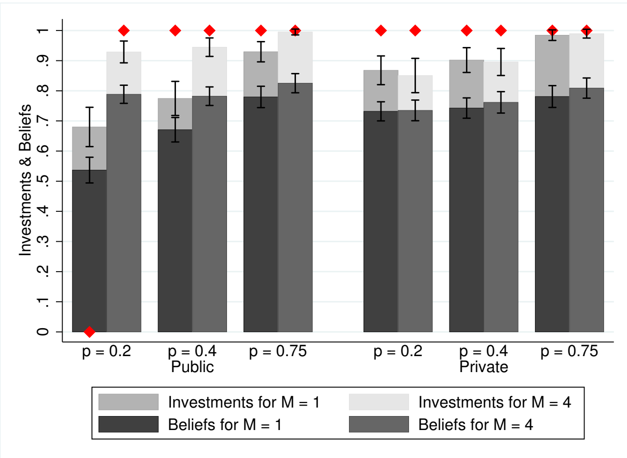
In Period 15, each subject can vote for a regime to be played in his or her group for the following three rounds. Given the payoffs, it is not too surprising that a majority of subjects

[15] Note that by experimental design the Investors cannot invest in a subgame following a no-invest decision, and that good Entrepreneurs have no choice but to repay each investment.

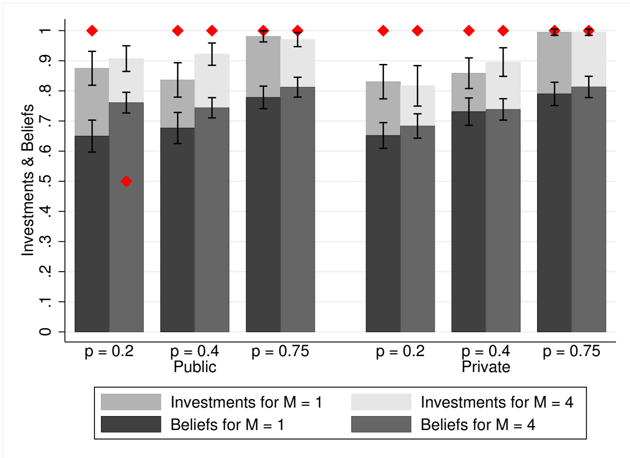
[16] These results stem from an OLS regression with standard-errors clustered at the Matching-Group level.

vote for Public over Private. Systematically, subjects in the role of Investors favor Public more than Entrepreneurs do: in all three treatments, the share of Investors who vote for Private is between 23% and 25%, while it is 41 – 52% among the Entrepreneurs. These shares, however, do not significantly differ between different levels of p_1.

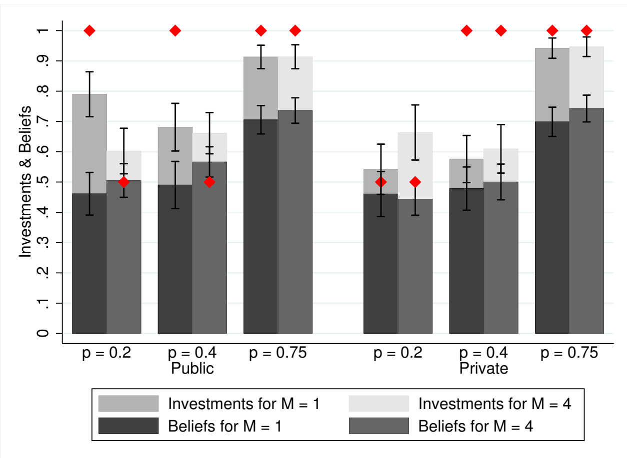
6.2 Average Behavior



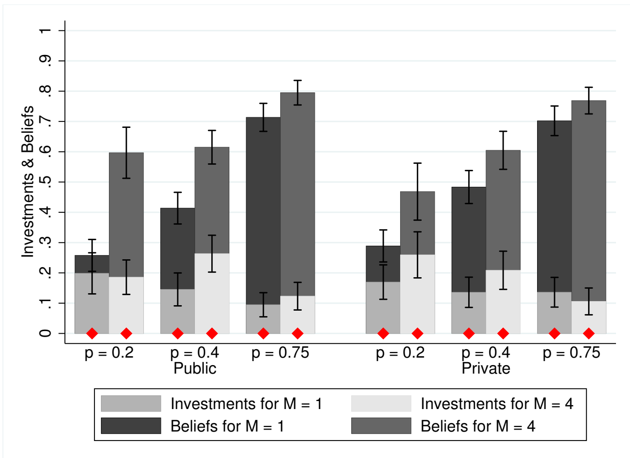
(a) 1^{st} period Investments



(b) 2^{nd} period investments (after repay)



(c) 3^{rd} period investments (after twice repay)



(d) 2^{nd} period investments (after default)

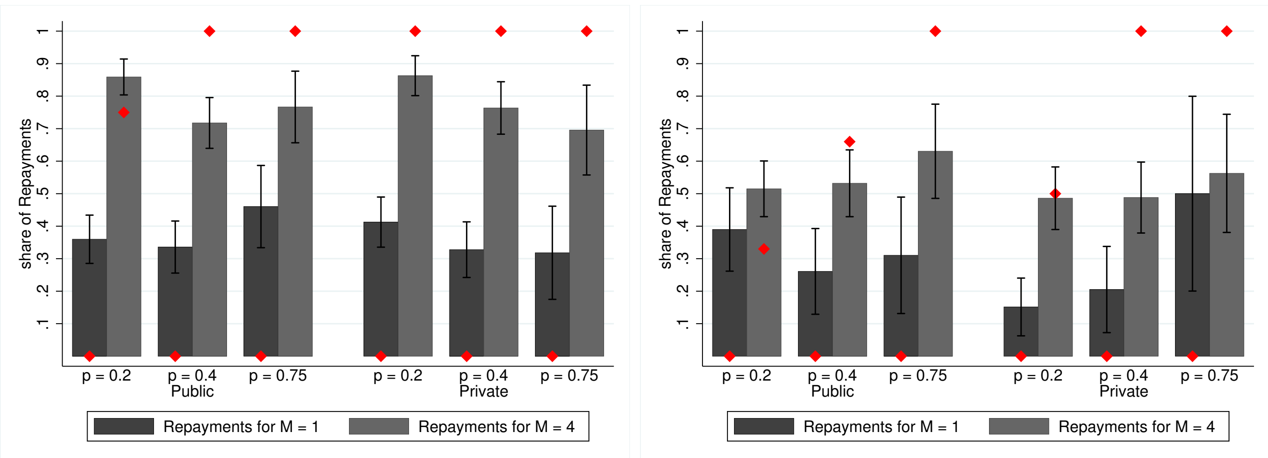
Figure 3: Share of investments and average beliefs thereof under different regimes, for different multipliers and in different treatments. Markers represent PBE predictions. Error bars show 95% confidence intervals.

Investments: Figure 3 and Table 4 give an overview of the share of investments in the different treatments and under the different regimes. Figure 3 (a) plots the initial investments. As can be seen in Table 4, the share of first period investments is lower for lower values of p_1, and significantly higher for high M in the Public regime. In the $p_1 = \frac{1}{5}$ treatment, first period investments are significantly higher under Private than under Public and low M. Under the Private regime, the share of initial investments is not significantly different between $p_1 = \frac{1}{5}$ and $p_1 = \frac{2}{5}$ (Wald test, $p > 0.1$), but significantly smaller for $p_1 = \frac{1}{5}$ or $p_1 = \frac{2}{5}$ compared to $p_1 = \frac{3}{4}$ (Wald test, $p < 0.01$). As Figure 3 (a) shows, Entrepreneurs' beliefs about Investors' behavior are lower than the actual investment for all initial investments, but show the same pattern as the actual investments.

In all three p_1 treatments, the share of initial investments under Public is (weakly) significantly lower for $M = 1$ than for $M = 4$ (clustered t-tests for $p_1 = \frac{1}{5}$ ($\frac{2}{5}, \frac{3}{4}$): p-value < 0.01 (p-value < 0.01, p-value < 0.1)). The first-round investments under the Private regime are significantly higher than the Public $M = 1$ investments (clustered t-test, p-value < 0.05 for every treatment). Compared to the Public $M = 4$ first-round investments, those under the Private regime are not significantly different.

Figure 3 (b) plots the share of investment decisions after one repayment observation (arising from the strategy method), given that the investor invested in the first period. To assure comparability with the beliefs of the Entrepreneurs about the investment behavior, Figure 3 (b) only contains the beliefs of Entrepreneurs who repaid in the first period. Table 4 reveals, that only in the $p = \frac{2}{5}$ treatment, the share of second period investments under Public is significantly higher for high M than for low M. The share of investment for Private does not significantly differ between $p_1 = \frac{1}{5}$ and $p_1 = \frac{2}{5}$ (clustered t-test, p-value > 0.1), but between $p_1 = \frac{3}{4}$ and the two lower p_1 treatments, respectively (p-value < 0.01). The same results hold under the Public regime for $M = 1$. For high M under the Public regime, only the second round investment between $p_1 = \frac{1}{5}$ and $p_1 = \frac{3}{4}$ is significantly different (p-value < 0.05). The investment difference between Private and Public becomes insignificant. However, as can be seen in Figure 3 (d), the investments after a default observation are significantly lower than the investments after a repay observation in all treatments, under all regimes and for both multipliers (p-value < 0.01). Figure 3 (d) shows that Entrepreneurs who default enormously overestimate the investment behavior after a default, which can also explain their behavior: falsely believing that a large share of Investors keeps investing after a default makes defaulting more attractive.

Panel (c) of Figure 3 shows the investments in the third period after two repay observations (and two investment decisions in the first two periods). Table 4 shows that under the Public regime, there are no significant differences in the share of third period investments between $M = 1$ and $M = 4$ in the $p_1 = \frac{2}{5}$ and $p_1 = \frac{3}{4}$ treatment. However, in the $p_1 = \frac{1}{5}$ treatment, the share of investments after two repay observations for a low multiplier is significantly higher than for a high multiplier. This implies that Investors understand the reputational incentives of the bad Entrepreneurs. Observing two repayments for a low multiplier most likely arises from a good Entrepreneur, while two repayments with a high multiplier can also arise from a bad Entrepreneur who defaults in the last period. Interestingly, the Entrepreneurs do not believe the Investors can discern the reputational incentives, as can be seen from the beliefs (clustered t-test, p-value > 0.1). Under the Private regime, the third period investments between the $p_1 = \frac{1}{5}$ and the $p_1 = \frac{2}{5}$ treatment are not significantly different (p-value > 0.1), but both are significantly lower than in the high p_1 treatment (p-value < 0.01). A more detailed analysis of the beliefs follows in section 6.3.



(a) 1^{st} period repayments

(b) 2^{nd} period repayments (after repay)

Figure 4: Share of repayments of bad Entrepreneurs under different regimes, for different multipliers and in different treatments. Good Entrepreneurs repaying by design are omitted in this graph. Markers represent PBE predictions. Error bars show 95% confidence intervals.

Table 4: Investment behavior after Repay observations

	Investment in Period 1		Investment in Period 2		Investment in Period 3	
	(1)	(2)	(3)	(4)	(5)	(6)
$p = \frac{1}{5}$	0.860***	0.951***	0.825***	0.893***	0.594***	0.898***
	(0.0244)	(0.00746)	(0.0396)	(0.0262)	(0.0645)	(0.0334)
$p = \frac{1}{5}$	-0.180***	-0.189***	0.0505	0.0684	0.196***	0.136*
$\times$ *Public*	(0.0445)	(0.0452)	(0.0520)	(0.0562)	(0.0691)	(0.0670)
$p = \frac{1}{5} \times$ *Public*	0.249***	0.247***	0.0321	0.00501	-0.188***	-0.115**
$\times M = 4$	(0.0584)	(0.0616)	(0.0415)	(0.0386)	(0.0498)	(0.0501)
$p = \frac{2}{5}$	0.899***	1.019***	0.876***	0.934***	0.592***	0.534***
	(0.0266)	(0.0138)	(0.0248)	(0.0123)	(0.0615)	(0.0276)
$p = \frac{2}{5}$	-0.124**	-0.134***	-0.0397*	-0.0372	0.0891	0.0700
$\times$ *Public*	(0.0457)	(0.0482)	(0.0234)	(0.0272)	(0.0667)	(0.0583)
$p = \frac{2}{5} \times$ *Public*	0.170***	0.178***	0.0856**	0.0919**	-0.0198	-0.0336
$\times M = 4$	(0.0449)	(0.0467)	(0.0341)	(0.0367)	(0.0554)	(0.0509)
$p = \frac{3}{4}$	0.987***	1.009***	0.995***	0.953***	0.944***	0.769***
	(0.00576)	(0.00672)	(0.00345)	(0.00655)	(0.0192)	(0.0206)
$p = \frac{3}{4}$	-0.0575**	-0.0579**	-0.0137	-0.0145	-0.0314	-0.0348
$\times$ *Public*	(0.0250)	(0.0267)	(0.00900)	(0.0103)	(0.0334)	(0.0348)
$p = \frac{3}{4} \times$ *Public*	0.0656**	0.0619**	-0.0106	-0.00733	0.000662	0.00229
$\times M = 4$	(0.0241)	(0.0230)	(0.0152)	(0.0141)	(0.0302)	(0.0322)
Observations	2380	2380	2132	2132	1947	1947
Clusters	35	35	35	35	35	35
Fixed effects	NO	YES	NO	YES	NO	YES

Notes: OLS regressions on the binary *Investment* decision initially (columns (1) and (2)), in the second period after a repayment observation (columns (3) and (4)), and in the third period after two repayment observations (columns (5) and (6)). Regressions on investment in the second period are conditional on investments in the first period, and regressions on investment in the third period are conditional on investments in the first and second period. Standard errors clustered at the matching group level are depicted in parentheses. Columns (2), (4) and (6) include subject fixed effects. The different levels of p_1 are varied between subjects.

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 5: Repayment behavior

	Repayment in Period 1		Repayment in Period 2	
	(1)	(2)	(3)	(4)
$M = 1$	0.368***	0.284***	0.273***	0.728***
	(0.0347)	(0.0493)	(0.0391)	(0.0816)
$M = 4 \times p_1 = \frac{1}{5}$	0.859***	0.752***	0.515***	1.012***
	(0.0542)	(0.0457)	(0.0472)	(0.0173)
$M = 4 \times p_1 = \frac{1}{5}$	0.00393	-0.00270	-0.0289	-0.0489
$\times$ *Private*	(0.0123)	(0.0204)	(0.0871)	(0.0694)
$M = 4 \times p_1 = \frac{2}{5}$	0.718***	0.662***	0.532***	1.051***
	(0.0735)	(0.107)	(0.0843)	(0.115)
$M = 4 \times p_1 = \frac{2}{5}$	0.0461	0.0524	-0.0438	-0.0269
$\times$ *Private*	(0.0414)	(0.0538)	(0.0753)	(0.0929)
$M = 4 \times p_1 = \frac{3}{4}$	0.767***	0.631***	0.630***	1.098***
	(0.0441)	(0.0865)	(0.0844)	(0.125)
$M = 4 \times p_1 = \frac{3}{4}$	-0.0710	-0.0189	-0.0679	-0.185***
$\times$ *Private*	(0.0841)	(0.0564)	(0.0607)	(0.0573)
Observations	1314	1314	750	750
Clusters	35	35	35	35
Fixed effects	NO	YES	NO	YES

Notes: OLS regressions on the binary *Repayment* decision in the first period (columns (1) and (2)) and in the second period conditional on repayment in the first period (columns (3) and (4)). Good Entrepreneurs are excluded in the regressions. Columns (2) and (4) include subject fixed effects. The different levels of p_1 are varied between subjects.
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Repayments: Figure 4 plots the repayment decisions of the bad Entrepreneurs in the first period, and the repayment decisions of the bad Entrepreneurs who repay initially in the second period. Table 5 depicts the results of an OLS regression thereof. Initial repayments are significantly lower for lower M in all cases, but repayments do not significantly differ between Private and Public. The fixed effects regression that only takes within subject variation into account reveals, that in the second period, a default occurs significantly more often under Private than under Public for $p_1 = \frac{3}{4}$.

6.3 Beliefs

In perfect Bayesian equilibria, beliefs of the players play a crucial role. To observe whether discrepancies of behavior and theoretical prediction source in deviating actions or in deviating beliefs followed by the actions, we performed a precise belief elicitation in the experiment. An Investor had to enter a belief (a number between 0 and 100) about the likelihood that the Entrepreneur she is matched to chooses to repay a potential investment. This elicitation was performed for every investment choice of the Investor in the strategy method. Similarly, every Entrepreneur had to enter a number between 0 and 100 about his belief that an Investor invests in the current period. These beliefs were incentivized with quadratic scoring rule.[17]

6.3.1 Investors Beliefs about Repayment of Entrepreneur

Table 6 depicts the averages of the beliefs entered by the Investors. The rows of second (third) period beliefs only contain those after a repay observation in the first (first and second) period. Columns *Behavior* and *Theory* depict the actual behavior of the Entrepreneurs in the respective situations, as well as the theoretical prediction arising from the PBE.

		Public, $M = 1$				Public, $M = 4$				Private		
		Belief	Behavior	Theory		Belief	Behavior	Theory		Belief	Behavior	Theory
1^{st}	$p_1 = .2$	.42	.49	.2	$<^{***}$	.68	.89	.8	$>^{***}$	.57	.68	.6
Period	$p_1 = .4$	.52	.58	.4	$<^{***}$	.72	.81	1	$>^{***}$	.63	.73	.7
	$p_1 = .75$	.76	.84	.75	$<^{***}$	.86	.92	1	$>^{***}$	.78	.89	.875
2^{nd}	$p_1 = .2$	.53	.6	1	$<$	.58	.67	.25	$>$	.55	.53	1
Period	$p_1 = .4$	.59	.69	1	$<$	.65	.74	.8	$>^{*}$	.58	.72	1
	$p_1 = .75$	.8	.91	1	$\approx$	.79	.89	1	$\approx$	.8	.94	1
3^{rd}	$p_1 = .2$	.54	.57	1	$>^{***}$	.37	.38	.5	$\approx$	.38	.5	.5
Period	$p_1 = .4$	.57	.83	1	$>$	.49	.65	.5	$\approx$	.5	.76	.57
	$p_1 = .75$	.78	.93	1	$>^{**}$	.72	.83	.75	$<$	.75	.93	.86

Table 6: Investors Belief about Repayment.

Notes: This table contains the averages of the entered beliefs of the Investors about the probability of repayment in the respective situation. Behavior depicts the actual empirical probability of repayment of the Entrepreneurs in the respective situation. Theory depicts the theoretical prediction arising from the PBE analysis. All numbers rounded to the second digit. The comparative signs report the significance levels of a pairwise comparison of the beliefs, clustered at the matching group level. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

The pairwise comparisons (regressions clustered at the matching group level) within the Public regime between beliefs in case of $M = 1$ and $M = 4$ reveals that Investors seem to realize

[17] The beliefs of the final three rounds were not incentivized. Therefore, we exclude them in this section.

that the Entrepreneurs incentives to repay are lower for lower M and that the probability to be matched with a good Entrepreneur after observing two repay observations is therefore higher in case of $M = 1$ than in case of $M = 4$. Hence, the Investor understands the reputational incentives of the Entrepreneur. Comparing the Investor's beliefs under the Private regime with the Public regime and high multiplier, however, reveals no clear sign of belief about the mixed strategy equilibrium played by the Entrepreneur.

6.3.2 Entrepreneurs Beliefs about Investment

Table 7 depicts the averages of the beliefs entered by the Entrepreneurs. The rows of second (third) period beliefs only contain those after a previous repay choice in the first (first and second) period. Columns *Behavior* and *Theory* depict the actual behavior of the Investors in the respective situations, as well as the theoretical prediction arising from the PBE.

		Public, $M = 1$				Public, $M = 4$				Private		
		Belief	Behavior	Theory		Belief	Behavior	Theory		Belief	Behavior	Theory
1^{st}	$p_1 = .2$	.52	.69	0	$<^{***}$	.78	.94	1	$>$	.73	.87	1
Period	$p_1 = .4$	.66	.77	1	$<^{***}$	.77	.95	1	$>$	.75	.91	1
	$p_1 = .75$	.77	.92	1	$<$	.82	.99	1	$>$	.79	.99	1
2^{nd}	$p_1 = .2$	.64	.88	1	$<^{***}$	.77	.91	.5	$>^{***}$	.67	.83	1
Period	$p_1 = .4$	.68	.82	1	$<$	.73	.92	1	$\approx$	.73	.87	1
	$p_1 = .75$	.77	.97	1	$<$	.8	.98	1	$\approx$	.79	.99	1
3^{rd}	$p_1 = .2$	.45	.82	1	$<$	.49	.61	.5	$>$	.44	.58	.5
Period	$p_1 = .4$	.48	.69	1	$<$	.55	.62	.5	$>$	.5	.6	1
	$p_1 = .75$	.68	.89	1	$<$	.71	.9	1	$\approx$	.72	.94	1

Table 7: Entrepreneurs Belief about Investment.

Notes: This table contains the averages of the entered beliefs of the Entrepreneurs about the probability of Investment in the respective situation. Behavior depicts the actual empirical probability of investment in the respective situation. Theory depicts the theoretical prediction arising from the PBE analysis. All numbers rounded to the second digit.The comparative signs report the significance levels of a pairwise comparison of the beliefs, clustered at the matching group level. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

The pairwise comparisons show no clear sign of belief about mixed strategy play. Further, Entrepreneurs do not seem to realize that Investors figure out the reputational incentives of the Entrepreneurs. While the Investor's beliefs (table 6) shows clear signs thereof, Entrepreneurs do not seem to realize that investors learn more about the Entrepreneurs type in case they observe a repayment in case of $M = 1$ compared to $M = 4$. Tables 6 and 7 further show that the beliefs are in general more pessimistic than actual behavior.

6.4 Potential Reasons for Deviations from Hypothesized Behavior

Our analysis has revealed a couple of deviations from our theoretical predictions. In the following, we shed some light on potential reasons for these deviations. For this purpose, we first elaborate on the high share of *bad* Entrepreneurs who repay for $M = 1$ including correlations with cognitive ability (section 6.4.1). Further, we explore the role of risk aversion empirically as well as theoretically (section 6.4.2), propose another more unconventional equilibrium (section 6.4.3), and analyze how far the behavior might be a best response to the incentives that result from the behavior of other subjects, which differs from the incentives in the theoretically predicted equilibrium (section 6.4.4).

6.4.1 Repayments for $M = 1$

Cognitive Ability of deviating players The calculation of the equilibria assumes a high level of cognitive ability. Although we did not specifically test the intelligence of the subjects in the laboratory, we asked for their high-school math grade in the post experimental questionnaire. In the following, we use the grade entered by the subject as a proxy for their cognitive ability.[18] To see how behavior differs between people with different high-school math grade, we test the influence of math grade on investment and repayment behavior.

Concerning the repayment behavior, the most straightforward prediction is for *bad* Entrepreneurs not to repay in case the multiplier is low. The data shows, however, that 37.96% of the bad Entrepreneurs with low multiplier repay an investment in the first period. Panel (1) of table 8 presents the results of an OLS regression showing a highly significant positive correlation between a bad high school math grade and repayment behavior for low multiplier in the experiment.

For the investments, the most straightforward prediction (for both regimes) is not to invest after a default has occurred. The data shows that 17.53% of the Investors who invested initially continue to invest in the second period if a default occurred in the first period. 10.81% of the Investors who invested in the first and second period, also invest in the third period if a default occurred in the second period. Panel (2) and (3) of table 8 show that the correlation between

[18]The math grade in the German school system ranges from 1 (best) to 6 (worst).

math grade and this unhypothesized behavior is also (weakly) significant, and that subjects with a better math grade behave more consistently with our theoretical predictions in these situations.

Table 8: Behavior and Math Grade in High School

	1^{st} Period Repayment if $M = 1$	2^{nd} Period Investment after Default	3^{rd} Period Investment after Default
	(1)	(2)	(3)
Math Grade	0.082^{***}	0.039^{*}	0.076^{***}
	(0.029)	(0.022)	(0.020)
constant	0.184^{**}	0.090^{*}	-0.063
	(0.080)	(0.051)	(0.044)
Observations	562	1744	1589
Clusters	35	35	35
R^2	0.0329	0.0106	0.0623

Notes: Column (1): OLS regression on the binary *Repayment* decision of bad Entrepreneurs in the first period if $M = 1$. Column (2): OLS regression on the second Period *Investment* decision of Investors in case a Default occurred in the first period. Column (3): OLS regression on the third Period Investment decision of Investors in case the first Period investment has been repaid and a Default occurred in the second period. Standard-errors are clustered at the matching-group level and depicted in parentheses. Math Grade is self reported and lies between 1 (good) and 6 (bad).
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Equilibrium adjustment including repayments for $M = 1$: Assuming a commonly known share of *bad* Entrepreneurs who repay in the first Period ($\lambda_1 \in [0, 1]$) and the second Period ($\lambda_2 \in [0, 1]$) changes the equilibrium predictions for investors in the model for the Private regime and the Public regime with low multiplier.[19]

In the experiment, these shares are $\lambda_1 = 0.37$ and $\lambda_2 = 0.27$. Panel c) in Figure 5 plots the equilibrium probability of a third round investment given the assumption of payoff-maximizing Investors and publicly known shares $\lambda_1 = 0.37$ and $\lambda_2 = 0.27$. The figure reveals that for these

[19]To include the deviating findings of the bad Entrepreneurs who repay with $M = 1$ into the model, we assume that no Entrepreneur repays after a previous default, and that every player except these deviating Entrepreneurs plays a payoff-maximizing strategy.

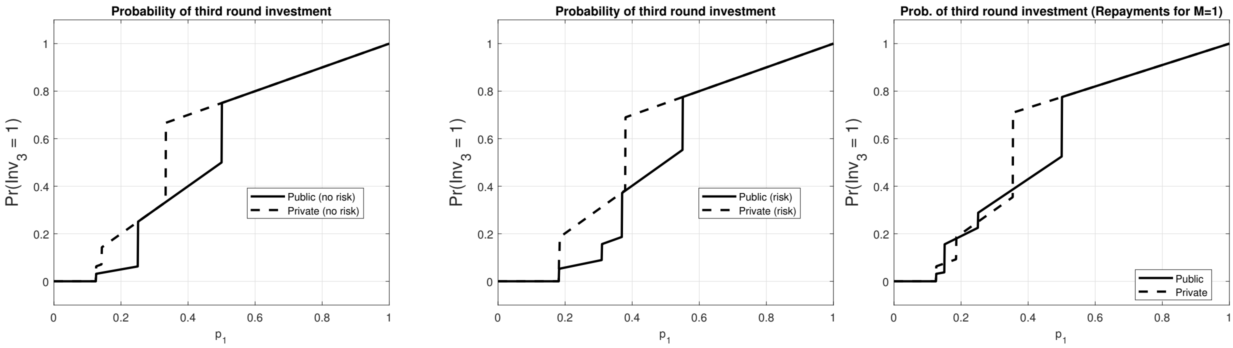
values, the range of p where the Private regime dominates the Public regime decreases. By implementing the shares $\lambda_1 > 0$ and $\lambda_2 > 0$ to the model, the following changes occur:

- Public, $M = 1$: The threshold of p where investing leads to a higher expected payoff than not investing decreases to $p_1 = \frac{1-\lambda_1-\lambda_1\lambda_2}{4-\lambda_1-\lambda_1\lambda_2}$, so there are more investments in the Public $M = 1$ case. For Public, $M = 4$ there are no differences, as the new assumption of more repayments in case of $M = 1$ is not relevant in that case.

- Private: The thresholds of the equilibria outlined in Lemma 4 increase; As repayments can also occur if an Entrepreneur is bad and $M = 1$, the Investor learns less about the type after observing a repayment. The threshold of p_1 where the Investor invests throughout the game if no defaults were observed increases to $p_1 \geq \frac{1+\lambda_1\lambda_2}{3+\lambda_1\lambda_2}$, and the range of p_1 where the Investor mixes in the second and third period while the Entrepreneur with $M = 4$ mixes in the first and second period increases to $\frac{1}{8} < p_1 \leq \frac{1+\lambda_1}{7+\lambda_1}$.

Therefore, a publicly known share of repaying bad Entrepreneurs with a low multiplier increases the probability of investments under the Public regime and decreases the probability of investment in the Private regime. For high values of λ_1 and λ_2 this can even reverse the predictions made by the PBE without repaying bad Entrepreneurs with low multiplier. Unfortunately, we cannot cleanly know the values of λ_1 and λ_2 the Investors in the experiment believed, but we only know that the values extracted from the Entrepreneur's behavior seem to be rather high. Without properly testing this claim, we therefore propose the high shares of repaying bad Entrepreneurs as a potential reason for not finding the dominance of the Private regime over the Public regime.

6.4.2 Risk aversion



(a) risk neutral players

(b) risk averse players

(c) Share of bad entrepreneurs repays with $M = 1$.

Figure 5: Equilibrium probability that third round investment takes place under the Public (solid line) and the Private regime (dashed line). Panel c) plots the equilibrium probability of third round investments with the assumption that a share of $\lambda_1 = 0.37$ ($\lambda_2 = 0.27$) bad Entrepreneurs repays with $M = 1$ in the first (second) period.

The theoretical analysis above holds for risk neutral players. In behavioral economics, it is well-documented that individuals dislike risk (see e.g. Harrison et al. (2008) for an overview). Including risk aversion to the model changes the predicted strategies and thresholds of the players. Under the Public regime, the Investor faces the risk that she might be matched with a bad Entrepreneur who might not repay. Under Private, there is the additional dimension of uncertainty about the multiplier. Not investing is not risky for an Investor, as an Entrepreneur cannot move thereafter. Investing is more risky as it might result in either a gain or a loss. For higher p_1, there is in general less risk for an Investor, as the behavior of good Entrepreneurs is perfectly predictable.

To test whether risk aversion may be a factor that can explain the observed deviations from theory, we first calculate the equilibria of the game including the assumption of risk aversion. Following the standard approach by assuming a concave utility function $u(x) = \ln(x)$, and using the points in the experiment as payoff x, we can recalculate the equilibria for the parameters chosen in the experiment.[20] The PBE equilibria including risk aversion predict new equilibrium thresholds. The main strategies, to default whenever $M = 1$ and in the third period of each game, as well as to stop investing after a default occurred remain unchanged.

[20]Note that in the experiment each round starts with a starting budget of 30 points.

Under Private, for $0 < p_1 < 0.1813$, there is the no-investment equilibrium. The range of the equilibrium where Investors mix in the second and third period shrinks to $0.1813 < p_1 < 0.1834$. For $0.1834 < p_1 < 0.3796$, there is the equilibrium where Investors invest in the first and second period but mix in the third period, while Entrepreneurs with $M = 4$ repay in the first period but mix in the second period. For $p_1 > 0.3796$, there is the pure strategy equilibrium where Investor invests as long as all previous investments have been repaid and Entrepreneurs with $M = 4$ repay in the first and second period, and default in the third period.

Under Public for $M = 4$, also the same structure of equilibria remains with different thresholds by including risk aversion to the model: For $p_1 < 0.1813$, no investments are made. For $0.1813 < p_1 < 0.31$, the equilibrium strategies of the Investor are to mix in the second and third period, and the Entrepreneur to mix in the first and second period. For $0.31 < p_1 < 0.5503$, Investor mixes in the third period and Entrepreneur mixes in the second period. For $p > 0.5503$, Investor invests as long as no default occurred and Entrepreneur repays in the first and second period.

Hence, the main theoretical finding, that more investments and repayments should occur under the Private regime for a large range of p_1, remains unchanged by including risk aversion to the model. Including risk aversion into the model, however, changes three things: 1) Not investing becomes more attractive and therefore shifts the thresholds for a specific type of equilibrium to the right: The share of good Entrepreneurs has to be higher in order to be willing to invest. 2) For the mixed strategy equilibria, in order to render a risk-averse Entrepreneur indifferent whether he repays in a period, the mixing probability of a reinvestment after a repay has to increase. 3) For the Entrepreneurs it is the other way around: To render the Investor indifferent whether to invest following a repayment in the mixed strategy equilibria, the repayment probability has to decrease by including risk aversion. By decreasing the repayment probability, the Investor can better update her belief about the type of player, which is needed to remain indifferent whether to invest or not after not investing becomes more attractive due to risk aversion. These two differing probabilities lead to the same equilibrium probability that a third round investment takes place for a given value of p_1 if the same type of equilibrium is played for this value. The only thing that differs by including risk aversion are the thresholds for the different types of equilibria. The exact thresholds obviously depend on the utility function we assume, so we cannot claim that including risk aversion in general would lead exactly to the described equilibrium outlined above for the three levels of p_1 chosen in the experiment. Figure 5 plots the predicted probability that third round investment takes place, with and without risk aversion, for the parameter values $r = 1$ and $q = \frac{1}{2}$.

To see empirically whether risk might be a relevant factor in the experiment, we use the data from the post experimental questionnaire. Subjects were asked to answer the question *'How risk tolerant would you assess yourself?'* on a 7 point Likert scale. We caution, however, that the answer to this question was non-incentivized and self-reported. This does not allow us to claim any causal evidence on the relationship between behavior and reported risk attitudes. In the following, we therefore look at correlations between the answer to this question and the investment and repayment behavior. Table 9 regresses the investment and repayment rates with the self-reported risk preference of an individual. The table shows no relevant correlation between self-reported risk aversion and behavior in the experiment. The theory including risk-aversion also leads to similar equilibrium predictions than the PBE without risk aversion if one assumes that risk averse subjects also believe other subjects to be risk averse and adapt their behavior accordingly. We therefore believe that risk aversion does not serve as good explanation for the findings that deviate from theory.

6.4.3 Commitment Equilibrium

Mixed strategies necessarily reduce ex-ante efficiency because they always include a risk that the game will end abruptly if the Entrepreneur defaults or if the Investor does not invest. If the bad Entrepreneur defaults early on as part of a mixed-strategy equilibrium, both the Investor and the Entrepreneur lose those mutual gains which would have been obtained had the Entrepreneur been able to mimic the good type throughout the whole game.

One way to eliminate mixed strategies altogether, and thereby perhaps model actual behavior in the lab, is to consider an equilibrium in which the Investor commits to investing with certainty as long the history of play does not include defaults. As this type of a strategy would not make use of beliefs, except for the very first investment, we also call it a 'non-Bayesian equi-

Table 9: Behavior and self-reported Risk Attitude

	1^{st} Period Repayment (1)	2^{nd} Period Repayment (2)	1^{st} Period Investment (3)	2^{nd} Period Investment (4)	3^{rd} Period Investment (5)
Risk Loving	0.010	0.027	0.003	-0.001	0.033
	(0.028)	(0.030)	(0.011)	(0.012)	(0.022)
Public $\times$ $M = 1$			-0.117***	0.002	0.077**
			(0.026)	(0.018)	(0.036)
Public $\times$ $M = 4$	-0.005	0.048	0.039***	0.029	-0.004
	(0.023)	(0.053)	(0.010)	(0.020)	(0.031)
constant	0.751***	0.380**	0.906***	0.908***	0.593***
	(0.129)	(0.147)	(0.050)	(0.049)	(0.116)
Observations	627	497	2380	2132	1947
Clusters	35	35	35	35	35
R^2	0.0014	0.0074	0.0391	0.0021	0.0155

Notes: Risk Loving is a self-reported variable with values between 1 (very risk averse) to 7 (very risk loving). Column (1): OLS regression on the binary *Repayment* decision of bad Entrepreneurs in the first period if $M = 4$. Column (2): OLS regression on the binary *Repayment* decision of bad Entrepreneurs in the second period if $M = 4$ after repayment in the first period. Column (3): OLS regression on the first Period *Investment* decision of Investors. (4): OLS regression on the second Period *Investment* decision of Investors after first period investment and repayment observation. (5): OLS regression on the third Period *Investment* decision of Investors after first and second period investment and two repayment observations. Standard-errors are clustered at the matching-group level and depicted in parentheses.

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

librium'. Given that the Investor's strategy does not depend on her beliefs, the Entrepreneur does not have to employ a mixed strategy either. In theory, a commitment equilibrium can be sustained if and only if Investor the can truly commit to ignoring her beliefs. This is difficult to obtain in practice, although informal commitment such as pre-play communication could potentially help to sustain the equilibrium. In our experiment, the Investor has no commitment power but we propose this non-Bayesian equilibrium strategy as the complexity of the PBE can shift the behavior to this easier non-Bayesian strategy, and/or alter the beliefs about others playing this less complex strategy, which would make it even optimal for fully rational subjects to follow the non-Bayesian equilibrium strategy.

Definition 1 (Commitment equilibrium)**.** *In a Commitment equilibrium, provided that the Investor makes the first investment, she commits to investing in every further period as long* *as the Entrepreneur does not default. If $M = 4$, the bad Entrepreneur repays an investment with certainty in every period but the last period in which she defaults. If a default occurs, the Investor stops investing and bad Entrepreneur defaults in all remaining periods of the game if given the chance. If $M = 1$, bad Entrepreneur defaults for all histories of play.*

The construction of a Commitment equilibrium for both regimes is straightforward and we do not provide the formal characterization here. The equilibrium differs between the information regimes mainly with respect to the condition for the first investment. Under the Public regime, if $M = 1$, Lemma 3 characterizes the condition for an equilibrium with investments. If $M = 4$, the Investor enters the game if and only if

$$3p_1 r + (1 - p_1)(2r - 1) \geq 0, \tag{2}$$

which, leads to $p_1 \geq \frac{1-2r}{r+1}$ and holds for all p_1 if $r = 1$. Under the Private regime, the Investor makes the first investment if

$$3p_1 r + (1 - p_1)\left[(1 - q)(2r - 1) - q\right] \geq 0, \tag{3}$$

which, for $q \in (0, 1)$, yields an investment threshold strictly higher than that resulting from condition (2). For our experiment, with $r = 1$ and $q = \frac{1}{2}$, both conditions (2) and (3) hold for all priors. When $M = 1$, investing is optimal under the Public regime only for priors above $\frac{1}{4}$. Based on the comparison of ex-ante expected payoffs across the regimes, the following result regarding the numerical example is readily established.

Lemma 5. *In a game with $r = 1$, and $q = \frac{1}{2}$, a Commitment equilibrium weakly Pareto dominates the respective PBE under both information regimes, with strict Pareto dominance for all prior beliefs $p_1 < \frac{1}{2}$ under the Public regime, and for all prior beliefs $p_1 < \frac{1}{5}$ under the Private regime.*

Proof. In the appendix. □

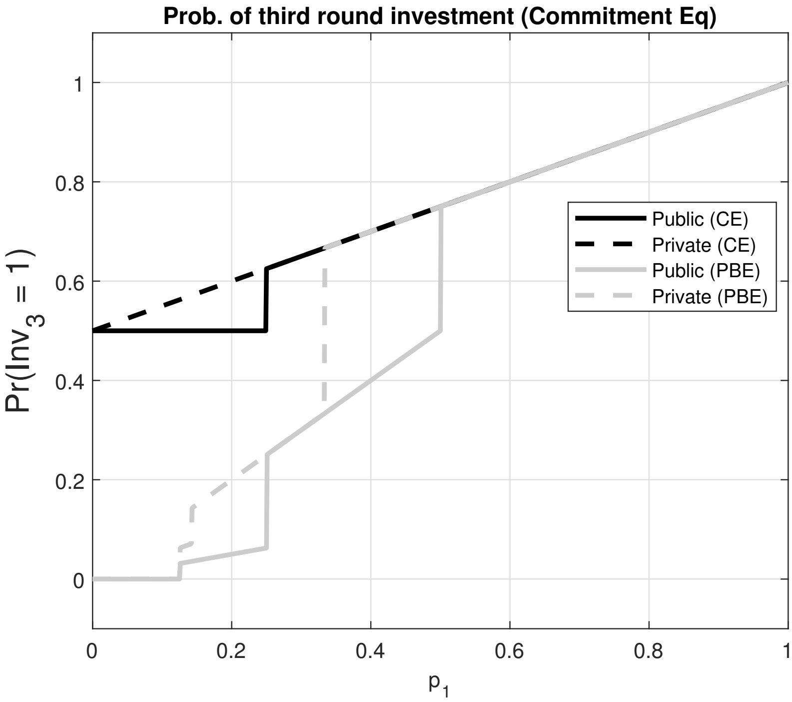


Figure 6: Probability of third round investment in the Commitment Equilibrium and the PBE.

Figure 6 plots the equilibrium probabilities for a third period investment under the Private and the Public regime for the parameters chosen in the experiment: $r = 1$ and $q = \frac{1}{2}$. When comparing expected payoffs between Commitment equilibria across regimes, the only difference in expected payoffs results from the fact that investments are withheld under the Public regime when $M = 1$. In all other respects, in our numerical setup, as the first investment is always made and strategies do not depend on information about M, expected payoffs are equal across regimes. The Public regime dominates for priors below $\frac{1}{4}$ because the Investor avoids the expected negative payoff that would result from investing when $M = 1$. Under the Private regime, this loss is outweighed by expected gains that occur if M is high which induces the Investor to invest even for low priors.

This also helps to understand the intuition of the dominance of Private regime PBE over Public regime PBE. The same benefit from being able to tell if M is low is still present. However, equilibrium behavior if M is high differs between the two regimes, and the benefits of having a Private regime are high enough to outweigh the disadvantage of not being able to tell if M is low.

When testing the existence of the Commitment equilibrium in the data, we see little support. The observed lack of difference between Private and Public in the $p_1 = \frac{2}{5}$ treatment would be in line with the idea of the commitment equilibrium. The beliefs of tables 6 and 7, however, as well as the decreasing repayment rates of table 5 and the decreasing investment rates of table 4, are not compatible with the idea of the Commitment Equilibrium.

6.4.4 Empirical Best response

The treatment difference p_1 denotes the probability that an Entrepreneur is good and repays every investment by design. Figure 4 shows that a non-negligible share of bad Entrepreneurs also repays for a low multiplier. The probability of being good Entrepreneur, p_1 therefore serves as a lower bound for repaying subjects. To see whether the predicted optimal strategies still hold given the actual behavior of the others, the best-responses are calculated. Table 10 depicts the expected number of points for each possible action within one round, given the average behavior of all other subjects in the experiment. As we do not allow the game to proceed after a non-investment decision, there are 26 different invest and not-invest combinations possible in every round.[21] Four of them are consistent with a trigger strategy.[22] The table contains the expected number of points for each of these four strategies, as well as for the not-trigger strategy leading to the highest number of points.

In a given treatment (with fixed p_1), each Investor is faced with three different scenarios at some point within the experiment. She has to choose her investment strategy under the Public regime for a high and low multiplier, as well as for the Private regime with an unknown multiplier. In all three treatments, for every scenario except Public, $p_1 = \frac{1}{5}, M = 4$, playing $\{I, I, NI, I, NI, \emptyset, \emptyset\}$ leads to the highest expected payoff.[23] In the above-mentioned case where it is different, playing trigger but not investing in the third period leads to a higher payoff than investing in every period.

[21] We denote an Investor's action in the following contingencies (in the given order) {period 1, period 2 after R, period 2 after D, period 3 after RR, period 3 after RD, period 3 after DR, period 3 after DD}.

[22] These four are 1) Not invest initially ($\{NI, \emptyset, \emptyset, \emptyset, \emptyset, \emptyset, \emptyset\}$), 2) invest initially, not invest afterwards ($\{I, NI, NI, \emptyset, \emptyset, \emptyset, \emptyset\}$) , 3) $\{I, I, NI, NI, NI, \emptyset, \emptyset\}$, and 4)$\{I, I, NI, I, NI, \emptyset, \emptyset\}$.

[23] This strategy is in line with the Commitment strategy if $p_1 > \frac{1}{4}$.

Table 10: Expected Points of different Actions given other's average behavior

			Public		Private	
			$M=1$	$M=4$	$M=1$	$M=4$
$p_1 = \frac{1}{5}$	E	EP(RRD)	21.95	**85.73**	18.52	**78.26**
		EP(RDD)	29.95	**85.53**	29.23	**78.55**
		EP(DRD)	36.05	73.25	37.41	70.40
		EP(DDD)	**38.55**	76.09	**40.80**	73.19
	Inv	EP(III)	**32.00**	38.41	**36.71**	
		EP(IIN)	31.12	**39.95**	34.95	
		EP(INN)	29.76	37.74	34.20	
		EP(NNN)	30	30	30	
		max EP(not trigger)	30.24	39.23	33.53	
$p_1 = \frac{2}{5}$	E	EP(RRD)	20.18	**89.36**	17.80	**82.38**
		EP(RDD)	29.15	88.00	29.63	**82.47**
		EP(DRD)	37.04	76.82	38.01	71.19
		EP(DDD)	**39.11**	79.21	**40.75**	73.01
	Inv	EP(III)	**38.54**	**42.60**	**41.71**	
		EP(IIN)	35.07	40.89	37.91	
		EP(INN)	32.03	36.61	34.55	
		EP(NNN)	30	30	30	
		max EP(not trigger)	37.05	41.45	39.76	
$p_1 = \frac{3}{4}$	E	EP(RRD)	19.91	**104.50**	19.58	**106.46**
		EP(RDD)	30.92	92.25	30.86	92.65
		EP(DRD)	39.16	74.99	39.19	73.95
		EP(DDD)	**40.22**	75.28	**41.20**	74.78
	Inv	EP(III)	**51.51**	**53.13**	**51.91**	
		EP(IIN)	44.36	46.83	44.43	
		EP(INN)	37.30	38.84	36.82	
		EP(NNN)	30	30	30	
		max EP(not trigger)	50.31	52.54	51.50	

Notes: The (bad) Entrepreneurs actions *Repay* and *Default* are labeled as R and D respectively. Similarly, I and N stand for *Invest* and *Not Invest*. The action that maximizes the expected number of points is represented in bold numbers. If the best- and second-best reaction are less than 0.5% different from each other, both alternatives are represented in bold.

A bad Entrepreneur can choose between four different actions every round: Repay twice, repay in the first period only, repay in the second period only, or default in both periods. Table 10 also depicts for the Entrepreneur the expected number of points in the respective scenarios for each different action, given the average behavior of the Investors. Whenever $M = 1$ it is indeed optimal to default throughout the round, as repaying leads to a higher negative transfer than the investment itself. In the $p_1 = \frac{3}{4}$ treatment, where the Commitment strategy and the PBE strategy lead to the same action (repay in both periods), repaying twice is also the profit maximizing choice.

In the treatments with $p_1 = \frac{2}{5}$, repaying in both periods is profit maximizing for $M = 4$ under the Public regime, but leads to the same outcome as repaying only in the first period under the Private regime.[24] Similarly, in the $p_1 = \frac{1}{5}$ treatment, under the Private as well as the Public regime, repaying only in the first period leads to the same expected outcome as repaying in the first and second period respectively. To sum up, the predicted indifference between repaying in the second period or not in the $p_1 = \frac{1}{5}$ treatment can indeed be found in the data. For the Public, $p_1 = \frac{2}{5}$ treatment, however, the Investors average behavior in the laboratory does not lead to the predicted indifference as in the PBE.

7 Discussion and Conclusion

Our aim in this paper has been to study the effect of information about the multiplier on trust and repayments. Therefore, we have chosen to keep the model as close to the 'standard' trust game as possible. Thus, despite the labels we use, the model is not intended to be a realistic model of investment behavior. However, with small changes and adjustments, the model could be shaped to better represent an actual investment game, without significant changes to the qualitative results. For instance, allowing the Entrepreneur to refuse investments would be an innocent but realistic additional assumption.

The theoretical part of the paper describes the perfect Bayesian equilibrium of the game: the Investors and the Entrepreneurs play (for a large range of p_1) mixed strategies. These mixed strategies lead to the possibility of Bayesian updating between the periods, and the observability of the multiplier becomes crucial in comparing the expected equilibrium payoffs. Comparing the predictions of the PBE reveals that the expected payoffs of the Investor and the strategic Entrepreneur are weakly higher in case of private information about the multiplier compared to public information about the multiplier.

Testing the implication of the observability in the laboratory reveals that the probability of reaching the third round does not differ much between the Private and the Public regime. The comparative statics of average investment behavior observed are also not in line with the predicted equilibrium behavior. In the experiment, the multiplier and the type of Entrepreneur

[24] The expected number of points for these two actions differs by less than 0.5% (82.38 and 82.47).

are both randomly determined at the beginning of each round. This design allows us to see whether the insignificance of the difference in the average behavior comes from heterogeneous play of the subjects. A fixed-effect regression that only takes into account the variation between high and low M within the behavior of a subject over time, however, also reveals no signs that PBE is played. Nevertheless, the experiment reveals that the fundamentals of the model are well represented in the behavior of subjects: more repayments for higher M; bad Entrepreneurs imitate good Entrepreneurs to improve their reputation; Investors react to the increased reputation of Entrepreneurs; and Investors invest more often for a higher share of good Entrepreneurs.

The experimental data reveals one particularly striking deviation from the theoretically predicted behavior: A large share of strategic Entrepreneurs repays investments even for a low multiplier. This behavior results in lower payoff of these entrepreneurs, and we detected a strong correlation with our proxy for cognitive capability. Implementing such a share of deviating players, we re-calibrated the model and could show that the existence of such players also decreases the predicted difference between the two regimes we compare, and would be in line with the data we observe.

The paper shows, that whether asymmetric information between an Investor and an Entrepreneur about the profitability of a startup is welfare increasing or not, depends on the specifics of the market that is observed. If everyone behaved purely strategic and payoff-maximizing, we argue that it leads to higher welfare if the profitability of the startup remains private information of the Entrepreneur. The existence of some *irrational* Entrepreneurs, however, would suffice to erase or even reverse this predicted welfare difference.

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Appendix

A Equilibrium Predictions for the $T \geq 2$ Game

Public regime

The following strategies and beliefs characterize the Perfect Bayesian Equilibrium as a function of prior belief p_1 and M for a T-period game in which information about M is public knowledge. Result of Lemma 1 still applies: only the bad Entrepreneur with $M = 4$ has reputation concerns.

If $M = 1$, and

- $p_1 \geq \frac{1}{1+Tr}$, Investor invests in the first period and re-invests in all later periods if all previous investments have been repaid. Bad Entrepreneur defaults in the first period. Formally:
  - $\sigma_1^{Inv}(\emptyset) = 1$, and $\sigma_t^{Inv}(h_t) = 1$, for all $t > 1$ if $D \notin h_t$. $\sigma_t^{Inv}(h_t) = 0$ if $D \in h_t$.
  - $\sigma_t^E(h_t) = 0$ for all $t \geq 0$ and h_t.
  - Equilibrium beliefs: $p_t(h_t) = 1$ if $h_t = (I, R, ...)$ and $p_t(h_t) = 0$ if $h_t = (I, D, ...)$.
- $p_1 < \frac{1}{1+Tr}$, Investor never invests. If given the opportunity, bad Entrepreneur would always default. Equilibrium beliefs: $p_t(h_t) = 1$ if $h_2 = (I, R)$, and $p_t(h_t) = 0$ for all other histories.

If $M = 4$, and

- $p_1 \geq \frac{1}{1+r}$, Investor invests in the first period and re-invests in all later periods if all previous investments ave been repaid. Bad Entrepreneur repays in all but the last period. Formally:
  - $\sigma_1^{Inv}(\emptyset) = 1$, and $\sigma_t^{Inv}(h_t) = 1$, for all $t > 1$ if $D \notin h_t$. $\sigma_t^{Inv}(h_t) = 0$ if $D \in h_t$.
  - $\sigma_t^E(h_t) = 1$ for all $t < T - 1$ if $D \notin h_t$, else $\sigma_t^E(h_t) = 0$. $\sigma_T^E(h_T) = 0$ for all h_T.
  - Equilibrium beliefs: $p_t(h_t) = p_1$ for all $h_t = (I, R, ...)$, and $p_t(h_t) = 0$ if $D \in h_t$.

- $p_1 \in \left[\frac{1}{(1+r)^T}, \frac{1}{1+r}\right)$, Investor invests in the first period. Equilibrium consists of pure strategies for some periods after which both the bad Entrepreneur and the Investor randomize their actions and keep doing so until the last period in which the bad Entrepreneur defaults with certainty if given the chance. More specifically, if in period $t < T$
  - $p_t(h_t) < \frac{1}{(1+r)^{T-t}}$, bad Entrepreneur randomizes in period t by repaying with probability
  $$\sigma_t^E(h_t) = \frac{\left[(1+r)^{T-t} - 1\right] p_t(h_t)}{1 - p_t(h_t)}. \quad (4)$$
  If Entrepreneur randomizes in period t, Investor randomizes in period $t+1$ by investing with probability $\sigma_{t+1}^{Inv}(h_{t+1}) = \frac{1+r}{4}$.
  - Equilibrium beliefs: $p_{t+1}(h_{t+1}) = \frac{p_t(h_t)}{p_t(h_t)+(1-p_t(h_t))\sigma_t^E(h_t)}$.
- $p_1 < \frac{1}{(1+r)^T}$, Investor never invests. Bad Entrepreneur, if gets the chance to move, defaults with certainty. Formally:
  - $\sigma_t^{Inv}(h_t) = 0$ for all $t = 1, ..., T$.
  - $\sigma_t^E(h_t) = 0$ for $t \geq 1$ and for all h_t,
  - Equilibrium beliefs: $p_t(h_t) = p_1$ for all h_t. [25]

Private regime

The following strategies and beliefs characterize the Perfect Bayesian Equilibrium as a function of prior belief p_1 and M for a T-period game in which information about M is private knowledge of the Entrepreneur. Result of Lemma 1 still applies: only the bad Entrepreneur with $M = 4$ has reputation concerns.

For all q, if $p_1 \geq \max\left\{\frac{1-q}{1+r-q}, \frac{1-(T-1)r(1-q)}{1-(T-1)r(1-q)+Tr}\right\}$, Investor invests in the first period and re-invests in all later periods if all previous investments have been repaid. Bad Entrepreneur repays in all but the last period. Formally:

- $\sigma_1^{Inv}(\emptyset) = 1$, and $\sigma_t^{Inv}(h_t) = 1$, for all $t > 1$ if $D \notin h_t$, else $\sigma_t^{Inv}(h_t) = 0$.

[25] Possible out-of-equilibrium beliefs could be $p_t(h_t) = p_1$ for all h_t.

- $\sigma_t^E(h_t \mid M=4) = 1$ for all $t < T-1$ if $D \notin h_t$, else $\sigma_t^E(h_t \mid M=4) = 0$. $\sigma_T^E(h_T \mid M=4) = 0$ for all h_T.
- $\sigma_t^E(h_t \mid M=1) = 0$ for all h_t.
- Equilibrium beliefs: $p_t(h_t) = \frac{p_1}{p_1+(1-p_1)(1-q)}$ for all $t > 1$.

If $q \leq \frac{(1+r)(T-1)}{(1+r)T-r}$ and $p_1 \in \left[\frac{1}{(1+r)^T}, \frac{1-q}{1+r-q}\right)$, Investor invests in the first period. Equilibrium consists of pure strategies for some periods after which both the bad Entrepreneur with $M=4$ and the Investor start to randomize their actions and keep doing so until the last period in which the bad Entrepreneur defaults with certainty if given the chance. Bad Entrepreneur with $M=1$ always defaults if given the chance. More specifically, in period 1, if $p_1 < \frac{1-q}{(1+r)^{T-1}-q}$, bad Entrepreneur with $M=4$ randomizes and repays with probability

$$\sigma_1^E(h_1) = \frac{\left[(1+r)^{T-1}-1\right] p_1(h_1)}{(1-p_1(h_1))(1-q)}. \tag{5}$$

Otherwise, bad Entrepreneur repays in period 1 with certainty and randomizes later. If in period $1 < t < T$,

$$p_t(h_t) < \frac{1}{(1+r)^{T-t}}, \tag{6}$$

bad Entrepreneur with $M=4$ randomizes in period t by repaying with probability

$$\sigma_t^E(h_t) = \frac{\left[(1+r)^{T-t}-1\right] p_t(h_t)}{1-p_t(h_t)}. \tag{7}$$

Moreover, an equilibrium with mixing from period $t \geq 1$ onwards exists if $p_1 \geq \bar{p}_t$, where $\bar{p}_t$ is a threshold for the Investor to enter the game by making the first investment in period 1, given that the Entrepreneur randomizes starting from period t onward. It is obtained from the following incentive condition:

$$p_1 tr - (1-p_1)q + (1-p_1)(1-q)\left[(t-1)r + \sigma_t^E(h_t)r - (1-\sigma_t^E(h_t))\right] \geq 0. \tag{8}$$

If Entrepreneur randomizes in period t, Investor randomizes in period $t+1$ by investing with probability $\sigma_{t+1}^{Inv}(h_{t+1}) = \frac{1+r}{4}$ as long as $D \notin h_{t+1}$.

Equilibrium beliefs of the Investor:

$$p_{t+1}(h_{t+1}) = \frac{p_t(h_t)}{p_t(h_t) + (1 - p_t(h_t))(1 - q)\sigma_t^E(h_t)}. \tag{9}$$

For all q, if $p_1 < \frac{1}{(1+r)^T}$, Investor never invests. Bad Entrepreneur, if gets the chance to move, defaults with certainty. Formally:

- $\sigma_t^{Inv}(h_t) = 0$ for all $t = 1, ..., T$.
- $\sigma_t^E(h_t) = 0$ for $t \geq 1$, and for all h_t.
- Equilibrium beliefs: $p_t(h_t) = p_1$ for all h_t. [26]

If $q > \frac{(1+r)(T-1)}{(1+r)T-r}$ and $p_1 < \frac{1-(T-1)r(1-q)}{1-(T-1)r(1-q)+Tr}$, Investor never invests. Bad Entrepreneur, if gets the chance to move, defaults with certainty. The equilibrium is formally as above.

B Proofs

B.1 Lemma 2 (Public regime $M = 4$)

Lemma 2. *If $M = 4$, and given the initial prior p_1, the unique PBE of the game is characterized by the following strategies.*

- *If $p_1 \geq \frac{1}{1+r}$, Investor invests in every period if all earlier investments have been repaid. If a default occurs, Investor invests never again. Entrepreneur repays with certainty in periods 1 and 2, and defaults in period 3. Equilibrium beliefs: $p_t(h_t) = p_1$.*
- *If $\frac{1}{(1+r)^2} \leq p_1 < \frac{1}{1+r}$, Entrepreneur repays with certainty in period 1, with probability $\frac{rp_1}{1-p_1}$ in period 2, and defaults in period 3. Investor invests in periods 1 and 2 with certainty if there has been no default. In period 3, if all previous investments have been repaid, Investor invests with probability $\frac{1+r}{4}$. If a default occurs, Investor invests never again. Equilibrium beliefs: $p_2(I,R) = p_1$, $p_3(I,R,I,R) = \frac{1}{1+r}$, and $p_2(h_2) = p_3(h_3) = 0$ if $D \in h_t$.*

[26]Possible out-of-equilibrium beliefs could be $p_t(h_t) = p_1$ for all h_t.

- *If* $\frac{1}{(1+r)^3} \leq p_1 < \frac{1}{(1+r)^2}$*, Entrepreneur repays in periods* 1 *and* 2 *with probabilities* $\frac{(1+r)^2 p_1 - p_1}{1-p_1}$ *and* $\frac{1}{2+r}$*, respectively, and defaults in period* 3*. Investor invests in period* 1 *with certainty, and in periods* 2 *and* 3 *with probability* $\frac{1+r}{4}$ *if no default has occurred. If a default occurs, Investor does not invest in any remaining period. Equilibrium beliefs:* $p_2(I, R) = \frac{1}{(1+r)^2}$*,* $p_3(I, R, I, R) = \frac{1}{1+r}$*, and* $p_2(h_2) = p_3(h_3) = 0$ *if* $D \in h_t$*.*

- *If* $p_1 < \frac{1}{(1+r)^3}$*, Investor does not invest in any period. If an investment is made in period* 1*, Entrepreneur defaults with certainty. Equilibrium beliefs:* $p_1 = p_2(h_2) = p_3(h_3)$*.* [27]

Proof. Consider the set of priors $p_1 \geq \frac{1}{1+r}$. Given the strategy of E, Investor faces no risk of default in any period except the last. Since an investment is optimal in the last period if $p_3(h_3) \geq \frac{1}{1+r}$, and given equilibrium beliefs, by which $p_3(h_3) = p_1$, investing is optimal in each of the three periods. Given Entrepreneur's strategy, Investor's expected payoff from investing with certainty in all periods is given by $3p_1 r + (1 - p_1)(2r - 1)$, that is, investing is optimal over not investing at all if $p_1 \geq \frac{1-2r}{1+r}$ which holds for all $r \in (0, 1]$. Investor has no incentive to deviate and stop investing earlier than suggested by the equilibrium since that would yield her a lower expected payoff. By Lemma 1, bad Entrepreneur has incentives to repay until the last period and has hence no incentive to deviate from the suggested equilibrium strategy.

Consider priors $\frac{1}{(1+r)^2} \leq p_1 < \frac{1}{1+r}$. Let us check that no player has an incentive to deviate from the proposed equilibrium. Given Entrepreneur's strategy, Investor's posterior belief at the beginning of period 3 is given by Bayes Rule as

$$p_3(h_3) = \frac{p_2(h_2)}{p_2(h_2) + (1 - p_2(h_2))\sigma_2^E} \tag{10}$$

where, given that Entrepreneur repays in period 1 with certainty, $p_2(h_2) = p_1$. Inserting in the above $\sigma_2^E = \frac{rp_1}{1-p_1}$, it can be shown that equilibrium belief $p_3(h_3) = \frac{1}{1+r}$ which makes Investor indifferent between investing and not investing in period 3.

Given Entrepreneur's strategy, Investing in period 2 is optimal over not investing if

$$p_2(h_2)r + (1 - p_2(h_2)) \left[\sigma_2^E r - (1 - \sigma_2^E)\right] \geq 0 \tag{11}$$

[27]Possible out-of-equilibrium beliefs could be $p_t(h_t) = p_1$ for all h_t.

where expected payoff from period 3 is 0 and omitted from the equation. Substituting for $\sigma_2^E = \frac{rp_1}{1-p_1}$, the above condition holds if $p_2(h_2) \geq \frac{1}{(1+r)^2}$ which holds by assumption.

In period 1, investor's expected payoff from investing in periods 1 and 2, and randomizing in period 3 is given by

$$2p_1 r + (1-p_1)\left[r + \sigma_2^E r - (1-\sigma_2^E)\right] \geq 0 \tag{12}$$

where expected payoff from period 3 is 0 and therefore omitted. Substituting for $\sigma_2^E = \frac{rp_1}{1-p_1}$ and rearranging shows that Investor invests in period 1 if $p_1 \geq \frac{1-r}{1+3r}$ which holds by assumption: $\frac{1-r}{1+3r} < \frac{1}{(1+r)^2}$ for all $r \in (0,1]$. Since investing is optimal over not investing both in period 1 and in period 2, any deviation from the proposed equilibrium would yield the Investor a strictly lower expected payoff.

Consider then the Entrepreneur and assume that the Investor plays according to the proposed equilibrium. By Lemma 1, Entrepreneur has an incentive to repay until the last period. He obviously has no incentive to deviate from defaulting in period 3. In period 2, repaying yields him an expected payoff of $4-(1+r)+\sigma_3^{Inv}(h_3)V_3(h_3)$, where continuation payoff $V_3(h_3)=4$. Not repaying in period 2 would give him a payoff of 4 from the remainder of the game. His indifference condition,

$$4-(1+r)+4\sigma_3^{Inv}(h_3) = 4 \tag{13}$$

can be shown to hold exactly when $\sigma_3^{Inv}(h_3) = \frac{1+r}{4}$ as suggested by the equilibrium. Moreover, Entrepreneur has no incentive to deviate from the proposed equilibrium. If he repays in period 1 with less than certainty, his expected payoff from the game would be lower because the game might end already after period 1, depriving him of his positive continuation payoffs. If he repays in period 2 with a probability $\sigma_2^E - \epsilon$, for any $\epsilon > 0$ his expected payoff $4-(1+r)+(\sigma_2^E-\epsilon)(4-1-r+4)+(1-\sigma_2^E+\epsilon)4$ is strictly lower than his expected payoff in the proposed equilibrium, $4-(1+r)+(\sigma_2^E)(4-1-r+4)+(1-\sigma_2^E)4$. If he repays in period 2 with probability $\sigma_2^E+\epsilon$, then for any $\epsilon>0$, Investor's posterior belief at the beginning of period 3 would not be enough for her to invest in the last period, and Entrepreneur's expected payoff would be given by $4-(1+r)+(\sigma_2^E+\epsilon)(4-1-r)+(1-\sigma_2^E-\epsilon)4$. For any $\epsilon>0$ this is strictly lower than in the proposed equilibrium.

Consider priors $\frac{1}{(1+r)^3} \leq p_1 < \frac{1}{(1+r)^2}$. Assume that the Entrepreneur follows the equilibrium strategy and consider the Investor. It is easy to show, using Bayes Rule, that Entrepreneur's proposed strategy gives rise to the equilibrium beliefs as proposed by the equilibrium. Given equilibrium beliefs, Investor is indifferent between investing and not investing in period 3 and has hence no incentive to deviate.

In period 2, investor is indifferent between investing and not investing if

$$p_2 r + (1-p_2)\left[\sigma_2^E r - (1-\sigma_2^E)\right] = 0, \tag{14}$$

which holds when $\sigma_2^E = \frac{1-(1+r)p_2}{(1-p_2)(1+r)}$. Substituting for equilibrium belief $p_2(h_2) = \frac{1}{(1+r)^2}$, the condition reduces to $\sigma_2^E = \frac{1}{2+r}$ as suggested by the equilibrium.

In period 1, investor has no incentive to deviate from investing if

$$p_1 r + (1-p_1)\left[\sigma_1^E r - (1-\sigma_1^E)\right] \geq 0 \tag{15}$$

where expected payoff from periods 2 and 3 is 0 and therefore omitted. Substituting for $\sigma_1^E = \frac{(1+r)^2 p_1 - p_1}{1-p_1}$ and rearranging shows that Investor invests in period 1 if $p_1 \geq \frac{1}{(1+r)^3}$ which holds by assumption.

Consider the Entrepreneur and assume that the Investor follows the equilibrium strategy. Entrepreneur's indifference condition in period 2 is characterized as

$$4-(1+r)+4\sigma_3^{Inv}(h_3) = 4 \tag{16}$$

which holds exactly when $\sigma_3^{Inv}(h_3) = \frac{1+r}{4}$ as suggested by the equilibrium. In period 1, Entrepreneur is indifferent between repaying and defaulting if

$$4-(1+r)+\sigma_2^{Inv} V_2(h_2) = 4 \tag{17}$$

where continuation payoff from period 2 onward,$V_2(h_2)$, must equal 4 given that Entrepreneur is indifferent in period 2 between repaying and defaulting. Given Investor's strategy, Entrepreneur is indifferent in period 1, too. Moreover, he has no incentive to deviate from his proposed mixed strategy, neither in period 1 nor in period 2. Repaying with a lower probability in period 1 would yield expected payoff of $(\sigma_1^E - \epsilon)(4 - 1 - r + 4) + (1 - \sigma_1^E + \epsilon)4$ which for all $\epsilon > 0$ is strictly less than in the suggested equilibrium. Repaying in period 1 with a higher probability would induce a lower posterior belief of the Investor who would not continue investing in period 2. Therefore, expected payoff $(\sigma_1^E + \epsilon)(4 - 1 - r) + (1 - \sigma_1^E - \epsilon)4$ is strictly less than in the proposed equilibrium for all $\epsilon > 0$.

□

B.2 Lemma 3 (Public regime $M = 1$)

Lemma 3. *If $M = 1$, the unique PBE of the game is characterized by the following strategies:*

- *Investor invests in the first period if $p_1 \geq \frac{1}{1+3r}$ and otherwise does not invest. In all later periods, Investor invests if all previous investments have been repaid.*
- *Entrepreneur defaults with certainty whenever an investment is made.*
- *Equilibrium beliefs: $p_2(I, R) = 1$, $p_2(I, D) = 0$, $p_3(h_3) = 1$ if $D \notin h_3$, and $p_3(h_3) = 0$ if $D \in h_3$.*
- *If $p_1 < \frac{1}{1+3r}$, no investments are made. If Entrepreneur gets to move, he defaults with certainty. Equilibrium beliefs: $p_1 = p_2(h_2) = p_3(h_3)$ where $h_2 =$ (Not invest), and $h_3 =$ (Not invest, Not invest).* [28]

Proof. Consider the Investor and assume Entrepreneur follows the proposed equilibrium strategy. Investing in period 1 is optimal if

$$3p_1 r - (1 - p_1) \geq 0 \tag{18}$$

which holds when $p_1 \geq \frac{1}{1+3r}$. By Lemma 1, Entrepreneur has no reputation concerns and his best response to Investor's strategy is to default immediately.

[28] Possible out-of-equilibrium beliefs could be $p_t(h_t) = p_1$ for all h_t.

□

B.3 Lemma 4 (Private regime)

Lemma 4. *The following strategies characterize the unique perfect Bayesian equilibrium of the three-period game and prior belief p_1 in the Private regime.*

- *for all p_1, $\sigma_t^E(h_t \mid M=1)=0$ for all t, and $\sigma_3^E(h_3 \mid M=4)=0$ for all h_3.*

When $q < \frac{r(1+r)^2}{(1+r)^3-1}$, and if

- *$p_1 \geq \frac{1-q}{1+r-q}$, the equilibrium is in pure strategies:*[29] *Investor invests in all periods with certainty. Bad Entrepreneur with $M=4$ repays in periods 1 and 2 with probability 1 and defaults in the last period. More formally:*
  - *$\sigma_1^{Inv}(\emptyset)=1$. For $t=2,3$, $\sigma_t^{Inv}(h_t)=1$ if $D \notin h_t$, else $\sigma_t^{Inv}(h_t)=0$.*
  - *For $t=1,2$, $\sigma_t^E(h_t \mid M=4)=1$ if $D \notin h_t$, else $\sigma_t^E(h_t \mid M=4)=0$.*
  - *Equilibrium beliefs: $p_2(I,R)=\frac{p_1}{p_1+(1-q)(1-p_1)}$, $p_3(I,R,I,R)=p_2$, and $p_t(h_t)=0$ if $D \in h_t$.*

- *$p_1 \in \left[\frac{1-q}{(1+r)^2-q}, \frac{1-q}{1+r-q},\right)$, Investor invests in periods 1 and 2, and randomizes in period 3. Bad Entrepreneur with $M=4$ repays in period 1, randomizes in period 2 and defaults in period 3 if given the opportunity. Formally:*
  - *$\sigma_1^{Inv}(\emptyset)=1$, $\sigma_2^{Inv}(h_2)=1$ if $h_2=(I,R)$, else $\sigma_2^{Inv}(h_2)=0$. $\sigma_3^{Inv}(h_3)=\frac{1+r}{4}$ if $h_3=(I,R,I,R)$, else $\sigma_3^{Inv}(h_3)=0$.*
  - *$\sigma_1^E(I \mid M=4)=1$, $\sigma_2^E(I,R,I \mid M=4)=\frac{rp_1}{(1-p_1)(1-q)}$.*
  - *Equilibrium beliefs: $p_2(I,R)=\frac{p_1}{p_1+(1-q)(1-p_1)}$, $p_3(I,R,I,R)=\frac{p_1}{p_1+(1-p_1)(1-q)\sigma_2^E}$ and $p_t(h_t)=0$ if $D \in h_t$.*

- *If $p_1 \in \left[\frac{1}{(1+r)^3}, \frac{1-q}{(1+r)^2-q}\right)$, Investor invests in period 1, and randomizes in periods 2 and 3. Bad Entrepreneur with $M=4$ randomizes in periods 1 and 2. Formally:*

[29] We assume that in the knife-edge case where $p_1=\frac{1-q}{1+r-q}$, if Entrepreneur repays with certainty, Investor invests with certainty in the last period. Investor randomizes her action in equilibrium only if E randomizes in the previous period.

– $\sigma_1^{Inv}(\emptyset) = 1$, $\sigma_2^{Inv}(I,R) = \sigma_3^{Inv}(I,R,I,R) = \frac{1+r}{4}$. *For all other histories,* $\sigma_t^{Inv}(h_t) = 0$.

– $\sigma_1^E(I \mid M=4) = \frac{(1+r)^2 p_1 - p_1}{(1-p_1)(1-q)}$, $\sigma_2^E(I,R,I \mid M=4) = \frac{1}{2+r}$.

– *Equilibrium beliefs:* $p_2(I,R) = \frac{p_1}{p_1+(1-q)(1-p_1)\sigma_1^E}$, $p_3(I,R,I,R) = \frac{p_1}{p_1+(1-q)(1-p_1)\sigma_1^E\sigma_2^E}$, *and* $p_t(h_t) = 0$ *if* $D \in h_t$.

- *If* $p_1 \in \left[0, \frac{1}{(1+r)^3}\right)$, *Investor does not invest in any period. Bad Entrepreneur with* $M=4$, *if given the chance to move, defaults in all periods. Formally:*

  – $\sigma_t^{Inv}(h_t) = 0$ *for all* h_t.

  – $\sigma_t^E(h_t \mid M=4) = 0$ *for all* h_t.

  – *Equilibrium beliefs:* $p_1 = p_2(NI) = p_3(NI,NI)$. [30]

If $q \in \left[\frac{r(1+r)^2}{(1+r)^3-1}, \frac{2+2r}{3+2r}\right)$, *and if*

- $p_1 \geq \frac{1-q}{1+r-q}$, *the equilibrium is in pure strategies as outlined above.*

- $p_1 \in \left[\frac{q+(1-q)(1-r)}{(1+r)^2+qr}, \frac{1-q}{1+r-q}\right)$, *Investor invests in periods 1 and 2, and randomizes in period 3. Bad Entrepreneur with* $M=4$ *repays in period 1, randomizes in period 2 and defaults in period 3 if given the opportunity. The equilibrium is formally as outlined above.*

- $p_1 < \frac{q+(1-q)(1-r)}{(1+r)^2+qr}$, *no equilibrium with investments can be sustained. Equilibrium is formally as outlined above.*

If $q > \frac{2+2r}{3+2r}$, *and if*

- $p_1 \geq \frac{1+2qr-2r}{1+2qr+r}$, *the equilibrium is in pure strategies as outlined above.*

- $p_1 < \frac{1+2qr-2r}{1+2qr+r}$, *no equilibrium with investments can be sustained. The equilibrium is formally identical to the ones outlined above.*

Proof. Assume that $q < \frac{r(1+r)^2}{(1+r)^3-1}$ and consider an equilibrium in pure strategies. Working backwards, investing in the last period is optimal if and only if $p_3(h_3) \geq \frac{1}{2}$. Since there is

[30] Possible out-of-equilibrium beliefs could be $p_t(h_t) = p_1$ for all h_t.

no learning after the first period, it must be that the posterior belief of the Investor at the beginning of period 2 must be at least $\frac{1}{1+r}$. That is,

$$\frac{p_1}{p_1 + (1-q)(1-p_1)} \geq \frac{1}{1+r} \tag{19}$$

or $p_1 \geq \frac{1-q}{1+r-q}$.

Checking that Investor has no incentive to deviate: Given Entrepreneur's strategy, after a repayment, investing in period 2 is optimal if and only if:

$$2rp_2 + (1-p_2)(r-1) \geq 0 \tag{20}$$

which holds for all $p_2 \geq \frac{1-r}{1+r}$. Given Entrepreneur's strategy, equilibrium beliefs $p_2(h_2) \geq \frac{1}{1+r}$ satisfy the condition and investing in period 2 is optimal for Investor.

Given Entrepreneur's strategy, investing is optimal in period 1 if and only if:

$$3rp_1 + (1-p_1)\left[(1-q)(2r-1) - q\right] \geq 0 \tag{21}$$

which can be shown to hold for all $p_1 \geq \frac{1+2qr-2r}{1+2qr+r}$. Hence, a pure strategy equilibrium can be sustained for all $p_1 \geq \max\left\{\frac{1-q}{1+r-q}, \frac{1+2qr-2r}{1+2qr+r}\right\}$. Further, it can be shown that, under the initial assumptions on q, $\max\left\{\frac{1-q}{1+r-q}, \frac{1+2qr-2r}{1+2qr+r}\right\} = \frac{1-q}{1+r-q}$.

Given Investor's strategy, bad Entrepreneur has no incentive to deviate: if he defaults prior to period 3, the game ends and Entrepreneur loses his positive continuation payoffs.

Consider now priors $p_1 \in \left[\frac{1-q}{(1+r)^2-q}, \frac{1-q}{1+r-q}\right)$ and assume that all players follow the equilibrium strategies outlined in the Lemma. Let us check that no player has an incentive to deviate.

Working backwards, Investor is willing to mix in period 3 if her belief $p_3(h_3) = \frac{1}{1+r}$. Using Entrepreneur's equilibrium strategy and Bayes' Rule, it is easy to show that they give rise to this posterior belief. Given Entrepreneur's strategy, Investor invests in period 2 if

$$p_2(R)r + (1-p_2(R))\left[\sigma_2^E r - (1-\sigma_2^E)\right] \geq 0 \tag{22}$$

where it is enough to consider the expected payoff from period 2 since expected payoff from period 3 must equal 0 given that Investor is indifferent between investing and not investing. From equation (22), investing is optimal if $\sigma_2^E \geq \frac{1-p_2(1+r)}{(1-p_2)(1+r)}$. In equilibrium, Entrepreneur's strategy must satisfy the following condition which ensures that Investor's posterior beliefs make her indifferent between investing and not investing in period 3:

$$\frac{p_2}{p_2 + (1-p_2)\sigma_2^E} = \frac{1}{1+r} \tag{23}$$

from where one can solve that $\sigma_2^E = \frac{rp_2}{1-p_2}$.

Comparing this to Entrepreneur's equilibrium strategy it can be shown, using some simple algebra, that

$$\frac{rp_2}{1-p_2} \geq \frac{1-p_2(1+r)}{(1-p_2)(1+r)} \tag{24}$$

if $p_2(h_2) \geq \frac{1}{(1+r)^2}$. Given Entrepreneur's strategy, equilibrium posterior belief $p_2(h_2) = \frac{p_1}{p_1+(1-p_1)(1-q)}$. It can be shown that $\frac{p_1}{p_1+(1-p_1)(1-q)} \geq \frac{1}{(1+r)^2}$ for all $p_1 \geq \frac{1-q}{(1+r)^2-q}$.

Given Entrepreneur's strategy, investing is optimal in period 1 if

$$2rp_1 + (1-p_1)\left\{q(-1) + (1-q)\left[r(1+\sigma_2^E) - (1-\sigma_2^E)\right]\right\} \geq 0 \tag{25}$$

Substituting for σ_2^E, the above condition can be rewritten as

$$2rp_1 + (1-p_1)\left\{q(-1) + (1-q)\left[r + \frac{r^2p_1}{(1-p_1)(1-q)} - \frac{(1-p_1)(1-q) - rp_1}{(1-p_1)(1-q)}\right]\right\} \geq 0 \tag{26}$$

which can be rewritten as

$$2rp_1 - (1-p_1)q + (1-p_1)(1-q)r + r^2p_1 - (1-p_1)(1-q) + rp_1 \geq 0. \tag{27}$$

After some rearranging it can be shown that investing is optimal if

$$p_1 \geq \frac{q + (1-q)(1-r)}{(1+r)^2 + qr}. \tag{28}$$

Hence, given Entrepreneur's strategy, Investor does not have incentive to deviate from her strategy as long as $p_1 \geq \max\left\{\frac{1-q}{(1+r)^2-q}, \frac{q+(1-q)(1-r)}{(1+r)^2+qr}\right\}$. Further, it can be shown that $\max\left\{\frac{1-q}{(1+r)^2-q}, \frac{q+(1-q)(1-r)}{(1+r)^2+qr}\right\} = \frac{1-q}{(1+r)^2-q}$ if $q < \frac{r(1+r)^2}{(1+r)^3-1}$.

Consider the Entrepreneur with $M = 4$. He is indifferent between repaying an defaulting in period 2 if and only if

$$4 - (1+r) + 4\sigma_3^{Inv} = 4 \tag{29}$$

that is, if and only if $\sigma_3^{Inv} = \frac{1+r}{4}$ which is in line with the Investor's proposed equilibrium strategy. Given Investor's equilibrium strategy, repaying in period 1 is optimal if and only if $4-(1+r)+4 \geq 4$ which holds for all r. Notice that the continuation payoff after repaying in period 1 is given by 4 because of the indifference condition in (29).

Consider then priors $p_1 \in \left[\frac{1}{(1+r)^3}, \frac{1-q}{(1+r)^2-q}\right)$ and the equilibrium strategies outlined in the Lemma. Let us check that no player has an incentive to deviate.

Given equilibrium strategy of the Entrepreneur and using Bayes Rule, one can show that Investor's beliefs at the beginning of period 2 are given by $\frac{1}{(1+r)^2}$ and at the beginning of period 3 given by $\frac{1}{1+r}$. These beliefs make the Investor indifferent between investing or not investing in period 2 and 3, respectively. For the indifference condition for period 2 we refer to equations (22), (23) and (24) earlier in the proof.

In period 1, investor has no incentive to deviate as long as her expected payoff from the first period is larger than 0. That is, if

$$p_1 r + (1-p_1)\left\{q(-1) + (1-q)\left[\sigma_1^E r - (1-\sigma_1^E)\right]\right\} \geq 0. \tag{30}$$

After substituting for σ_1^E one can show using simple algebra that the above condition holds for all $p_1 \geq \frac{1}{(1+r)^3}$, in line with the underlying assumptions.

Consider the Entrepreneur. It is easy to show that given Investor's proposed strategy, the bad Entrepreneur has no incentive to deviate from his proposed strategies: If he would repay in period 1 with a higher probability, Investor's posterior belief would be too low for her to invest in the next period and the game would end before period 3. If he would repay with a lower probability, it would increase the probability that the game ends before period 3, thereby reducing his expected payoff from the game.

For priors lower than $\frac{1}{(1+r)^3}$, Investor never invests because condition (30) does not hold anymore. This leaves room for defining Entrepreneur's strategy. Given E's strategy outlined in the Lemma, Investor's best response is not to invest. Given the off-the-equilibrium beliefs of the Investor, even an Entrepreneur with a high M would default because a repayment would not lead Investor to revise her beliefs and make a reinvestment.

Now assume that $q > \frac{r(1+r)^2}{(1+r)^3-1}$ but $q \leq \frac{2+2r}{3+2r}$. It can be shown that under these conditions, $\max\left\{\frac{1-q}{1+r-q}, \frac{1+2qr-2r}{1+2qr+r}\right\} = \frac{1-q}{1+r-q}$. Referring to the earlier proof, a pure strategy equilibrium exists for all priors $p_1 \geq \frac{1-q}{1+r-q}$. Consider priors $p_1 < \frac{1-q}{1+r-q}$. Under the assumptions on q, it can be shown that $\max\left\{\frac{1-q}{(1+r)^2-q}, \frac{q+(1-q)(1-r)}{(1+r)^2+qr}\right\} = \frac{q+(1-q)(1-r)}{(1+r)^2+qr}$. Referring to earlier parts of the proof, it can be shown that all conditions from (22) to (29) hold and a mixed-strategy equilibrium as suggested in the Lemma can be sustained for priors $p_1 \in \left[\frac{q+(1-q)(1-r)}{(1+r)^2+qr}, \frac{1-q}{1+r-q}\right)$. Consider then priors $p_1 < \frac{q+(1-q)(1-r)}{(1+r)^2+qr}$. A mixed-strategy equilibrium consisting of Entrepreneur randomizing in period 1 cannot be sustained because $\frac{1-q}{(1+r)^2-q} < \frac{1}{(1+r)^3}$. This means that any equilibrium with Entrepreneur randomizing in period 1 would require Entrepreneur to repay in period 1 with a probability higher than 1. Put differently, bad Entrepreneur would always have an incentive to deviate from his mixed strategy in period 1 because repaying with certainty would induce a high enough posterior belief for the Investor to continue investing in period 2. However, for this range of p_1, Entrepreneur repaying with certainty in period 1 cannot be sustained either. Entrepreneur's off-the-equilibrium strategy is not uniquely pinned down but it is easy to show that the characterization in the Lemma is consistent with Investor choosing to not invest.

Finally, assume that $q > \frac{2+2r}{3+2r}$. An equilibrium in pure strategies exists for all $p_1 \geq \frac{1+2qr-2r}{1+2qr+r}$ as outlined earlier in the proof. However, all mixed-strategy equilibria unravel because under the assumption on q, $\frac{1-q}{1+r-q} < \frac{q+(1-q)(1-r)}{(1+r)^2+qr}$ and $\frac{1-q}{(1+r)^2-q} < \frac{1}{(1+r)^3}$.

The former of these conditions implies that a mixed-strategy equilibrium with Entrepreneur randomizing in period 2 cannot be sustained. Following (19), for all priors above $\frac{1-q}{1+r-q}$, Investor's posterior belief is larger than $\frac{1}{1+r}$ when Entrepreneur repays with certainty in period 1. For any $p_1 \geq \frac{q+(1-q)(1-r)}{(1+r)^2+qr}$, this leaves no room for randomizing in period 2 as Investor's posterior belief would already be above the threshold for investing in the last period. To put it differently, the mixed strategy equilibrium would require Entrepreneur to repay with a probability larger than 1. On the other hand, an equilibrium in pure strategies cannot be sustained either, since the incentive condition in (21) does not hold.

The latter condition, $\frac{1-q}{(1+r)^2-q} < \frac{1}{(1+r)^3}$, implies that an equilibrium with the Entrepreneur mixing in periods 1 and 2 cannot be sustained either, as argued earlier in the proof.

□

B.4 Proof of Proposition 1

Proof. **Public regime:** Ex-ante expected payoffs generally:

- $p_1 \geq \frac{1}{1+r}$: $\Pr(M=1)\,[3rp_1 - (1-p_1)] + \Pr(M=4)\,[3rp_1 + (1-p_1)(2r-1)]$
- $p_1 \in \left[\frac{1}{(1+r)^2}, \frac{1}{1+r}\right)$: $\Pr(M=1)\,[3rp_1 - (1-p_1)] + \Pr(M=4)\left[r - 1 + (1+r)^2 p_1\right]$
- $p_1 \in \left[\frac{1}{1+3r}, \frac{1}{(1+r)^2}\right)$: $\Pr(M=1)\,[3rp_1 - (1-p_1)] + \Pr(M=4)\left[(1+r)^3 p_1 - 1\right]$
- $p_1 \in \left[\frac{1}{(1+r)^3}, \frac{1}{1+3r}\right)$: $\Pr(M=4)\left[(1+r)^3 p_1 - 1\right]$
- $p_1 < \frac{1}{(1+r)^3}$: 0

With $r = 1$ and $\Pr(M=1) = q$, and $\Pr(M=4) = 1-q$ the above reduce to:

- $p_1 \geq \frac{1}{2}$: $q\,(4p_1 - 1) + (1-q)\,(2p_1 + 1)$
- $p_1 \in \left[\frac{1}{4}, \frac{1}{2}\right)$: $q\,(4p_1 - 1) + (1-q)\,(4p_1)$
- $p_1 \in \left[\frac{1}{8}, \frac{1}{4}\right)$: $(1-q)\,(8p_1 - 1)$
- $p_1 < \frac{1}{8}$: 0

Private regime: Given $r = 1$, following thresholds arise: $\frac{1-q}{1+r-q} = \frac{1-q}{2-q}$, $\frac{1+2qr-2r}{1+2qr+r} = \frac{2q-1}{2q+2}$, $\frac{1-q}{(1+r)^2-q} = \frac{1-q}{4-q}$, $\frac{q+(1-q)(1-r)}{(1+r)^2+qr} = \frac{q}{4+q}$, and $\frac{1}{(1+r)^3} = \frac{1}{8}$. Moreover, $\frac{2+2r}{3+2r} = \frac{4}{5}$, and $\frac{r(1+r)^2}{(1+r)^3-1} = \frac{4}{7}$. Expected payoffs:

When $q \leq \frac{4}{7}$, and

- $p_1 \geq \frac{1-q}{2-q}$: $\Pr(M=1)\left[3rp_1-(1-p_1)\right]+\Pr(M=4)\left[3rp_1+(1-p_1)(2r-1)\right]=q(4p_1-1)+(1-q)(2p_1+1)$
- $p_1 \in \left[\frac{1-q}{4-q}, \frac{1-q}{2-q}\right)$: $r+\left[(1+r)^2p_1-1\right]-(1-p_1)\Pr(M=1)r=4p_1-q(1-p_1)$
- $p_1 \in \left[\frac{1}{8}, \frac{1-q}{4-q}\right)$: $(1+r)^3p_1-1=8p_1-1$
- $p_1 < \frac{1}{8}$: 0

When $q \in \left(\frac{4}{7}, \frac{4}{5}\right]$, and

- $p_1 \geq \frac{1-q}{2-q}$: $\Pr(M=1)\left[3rp_1-(1-p_1)\right]+\Pr(M=4)\left[3rp_1+(1-p_1)(2r-1)\right]=q(4p_1-1)+(1-q)(2p_1+1)$
- $p_1 \in \left[\frac{q}{4+q}, \frac{1-q}{2-q}\right)$: $r+\left[(1+r)^2p_1-1\right]-(1-p_1)\Pr(M=1)r=4p_1-q(1-p_1)$
- $p_1 < \frac{q}{4+q}$: 0

When $q > \frac{4}{5}$, and

- $p_1 \geq \frac{2q-1}{2q+2}$: $\Pr(M=1)\left[3rp_1-(1-p_1)\right]+\Pr(M=4)\left[3rp_1+(1-p_1)(2r-1)\right]=q(4p_1-1)+(1-q)(2p_1+1)$
- $p_1 < \frac{2q-1}{2q+2}$: 0

Moreover, following orderings can be established.

$\frac{1-q}{2-q} < \frac{1}{2}$ for all $q > 0$, $\frac{1-q}{2-q} < \frac{1}{4}$ when $q > \frac{2}{3}$, and $\frac{2q-1}{2q+2} < \frac{1}{4}$ for all $q < 1$.

With this information, following intervals of prior beliefs can be established as a function of q.

- When $q \leq \frac{4}{7}$: $p_1 \geq \frac{1}{2}$, $p_1 \in \left[\frac{1-q}{2-q}, \frac{1}{2}\right)$, $p_1 \in \left[\frac{1}{4}, \frac{1-q}{2-q}\right)$, $p_1 \in \left[\frac{1-q}{4-q}, \frac{1}{4}\right)$, $p_1 \in \left[\frac{1}{8}, \frac{1-q}{4-q}\right)$, and $p_1 < \frac{1}{8}$.
- When $q \in \left(\frac{4}{7}, \frac{2}{3}\right]$: $p_1 \geq \frac{1}{2}$, $p_1 \in \left[\frac{1-q}{2-q}, \frac{1}{2}\right)$, $p_1 \in \left[\frac{1}{4}, \frac{1-q}{2-q}\right)$, $p_1 \in \left[\frac{q}{4+q}, \frac{1}{4}\right)$, $p_1 \in \left[\frac{1}{8}, \frac{q}{4+q}\right)$, and $p_1 < \frac{1}{8}$.
- When $q \in \left(\frac{2}{3}, \frac{4}{5}\right]$: $p_1 \geq \frac{1}{2}$, $p_1 \in \left[\frac{1}{4}, \frac{1}{2}\right)$, $p_1 \in \left[\frac{1-q}{2-q}, \frac{1}{4}\right)$, $p_1 \in \left[\frac{q}{4+q}, \frac{1-q}{2-q}\right)$, $p_1 \in \left[\frac{1}{8}, \frac{q}{4+q}\right)$, and $p_1 < \frac{1}{8}$.
- When $q > \frac{4}{5}$, $p_1 \geq \frac{1}{2}$: $p_1 \in \left[\frac{1}{4}, \frac{1}{2}\right)$, $p_1 \in \left[\frac{2q-1}{2q+2}, \frac{1}{4}\right)$, $p_1 \in \left[\frac{1}{8}, \frac{2q-1}{2q+2}\right)$, and $p_1 < \frac{1}{8}$.

Result follows by comparing expected payoffs between Public and Private regime for each of the above detailed intervals. For $p_1 \geq \frac{1}{2}$, and for $p_1 < \frac{1}{8}$, Investor's expected payoff is identical across information regimes, so non-trivial comparisons arise when $p \in \left[\frac{1}{8}, \frac{1}{2}\right)$.

□

B.5 Proof of Proposition 2

Proof. Result follows directly by comparing the following ex-ante expected payoffs of the Entrepreneur, where the expressions after the equality sign are obtained after substituting for $r = 1$, $\Pr(M = 1) = \frac{1}{2}$, $\Pr(M = 4) = \frac{1}{2}$, and $\sigma_2^{Inv} = \sigma_3^{Inv} = \frac{1}{2}$.

Public regime:

- $p_1 \geq \frac{1}{1+r} = \frac{1}{2}$:
  - Good E: $\Pr(M = 1) \cdot 3\,[1 - (1 + r)] + \Pr(M = 4) \cdot 3\,[4 - (1 + r)] = -3q + 6(1 - q)$
  - Bad E: $\Pr(M = 1) \cdot 1 + \Pr(M = 4)\,[2 \cdot (4 - (1 + r)) + 4] = q + 8(1 - q)$
- $p_1 \in \left[\frac{1}{(1+r)^2}, \frac{1}{1+r}\right) = \left[\frac{1}{4}, \frac{1}{2}\right)$:
  - Good E: $\Pr(M = 1)\,[1 - (1 + r)] \cdot 3 + \Pr(M = 4)\,[4 - (1 + r)]\left(2 + \sigma_3^{Inv}\right) = -3q + 5(1 - q)$
  - Bad E: $\Pr(M = 1) \cdot 1 + \Pr(M = 4)\,[(4 - (1 + r)) + 4] = q + 6(1 - q)$
- $p_1 \in \left[\frac{1}{(1+r)^3}, \frac{1}{1+3r}\right) = \left[\frac{1}{8}, \frac{1}{4}\right)$:
  - Good E: $\Pr(M = 1) \cdot 0 + \Pr(M = 4)\,[4 - (1 + r)]\left(1 + \sigma_2^{Inv} + \sigma_2^{Inv}\sigma_3^{Inv}\right) = \frac{7}{2}(1 - q)$
  - Bad E: $\Pr(M = 1) \cdot 0 + \Pr(M = 4) \cdot 4 = 4(1 - q)$

Private regime:

When $q \leq \frac{4}{7}$, and

- $p_1 \geq \frac{1-q}{2-q}$,
  - Good E: $\Pr(M = 1)\,[1 - (1 + r)] \cdot 3 + \Pr(M = 4)\,[4 - (1 + r)] \cdot 3 = -3q + 6(1 - q)$
  - Bad E: $\Pr(M = 1) \cdot 1 + \Pr(M = 4)\,[(4 - (1 + r)) \cdot 2 + 4] = q + 8(1 - q)$
- $p_1 \in \left[\frac{1-q}{4-q}, \frac{1-q}{2-q}\right)$,

– Good E: $\Pr(M=1)\left[1-(1+r)\right]\left(2+\sigma_3^{Inv}\right)+\Pr(M=4)\left[4-(1+r)\right]\left(2+\sigma_3^{Inv}\right)=-\frac{5}{2}q+5(1-q)$
– Bad E: $\Pr(M=1)\cdot 1+\Pr(M=4)\left[4-(1+r)+4\right]=q+6(1-q)$

- $p_1 \in \left[\frac{1}{8}, \frac{1-q}{4-q}\right)$,
  – Good E: $\{\Pr(M=1)\left[1-(1+r)\right]+\Pr(M=4)\left[4-(1+r)\right]\}\left(1+\sigma_2^{Inv}+\sigma_2^{Inv}\sigma_3^{Inv}\right)=-\frac{7}{4}q+\frac{7}{2}(1-q)$
  – Bad E: $\Pr(M=1)\cdot 1+\Pr(M=4)\cdot 4=q+4(1-q)$
- $p_1 < \frac{1}{8}: 0$

When $q \in \left(\frac{4}{7}, \frac{4}{5}\right]$, and

- $p_1 \geq \frac{1-q}{2-q}$,
  – Good E: $\Pr(M=1)\left[1-(1+r)\right]\cdot 3+\Pr(M=4)\left[4-(1+r)\right]\cdot 3=-3q+6(1-q)$
  – Bad E: $\Pr(M=1)\cdot 1+\Pr(M=4)\left[(4-(1+r))\cdot 2+4\right]=q+8(1-q)$
- $p_1 \in \left[\frac{q}{4+q}, \frac{1-q}{2-q}\right)$,
  – Good E: $\Pr(M=1)\left[1-(1+r)\right]\left(2+\sigma_3^{Inv}\right)+\Pr(M=4)\left[4-(1+r)\right]\left(2+\sigma_3^{Inv}\right)=-\frac{5}{2}q+5(1-q)$
  – Bad E: $\Pr(M=1)\cdot 1+\Pr(M=4)\left[4-(1+r)+4\right]=q+6(1-q)$
- $p_1 < \frac{q}{4+q}: 0$

When $q > \frac{4}{5}$, and

- $p_1 \geq \frac{2q-1}{2q+2}$,
  – Good E: $\Pr(M=1)\left[1-(1+r)\right]\cdot 3+\Pr(M=4)\left[4-(1+r)\right]\cdot 3=-3q+6(1-q)$
  – Bad E: $\Pr(M=1)\cdot 1+\Pr(M=4)\left[(4-(1+r))\cdot 2+4\right]=q+8(1-q)$
- $p_1 < \frac{2q-1}{2q+2}: 0$

The result follows from comparing expected payoffs across the regimes for the intervals of p_1 as outlined in the proof of Proposition 1. For $p_1 \geq \frac{1}{2}$, and for $p_1 < \frac{1}{8}$, Entrepreneur's expected payoff is identical across information regimes, so non-trivial comparisons arise when $p \in \left[\frac{1}{8}, \frac{1}{2}\right)$.

□

B.6 Proof of Lemma 5 (Commitment Equilibrium)

Expected payoffs in the **Public regime PBE** are as stated in the Proofs of Propositions 1 and 2 after substituting for $q = \frac{1}{2}$:

- $p_1 \geq \frac{1}{2}$: Investor: $3p_1$, Good E: 1.5, Bad E: 4.5
- $p_1 \in [\frac{1}{4}, \frac{1}{2})$: Investor: $4p_1 - \frac{1}{2}$, Good E: 1, Bad E: 3.5
- $p_1 \in [\frac{1}{8}, \frac{1}{4})$: Investor: $4p_1 - \frac{1}{2}$, Good E: $\frac{7}{4}$, Bad E: 2
- $p_1 < \frac{1}{8}$: 0 for all

In a **commitment equilibrium**, two investment thresholds arise. If $M = 4$ Investor invests if $3p_1 + (1 - p_1)(2 - 1) \geq 0$ which holds for all $p_1 \geq 0$. If $M = 1$ Investor invests if $p_1 \geq \frac{1}{4}$. Expected payoffs in a commitment equilibrium are given below.

- $p_1 \geq \frac{1}{4}$: Payoffs are as in the Public regime for $p_1 \geq \frac{1}{2}$. That is, Investor: $3p_1$, Good E: 1.5, Bad E: 4.5
- $p_1 \in [0, \frac{1}{4})$: Investor: $\frac{1}{2}(3p_1 + (1 - p_1)) = p_1 + \frac{1}{2}$, Good E: $\frac{1}{2}(4 - 2) \cdot 3 = 3$, Bad E: $\frac{1}{2}[(4 - 2) \cdot 2 + 4] = 4$

Comparing payoffs for each of the following cases proves the result: $p_1 \geq \frac{1}{2}$, $p_1 \in [\frac{1}{4}, \frac{1}{2})$, $p_1 \in [\frac{1}{8}, \frac{1}{4})$, $p_1 < \frac{1}{8}$.

Ex-ante expected payoffs in the **Private regime PBE** are as stated in the Proofs of Propositions 1 and 2 after substituting for $q = \frac{1}{2}$:

- $p_1 \geq \frac{1}{3}$: Investor: $3p_1$, Good E: 1.5, Bad E: 4.5
- $p_1 \in [\frac{1}{7}, \frac{1}{3})$: Investor: $\frac{9}{2}p_1 - \frac{1}{2}$, Good E: $\frac{5}{4}$, Bad E: 3.5
- $p_1 \in [\frac{1}{8}, \frac{1}{7})$: Investor: $8p_1 - 1$, Good E: $\frac{7}{8}$, Bad E: 2.5
- $p_1 < \frac{1}{8}$: 0 for all

In a **commitment equilibrium**, under the assumptions of r and q, Investor always makes the first investment. Therefore, players obtain the following expected payoffs for all priors $p_1 \geq 0$: Investor: $3p_1$, Good E: 1.5, Bad E: 4.5.

Comparing these payoffs to those in the Private regime PBE yields the result. $\square$