Managerial Reputation and Market Discipline*

Koji Asano†

April 14, 2015

Abstract

This paper studies delegated investment choices in which the managers are concerned with their reputations. Their reputation building is attributed to credit market imperfections that allow investors (i) to pour more their funds into managers with better reputation, and (ii) to run on ones with bad reputation below the threshold and fire them. In the monopolistic credit market, the manager with low pledgeability faces serious threat of withdrawals and thus become conservative. In the competitive credit markets, the growing demands for credit increase the interest rate and thereby even managers with low pledgeability engage in risk-taking.

JEL Classification: G01, G11, G2.

Keywords: managerial reputation, market-based regulation, pledgeability, competition.

*I am especially grateful to Katsuya Takii for beneficial discussions and suggestions. I would also like to thank Shingo Ishiguro, Junichiro Ishida, and Ryosuke Okazawa. I gratefully acknowledge financial support from the Japan Society for the Promotion of Science through a Grant-in-Aid for JSPS Fellows. All remaining errors are mine.

†Graduate School of Economics, Osaka University, 1-7 Machikaneyama, Toyonaka, Osaka 560-0043, Japan. E-mail: nge002ak@student.econ.osaka-u.ac.jp
1 Introduction

The global financial crisis of 2007–09 caused a controversy over the incentive of financial intermediaries, not only traditional banks but also the shadow banking sector (e.g., investment banks, money market mutual funds, and mortgage brokers). As highlighted by Rajan (2011), they engaged in risky investments, for example, holding the mortgage-backed securities (MBSs). The observation is the exact opposite to the idea of market discipline, which has been designated as the third pillar in Basel II. The market power was supposed to control managerial risk-taking through complete refusal to roll over the funds against the managers who get bad reputation, leading to their job losses. Our paper clarifies the mechanism of how investors responses to reputation change the managerial project choices and examines under what conditions risk taking is more likely to occur.

The forces of markets were recognized among academics and policy makers. Chevalier and Ellison (1999) demonstrate that the threat of losing jobs against managers with bad performances discourage them from taking risk. Calomiris and Kahn (1991), and Diamond and Rajan (2001) argue theoretically that runs are a disciplining mechanism that prevent financial institution managers from engaging in opportunistic behavior. The credibility of the market discipline had been more established by the situation in which the shadow banking institutions primarily raised funds through the short-term market and do not access safety nets the government offers, and thus, the threat of withdrawals has become pervasive among these institutions.\footnote{Morris and Shin (2008) describe that, for example, the balance sheets of Lehman Brothers and Bear Stearns largely comprise short-term liabilities. Lehman’s liabilities comprise short-term debt (8 percent), short positions (22 percent), collateralized borrowings (37 percent), and payables (12 percent). Bear Stearns’ liabilities comprise short-term debt (11 percent), short positions (11 percent), collateralized borrowing (34 percent), and payables (22 percent). Collateralized borrowing includes repos, while payables include cash...}

\footnote{Ben S. Bernanke, former chairman of the Federal Reserve, also pointed out the problem: “In general, our system relies on market discipline to constrain leverage and risk-taking by financial firms, supplemented by prudential oversight when government guarantees (such as deposit insurance) or risks to general financial stability are involved. However, the enormous losses and writedowns taken at financial institutions around the world since August, as well as the run on Bear Stearns, show that, in this episode, neither market discipline nor regulatory oversight succeeded in limiting leverage and risk-taking sufficiently to preserve financial stability.” (see Speech titled “Financial Regulation and Financial Stability,” in July 8, 2008, retrieved from http://www.federalreserve.gov/newsevents/speech/bernanke20080708a.htm.)}
In our paper, we develop a model of delegated portfolio management in which the managers are driven by reputation concerns. Investors can work on their decisions through adjusting their loan amounts based on their reputation. We formalize the force of market discipline in which to prevent withdrawals of funds, managers will avoid risk-taking compared to without the discipline. The aim of this paper is to show that reputation building encourages risk taking rather than restraints it, due to either of characteristics of financial markets in recent times: an increase in pledgeability (or ability to promise payments to investors) or an exposure to acute competition.

This paper presents a model where a risk-neutral manager who raises short-term funds from investors selects an investment strategy on their behalf. The manager has some ability that decides the possibility of a good performance. The managerial ability is unknown for the manager and investors, and both share beliefs about it, as in Holmström (1999). On the basis of manager’s performance, all agents update managerial reputation that is their belief about the probability of a high return. We incorporate the natural observation that the higher the return is, the more competent the manager is perceived to be. This implies that the riskiness in return represents the riskiness in reputation; more risky investments that produce higher returns have the possibility to provide the manager with better reputation.

Managers’ reputation concerns stem from credit market imperfections in which much borrowing leads the manager with limited liability to misbehave, along the line with Holmström and Tirole (1998, 2011). Since good reputation leads to the high borrowing capacity, investors decide how much they put their money into the manager according to the reputation. The reputational effects creates two opposing managerial incentives. On the one hand, a manager who performs well gets great reputation accompanied by substantial fund inflows. The implicit compensation structure induces the manager to take risky investments to appeal the competence. On the other hand, the managerial activity requires a fixed initial investment due to minimum agency costs. Combining with borrowing constraints, the

---

deposits of hedge fund customers.
minimum investment requirement creates the situation that investors will refuse to roll over their funds for the manager who obtains terrible reputation. These potential consequences of reputation, in turn, incentivize managers to take conservative strategy in order not to reveal bad performance.

The balance of two opposing reputational effects depends on managers’ own pledgeability: that determines the threshold of investors runs. Conservative strategy appears only when the manager is afraid to get bad reputation due to low pledgeability. As the pledgeability increases, however, investors become more tolerant for bad performance and more likely to roll over their funds. The manager without fear of withdrawals, in turn, is willing to engage in risk taking.

Next, we extend the basic model to the environment where investors can not only adjust their funds but also shift them to other managers. The change gives rise to the competitive credit market, that determines the interest rate. The rising demand for credit, by increasing the interest rate, reduces the gap of benefits between managers with good reputation, who will become borrowers, and ones with bad reputation, who will become lenders. The competitive pressure weakens the incentive to avoid withdrawals. As a result, the reputational effects to encourage risk taking dominate relatively, even though managers would act conservatively under no competition.

Our results imply that financial development (or an increase in pledgeability) and intense competition make the market discipline break down. Empirical studies suggest that at the root of both is financial liberalization and find that banking crises are likely to take place after the financial sector is liberalized (e.g., Kaminsky and Reinhart, 1999, and Demirgüç-Kunt and Detragiache, 1999). Along with these evidence, we incorporate into our model the argument of Rajan (2006) that these underlying changes in financial markets have altered managerial incentives, thereby increasing the potential risk, although they hold significant benefits as well.

This paper contributes to the literature on market discipline of which research is classified,
by Flannery (2001) and Bliss and Flannery (2002), into two distinct components: (i) the ability of market participants to obtain information about financial institutions (market monitoring) and (ii) the ability to actually penalize those managers with poor performances and discipline them (market influence). This paper belongs to the latter field. 3 Several empirical evidence supports that market indeed discipline bank behavior (e.g., Maechler and McDill, 2006; Nier and Baumann, 2006; Ashcraft, 2008).

Our paper is closely related to Diamond (1989) and Ordoñez (2013), where both show that although reputation concerns that arise from credit market can constraint risk-taking, the reputational incentive has limits. It is discouraged by severe adverse selection problem (Diamond, 1989) and coordination failure that arises from even small aggregate shocks (Ordoñez, 2013). In contrast to these papers, we point out that risk taking behavior is due to underlying changes in recent financial markets. Moreover, basically in both papers, the incentive to take risks arises from moral hazard problem regarding project choices, whereas the opposing incentive to behave prudently arises from reputation concerns. Unlike these papers, we show that both incentives arise from reputation concerns by instead allowing investors to adjust their funds flexibly.

On the other hand, there is a number of literature that investors’ reaction encourage risk taking, but not discourage it. Empirical evidence shows that an impressive performance by a mutual fund manager can attract disproportionately substantial inflows of funds and thus investors responses generate managers’ rewards that is convex in past performance (see Chevalier and Ellison, 1997, and Sirri and Tufano, 1998).

Dasgupta and Prat (2006) shows that asymmetric information about managerial ability leads to risk taking behavior by career concerned managers, because a conservative strategy strikes investors as poor ability. In contrast, since our paper is based on the symmetric information, the conservative strategy gives benefits to managers. In our work, according to underlying changes in financial markets, the benefits of conservative investments alter. Like

---

our paper, Guerrieri and Kondor (2012) show that managerial reputation concerns change depending on underlying economic conditions, but not on other agents’ behavior. In their paper, however, the focus is on asset price volatility.

Our approach that reputation concerns arise from credit market imperfection can shed new light on theoretical literature about career concerns and risk-taking. The literature shows that managers are tempted to behave “conservatively” in their bid to conceal information about their abilities that affect their labor market condition (see Holmström and Ricart i Costa, 1986, and Hirshleifer and Thakor, 1992). We incorporates into the model, unlike these works which assume fixed investment scales, characteristics that the amount of investments can change continuously according to reputation in case of finance. This smooth adjustments induce managers to behave “aggressively” to reveal information about their abilities.

This paper is organized as follows. Section 2 provides the basic framework of the model. Section 3 analyzes the equilibrium strategy based on the pledgeability. Section 4 introduces competition. Section 5 concludes. All the proofs are given in the Appendix A.

2 The Framework

In this section we describe the structure of our model with a financial institution manager, the characteristics of each investment strategy, and the limited commitment problem faced by the manager.

There are three dates, $t = 0, 1, 2$. There is a single good and a storage technology. There are two types of risk-neutral agents: an intermediary manager and many investors. The manager receives capital $A \in (0, 1)$ at the begging of $t = 0, 1$. The capital is not verifiable. All investors receive $1 - A$ unit of the good at $t = 0$, some endowments

---

4Hermalin (1993) and Tirole (2006, Ch. 7) obtains the result that a manager driven by reputation building prefers to risky investments. However, their model assumes that more risky investments have more noisy information about managerial ability. To conceal it, the manager driven by career concerns prefers “conservative” strategy in the sense of reputational risks, not project risks.
at \( t = 1 \), and nothing \( t = 2 \). Both investors and the manager consume the good only at \( t = 2 \), and their discount factors are one. \(^5\) They are protected by limited liabilities. The manager’s ability denoted by \( i \) takes two values: High (H) and Low (L). This ability denotes the manager’s skills for generating a good performance with high probability and is unknown to depositors, but also to the manager à la Holmström (1999). All the agents share ex ante belief \( \alpha \) that is the probability of being the H-type, and \( 1 - \alpha \) that is the probability of being the L-type. That is, \( \Pr(i = H) = \alpha \) and \( \Pr(i = L) = 1 - \alpha \).

While the manager has an opportunity to invest at \( t = 0, 1 \), the investors do not. The manager implements one of the following three strategies: investment in risky asset (Gambling or G-strategy), investment in most value-enhancing asset (Middle or M-strategy), or investment in the storage technology (Safety or S-strategy). To focus on strategic investments driven by reputation concerns, we assume away risk shifting problem: the choice of the investment strategies is publicly observable and verifiable. The G-strategy and the M-strategy either succeed or fail and their returns are linear in the investment level \( I_t \) at date \( t \). In case of success, the G-strategy made by a manager of type \( i \) at date \( t \) yields good returns \( G_t I_t \) with probability \( p_i > 0 \), whereas the M-strategy does \( M_t I_t \) (where \( M_t < G_t \)) with probability \( q_i > p_i \). In case of failure, returns from investment are 0, regardless of whether the G-strategy or the M-strategy is picked up, which implies that \( M_t > 0 \). The return of date-0 investment that produces at least one unit of good ensures management continuity unless investors refuse to roll over their funds. We assume that H-type manager is likely to produce high returns:

\[
\frac{p_H}{p_L} > \frac{q_H}{q_L}.
\]

This reflects the intuition that a manager with high ability can manage risky assets well, while one with low ability cannot. The S-strategy involves storage technology that is accessible

\(^5\)We assume profit-maximizing managers. Our approach, thus, reflects managers’ salaries in the modern financial sector that are based on the returns they generate; for example, stock options. This assumption aligns the interests of manager with those of shareholders, thereby abstracting the contract problem between the two parties.
by all agents and yield a payoff of 1 regardless of the manager’s ability and amount of investments.

A manager’s reputation is defined as belief about the probability of success with the M-strategy. At the beginning of date 0, the manager has ex ante reputation \( \pi = \alpha q_H + (1-\alpha)q_L \). Let us define \( \eta \) as ex ante belief about the probability of success with the G-strategy, allowing us to express that \( \eta = \alpha p_H + (1-\alpha)p_L \). We assume that the expected return generated by the date-0 M-strategy is the highest of the three strategies:

\[
\pi M_0 > \max \{1, \eta G_0\}. \tag{2}
\]

Moreover, to make an assumption of returns from date-1 investments, let us define the posterior belief about the probability of being H-type as \( \tilde{\alpha} \in [\alpha^{G,0}, \alpha^{G,1}] \), where \( \alpha^{G,0} \) and \( \alpha^{G,1} \) denote the beliefs in the worst case and in the best case respectively (see (6) and (7) for the precise definition). The definition produces posterior reputation \( \tilde{\pi} = \tilde{\alpha} q_H + (1-\tilde{\alpha})q_L \) and ex post belief about the probability of success with the G-strategy, \( \tilde{\eta} = \tilde{\alpha} p_H + (1-\tilde{\alpha})p_L \). We assume that for a manager with any belief \( \tilde{\alpha} \), the expected return generated by the date-1 M-strategy is the highest of the three strategies:

\[
\tilde{\pi} M_1 > \max \{1, \tilde{\eta} G_1\}. \tag{3}
\]

The condition implies that the date-1 investment with the M-strategy is always efficient.

A manager confronts borrowing constraints because of limited commitment problem where after data-1 investment, the manager chooses to behave without receiving private benefits, or misbehave and take private benefits, as in Holmström and Tirole (1998). If the manager behaves, the investment will go along as noted above. If the manager misbehaves, the probability of success goes down by \( \Delta \pi \in (0, p_L) \), where we assume that \( \Delta \pi \) is independent of managerial ability and investment strategies, for simplicity. Instead, the manager enjoys benefits \( BI_1 \) that is inalienable to investors. As shown later, the level of private ben-
efits determines the degree of manager’s pledgeability. Consequently, we can interpret the reduction in $B$, or increase in pledgeability, as the manifestation of financial developments (e.g., increases in liquidity of financial assets and improvements in investor protection laws), as the argument in Holmström and Tirole (2011, p. 86).

The manager has another moral hazard problem. Without getting the minimum rent $\hat{B}(B)$ with $\hat{B}'(B) > 0$, such manager would incur large disutility and neglect the investment. As private benefit $B$ increases, the requirement rent that allows the manager undertake the project also increases. For simplicity, we assume the linear form, $\hat{B}(B) = B\hat{I}$ with $\hat{I} > 0$. This assumption adds another incentive compatibility constraint, $BI_1 \geq B\hat{I}$; that is, the manager must invest at least $\hat{I}$ when behaving. These moral hazard problem exhibits the same structure as the variable investment technology with minimum investment requirement, like Aghion and Bolton (1997) and Matsuyama (2000). As we will show later, since the minimum requirement makes returns dramatically decreasing below the cutoff-point $\hat{I}$, the discontinuity creates fear of getting bad reputation. 6

We make three parametric assumptions regarding the moral hazard problem. First, the investment is worthless without efforts: $(\bar{\pi} - \Delta \pi)M_1 + B < 1$. Under this assumption, a manager cannot raise funds if misbehaving. Second, the equilibrium investment at $t = 1$ is finite:

$$\bar{\pi}M_1 - 1 < \frac{\bar{\pi}B}{\Delta \pi} \quad (4)$$

which means that the expected profit per unit of investment (the left-hand side) is lower than the agency rent per unit of investment (the right-hand side). This condition excludes manager’s self financing. Third, a manager with ex ante reputation $\pi$ is expected to collect

---

6Matsuyama (2000) also assumes that the managerial activity requires a fixed initial investment in an imperfect credit market. In the model, both restrictions create the discontinuous change in outcomes between those who can invest and those who cannot. The gap will affect the wealth of their children for the future. In contrast, our model focus on how the ex post gap affects the ex ante investment.
Managers offer financial contracts
Managers invest in one of three investment strategies
Both observe outcomes and update managerial reputation
Managers offer new contracts (in case of investors’ commitment problem)
Moral hazard: managers choose to behave or misbehave
Profits are realized

\[ \pi_{M_1} - (1 - A) \geq \frac{\pi B}{\Delta \pi}. \]

This means that the expected return of one unit of date-1 investment from the perspective of the manager is higher than the agency cost. This condition assures that the manager with ex ante reputation can avoid runs and continue to manage.

Next, we outline the timeline structure (see Figure 1). At \( t = 0 \) an investment manager borrows money from investors to invest in the asset markets on their behalf. The manager offers a short-term contract to each investor; accordingly investors decide whether they want to accept the offer. The manager then chooses one of the investment strategies. At \( t = 1 \) all the agents observe whether the chosen strategy is successful. After both the parties infer the manager’s true ability based on the strategy’s outcome and update their perception about the manager’s reputation, the manager offers a new contract and investors decide whether they roll over their funds. They may choose not to invest with the manager and withdraw their funds; we term this action as runs. Runs drive financial institutions to bankruptcy.
However, if investors choose to roll over their funds, the manager continues to deploy the investors’ funds based on one of three investment strategies. At $t = 2$ the manager decides whether to behave. Then, all the agents observe the outcomes of the investment made at $t = 1$ and investors receive payments.

3 Equilibrium Analysis

In this section, we characterize the pure strategy equilibrium and analyze the effect of the moral hazard problem on the investment decision at date $t = 0$ given the threats of withdrawals. First, we clarify the effect of investment strategies on the managerial reputation and derive the posterior beliefs at $t = 1$ on the equilibrium path. Then, through short-term borrowing contracts, we present the moral hazard problem that limits pledgeable income and the mechanism of runs in our model. Finally, based on the previous analysis, we investigate whether the possibility of runs harnesses the manager’s project choices ex ante.

3.1 Reputation Updates

Observing whether the investments are successful or not, all parties update their beliefs along the equilibrium path. The ex post reputation is closely linked to investment strategies given different degrees of information disclosure.

Managers who implement the S-strategy can conceal information about their ability and maintain their reputation $\pi$ because the return structure of this strategy is independent of the manager’s ability. The posterior beliefs along the equilibrium path of the G-strategy

\footnote{We ignore the posterior reputation at $t = 2$ because it is irrelevant for all the parties’ interests.}
conditional on 0 and 1 successes, denoted by \( \alpha^{G,0} \) and \( \alpha^{G,1} \), respectively are as follows:

\[
\alpha^{G,0} = \frac{\alpha(1 - p_H)}{\alpha(1 - p_H) + (1 - \alpha)(1 - p_L)},
\]
\[
\alpha^{G,1} = \frac{\alpha p_H}{\alpha p_H + (1 - \alpha)p_L}.
\]  

(6)

(7)

In the case of the M-strategy, the posterior probabilities conditional on 0 and 1 successes, denoted by \( \alpha^{M,0} \) and \( \alpha^{M,1} \), respectively are as follows:

\[
\alpha^{M,0} = \frac{\alpha(1 - q_H)}{\alpha(1 - q_H) + (1 - \alpha)(1 - q_L)},
\]
\[
\alpha^{M,1} = \frac{\alpha q_H}{\alpha q_H + (1 - \alpha)q_L}.
\]

From (1), we obtain the following relationship between the posterior beliefs:

\[
\alpha^{G,0} < \alpha^{M,0} < \alpha < \alpha^{M,1} < \alpha^{G,1}.
\]  

(8)

All the agents perceive the manager to be highly talented ability after a successful investment and incompetent after a failure. The difference between the G-strategy and the M-strategy is the quantum of information: the former reveals more information about managerial ability. This is because low ability manager cannot manage the high risk assets better than the most value-enhancing asset. Consequently, both the parties regard the manager who succeeds by the G-strategy more highly than the one who succeeds by the M-strategy (\( \alpha^{M,1} < \alpha^{G,1} \)), and the manager who fails by the G-strategy is regarded lower than the one who fails by the M-strategy (\( \alpha^{G,0} < \alpha^{M,0} \)).

Then, defining to be \( \pi^{G,j} \), \( \pi^{M,j} \), and \( \pi^{S,j} \) the reputation after observing the number of
success \( j \) by the G-strategy, the M-strategy, and the S-strategy respectively, we have

\[
\tilde{\pi} = \begin{cases} 
\pi^{G,j} = \alpha^{G,j}q_H + (1 - \alpha^{G,j})q_L & \text{with } j \in \{0, 1\} \text{ success by the G-strategy}, \\
\pi^{M,j} = \alpha^{M,j}q_H + (1 - \alpha^{M,j})q_L & \text{with } j \in \{0, 1\} \text{ success by the M-strategy}, \\
\pi^{S,1} = \pi & \text{with the S-strategy},
\end{cases}
\]

and

\[
\pi^{G,0} < \pi^{M,0} < \pi^{S,1} < \pi^{M,1} < \pi^{G,1},
\]

that is derived directly from (8).

The investment strategies in our model feature the relationship between returns and reputation; that is, the G-strategy is more volatile not only about returns but also about reputation than the M-strategy. The observation that investment risks and reputational risks are positively correlated is the key to our results.

### 3.2 Contracts, Limited Commitment, and Market Responses

At the beginning of \( t = 0 \) and \( t = 1 \), a manager makes a take-it-or-leave-it offer to investors with the storage technology as an outside option. They accept the offer in which expected payment is higher than the value of storage. We assume the contract structure as follows: (i) the contract is for a short-term, (ii) if the manager invests \( I_t \), and the investment succeeds, the investors get \( d_t \) and the manager will get the residuals, and (iii) if the investment fails, both parties do not get anything. Thus, the contract specifies the combination \((I_t, d_t)\) conditional on each date-\( t \) strategy.

**Date-0 contract.** Since there is no moral hazard problem, the manager does not face borrowing constraint and collects funds as much as possible. That means all resources in the economy (amounting to one) are used to investments. Thus, the payment conditional on the date-0 investment strategy \( d_0 \) is specified by the resource constraint and the participation constrain.
Date-1 contract. In the equilibrium, the manager takes the M-strategy at \( t = 1 \) because it generated the highest return of the three. Let \( \tilde{A} \) denote a capital the manager has at the beginning of \( t = 1 \). It take the following values depending on the outcome,

\[
\tilde{A} = \begin{cases} 
A^{G,1} = A + G_0 - \frac{1-A}{\eta} & \text{with a success by the G-strategy,} \\
A^{M,1} = A + M_0 + \frac{1-A}{\pi} & \text{with a success by the M-strategy,} \\
A^S = 2A & \text{with the S-strategy,} \\
A^{G,0} = A^{M,0} = A & \text{with a failure by the G-strategy or the M-strategy.}
\end{cases}
\]

The manager has at least \( A \) because of endowment at the beginning of \( t = 1 \). In case of a succeed of the G-strategy, the manager receives realized return after subtracting payments \((1 - A)/\eta\). In case of a succeed of the M-strategy, realized returns is \( M_0 \) and the payment is \((1 - A)/\pi\). In a case of the S-strategy, the manager can carry over initial capital \( A \). After observing the offered contract and anticipating to implement the M-strategy, investors roll over their funds in the financial institution if they get the new short-term contract satisfies the following participation constraint: \(^8\)

\[
\tilde{\pi}d_1 = I_1 - \tilde{A}.
\]  

(10)

The left hand side means the expected return to investors if they accept the contract, while the right hand side means the reservation utility.

Although the contract satisfying (10) allows investors to trust the financial institution with their money, it does not always hold due to moral hazard. We will show that this problem restricts pledgeability and gives rise to runs in an adverse scenario. The manager behaves on the equilibrium because investors never lend their money to a manager who jeopardizes them. This implies that the manager must get sufficient compensation that

\(^8\)Although investors accept the offer in which the expected payments is higher than 1, the manager with full bargaining power offers the contract which satisfies the participation constraint with equality in order to reduce the payments as possible.
satisfies the following incentive compatibility condition:

\[ \tilde{\pi}(M_1 I_1 - d_1) \geq (\tilde{\pi} - \Delta \pi)(M_1 I_1 - d_1) + BI_1. \]  

(11)

Combining (10) and (11), we get

\[ \tilde{\pi} \left( M_1 - \frac{B}{\Delta \pi} \right) I_1 \geq I_1 - \tilde{A}, \]

where the left-hand side represents pledgeable income. Since the manager must receive at least \( BI_1/\Delta \pi \) in order to avoid misbehaving, investors can pledge only up to the residual. As long as this condition holds, that is, the highest expected payment to investors (pledgeable income) is higher than the amount of lending, the manager can borrow money. The manager implementing the M-strategy which has positive net present value raise funds up to the condition binding:

\[ I_1(\tilde{\pi}) = k(\tilde{\pi})\tilde{A} \]

where

\[ k(\tilde{\pi}) = \frac{1}{1 - \tilde{\pi} \left( M_1 - \frac{B}{\Delta \pi} \right)} > 1 \]

from (4), which means the leverage per unit of own capital.

However, that investment is feasible only when it satisfies the minimum investment level that the assumption of the minimum rent creates. Unless the manager is not able to collect the minimum requirement, investors immediately withdraw their funds and drive the financial institution to bankruptcy. Thus, we have the run-proof condition,

\[ I_1(\tilde{\pi}) \geq \tilde{I}, \]

(12)

or equivalently, managerial reputation must exceed the threshold that depends on private
benefits $B$, denoted by $\hat{\pi}(B)$, to prevent withdrawals by investors:

$$\hat{\pi} \geq \hat{\pi}(B) = \frac{\hat{I} - A}{\left(M_1 - \frac{B}{\Delta\pi}\right)\hat{I}},$$

(13)

where $\hat{\pi}'(B) > 0$ and $\hat{\pi}(B) < \pi$ from (5). Our model presents the simple mechanism of information-induced runs that stem from negative information about the health of the financial institution. Since a manager with a good reputation can offer low interest rates and intensify the capacity to raise funds, investors do not run on that financial institution. On the other hand, managers with tainted reputations must promise large repayments to investors and thus cannot collect funds to reach minimum requirement, resulting in withdrawals. This mechanism represents the idea of market discipline: investors requiring high borrowing rates and withdrawing their money against bad performance.

The key point is how financial development changes the possibility of runs. (13) implies that a decrease in $B$ makes investors willing to lend more money and in turn mitigates their threat of withdrawals. The less subject the investments to moral hazard problem, the more tolerant investors towards managers’ failure.

### 3.3 Pledgeability and Investment Strategies

This subsection studies how pledgeability change a manager’s project choice when investors decide how much they invest into the manager depending on the reputation. First, to clarify the effects of manager’s reputation building, we see the benchmark case in which there is no response of investors to managerial reputation. Then, we characterize the equilibrium strategy as a function of the degree of financial development $B$. Without threat of runs, we will make sure that the manager has the incentives to take risk. Meanwhile, the threat of run can make the manager behave conservatively.

As the benchmark model without reputation concerns, consider that investors do not respond to managerial reputation and they decide to how much they invest their funds with
an exogenous probability that is independent of other variables in our model, as in Dasgupta and Prat (2006). Without the manager’s reputation concern, the choice of the benchmark strategy would be based only on expected returns. Thus, (2) implies that it is the M-strategy.

Lemma 1 Under the situation in which investors determine the amount they lend randomly, a manager takes the M-strategy.

Let us consider the equilibrium strategy with reputation concerns. As described above, at $t = 1$ the M-strategy is only equilibrium strategy because other strategies have negative net present value. The manager’s expected utility after updating the reputation into $\tilde{\pi}$, $U(\tilde{\pi})$, is given by

$$U(\tilde{\pi}) = \begin{cases} 
\tilde{\pi}(M_1 I_1 - d_1) = \mu(\tilde{\pi})A & \text{if } \tilde{\pi} \geq \hat{\pi}(B), \\
A & \text{if } \tilde{\pi} < \hat{\pi}(B), 
\end{cases}$$

where a rate of return on own capital is

$$\mu(\tilde{\pi}) \equiv \frac{\tilde{\pi} B}{\Delta \pi} > 1.$$

Thus, we can decompose $U(\tilde{\pi})$ into two parts,

$$U(\tilde{\pi}) = V(\tilde{\pi}) + \mu(\tilde{\pi})(\tilde{A} - A),$$

where $V(\tilde{\pi}) = \mu(\tilde{\pi})A$ if $\tilde{\pi} \geq \hat{\pi}(B)$, and $V(\tilde{\pi}) = A$ otherwise. The first component represents pure reputational effects; the manager who obtain reputation $\tilde{\pi}$ will get the expected return regardless of capital the manager holds. The second component represents collateral effects; the manager who obtains the profits $\tilde{A} - A$ uses them as collaterals and thereby will get the excess return.

We consider the situation without the threat of runs, where $\hat{\pi}(B) \leq \pi^{G,0}$. Figure 2
Figure 2: The expected utility without a threat of runs

depicts the expected value of pure reputational effects given the date-0 s-strategy, denoted by \( \mathbb{E}[V(\tilde{\pi}) \mid s] \). What we should highlight here is that the value function \( \mu(\tilde{\pi})A \) is convex in \( \tilde{\pi} \). A manager who gets better reputation can get perceived to succeed in the investment with higher probability, thereby collecting more funds. This increment of capacity to manage funds creates the convexity. Taking into account this benefit made by adjusting funds, the manager would like to reveal the information about managerial ability to exploit the chance.

The information effects show \( \mathbb{E}[V(\tilde{\pi}) \mid G] > \mathbb{E}[V(\tilde{\pi}) \mid M] \). On the other hand, from (2) the M-strategy has higher expected return than the G-strategy. The expected value of date-1 profits evaluated at \( t = 0 \) is given by \( \mathbb{E}[\mu(\tilde{\pi})(\tilde{A} - A) \mid G] \). If the efficiency loss compared to the value of profits yielded by the M-strategy \( \mathbb{E}[\mu(\tilde{\pi})(\tilde{A} - A) \mid M] - \mathbb{E}[\mu(\tilde{\pi})(\tilde{A} - A) \mid G] \) is not large, the benefits of information dominates the cost of efficiency and the manager chooses the the most informative strategy (in the sense of Blackwell), the G-strategy.

Next, we imagine that agents enter into the situation where financial market is less developed (i.e., \( B \) goes up) and the low probability of withdrawals threatens the manager,
such that $\pi^{G,0} < \hat{\pi}(B) \leq \pi^{M,0}$. This case is illustrated in Figure 3. A failure resulting from the G-strategy causes investor withdrawals due to an reduction in pliable income. The effect creates a discontinuous reduction in $[\mu(\hat{\pi}) - 1]A$ with $\pi^{G,0} < \hat{\pi} < \hat{\pi}(B)$ and provides strong disincentives to adopt the G-strategy. If the threat of punishment, $[\mu(\hat{\pi}) - 1]A$, is sufficiently large, the manager gets prefer to less informative strategy, the M-strategy.

Then, we consider the situation where financial market is much less developed (i.e., $B$ goes up furthermore) and the high probability of withdrawals threatens the manager (see Figure 4). This corresponds to the case where $\pi^{M,0} < \hat{\pi}(B) \leq \pi$ and a failure by either strategy does not assure management continuity. The increase in the fear reduces the benefits of the M-strategy and induces the manager to be more reluctant to reveal information. It follows that if the the threat of withdrawals, $[\mu(\hat{\pi}) - 1]A$, is sufficiently large, the manager is motivated to adopt the S-strategy in order to certainly conceal managerial ability and maintain the reputation. This entire discussion is summarized as a proposition. To simplify the notation, let us define the net value of revealing information about managerial ability by implementing the G-strategy relative to the M-strategy $V^{GM}$ and relative to the S-strategy $V^{GS}$:

$$V^{GM} = \mathbb{E} \left[ \mu(\hat{\pi}) \hat{A} \mid G \right] - \mathbb{E} \left[ \mu(\hat{\pi}) \hat{A} \mid M \right],$$

$$V^{GS} = \mathbb{E} \left[ \mu(\hat{\pi}) \hat{A} \mid G \right] - 2\mu(\pi)A.$$

**Proposition 1** Suppose that the efficiency loss by risk taking $\mathbb{E}[\mu(\hat{\pi})(\hat{A} - A) \mid M] - \mathbb{E}[\mu(\hat{\pi})(\hat{A} - A) \mid G]$ is sufficiently low.

(a) Suppose $B/\Delta \pi \in \left(M_1 - 1/\pi^{G,1}, M_1 - (\hat{I} - A)/\pi^{G,0}\hat{I} \right]$. We have $V^{GM} > 0$, that is, the equilibrium strategy is the G-strategy.

(b) Suppose $B/\Delta \pi \in \left(M_1 - (\hat{I} - A)/\pi^{G,0}\hat{I}, M_1 - (\hat{I} - A)/\pi^{M,0}\hat{I} \right]$. If

$$(1 - \eta) \left[ \mu(\pi^{G,0}) - 1 \right] A > V^{GM}, \quad (14)$$
Figure 3: The expected utility with a threat of runs in the case of $\pi^{G,0} < \hat{\pi}(B) < \pi^{M,0}$

Figure 4: The expected utility with a threat of runs in the case of $\pi^{M,0} < \hat{\pi}(B) < \pi$
the equilibrium strategy is the $M$-strategy.

(c) Suppose $B/\Delta \pi \in \left( M_1 - (I - A)/\pi^{M,0} I, M_1 - (I - A)/\pi I \right)$. If

$$(1 - \eta) \left[ \mu(\pi^{G,0}) - 1 \right] A > V^{GS},$$

(15)

the equilibrium strategy is the $S$-strategy.

If $B$ is low (in the case of (a)), a manager certainly ensures management continuity. Such manager is willing to reveal information about managerial competence in order to exploiting an opportunity to attract much funds. It follows that if the gross value of information is larger than the efficiency loss, the manager is induced to take risks.

If $B$ is in the middle range (in the case of (b)), the manager fears risks that investments would disclose much information about managerial incompetence by any chance. To mitigate the reputational risks, an opaque strategy that have less information is a more attractive option. The benefits of keeping the information secret and continuing management is represented as $(1 - \eta) \left[ \mu(\pi^{G,0}) - 1 \right] A$ in the condition (14) where the threat of withdrawals, $[\mu(\pi^{G,0}) - 1] A$, is weighted by the probability $1 - \eta$. Consequently, the fear of runs, if it is more intense than the incentive to reveal information, leads the manager to engage in more conservative strategy.

If $B$ is high (in the case of (c)), a manager faces high possibility of runs such that management cannot continue unless an investment succeeds. The condition (15) gives rise to significant fear of withdrawals such that the benefits of management continuity (or the costs of a poor reputation), $(1 - \eta) \left[ \mu(\pi^{G,0}) - 1 \right] A$, are higher than the net value of information disclosure due to the $G$-strategy relative to the $S$-strategy, $V^{GS}$. In such a case, the pressures of withdrawals from investors scarce the manager into exhibiting conservatism in order to conceal managerial incompetence.

These results are consistent with observations shown by John et al. (2008) who empirically demonstrate that poor governance and inadequate investor protection laws reduce managerial
incentive to undertake risky investments. Rajan (2006) also argues that a grave threat of bank runs might curtail the incentives for bankers to take risks and contribute to almost completely vanished banking crises in the 1950s and 1960s.

In other words, our result indicates that managers with good corporate governance or in countries with highly developed financial market may take risky investments aggressively. In such situation, investors are tolerant for failures. As a result, the manager cares little about investor refusal to roll over their funds and is willing to take risky investments to reveal information about managerial competence.

4 Competition among Managers

We thus far have discussed how reputation building affects managerial project choices in the monopolistic funding market in which investors adjust their funds put into the manager. In such a case, managers in a less developed financial market behave prudently. However, many countries that exercised financial liberalization have experienced increases in competition and financial fragility, and in particular that is more detrimental to less developed countries that is rife with a grave threat of runs (see Kaminsky and Reinhart, 1999). In this section, we address the question by allowing investors to adjust their funds not only within one of the managers but also among them. They face competitive financial market in the sense that both agents take the interest rate as given. We will show how the change of the market structure encourages risk taking behavior, but not discourage it. For this purpose, we assume in this section that $B/\Delta \pi > M_1 - (\hat{I} - A)/\pi^{\bar{M},\hat{I}}$, that is the case of Proposition 1 (c).

We introduce a mass $N$ ex ante identical managers who make independent investments. Although the environment is almost same, only difference is that investors can decide both how much they put their funds into a manager and who they do into at $t = 1$. The competition among managers makes them lose the market power and instead they borrow funds at rate $r$ and take it as exogenous.
Investors decide to roll over their funds if the offered contract satisfies, instead of (10), the following participation constraint:

$$\tilde{\pi}d_1 = r(I_1 - \tilde{A}).$$  \hspace{1cm} (16)

The cost of borrowing money becomes higher than in monopolistic case. Since the incentive compatibility condition is the same, we combine (11) with (16) and get

$$I_1(\tilde{\pi}, r) = k(\tilde{\pi}, r)\tilde{A}, \quad \text{where } k(\tilde{\pi}, r) \equiv \frac{r}{r - \tilde{\pi}(M_1 - \frac{B}{\Delta \pi})}.$$  \hspace{1cm} (16)

Thus, the run-proof condition (12) implies that

$$\tilde{\pi} \geq \tilde{\pi}(B, r) \equiv \frac{r(\hat{I} - A)}{(M_1 - \frac{B}{\Delta \pi})\hat{I}}.$$  \hspace{1cm} (17)

The manager’s expected utility after updating the reputation, $U(\tilde{\pi}, r)$, is given by

$$U(\tilde{\pi}, r) = \begin{cases} 
\mu(\tilde{\pi}, r)\tilde{A} & \text{if } \tilde{\pi} \geq \tilde{\pi}(B, r), \\
rA & \text{if } \tilde{\pi} < \tilde{\pi}(B, r),
\end{cases} \quad \text{where } \mu(\tilde{\pi}, r) \equiv \frac{B}{\Delta \pi}k(\tilde{\pi}, r).$$  \hspace{1cm} (18)

Managers who get good reputation will borrow and make profitable investment, whereas managers who get bad reputation will become lenders.

For technical reason, we assume that agency cost is not large such that

$$\frac{M_1}{\hat{I}} \min \{A^{G,1}, A^S\} \geq \frac{B}{\Delta \pi}.$$  \hspace{1cm} (19)

If the assumption is violated, some managers with good reputation must become lenders to clear the credit market even if they make profits by borrowing money. In such a case, we
must set some credit rationing rule. To avoid setting the specific rule, we make the above parametric assumption.

We focus on a symmetric equilibrium. The equilibrium rate \( r \) is determined in the credit market in which the rate equalizes the aggregate demand to the aggregate supply. Let us consider that the date-0 investment strategy is the G-strategy and define the following interest rate as \( r^G \). First, we move on to the demand side. No manager borrows at the rate \( r^G > \pi^{G,1}M_1 \). At \( r^G = \pi^{G,1}M_1 \), managers are indifferent between lending money and investing \( I_1(\pi^{G,1}, \pi^{G,1}M_1) \). \(^9\) If \( r^G < \pi^{G,1}M_1 \), all managers would like to borrow up to the limit \( I_1(\pi^{G,1}, r^G) - A^{G,1} \).

Next, we focus on the supply side. At \( r^G < 1 \), nobody supply the credit, whereas at the rate \( r^G \geq 1 \), all lenders supply all funds they have. Who lends money depends on the equilibrium rate. If the equilibrium rate is lower than \( \pi^{G,1}M_1 \), the lenders are investors and the manager who failed the investment. If the equilibrium rate is \( \pi^{G,1}M_1 \), the lenders are investors, the managers who failed the investment, and some of the managers who succeed the investment.

Figure 5 depicts the demand and supply functions, where the equilibrium rate is determined by their intersection. It is characterized by the market clearing condition

\[
\eta N [I_1(\pi^{G,1}, r^G) - A^{G,1}] = K + (1 - \eta)NA, \tag{20}
\]

where the left hand side is the aggregate demand for credit and the right hand side is the aggregate supply, which comprises the aggregate supply by investors, denoted by \( K \), and the one by the managers who failed, \((1 - \eta)NA\). The condition holds if \( r^G \in (1, \pi^{G,1}M_1) \). If the equilibrium rate reaches up to \( \pi^{G,1}M_1 \), some managers who succeeded get lenders to compensate for credit shortage. If the equilibrium rate gets down up to 1, some investors or managers who failed use storage technology to resolve excess credit supply.

\(^9\)Strictly speaking, managers are indifferent between lending and investing \( I_1 \) which is higher than \( \bar{I} \). Even at the case, the result is the same.
The above discussion is applicable to the cases of the date-0 M-strategy and S-strategy. The discussion and the market clearing implies the following Lemma. To simplify the notation, let us define demands for investors’ funds per manager given the date-0 G-strategy as $G(r_G)$, given the date-0 M-strategy as $M(r_M)$ where the interest rate is $r_M$, and given the date-0 S-strategy as $S(r_S)$ where the interest rate is $r_S$:

\[
\psi^G(r^G) = \eta \left[I_1(\pi^{G,1}, r^G) - A^{G,1}\right] - (1 - \eta)A,
\]
\[
\psi^M(r^M) = \pi \left[I_1(\pi^{M,1}, r^M) - A^{M,1}\right] - (1 - \pi)A,
\]
\[
\psi^S(r^S) = I_1(\pi, r^S) - A^S.
\]

**Lemma 2** The equilibrium rate $r^s$ for each $s = \{G, M, S\}$ is characterized as follows:

1. $r^s = 1$ if $\psi^s(1) < K/N$. 

Figure 5: The credit market equilibrium in the case of the date-0 G-strategy
2. the rate is such that

\[ \psi^s(r^s) = \frac{K}{N} \]

if \( \psi^s(\pi^{s,1}M_1) \leq K/N \leq \psi^s(1) \). Also \( r^s \) is decreasing in \( K/N \).

3. \( r^s = \pi^{s,1}M_1 \) if \( K/N < \psi^s(\pi^{s,1}M_1) \).

This Lemma shows the intuitive result. The equilibrium interest rate is determined by demand for investors’ funds per manager \( \psi^s(r^s) \) and supply of investors per manager \( K/N \). If the supply is sufficiently large such that \( \psi^s(1) < K/N \), some investors use storage technology to clear the credit market. As \( K/N \) decreases, the equilibrium interest rate increases. When \( K/N \) reaches up to more than \( \psi^s(\pi^{s,1}M_1) \), some managers who was successful in the investment become lenders to equalize the demand and the supply.

Taking into account Lemma 2 and the utility of the managers with reputation \( \tilde{\pi} \), (18), we have the expected utility of managers at date \( t = 0 \). For the date-0 G-strategy, it is given by

\[
E[U | G] = \begin{cases} 
\eta \mu(\pi^{G,1,1})A^{G,1} + (1 - \eta)A & \text{if } \psi^G(1) < K/N, \\
\pi^{G,1}M_1 \left[ \frac{K}{N} + \eta A^{G,1} + (1 - \eta)A \right] + (1 - \eta)\psi^{-1} \left( \frac{K}{N} \right) A & \text{if } \psi^G(\pi^{G,1}M_1) \leq K/N \leq \psi^G(1), \\
\pi^{G,1}M_1 \left[ \eta A^{G,1} + (1 - \eta)A \right] & \text{if } K/N < \psi^G(\pi^{G,1}M_1),
\end{cases}
\]

When \( K/N \) is large such that \( r^G = 1 \), the expected utility is the same as in monopolistic case. When \( K/N \) is middle such that \( 1 \leq r^G < \pi^{G,1}M_1 \), in the case of success they will get expected returns by investing their funds \( A^{G,1} \) into the project with a rate of return \( \mu(\pi^{G,1}, r^G) \). In case of failure, the managers lend their funds \( A \) at a rate \( r^G \). Since in case of \( r^G = \pi^{G,1}M_1 \) both lenders and borrowers get the same returns, the managers’ expected utility is considered as the one got by investing expected capital they hold at \( t = 1, \eta A^{G,1} + (1 - \eta)A \), into the project with a rate of return \( \pi^{G,1}M_1 \). For the date-0 S-strategy, the managers’ expected
utility is given by:

$$E[U | S] = \begin{cases} 
\mu(\pi, 1) A^S & \text{if } \psi^S(1) < K/N, \\
\pi \frac{B}{\pi} \left( \frac{K}{N} + A^S \right) & \text{if } \psi^S(\pi M_1) \leq K/N \leq \psi^S(1), \\
\pi M_1 A^S & \text{if } K/N < \psi^S(\pi M_1). 
\end{cases}$$

Since the S-strategy necessarily allows the managers to keep management, they get this utility by investing capital $A^S$ into the project with a rate of return $\mu(\pi, r^S)$.

Figure 6 shows the comparison of the expected utilities as a function of credit supply per manager $K/N$. When $K/N$ is large such that $r^G = r^S = 1$, the expected utility is the same as in the monopolistic market, resulting in $E[U | S] > E[U | G]$ from (15). However, when $K/N$ is sufficiently small below $(K/N)^*$, the relationship inverts.

Figure 7 illustrates why the competition makes the G-strategy more attractive. The situation in the monopolistic market is depicted as the dashed line, while the one in competitive market is depicted as the bold line. What we should emphasize in this figure is that the difference in the manager’s utility level between investing and lending diminishes via the increases in interest rates. The competitive pressure makes borrowing costs larger, and at the same time benefits lenders. The decreases in the difference in the utility level means that the threat of withdrawals weakens. As a result, the growing demand for credit undermines the incentive to behave conservatively and induces managers to take risks. Proposition 2 summarizes the result.

**Proposition 2** Suppose $B/\Delta > M_1 - (\bar{A} - A)/\pi^{M,0}$ and (15) holds. Suppose managers with mass $N$ and investors with aggregate capital $K$ trade credits through markets given an interest rate $r$. If $E[\pi(\bar{A} - A) | M] - E[\pi(\bar{A} - A) | G]$ is sufficiently low, there is a unique threshold $(K/N)^*$ such that when $K/N < (K/N)^*$, the equilibrium strategy is the G-strategy.

Our model may answer the question why market discipline broken down in the U.S. The
Figure 6: Comparison of the expected utility in the competitive funding market
Notes: The black line is the expected utility given the date-0 S-strategy $E[U \mid S]$ and the red line is the one given the date-1 G-strategy $E[U \mid G]$.

Figure 7: The expected utility in the competitive funding market in the case of $\pi^{M,0} < \hat{\pi}(B, r) < \pi$
Notes: The dotted line depicts the situation of monopolistic credit markets with $\pi^{M,0} < \hat{\pi}(B, 1) < \pi$ and assuming (15), whereas the bold line depicts the situation after introducing competition.
U.S. has experienced dramatic developments in the financial sector, coupled with deregulation that removed the entry barriers. Our model predicts that these changes alter how investors respond to managers’ performance and deprive investors of their ability to restrain managerial incentives. In turn, investors responses induce managers to take risks. This may support the statement by Rajan (2006) that technical change and intense competition among financial institutions in the recent financial sector have increased the potential for jeopardizing financial system.

Our result is also consistent with empirical findings that financial liberalization, which is the main forces of both financial development and intense competition, has strong consequences on financial fragility. In addition, the model implies that the adverse effect is more severe in the countries with lower quality of institutional level, since as shown in Figure 7, financial liberalization can change managers who would be extremely prudent into those with strong appetite for risks. The prediction is supported by evidence of Demirgüç-Kunt and Detragiache (1999).

5 Conclusion

This paper studies how investors affect portfolio management and what leads to the increase in the riskiness. Investors can affect managers’ portfolio strategies through adjusting the funds based on their performance. The investors responses give two opposing incentives to managers. On the one hand, they are tempted to take risks, since high performance attracts high inflow of funds. On the other hand, they become conservative by investors’ withdrawals. When the pledgeability is low, the manager faces more imminent threat of withdrawals. The fear for runs stimulates the incentive to avoid failure and discourages the manager from taking risks, resulting in conservatism in project choices. When the pledgeability is high, investors response induces the manager to take risk by mitigating the threat of runs.

We also document that competition among managers gives them the reputational incen-
tive to take aggressively. The competition in attracting funds increases the cost of borrowing. The rising of the interest rate reduces compensation for managers with good reputation, whereas it gives benefits to managers with bad reputation since they will become lenders. The reduction in benefits between borrowers and lenders weakens the threat of withdrawals. As a consequent, even managers who would be prudent in a case of monopoly are induced to take gambles.

Our results imply that reputation-based mechanism to behave conservatively does not work due to the two forces namely, financial developments and competition among managers. Considering that these factors characterize the financial sector in recent times, we may be able to derive an implication for financial crises and the policy against them. Although both financial development and deregulation have made enormous contributions to our economy, policy makers might have to heed to the negative aspects both factors have. They have simultaneously underlined the fragility of financial markets.

We highlight some limitations and extensions of our model. While we thus far focus on market-based incentive without any other interventions, many nations intervene in the financial sectors, thereby influencing the market response to managerial behavior. The government guarantee system (e.g., deposit insurance scheme and too-big-to-fail policy) may stabilize financial markets ex post, and it simultaneously may weaken market discipline ex ante. We need to take into account the trade off between the market discipline and the regulatory discipline. Moreover, although we focus on positive analysis, it is necessary to address normative question to design optimal policies. The macro prudential policy is an interesting issue for future studies.
A Appendix

A.1 Proof of Proposition 1

(a) The manager’s date 0 problem is as follows:

\[
\max_{s \in \{G,M,S\}, \ I_0(s), d_0(s)} \Pr\{\text{Good} \mid \alpha, s\} \mu(\tilde{x}_s^*) (A + R_0(s) I_0(s) - d_0(s)) \\
+ \Pr\{\text{Bad} \mid \alpha, s\} \mu(\tilde{x}_s^0) A,
\]

subject to

\[
\Pr\{\text{Good} \mid \alpha, s\} d_0(s) - (I_0(s) - A) \geq 0, \tag{A.1}
\]

\[
I_0(s) \leq 1. \tag{A.2}
\]

where \(R_0(s)\) is the return in case of success with strategy \(s\), \(A.1\) is the manager’s individual rationality constraint, and \(A.2\) is the resource constraint. \textit{Good} refers to a success and \textit{Bad} refers to a failure.

When \(A.1\) is not binding, the manager’s utility can increase by decreasing \(d_0(s)\). Thus, \(A.1\) is binding. Combing the object function with \(A.1\), we get the marginal benefit of \(I_0(s), R_0(s) - 1/\Pr\{\text{Good} \mid \alpha, s\} \geq 0\). Therefore, \(A.2\) is binding. The problem is rewritten as

\[
\max_{s \in \{G,M,S\}} \mathbb{E}[U(\tilde{\pi})] = \mathbb{E}[V(\tilde{\pi})] + \mathbb{E} \left[ \mu(\tilde{\pi}) (\tilde{A} - A) \right].
\]

As \(V(\tilde{\pi})\) is strictly convex in \(\tilde{\pi}\), Jensen’s inequality implies that

\[
\mathbb{E}[V(\tilde{\pi}) \mid M] > V(\pi).
\]
Using the relationship, we have

\[
\mathbb{E}[U(\bar{\pi}) \mid M] = \mathbb{E}[V(\bar{\pi}) \mid M] + \pi \mu(\pi^{M,1}) \left( M_0 - \frac{1 - A}{\pi} \right) \\
> V(\pi) + \mu(\pi^{M,1}) (\pi M_0 - 1 + A) \\
> V(\pi) + \mu(\pi) (\pi M_0 - 1 + A) \\
> 2\mu(\pi)A \\
= \mathbb{E}[U(\bar{\pi}) \mid S]
\]

where the last inequality is derived from (2).

Moreover, let \(x^G\) and \(x^M\) be signals that the G-strategy and the M-strategy produce respectively. In our model \(x^G\) is sufficient for \(x^M\), that is, there exist a non negative function \(h(x^M, x^G)\) for which the following three conditions hold:

\[
\Pr\{x^M \mid i\} = \sum_{x^G} h(x^M, x^G) \Pr\{x^G \mid i\} \quad \text{for all } x^M \text{ and for all } i,
\]

\[
\sum_{x^M} h(x^M, x^G) = 1 \quad \text{for all } x^G,
\]

\[
\sum_{x^G} h(x^M, x^G) \in (0, \infty) \quad \text{for all } x^M,
\]

where \(x^M\) and \(x^G\) take two values \textit{Good} or \textit{Bad}. Indeed, when we take \(h(\text{Good}, \text{Good}) = \frac{q_{PH}}{p_H} - \frac{1 - p_H}{p_H} \frac{q_{PH} - q_{HL}}{p_H - p_L}, h(\text{Good}, \text{Bad}) = \frac{q_{PL} - q_{HL}}{p_H - p_L}, h(\text{Bad}, \text{Good}) = 1 - \frac{q_{PH}}{p_H} + \frac{1 - p_H}{p_H} \frac{q_{PH} - q_{HL}}{p_H - p_L},\) and \(h(\text{Bad}, \text{Bad}) = 1 - \frac{q_{PL} - q_{HL}}{p_H - p_L},\) the above conditions are satisfied. By exploiting Theorem 2 in DeGroot (1970, p. 436), we can show that

\[
\mathbb{E}[V(\bar{\pi}) \mid G] > \mathbb{E}[V(\bar{\pi}) \mid M].
\]
Thus, the G-strategy yields higher expected utility than the M-strategy if

\[
\mathbb{E}[V(\pi) \mid G] > \mathbb{E}[V(\pi) \mid M] > \mathbb{E}\left[\mu(\pi) \left(\bar{A} - A\right) \mid M\right] - \mathbb{E}\left[\mu(\pi) \left(\bar{A} - A\right) \mid G\right].
\]

Note that the right hand side is negative when \( \pi M_0 = \eta G_0 \). This implies that there exists some parameters such that the condition holds.

(b) Suppose \( \pi^{G,0} < \hat{\pi}(B) < \pi^{M,0} \). This reduces the expected utility of a manager when implementing the G-strategy into

\[
\mathbb{E}[U(\pi) \mid G] = \mathbb{E}[\mu(\pi) A \mid G] + \mathbb{E}\left[\mu(\pi) \left(\bar{A} - A\right) \mid G\right] - (1 - \eta) \left[\mu(\pi^{G,0}) - 1\right] A,
\]

while utility function in cases of other strategies are unchanged. Thus, the M-strategy yields higher expected utility than the G-strategy if

\[
\mathbb{E}[\mu(\pi) A \mid G] - \mathbb{E}[\mu(\pi) A \mid M] - (1 - \eta) \left[\mu(\pi^{G,0}) - 1\right] A < \mathbb{E}\left[\mu(\pi) \left(\bar{A} - A\right) \mid M\right] - \mathbb{E}\left[\mu(\pi) \left(\bar{A} - A\right) \mid G\right].
\]

(c) Suppose \( \pi^{M,0} < \hat{\pi}(B) < \pi \). Since \( \mathbb{E}[V(\pi) \mid G] > \mathbb{E}[V(\pi) \mid M] \) from Figure 4, if \( \mathbb{E}\left[\mu(\pi) \left(\bar{A} - A\right) \mid M\right] - \mathbb{E}\left[\mu(\pi) \left(\bar{A} - A\right) \mid G\right] \) is sufficiently low, we have

\[
\mathbb{E}[U(\pi) \mid G] > \mathbb{E}[U(\pi) \mid M].
\]

Thus, the S-strategy yields the highest expected utility of the three if

\[
\mathbb{E}[\mu(\pi) A \mid G] - \mathbb{E}[V(\pi) \mid S] - (1 - \eta) \left[\mu(\pi^{G,0}) - 1\right] A < -\mathbb{E}\left[\mu(\pi) \left(\bar{A} - A\right) \mid G\right].
\]

\[\blacksquare\]
A.2 Proof of Lemma 2

First, we will show that the equilibrium rate after the date-0 $s$-strategy is $r^s \in [1, \pi^{s,1}M_1]$. If $r^s < 1$, no one supply credits. If $r^s > \pi^{s,1}M_1$, no manager borrow money because the date-1 participation constraint for managers is given by:

$$U(\tilde{\pi}) = \tilde{\pi}(M_1I_1 - d_1) \geq r\tilde{A},$$  \hspace{1cm} (A.3)

which is rewritten as by using (16),

$$(\tilde{\pi}M_1 - r)I_1 \geq 0.$$

(a) When $\psi^s(1) < K/N$, market clearing condition does not hold. To resolve excess supply, some investors or managers who failed must use storage technology. This is possible only when they are indifferent between lending and using storage technology. Thus, the equilibrium interest rate is 1.

(b) When $\psi^s(\pi^{s,1}M_1) \leq K/N \leq \psi^s(1)$, market clearing condition holds.

(c) When $K/N < \psi(\pi^{s,1}M_1)$, market clearing condition does not hold. To compensate for credit shortage, some managers who succeeded must become lender. This is feasible only if they are indifferent between lending and borrowing, which implies that the equilibrium rate is $\pi^{s,1}M_1$. Finally, we check whether the borrowing at least $\hat{I} - \bar{A}$ is feasible. The run-proof condition (17) implies that the borrowing is feasible if the interest rate is

$$r \leq \tilde{\pi} \left( \frac{M_1 - B/\Delta\pi}{\hat{I} - \bar{A}} \right).$$

The equilibrium satisfies this condition because $\tilde{\pi}M_1 \leq \frac{\tilde{\pi}(M_1 - B/\Delta\pi)\hat{I}}{\hat{I} - \bar{A}}$ by (19).
A.3 Proof of Proposition 2

When $\psi^G(\pi^{G,1}M_1) \leq K/N \leq \psi^G(1)$, market clearing condition (20) implies that

$$\frac{\partial r^G}{\partial (K/N)} = -\frac{r^G}{I_1(\pi^{G,1}, r^G)} A^{G,1} K/N + (1 - \eta) A.$$  

By using this equation, we have

$$\frac{\partial E[U \mid G]}{\partial (K/N)} = \pi^{G,1} B + \frac{\partial r^G}{\partial (K/N)} (1 - \eta) A$$

$$= \frac{1}{I_1(\pi^{G,1}, r^G)} \left[ \pi^{G,1} \frac{B}{\Delta \pi} I_1(\pi^{G,1}, r^G) - r^G A^{G,1} \frac{(1 - \eta) A}{K/N + (1 - \eta) A} \right]$$

$$\geq 0,$$

where the last inequality holds because of (A.3). Thus, $E[U \mid G]$ is nondecreasing in $K/N$. $E[U \mid S]$ is also nondecreasing in $K/N$ because when $\psi^S(\pi M_1) \leq K/N \leq \psi^S(1)$,

$$\frac{\partial E[U \mid S]}{\partial (K/N)} = \pi^{G,1} B > 0.$$

When $K/N > \max \{\psi^G(1), \psi^S(1)\}$, $E[U \mid S] > E[U \mid G]$ because of (15). Suppose $K/N < \min \{\psi^G(\pi^{G,1}M_1), \psi^S(\pi M_1)\}$. If $E[\bar{\pi}(\bar{A} - A) \mid M] - E[\bar{\pi}(\bar{A} - A) \mid G]$ is sufficiently low, we have $E[U \mid G] > E[U \mid S]$. Taking into account $E[U \mid G]$ and $E[U \mid S]$ are nondecreasing in $K/N$, there is a unique threshold $(K/N)^*$ such that

$$\begin{cases} 
E[U \mid S] > E[U \mid G] & \text{if } (K/N)^* < K/N, \\
E[U \mid S] < E[U \mid G] & \text{if } (K/N)^* > K/N.
\end{cases}$$

Next, we compare the expected utility of the G-strategy and the one of the M-strategy.
The expected utility of the M-strategy is given by

\[
E[U \mid M] = \begin{cases} 
\pi \mu(\pi^{M,1}, 1) \left( A + M_0 - \frac{1-\eta}{\pi} \right) + (1 - \eta)A & \text{if } \psi^M(1) < K/N, \\
\pi^{M,1} \frac{B}{A} \left( \frac{K}{N} + 2A + \pi M_0 - 1 \right) + (1 - \pi) r^M A & \text{if } \psi^M(\pi^{M,1} M_1) \leq K/N \leq \psi^M(1), \\
\pi^{M,1} M_1 (2A + \pi M_0 - 1) & \text{if } K/N < \psi^M(\pi^{M,1} M_1).
\end{cases}
\]

Suppose \( K/N < \psi^G(\pi^{G,1} M_1) \). Since

\[
\psi^M(\pi^{M,1} M_1) - \psi^G(\pi^{G,1} M_1) = \left( \frac{M_1}{B/\Delta \pi} - 1 \right) \left\{ (\pi^G(A + M_0) - \eta(A + G_0)) - (1 - \pi)A + (1 - \eta)A \right\}
\]

we have

\[
E[U \mid G] - E[U \mid M] = \pi^{G,1} M_1 (2A + \eta G_0 - 1) - \pi^{M,1} M_1 (2A + \pi M_0 - 1) > 0,
\]

if \( \mathbb{E}[\hat{\pi}(\hat{A} - A) \mid M] - \mathbb{E}[\hat{\pi}(\hat{A} - A) \mid G] \) is sufficiently low.

Suppose \( \psi^G(\pi^{G,1} M_1) \leq K/N \leq \min \{ \psi^M(1), \psi^G(1) \} \). In this case,

\[
E[U \mid G] - E[U \mid M] = \pi^{G,1} \frac{B}{\Delta \pi} \left( \frac{K}{N} + 2A + \eta G_0 - 1 \right)
\]

\[
+ (1 - \eta) \pi^{G,1} \left( M_1 - \frac{B}{\Delta \pi} \right) \frac{K/N + 2A + \eta G_0 - 1}{K/N + (1 - \eta)A} A - \pi^{M,1} \frac{B}{\Delta \pi} \left( \frac{K}{N} + 2A + \pi M_0 - 1 \right)
\]

\[
- (1 - \pi) \pi^{M,1} \left( M_1 - \frac{B}{\Delta \pi} \right) \frac{K/N + 2A + \pi M_0 - 1}{K/N + (1 - \pi)A} A.
\]

Defining \( \lambda^G = \frac{(1-\eta)A}{K/N+(1-\eta)A} \) and \( \lambda^M = \frac{(1-\pi)A}{K/N+(1-\pi)A} \), where \( \lambda^G > \lambda^M \), we can rewrite the
Thus, if \( E[U \mid G] > E[U \mid M] \), we have \( E[U \mid G] > E[U \mid M] \).

Suppose \( \min \{ \psi^M(1), \psi^G(1) \} < K/N \). Since \( E[U \mid G] \) is nondecreasing, Proposition 1 (c) implies that \( E[U \mid G] > E[U \mid M] \) if \( E[\mu(\bar{\pi})(\bar{A} - A) \mid M] - E[\mu(\bar{\pi})(\bar{A} - A) \mid G] \) is sufficiently low.

\[\begin{align*}
E[U \mid G] - E[U \mid M] &= \pi^{G,1} \left[ \lambda^G M_1 + (1 - \lambda^G) \frac{B}{\Delta \pi} \right] \left( \frac{K}{N} + 2A + \eta G_0 - 1 \right) \\
&\quad - \pi^{M,1} \left[ \lambda^M M_1 + (1 - \lambda^M) \frac{B}{\Delta \pi} \right] \left( \frac{K}{N} + 2A + \pi M_0 - 1 \right) \\
&> \left[ \lambda^M M_1 + (1 - \lambda^M) \frac{B}{\Delta \pi} \right] \times \\
&\quad \left\{ (\pi^{G,1} - \pi^{M,1}) \left( \frac{K}{N} + A \right) + E[\bar{\pi}(\bar{A} - A) \mid M] - E[\bar{\pi}(\bar{A} - A) \mid G] \right\}.
\end{align*}\]

References


