Never Seek that by Foul Means - Monitoring-, Which You May Have by Fair - Financial Reporting: An Experimental Study

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Abstract

We consider a principal-agent model in which a Creditor (principal) can monitor managers (agents) during the first stage of a lending relationship. Monitoring is motivated by the need to measure the economic viability of distressed firms in order to select reliable managers. Monitoring too much during the beginning of the lending relationship provides incentives to unreliable managers to invest in truthful reporting. In that case, rational cheaters can mimic reliable managers and the creditor monitors too much for nothing. However, no monitoring induces high cost of splitting with unreliable managers in a long-term relationship. Consequently, the creditor bears a long war of attrition. We provide experimental evidence based on this principal agent model. We study the hypothesis of a crowding out effect induced by an excessive monitoring.

Keywords: Incentives – Monitoring – Reporting - Screening –Experiments - Crowding-out effect.

JEL classification: D2, G3, M4, C9.

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1 Introduction

This paper investigates reporting strategies of managers and the resulting reactions to these reports by investors. The "expectation adjustment policy" predicts that managers will truthfully reveal their private information to align investors' expectations with their own (Ajinkya and Gift, 1984). However, from time to time, managers may benefit from issuing reports that manipulate market participant's beliefs about the firm's value. For instance, when a firm has performed poorly, we expect a manager to be more inclined to provide encouraging news about the firm's future prospects. Such a disclosure is aimed at convincing investors that they should maintain the manager in place because he is executing a business plan that will restore the company to financial health. However, managers' incentives to misreport their private information is affected by market participants' ability to assess the truthfulness of a management report.

The usefulness to test the reliability of managers is particularly important if one recognizes that creditors are uncertain about the economic viability of distressed firms. More specifically, creditors are typically interested in discriminating between two types of managers: those who are "intrinsically reliable", therefore make firm value-maximizing liquidation decisions and those who are instead "rational cheaters" and would persist with suboptimal projects if the probability of detection is sufficiently low. In this paper, we argue that creditors face a trade-off when deciding on the optimal monitoring policy in the beginning of a lending relationship.

On the one hand, continuous monitoring by creditors may be suboptimal since the probability of detection is very high so that "rational cheaters" would have no other choice to behave reliably. Consequently, creditors would never learn their types at a time when separation would be possible at a relatively low cost. On the other hand, random monitoring might be more revealing because "rational cheaters" would concede to cheat, and this allows discrimination between the two types of managers.

Furthermore, creditors are interested in identifying bad managers as early as possible, in order to avoid a long-term relationship when separation becomes too expensive. Reciprocally, bad managers have a strong incentive to mimic good managers because when separation becomes too costly they can misreport at no risk.

In the following, we briefly present the intuition of the model before the implications of the theory proposed in this paper are discussed in more detail.

We consider the following situation. We model a relationship between a lender and an entrepreneur that lasts at most two periods. At the beginning of the first period, an entrepreneur contacts investors to finance his project. Then each lender chooses his monitoring intensity. Subsequently, at time 1, after financing is done, the entrepreneur chooses his financial reporting strategy (or equivalently to truthfully report the firm's value or misrepresent their private information). Afterwards, at time 2, given the outcome of the monitoring procedure, the lender decides to immediately liquidate the firm or allow it to continue its operations. If the firm and its creditor can not agree, the firm is liquidated for a value normalized to zero and all parties receive nothing. If the firm and its creditor agree to reorganize the firm's debts, the firm continues to operate.[1] At time 3, if there is no liquidation, the project returns final cash flows. After repayments and cash flows are realized period 1 ends. In period 2, all remaining entrepreneurs again decide to report truthfully the firm's financial state or cheat. Then the game ends.

Overall, in the framework of this paper, less monitoring in the beginning of a relationship may screen out rational cheaters and thus is beneficial for the creditor if the cost of terminating the relationship increases over time. First is the suggestion that agents' actions are consistent with an individual's "identity". In our model, we distinguish between high-ability managers who are willing to build a reputation for truthful reporting unconditionally and low-ability managers who instead face reporting costs and therefore are potential cheaters. Hence, creditors is interested in evicting the latter. In the context of employment relationships, heterogeneity of agents with respect to the cost of exerting effort is supported by empirical evidence suggested by Nagin, Rebitzer, Sanders, and Taylor (2002), Ichino and Riphahn (2003), and Ichino and Muehlheusser (2003).[2] While their focus is on labor markets, ours is on credit markets for start-up finance.

Second, the model captures the idea that splitting from a agent and ending a lending relationship becomes more costly for the creditor as the length of the relationship increases. This assumption captures a feature that strongly characterizes firm-lender relationships. Recent empirical work has focused on how relationships between a firm and its potential lenders affect the firm's

[1] In our setting, renegotiation can occur either privately or in the bankruptcy courts. It is assumed to be immediate and costless.

[2] See also (Ichino, A., and Muehlheusser, G.,2003)

value. One group of studies demonstrates that the existence of a firm-lender relationship increases the value of the firm (Hoshi et al., 1990, James and Wier, 1990), whereas a second group measures the strength of that relationship (Berger and Udell, 1995, Petersen and Rajan, 1994). More specifically, they show that the length of the relationship affects the availability as well as the cost of credit. When a firm obtains financial services, the prospective lender may monitor the firm's use of the services to generate valuable information about the firm's financial condition. Hence, ending the relation may become increasingly costly for the lender because of sunk costs paid at some point during the relationship. In our model, the bank wants to identify low-ability managers as early as possible, in order not to remain stuck with them when a plan of reorganization becomes too expensive.

Finally, our paper is related to the literature on information disclosure. From the private information production incentives literature, disclosure can weaken the gain to private information production. In particular, Diamond (1985), Fishman and Hagerty (1992) consider that information disclosure by firms has a "crowding out" effect in that it may reduce the informational advantage that informed investors have and hence weaken their incentives to become informed at a cost. Moreover, the "crowding-out" theory suggests that tighter monitoring may reduce the overall effort because of the hidden cost of sanctions. More specifically, economic incentives may hinder intrinsic motivation if the agents are considered as being controlled, thus reducing either their self-esteem or self-determination.[3] Monitoring is thus considered as signaling a lack or a breach of trust. In this paper, we would like to test experimentally the trade-off creditors face when deciding on the optimal monitoring intensity in the beginning of a lending relationship. We study the hypothesis of a crowding out effect induced by an excessive monitoring.

The remainder of the paper is organized as follows. Section 2 presents the economic model. Section 3 analyzes the bank's decisions regarding the liquidation versus the continuation of the investment project. Section 4 presents our empirical findings.

[3]The existence of a crowding-out effect is however contested (Prendergast 1999) or neglected by economists, at the exception of Frey (1997), Frey and Oberholzer-Gee (1997), Bohnet et al. (2000), Gneezy and Rustichini (2000).

2 The basic model

2.1 The environment

We consider a lending relationship lasting at most two periods where an investor (a bank) faces $N \geq 1$ debtors (entrepreneurs). The first period is a probation period in which investors estimate the entrepreneur's eligibility for a loan program. The second period is the time after probation. All participants are risk neutral and the risk free rate is normalized to zero. There are two indistinguishable types at the beginning of the first period: high-ability types (H) and low-ability types (L). Let α be the proportion of entrepreneurs that are high-ability. This information is common knowledge.

At time 0, risk neutral entrepreneurs have access to a project that requires a fixed initial investment of \$1. Entrepreneurs have no wealth such that they must borrow from the bank to finance the project and have a zero reservation utility. The project is successful with probability p, in which case the entrepreneur gets cash flows of y. If the project fails, cash flows are zero. At the end of the first period, conditional on success, the entrepreneur has to repay d to the bank. We assume that managers are liable for payment to the bank only to the extent of current revenues. Therefore, the firm is restricted to a nonnegative cash flow,i.e. $d \leq y$. Given the outcome of the monitoring procedure, the project can be liquidated for a value normalized to zero or continued. If the project is continued, the entrepreneur obtains a fixed amount of working capital, K in period 2.

At time 1 after initiating the project, the manager learns privately whether the project is profitable. The profitability of the project determines the distribution of payoffs that are generated in the first period. Subsequently, the manager decides between revealing the firm's financial situation to the bank or manipulating earnings. In particular, managers choose an action from $\{T, C\}$ where T and C denote "truthful reporting" and "cheating", respectively.

During the probation period, the bank chooses the intensity of its monitoring activities, denoted by $\lambda \in [0, 1]$. Hence, the bank learns when misreporting has occurred with probability λ; with probability $(1 - \lambda)$, the bank will get no further information about the manager's reporting strategy. More specifically, the outcome of the monitoring activity is defined as $M \in \{T, C\}$ where T perfectly reveals that "truthful reporting" has occurred and C perfectly reveals that "cheating" has occurred. It is assumed that monitoring has no cost for the bank.

At time 2, after observing the outcome of the monitoring activity and updating its beliefs about the managers' types using Baye's rule, the bank makes a liquidation decision $L \in \{0, 1\}$, where $L = 1$ denotes that liquidation occurs and $L = 0$ denotes a renegotiation decision. Hence, the bank chooses to immediately liquidate the firm or allow it to continue its operations through a debt restructuring. We assume that the costs associated with a debt restructuring in the second period are prohibitively high. This assumption serves to illustrate that the bank wants to identify low-ability managers as early as possible, in order not to remain stuck with them when a plan of reorganization becomes too expensive. It is also assumed that the population of managers is sufficiently large such that, monitoring one manager gives no further inference about the pool of the remaining $N - 1$ managers.

Although all managers are equally valuable to the bank when they truthfully report the firm's financial situation, they differ in the size of financial reporting costs. In particular, while high-ability managers do not face any cost of providing cash flow statements, low-ability managers bear some costs when report truthful cash flows states to the bank. Financial reporting costs f_i in period i, $i = 1, 2$ for low-ability managers, where $f_1 = f$ and $f_2 = k.f$ with $k > 0$, and f is drawn from a distribution function $H(f) \in C^2$ with support $[0, 1]$ at the beginning of the game. The parameter k allows for discounting financial reporting costs with respect to the length of period two relative to period one. Furthermore, we assume that in period 1, truthful reporting is privately optimal for a low-ability type for any value of f when he is monitored with certainty. In other words, the benefit from continuation is strictly greater than the maximum cost of truthful reporting: $K > 1$.

We assume that, in period 2, by dealing with an entrepreneur who cheats and misreports the firm's financial state, the bank gains nothing. In opposition, by dealing with a manager who reports truthfully the firm's financial situation, the bank obtains non-transferable private benefits B. It can be interpreted as the psychological benefit enjoyed by the bank when dealing with a reliable entrepreneur. Non-transferable benefits from continuation would also arise in a dynamic extension of the model. In that context, they would reflect the expectation of the rents to be obtained by the banks in the future. Hence, B can be understood as a reduced form representation of these future rents. We assume that ex-post liquidation is inefficient in the sense that $B > 0$. Furthermore, we also assume that $B > K$.

In period 2, we want the bank to continue rather than liquidate the project whenever its beliefs after the monitoring process are greater or equal

to the prior, α of dealing with a high-ability entrepreneur. We thus make the following assumption:

Assumption 1: $\alpha(B-K)+(1-\alpha)(-K)>0$

The first term corresponds to the bank's expected payoff when facing a high-ability entrepreneur. In period 2, the bank will receive private benefits from continuation B and provides the entrepreneur with working capital K. The second term corresponds to the expected payoff from dealing with a low ability entrepreneur to whom the bank provides capital.

2.2 Sequence of events

We consider a message game between a lender and an entrepreneur. The lending relationship is assumed to last at most two periods. At the beginning of the first period, at time 0, an entrepreneur contacts investors to finance his project. The bank (sole creditor) then sets and commits to a monitoring intensity for the first period of the lending relationship. Subsequently, at time 1, after financing is done, the entrepreneur chooses his financial reporting strategy. Afterwards, at time 2, given the outcome of the monitoring procedure, the lender decides to immediately liquidate the firm or allow it to continue its operations. The liquidation value if the firm is normalized to zero such that lenders get nothing. At time 3, if there is no liquidation, the project returns final cash flows. After repayments and cash flows are realized period 1 ends. In period 2, again all remaining entrepreneurs decide to report truthfully the firm's financial state or cheat. Then the game ends.

2.2.1 Timing of events

Period 1:

· Time 0 : Entrepreneurs contacts investors to finance an investment project. The bank chooses a monitoring intensity λ for the first period.

· Time 1: Entrepreneur's financial reporting strategy $a_i^\theta \in \{T, C\}$ chosen; monitoring occurs with probability λ.

· Time 2: Monitoring outcome $M \in \{T, C\}$ realized; Renegotiation or liquidation decision $L \in \{0, 1\}$

· Time 3: Cash flows and repayments are realized.

Period 2:

Entrepreneurs again choose reporting strategy

3 Equilibrium behaviors

The seminal papers by Kreps,Wilson, Milgrom and Roberts (1982) give formal treatment to the issues of reputation acquisition by extending subgame perfection to games of imperfect information. The incomplete information prevailing in the relationship between lenders and borrowers implies that the equilibrium concept used in this model is the perfect Bayesian equilibrium (PBE). A PBE is a set of strategies and beliefs such that, at each period of the game, each agent's strategies are optimal given the beliefs about the other player's type and the beliefs are obtained from equilibrium strategies and observed actions using Baye's' rule whenever it is applicable.

We use backward induction to derive the equilibrium behavior of managers and the bank's optimal liquidation versus continuation decision. Consequently, we start the analysis of the game at the second period and present the managers' optimal financial reporting decision. Then, we look at the bank's optimal liquidation decision in the first period at time 2 after monitoring has been carried out. Then, we consider each manager's optimal reporting strategy at time 1 for a given probability of monitoring intensity. Finally, we determine the optimal choice of monitoring intensity at stage 1, under the assumption that the continuation equilibrium is played subsequently.

3.1 Entrepreneurs' financial reporting strategy in the second period

We first present each manager's optimal financial reporting decision during the second period, and denote by $a_i^\theta \in \{T, C\}$ the action chosen by type $\theta \in \{H, L\}$ in period $i = 1, 2$. More specifically, high-ability managers (H) and low-ability managers (L) choose an action from $\{T, C\}$ where T and C denote "truthful reporting" and "cheating", respectively.

Let us first consider a high-ability entrepreneur (H): Since he bears no financial reporting costs, he is indifferent between providing truthful reporting

of the firm's financial situation or cheating. In either case, he receives a period 2 payoff of K which is the advancement in capital provided by the bank when there is no liquidation. Throughout we assume that both types report truthfully the firm's financial situation when indifferent so that high-ability entrepreneurs will always choose the action corresponding to $a_2^H = T$.

In opposition, low-ability managers (L) receives a period 2 payoff of $(K - k.f)$ from reporting truthfully cash flows states to the bank, where $k.f$ are the cost associated with financial reporting. Alternatively, the low-ability managers receives a date 2 payoff of (K) from misreporting cash flows states to the bank, hence saving on reporting costs. Consequently, low-ability managers will always cheat in period 2. Thus for him, $a_2^L = C \ \forall f > 0$.

3.2 The bank's liquidation decision at time 2

In this section, we consider the bank's optimal liquidation versus continuation decision at time 2 after monitoring has been carried out

First, denote by $\pi \in [0, 1]$ the belief of dealing with a high-ability entrepreneur conditional on the outcome of the monitoring activity:

$$\pi := \Pr(\theta = H|M) \tag{1}$$

Given that high-ability managers will report truthfully the firm's financial situation while low-ability managers will always cheat in period 2, the bank's expected utility from an entrepreneur in period 2 as a function of π is given by:

$$\pi(B - K) + (1 - \pi)(-K) \tag{2}$$

The first term on the right hand side corresponds to the expected profits conditional on facing a high-ability type. In that case, the bank enjoys private benefits minus the capital advancement in case of continuation of the project. The second term indicates the expected loss from dealing with a low-ability type who avoids giving any value to the bank. However, the bank has provided the entrepreneur with capital.

The bank's expected utility may be positive or negative. In consequence, the bank will liquidate the entrepreneur's project whenever the outcome of

the monitoring activity provides a belief sufficiently low about the entrepreneur being a high-ability type, i.e. when:

$$L^*(\pi) = \begin{cases} 1 \text{ if } \pi < \frac{K}{B} \\ 0 \text{ otherwise} \end{cases} \tag{3}$$

3.3 The manager's financial reporting strategy at time 1

Now, we consider each manager's optimal reporting strategy at time 1 for a given probability of monitoring intensity. Again, high-ability managers (H) and low-ability managers (L) choose an action from $\{T, C\}$ where T and C denote "truthful reporting" and "cheating", respectively.

We first consider a high-ability entrepreneur (H). On the equilibrium path, by reporting truthfully the firm's cash flows (or equivalently by choosing T) and conditional on success, a high-ability entrepreneur gets $p(y-d)$ in period 1, and the continuation value K in period 2. If the bank monitors the entrepreneur, the outcome of the monitoring activity leads to $M = T$, such that the bank holds the beliefs $\pi^* = \frac{\alpha}{\alpha+(1-\alpha)t(\lambda)} > \alpha$, where $t(\lambda)$ denotes the probability of truthful reporting. Consequently, by assumption 1, the bank's optimal liquidation decision correspond to no liquidation, i.e. $L = 0$. If there is no monitoring, the bank holds the belief $\pi^* = \alpha$ and the entrepreneur's project is not liquidated either.[4]

On the other hand, when a high-ability entrepreneur chooses to cheat (or equivalently by choosing C) his payoff is still $p(y-d)$ in period 1, since a high-ability type bears no reporting costs, however, he is monitored with probability λ and found to be cheating such that the bank holds the belief $\pi^* = \Pr(\theta = H|M = C) = 0$. Consequently, the bank's optimal decision is to liquidate the project. It follows that the entrepreneur's expected payoff from cheating in period 2 is $(1-\lambda)K$ and thus, a deviation is never profitable for the high-ability type. In summary, a high-ability entrepreneur will always choose to report truthfully the firm's financial situation: $a_1^{H*} = T$.

We now consider a low-ability entrepreneur (L). On the equilibrium path, when a low-ability entrepreneur chooses T he gets $p(y-d) - f$ in period 1, where c denotes the reporting costs supported by low ability types. If there is

[4]Note that from assumption 1 we can alternatively assume that an agent's investment project cannot be liquidated without being monitored.

some monitoring, he is taken to be a high-ability entrepreneur such that the project is not liquidated, hence the entrepreneur gets a capital advancement, K in period 2. In that case, the low-ability entrepreneur will cheat and thus save the reporting costs in that period.

On the other hand, when a low-ability entrepreneur chooses C his payoff is just $p(y-d)$ since by cheating, he avoids reporting costs to the bank. However, he is monitored with probability λ and found to be cheating such that the bank holds the belief $\pi^* = \Pr(\theta = H|M = C) = 0$. Given this belief, the bank's optimal decision is to liquidate the project. Consequently, in period 2, the entrepreneur's expected payoff from cheating is again $(1-\lambda)K$. It follows that cheating, C is preferred to truthful reporting, T if and only if:

$$\begin{aligned} p(y-d) + (1-\lambda)K &> p(y-d) - f + K \\ &\Leftrightarrow f > \lambda K \end{aligned} \tag{4}$$

Thus, the optimal decision of a low-ability type as a function of the probability of monitoring, λ and the financial reporting costs, c is given by:

$$a_1^{L^*}(\lambda, c) = \begin{cases} C \text{ if } f > \lambda K \\ T \text{ if } f \leq \lambda K \end{cases} \tag{5}$$

A low-ability entrepreneur will cheat and misreport the firm's cash flow states to the bank whenever his financial reporting costs are sufficiently high.

Let $\bar{\lambda} = \frac{1}{K}$ be a threshold that relates the benefit from continuation in period 2 (or equivalently K) to the maximum cost of reporting financial state for a low-ability entrepreneur in period 1 which is equal to 1. Clearly, when K is relatively large, then $\bar{\lambda}$ is low, such that cheating in period 1 is undesirable for a low-ability type. Thus, as long as $\lambda \geq \bar{\lambda}$ all low-ability entrepreneurs will choose to report truthfully the firm's financial state. Consequently, no entrepreneur will cheat any longer on the equilibrium path so that the following beliefs $\pi^* = \Pr(\theta = H|M = T) = \alpha$ will always hold while $\pi^* = \Pr(\theta = H|M = C) = 0$ is a zero probability event. We will show in section 4 that this equilibrium continuation is unique.

Although even a relatively low level of monitoring intensity λ would induce low-ability entrepreneurs to always report truthfully the firm's financial state as long as λ is set greater or equal than $\bar{\lambda}$, we will show below that it is indeed optimal for the bank to choose some $\lambda < \bar{\lambda}$. This would allow for both possible actions, C and T to occur with positive probability on the equilibrium path.

3.4 The bank's optimal choice of monitoring intensity λ at time 1

We now derive the bank's optimal choice of the monitoring intensity λ at time 1. The bank's objective is to maximize its expected payoff.

Consider a high-ability entrepreneur (H). In period 1, there are αN high ability entrepreneurs. At this period, none of them cheat and in consequence, there is no liquidation. In period 2, none of them cheat and the bank gains $(B-K) > 0$ from dealing with a high-ability type. Note that when the bank faces high-ability entrepreneurs, its payoffs are independent of the monitoring probability, λ, which in turn neither influences the number of high-ability types in each period nor the entrepreneurs' financial reporting strategy.

Consider a low-ability entrepreneur (L). In period 1, a low-ability entrepreneur will cheat whenever the reporting costs are sufficiently high, i.e. $f > \lambda K$. Hence, form the bank's point of view, the probabilities of reporting truthfully the firm's cash flows and cheating are given by, respectively:

$$c(\lambda) := \Pr(f > \lambda K) = \max(0, 1 - H(\lambda K)) \tag{6}$$

$$t(\lambda) := \Pr(f \leq \lambda K) = \min(H(\lambda K), 1) \tag{7}$$

Clearly we have $\frac{dc}{d\lambda} \leq 0$ and $\frac{dt}{d\lambda} \geq 0$ and $c'(\lambda) = -t'(\lambda)$.

Since there are $(1-\alpha)N$ low-ability entrepreneurs, the expected payoff for the bank in period 1 is given by:

$$\begin{aligned} V_1 &= (1-\alpha)N[c(\lambda)pd + t(\lambda)pd] \\ V_1 &= (1-\alpha)N(pd) \end{aligned} \tag{8}$$

where pd is the probability of repayment conditional on the investment success. Note that this term is independent of the monitoring intensity λ. Hence, in period 1, the bank monitors entrepreneurs in order to detect low ability types. More specifically, from the bank's point of view, monitoring in the first period is important to the extent that it influences the number of low ability types in period 2. Consequently, the monitoring intensity λ should be set in a way that induces some entrepreneurs to cheat in period 1, in order to allow for the detection of low ability entrepreneurs.

Formally, the number of low ability types remaining in period 2 is composed of those who cheat but get detected only with probability λ and

those who report truthfully and are not identified through monitoring: $(1-\alpha)N[t(\lambda)+(1-\lambda)c(\lambda)]$. Given this number, the expected payoff generated by low-ability entrepreneurs for the bank in period 2 is given by:

$$V_2 = (1-\alpha)N[t(\lambda)+(1-\lambda)c(\lambda)](-K) \tag{9}$$

where $-K$ is the capital provided to entrepreneurs in case of continuation.

In summary, we showed that the bank's expected payoff from the high-ability entrepreneur and from the low-ability entrepreneur in period 1, respectively, is independent of the monitoring intensity, λ. In contrast, from equation (9), we note that the optimal monitoring intensity λ^* is uniquely determined by $Z(\lambda) = (1-\lambda+\lambda t(\lambda))(-K)$.

4 Analysis

This section analyses the bank's decisions regarding the liquidation versus the continuation of the investment project.

We focus on the equilibrium continuation and then see how it can be supported:

Lemma 1 *At time 1, for all $\lambda < \bar{\lambda} = \frac{1}{K}$, there exists a unique equilibrium continuation in which,*

(i) A high-ability entrepreneur chooses to report truthfully the firm's financial situation, i.e. $a_1^{H*} = T$ independent of the monitoring intensity, λ.

(ii) A low-ability entrepreneur chooses to cheat, i.e. $a_1^{L^*}(\lambda, f) = C$ whenever his reporting costs, f are sufficiently high. This happens with probability $(1-t(\lambda)) > 0$.

(iii) The bank's beliefs after the monitoring intensity has been chosen are given by:

$$\pi^* = \Pr(\theta = H|M = T) = \frac{\alpha}{\alpha+(1-\alpha)t(\lambda)} > \alpha \tag{10}$$

$$\pi^* = \Pr(\theta = H|M = C) = 0 \tag{11}$$

and the bank optimally liquidates the projects of entrepreneurs for whom $M = C$ holds and keeps all others, including the entrepreneurs who have not been monitored.

Proposition 2 *Given equilibrium continuation 1, the optimal monitoring intensity for the bank induces cheating and misreporting from entrepreneurs on the equilibrium path, i.e.:* $0 < \lambda^* < \bar{\lambda} = \frac{1}{K} < 1$.

Proof. Since the objective function of the bank is continuous in the interval $[0, \bar{\lambda})$, we show that (i) the bank's expected payoff is strictly increasing at $\lambda = 0$ and strictly decreasing as $\lambda \to \bar{\lambda}$, and (ii) the optimal monitoring intensity, $\lambda = \lambda^*$ lies between the two "corner" solutions, $\lambda = 0$ and $\lambda \to \bar{\lambda}$.

First, as above we define $Z(\lambda) = (1 - \lambda + \lambda t(\lambda))(-K)$.

(i) We need to show that $Z'(\lambda = 0) > 0$ and $Z'(\bar{\lambda} \to \frac{1}{K}) < 0$:

$$Z'(\lambda) = (-1 + t(\lambda) + \lambda t'(\lambda))(-K)$$

with: $Z'(\lambda = 0) = K > 0$
and $Z'(\bar{\lambda} \to \frac{1}{K}) = (-1 + t(\frac{1}{K}) + \frac{1}{K}t'(\frac{1}{K}))(-K) = -t'(\frac{1}{K}) < 0$

(ii) Note that:

$$\begin{aligned} Z(0) &= -K \\ Z(\frac{1}{K}) &= -K + 1 - Z(\frac{1}{K}) = -K \\ Z(\lambda^*) &= (1 - \lambda^* + \lambda^* t(\lambda^*))(-K) \end{aligned}$$

and thus,

$$\begin{aligned} Z(\lambda^*) - Z(0) &> 0 \\ -K + K\lambda^* - K\lambda^* t(\lambda^*) &> -K \\ K\lambda^*(1 - t(\lambda^*)) &> 0 \\ t(\lambda^*) &< 1 \end{aligned}$$

which is true for all $\lambda^* < \lambda$. hence, the bank's expected payoff is strictly higher when an interior level of monitoring intensity, λ is chosen. ■

Note first that $\lambda^* < \bar{\lambda}$ implies that the equilibrium behaviors determined by Lemma 1 are optimal and so Lemma 1 together with Proposition 1 characterize indeed the unique equilibrium.

The above proposition states that when the monitoring intensity λ is too low, only few low-ability entrepreneurs are identified. In contrast, when λ is too high, each low-ability entrepreneur is less likely to misreport in period 1, such that the bank is unable to identify them through monitoring either. As low-ability types misreport with certainty in period 2, yielding a negative payoff for the bank $-k$, too much monitoring in the first stage of the relationship is never in the bank's interest. This mechanism is completely independent of the costs of monitoring for the bank. Instead, it relies on the benefit for the entrepreneurs from future interaction with the bank in comparison to the cost of providing reliable financial reporting at the beginning of the relationship.

We now consider the percentage gain in profits for the bank from choosing a monitoring intensity with probability $\lambda = \lambda^*$, compared to monitoring too much, $\lambda \to \bar{\lambda}$ or not monitoring at all, $\lambda = 0$. Recall that the benefits of monitoring optimally relates to the share of low-ability types remaining in period 2 such that the bank is able to filter them out.

Denote by $q(\lambda)$ the probability that a low-ability type remains in period 2:

$$q(\lambda) = 1 - \lambda c(\lambda)$$

which reflects the fact that the firm is liquidated only if its manager manipulates earnings in period 1 and is detected through monitoring. Since, $q(\lambda = 0) = q(\lambda \geq \bar{\lambda}) = 1$, all low-ability managers remain in period 2 and the bank's payoff is:

$$V_2(\lambda = 0) = V_2(\lambda \to \bar{\lambda}) = (1 - \alpha)N(-K) \tag{12}$$

Consider now the case where the optimal monitoring intensity, λ^* is chosen instead. Then, the probability that a low-ability type remains in period 2 is strictly less than 1, i.e. $q(\lambda^*) = 1 - \lambda^* c(\lambda^*) < 1$. Thus, the bank is able to filter out some of the low-ability managers so that its payoff is:

$$V_2(\lambda = \lambda^*) = (1 - \alpha)N[1 - \lambda^* c(\lambda^*)](-K) \tag{13}$$

By taking the difference between equation (13) and (12), the bank's gain from choosing an "interior" monitoring intensity, λ^* is:

$$\begin{aligned} \Delta V &= V_2(\lambda = \lambda^*) - V_2(\lambda = 0) \\ &= (1 - \alpha)N[-\lambda^* c(\lambda^*)](-K) > 0 \end{aligned} \tag{14}$$

Relative to the payoff obtained in the "corner" solutions given by equation (12), the percentage increase in profits can thus be calculated as:

$$\frac{\Delta V}{V_2(\lambda = 0)} = \lambda^* c(\lambda^*) \tag{15}$$

This example highlights a corollary implication of our model. On the one hand, it is never optimal to monitor too much during the probation period, as suggested by proposition 1, but in addition, when $\bar{\lambda}$ is too low, reflecting that the benefit from continuation in period 2 is high, probation is not a very effective device to filter out low-ability types. On the other hand, when $\bar{\lambda}$ is high, reflecting that the maximum cost of reporting financial state is high compared to the benefit from continuation in period 2, the bank can use monitoring as a selection device during probation periods and realizes substantial gains. However, it is never optimal to set the monitoring probability λ^* above the threshold $\bar{\lambda}$.

5 Experimental design and empirical analysis

Our model suggests that relationships in which too much monitoring takes place at the beginning should perform worse at later stages of their development. In particular, a larger fraction of cheaters, or equivalently a higher probability of not truthful reporting behavior from a single agent, should emerge in the long run when the creditor monitors managers too much at the beginning. In the following section, we aim at providing empirical evidence on this testable prediction of our model through an experimental setting.

The experiment is performed at GATE (Groupe d'Analyse et de Théorie Economique, University of Lyon, France), using the Regate software. Six 20-period sessions are run. Seventy-two participants are drawn from the undergraduate classes of the Engineering and Textile School of Lyon; all are inexperienced subjects. Group assignment was by random allocation at the beginning of the session in order to control for the non-experimentally induced heterogeneity.

In order to study the bank's optimal monitoring intensity and the managers' attempt to cheat in a long-lasting relationship, we use a stranger-matching protocol. All interactions between participants remained anonymous.

A session lasted 60 minutes on average. All transactions were conducted in ECUs (Experimental Currency Units), with the ECU-EURO conversion rate set at 100 ECU = 1 €. At the end of the session, each subject was paid in cash the sum of his payoffs obtained during the 20 periods. A show-up fee of 2.3 € was added to the total.

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