Monitoring versus Gatekeeping

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Abstract

I study alternative mechanisms for ameliorating informational problems in collective credit organizations facing adverse selection and moral hazard. I consider alternative mechanisms both with and without the possibility of the investor colluding with the monitor. I show that the optimal gatekeeping mechanism satisfies both budget balance and individual rationality and dominates peer monitoring. The basic intuition is that while the monitor needs to be encouraged to seek information (and incur a cost), the default under gatekeeping is to deny credit - and therefore it is the informed party that seeks gatekeepers, and reveals information through side payments.

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1 Introduction

I consider an economy with a large number of agents with productivity drawn from a uniform distribution on the unit interval, who could either invest in a productive opportunity or become monitors. I consider alternative mechanisms aiming to implement both an efficient division of agents between investors and monitors, as well as optimal choice of effort by investors - both with and without the possibility of the investor colluding with (i.e. offering a bribe to) the monitor. The mechanisms I consider satisfy individual rationality as well as budget balance.

The literature mentions the problem of collusion between monitors and investors as well as the problem of free riding by a monitor on others. Even when there is no explicit joint liability, a group such as members of a cooperative - where often the cooperative is the only viable source of credit - face implicit joint liability, as high default rate would eventually lead to higher charges to the whole group. Thus members have an incentive to monitor each other. But whenever monitoring is costly, in any not-very-small group, peer monitoring incentives are diluted by the possibility of free riding.

I show that under optimal design these problems can be solved - and create no extra inefficiency.

I derive optimal monitoring mechanisms with and without collusion with efficient assignment of monitors, and efficient investment, and efficient choice of effort. Optimal monitoring design can be adapted to prevent collusion. Gatekeeping works through side payments and therefore explicitly takes into account all collusive arrangements at the outset. Thus neither the outcome under monitoring nor that under gatekeeping are influenced by collusion.

However, monitoring mechanisms are inefficient even with respect to the second best. What matters is efficient assignment and the incentive to monitor. The conjunction of these problems create inefficiency. To ensure that monitors actually do their job, monitoring must have a certain payoff. But the need to pay for monitoring creates an incentive problem in choice of investment. Investment, to be worthwhile, must pay at least as much as monitoring. The division of agents between investors and monitors is thus endogenous, and the payoff structures need to be designed carefully to avoid inefficient investment.

A solution is to allow side payments and to make use of them in generating optimal monitoring and consequent efficient investment incentives. I show that this can be done by creating a system of competing gatekeepers, who are allocated extra property rights compared to monitors.

I derive the optimal budget balanced gatekeeping mechanism and show that this recovers first best efficiency creating through efficient rent extraction. Thus gatekeeping dominates monitoring.

The basic intuition is as follows. While the monitor needs to be encouraged to actively seek information, the problem is opposite for gatekeepers - under optimal payments, the incentive to deny is set by the mechanism. The default is to deny credit - and it is the informed party (investor) who must get the gatekeeper to agree by providing side payments. Thus while monitors have to seek information (at a cost), under the right design of gatekeeping, it is the informed who seek gatekeepers, and reveal private information through side payments. At the same time, competition among gatekeepers limits the rent seeking ability of gatekeepers. This makes competitive gatekeeping more effective.

2 The Model

There is a continuum of agents. Each agent can either earn a safe return or invest in a risky project. Without loss of generality, set the net safe return to 0. Each investment project requires an indivisible investment of 1. The rate of return from production is a random variable that can take two values 0, and $R > 1$. The state where the realized value of the rate of return is R, is called "success," and the other state is called "failure." The probability of success of a project depends on the project's "type" as well as the effort of the agent. Project "type" denotes the intrinsic success probability (i.e. quality) of a project. This is a random variable p with a uniform distribution on $[0, 1]$. Types are independent across projects.

Agents have zero initial wealth.

The effort (effort denotes provision of private inputs such as - in agriculture - quality and quantity of fertilizer, quantity of water, quantity of workers hired to plant seeds, the quality of the seeds used) of the agent could be high or low. If the agent takes high effort, the success probability of the project is given by p, the project's type. If, on the other hand, the agent takes low effort, the success probability is reduced to αp, $0 < \alpha < 1$.

Low effort is cost-less. The cost of high effort, ϕ, however, depends on the state of nature. The cost is $\phi_L = (1 - \alpha)$ with probability θ, and $\phi_H = m(1 - \alpha)$ with probability $(1 - \theta)$, where $m > 1$. Each project draws a cost of effort independently of others.

Note that the lower the α, the greater the "distance" between high and low effort in terms of the success probability - and the higher the cost of high effort relative to low effort. At $\alpha = 1$, there is no difference between the outcomes of low and high efforts, and they have the same cost.

Thus whenever effort is high, the total resource cost is $1 + (1 - \alpha) = 2 - \alpha$. Thus the return is either 0 or $R(2 - \alpha)$. On the other hand, if effort is low, the total investment is just 1, and the return is 0 or R.

I make the following assumptions:

$$\alpha R < 1.$$

Thus low effort by any type is socially suboptimal. Second, m is high enough so that

$$R(2 - \alpha) - m(1 - \alpha) < 1.$$

Thus when the cost of effort is high (ϕ_H), investment is socially undesirable.

The type of a project as well as the level of effort exerted are the agent's private information. However, the distribution of project types and the parameter α are public information. Further, investment is observable. This rules out direct consumption of a loan.

2.1 Benchmark Investment

First, consider the projects for which cost of effort is low. For high effort to be socially optimal, two conditions must be satisfied.First, it must be that for $p \geq p_{\text{fb}}$, $pR(2-\alpha) -$

$(1-\alpha)-1 \geq \alpha pR(2-\alpha)-1$ (high effort is better), and for $p < p_{\text{fb}}$, $\alpha pR(2-\alpha)-1 \leq 0$ (non participation is better). Satisfying the first inequality requires

$$p_{\text{fb}}R(2-\alpha)-(1-\alpha) \geq \alpha p_{\text{fb}}R(2-\alpha), \tag{2.1}$$

and satisfying the second inequality requires

$$\alpha p_{\text{fb}}R(2-\alpha)-1 \leq 0. \tag{2.2}$$

If high effort is socially optimal, the first-best investment cutoff (denoted p_{fb}) is given by $R(2-\alpha)p_{\text{fb}}-(1-\alpha)=1$, i.e.

$$p_{\text{fb}} = \frac{1}{R}. \tag{2.3}$$

Note that since $R > 1$, the first best cutoff is smaller than 1 - i.e. the first best investment level is positive.

Since $p_{\text{fb}}R = 1$, the inequalities (2.1) and (2.2) above imply $\alpha(2-\alpha) \leq 1$ - i.e. $(1-\alpha)^2 \geq 0$. This holds since $\alpha < 1$.

For all projects with high cost of effort social optimality requires not investing.

Thus if the cost of effort is low, the first best cutoff type is given by 2.3, and social optimality requires all types above the first best cutoff type to invest with high effort, and all types below to not invest. Further, if cost of effort is high, social optimality requires all types to not invest.

2.2 Monitoring and Second Best

A monitor spends C, learns about the project and its environment and reports the cost of effort. Investment is allowed to proceed only if the monitor reports low cost. Once investment starts, the monitor checks and reports on the level of provision of effort, and if the report says low effort, all output is seized. If monitor reports high cost or low effort, the investor has the option of paying C to the center who then verifies the state (incurring cost C), and if the monitor's report turns out false, reverses the decision against the investor and fines the monitor all fees received from all the projets assigned to him.

For all projects with high cost of effort social optimality requires not investing. For all projects with a low cost of effort, the second-best investment cutoff under monitoring (denoted p_{sb}) is given by $R(2-\alpha)p_{\text{sb}} - (1-\alpha) = 1 + C$, i.e.

$$p_{\text{sb}} = \frac{1}{R}\left(1 + \frac{C}{2-\alpha}\right). \tag{2.4}$$

2.3 Gatekeeping

There are multiple investment gates, with gatekeepers. The sequence of moves is as follows. An investor applies to a gatekeeper seeking a permit to invest - the gatekeeper either says NO, or allows investment to proceed.

3 Inefficiency Without Monitoring or Gatekeeping

In the absence of peer monitoring or gatekeeping, under any contract, for there to be positive investment with high effort when environment is favorable, it must be that

$$p(R(2-\alpha) - T) - (1-\alpha) \geq 0 \tag{3.1}$$

for some positive measure of projects, where $T > 0$ is the payment to be made by an investor in the success state. Given limited liability, the payment in the failure state is zero[(1)].

Now suppose investment is efficient - so that investment takes place only if environment is favorable, and then only types $p \geq 1/R$ invest. A necessary condition for this to be true is that equation 3.1 holds at $p = 1/R$. But at $p = 1/R$, the equation becomes $1 - T/R \geq 0$, implying that $R - T \geq 0$. This in turn implies that $\alpha p(R-T) > 0$ for all types p. But this is the participation constraint for projects who do not want to invest with a high level of private inputs. Therefore if environment is unfavorable so that a high level of private inputs are required to enhance productivity, all types invest with low levels of private inputs, and when environment is favorable, if the incentive to

[(1)] T is given by the budget balance equation $\overline{p}T = 1$. $\overline{p}$ is the average probability of success, and thus $\overline{p}T$ is the expected repayment, and this needs to equal the original loan of 1.

provide high levels of private input binds at $p = 1/R$, then all types $p < 1/R$ also invest - but with low levels of private inputs. This contradicts the supposition of efficiency above.

Thus efficiency is not attainable. In fact, since all types invest always (overinvestment), and a high level of private inputs is provided only by some types only when environment is favorable, the outcome is very far from the efficient solution.

4 Optimal Peer Monitoring Design

For each project under a monitor, consider a payment scheme (for the monitor) $\mathbf{Y} = (Y_{\mathrm{S}}, Y_{\mathrm{F}}, Y_{\mathrm{NI}})$ where Y_{S} and Y_{F} are the payments made to the monitor when investment takes place and results in success and failure respectively, and Y_{NI} is the payment made to the monitor when no investment takes place (i.e. the project is not operated).

From limited liability, $Y_{\mathrm{S}} \geq 0$, $Y_{\mathrm{F}} \geq 0$, $Y_{\mathrm{NI}} \geq 0$, and $T_F \leq 0$.

Let $\overline{Y}_{\mathrm{I}}\,(\overline{p}) = \big(\overline{p}\, Y_{\mathrm{S}} + (1-\overline{p})\, Y_{\mathrm{F}}\big)$, and $\overline{Y}_{\mathrm{I}}\,(\alpha\,\overline{p}) = \big(\alpha\,\overline{p}\, Y_{\mathrm{S}} + (1-\alpha\,\overline{p})\, Y_{\mathrm{F}}\big)$.

Any payment scheme for the monitor must make it worthwhile for the monitor to incur the cost of monitoring. By incurring the cost of monitoring, the monitor receives $\theta\,\overline{Y}_{\mathrm{I}}\,(\overline{p}) + (1-\theta)\; Y_{\mathrm{NI}} - C$, while not incurring the cost gives him a payoff of $\theta\,\overline{Y}_{\mathrm{I}}\,(\overline{p}) + (1-\theta)\;\overline{Y}_{\mathrm{I}}\,(\alpha\,\overline{p})$.

Thus the following incentive-to-monitor constraint must be satisfied:

$$\theta\,\overline{Y}_{\mathrm{I}}\,(\overline{p}) + (1-\theta)\; Y_{\mathrm{NI}} - C \quad\geq\quad \theta\,\overline{Y}_{\mathrm{I}}\,(\overline{p}) + (1-\theta)\;\overline{Y}_{\mathrm{I}}\,(\alpha\,\overline{p}).$$

Further, the expression on the left hand side must be positive to ensure participation by the monitor. However, from limited liability, both $\overline{Y}_{\mathrm{I}}\,(\overline{p})$ and $\overline{Y}_{\mathrm{I}}\,(\alpha\,\overline{p})$ are positive. Thus the participation constraint is satisfied whenever the incentive constraint is satisfied. Simplifying the inequality above,

$$\big(\mathrm{IC}_{\,\mathrm{M}}\big) \qquad (1-\theta)\; Y_{\mathrm{NI}} - C \quad\geq\quad (1-\theta)\;\overline{Y}_{\mathrm{I}}\,(\alpha\,\overline{p}). \tag{4.1}$$

A general form of repayment contract is given by (T, T_F), where T is the payment made by the investor in the success state and T_F is the payment in the failure state.

Note that from limited liability, $T_F \leq 0$. Since $T_F(\cdot) < 0$ only dilutes incentives to take higher effort by paying agents in the failure state and at the same time reduces the payoff of the bank, any optimal contract sets $T_F(\cdot) = 0$. Thus without loss of generality we can specify a repayment contract as a payment T in the success state.

Thus any scheme of transfers (including payments to monitors and payments by investors) is a vector $(\mathbf{Y}, T)$.

Given any such scheme, the investment cutoff type p_* is given by the following participation constraint for investors which says that the marginal investor (denoted by type p_*) must earn just as much as a monitor:

$$(\text{PC}_{\text{I}}) \quad \theta\Big(p_*(R(2-\alpha) - T) - (1-\alpha)\Big) = \frac{1-p_*}{p_*}\Big(\theta\, \overline{Y}_{\text{I}}(\overline{p}) + (1-\theta)\, Y_{\text{NI}} - C\Big). \quad (4.2)$$

Finally, budget balance implies that the payment by investors must account for loan repayments as well as payment to monitors:

$$(\text{BB}) \qquad \left[\theta\, \overline{Y}_{\text{I}}(\overline{p}) + (1-\theta)\, Y_{\text{NI}}\right] = \theta\ (\overline{p}\, T - 1)\,. \qquad (4.3)$$

Using budget balance, the incentive-to-monitor constraint can be written as:

$$(\text{IC}^{'}_{\text{M}}) \qquad \theta\,(\overline{p}\, T - 1) - C \ \geq\ \theta\, \overline{Y}_{\text{I}}(\overline{p}) + (1-\theta)\, \overline{Y}_{\text{I}}(\alpha\, \overline{p}) \qquad (4.4)$$

and the investment cutoff condition (PC-I) can be written as:

$$(\text{PC}^{'}_{\text{I}}) \qquad p_*\,(R(2-\alpha) - T) - (1-\alpha) = \left(\frac{1-p_*}{p_*}\right)\left(\overline{p}\, T - 1 - \frac{C}{\theta}\right). \qquad (4.5)$$

First, let us suppose for the moment that constraint (4.4) is satisfied. This implies all investing types take high effort, or they do not invest. This implies that whenever the cost of effort is high, the investor does not invest.

The concern then is to set the level of the charge T to investors such that only the types above the first best cutoff invest when the cost of effort is low. This can be achieved by setting T to a level such that the value of the cutoff type p_*, which is implicitly defined by equation (4.5),coincides with the first best cutoff p_{sb}.

The T that achieves this is given by solving equation (4.5) at $p_* = p_{\text{sb}}$. Solving, the optimal charge T^* is given by

$$T^* = \frac{2(\theta + c(1 - (1-\theta)p_{\text{sb}}))}{\theta(1 + p_{\text{sb}}^2)}. \tag{4.6}$$

Theorem 1. *Under optimal contract,* $Y_{\text{S}} = Y_{\text{F}} = 0$.

Proof: Note that T^* is derived under the assumption that constraint 4.4 holds. This is true whenever 4.4 holds with $T = T^*$. Let $\theta\overline{Y}_{\text{I}}(\overline{p}) + (1-\theta)\overline{Y}_{\text{I}}(\alpha\,\overline{p}) = \phi$. Note that if $\phi > 0$, the higher the ϕ, the higher T^* needs to be to satisfy the constraint. Now,

$$\frac{\partial T^*}{\partial R} = \frac{\partial T^*}{\partial p_{\text{sb}}}\frac{\partial p_{\text{sb}}}{\partial R}.$$

From equation 4.6,

$$\frac{\partial T^*}{\partial p_{\text{sb}}} = -\frac{2}{\theta}\left(\frac{(1-\theta)C(1-p_{\text{sb}}^2) + 2p_{\text{sb}}(\theta + C)}{(1+p_{\text{sb}}^2)^2}\right) < 0.$$

Further, since $p_{\text{sb}} = \frac{1}{R}\left(1 + \frac{C}{2-\alpha}\right)$, $\frac{\partial p_{\text{sb}}}{\partial R} < 0$. Thus $\frac{\partial T^*}{\partial R} > 0$. Thus as ϕ increases, and therefore T^* increases, the range of values of R for which second best can be attained shrinks - i.e. suppose $\theta\overline{Y}_{\text{I}}(\overline{p}) + (1-\theta)Y_{\text{NI}}$ is held constant, and increase ϕ above 0. Then constraint 4.4 holds whenever $R \geq R_{\min}(\mathbf{Y}, T^*, \phi)$ where $R_{\min}(\mathbf{Y}, T^*, \phi)$ increases in ϕ. Also note that ϕ does not play any role in the other constraint. Thus the optimal contract involves $\phi = 0$. Now, $\phi = \beta Y_{\text{S}} + (1-\beta)Y_{\text{F}}$, where $\beta = (\theta + (1-\theta)\alpha)\overline{p} < 1$. Since $Y_{\text{S}} \geq 0$, and $Y_{\text{F}} \geq 0$, $\phi = 0$ implies that $Y_{\text{S}} = Y_{\text{F}} = 0$. □

Thus the optimal scheme of payment to monitors $\mathbf{Y}^* = (Y_{\text{S}}{}^*, Y_{\text{F}}{}^*, Y_{\text{NI}}{}^*)$ is given by

$$Y_{\text{S}}{}^* = Y_{\text{F}}{}^* = 0, \tag{4.7}$$

$$Y_{\text{NI}}{}^* = \frac{\theta}{(1-\theta)}(\overline{p}_{\text{sb}}T^* - 1) \tag{4.8}$$

where, the payment $Y_{\text{NI}}{}^*$ is derived from the budget balance condition (BB) and equation 4.6 above, and

$$\overline{p}_{\text{sb}} = \frac{(1 + p_{\text{sb}})}{2} = \frac{(2-\alpha)(1+R) + C}{2R(2-\alpha)}.$$

This proves the following result.

THEOREM 2. *In the absence of collusion, the transfer scheme* $(\mathbf{Y}^*, T^*)$ *described below attain second best whenever* $R > R_{\min}(\mathbf{Y}^*, T^*)$, *where*

$$R_{\min}(\mathbf{Y}^*, T^*) = \left(1 + \frac{C}{2-\alpha}\right)\left[\frac{(\theta + C(2-\theta))}{\theta + \theta C}\right]. \tag{4.9}$$

The transfer scheme is as follows.

- *Each investor pays* T^* *given by (4.6) in the success state, and zero otherwise.*
- *Each monitor receives* ${Y_{\mathrm{NI}}}^*$ *given by (4.8) whenever investment does not take place, and* ${Y_{\mathrm{S}}}^* = {Y_{\mathrm{F}}}^* = 0$ *otherwise.*

Proof: I showed above that $(\mathbf{Y}^*, T^*)$ implements the second best cutoff whenever constraint 4.4 is satisfied. Using $\overline{Y}_{\mathrm{I}}(\overline{p})^* = 0$, and $p_* = p_{\mathrm{sb}}$, the constraint 4.4 holds whenever R exceeds $R_{\min}(\mathbf{Y}^*, T^*)$ as stated. $\square$

Note that attaining second best requires implementing the second best cutoff whenever $p_{\mathrm{sb}} < 1$, i.e. whenever $R > 1 + C/2 - \alpha$. However, since $2 - \theta > 1$, $R_{\min}$ above exceeds $1 + C/2 - \alpha$.

5 Monitoring Design Under Collusion

The solution above would not work if investors could collude with monitors. Collusion here implies that an investor can make side payments to the monitor. This adds a further constraint. Once C is incurred, and the monitor discovers that the effort cost is high, he should report this truthfully - and not be persuaded by any bribe offer by the investor. Note that the maximum bribe that an investor can offer (any such offer is a payment promised in the success state) is $R(2-\alpha) - T$. Any such offer translates into an expected payoff of $\alpha\overline{p}(R(2-\alpha) - T)$ for the monitor. Not accepting a bribe (and thus reporting truthfully) leads to the project not being funded and this earns the monitor a payoff of Y_{NI}. This explains the following "no-successful-bribe" constraint:

$$\text{(No-Successful-Bribe)} \qquad Y_{\mathrm{NI}} \geq \alpha\overline{p}(R - T) + \overline{Y}_{\mathrm{I}}(\alpha\,\overline{p}). \tag{5.1}$$

Let $B \geq 0$ be a fixed base payment to each investor and monitor. Thus each agent is promised a payoff of at least B in each state and irrespective of the choice to become monitor or investor. The last section implicitly assumed $B = 0$. I show below that such a fixed payment has no role to play if collusion can be ruled out at the outset - so that the analysis is without loss of generality. However, if collusion is possible, so that there is a no-successful-bribe constraint, this plays an important role.

Note that since B is a promised fixed base salary to all agents, agents cannot be paid less than B - thus limited liability still implies $(Y_{\mathrm{S}}, Y_{\mathrm{F}}, Y_{\mathrm{NI}}) \geq 0$, and $T_S \leq 0$.

As before, the incentive constraint for monitors is given by 4.1, and the investment cutoff is given by 4.2.

The budget balance equation is given by

$$(1-p_*)B + p_*\left(B \;+\; \frac{(1-p_*)}{p_*}\left[\theta \overline{Y}_{\mathrm{I}}\,(\overline{p}) + (1-\theta)Y_{\mathrm{NI}}\right]\right) = (1-p_*)\theta(\overline{p}T - 1)$$

Simplifying,

$$\text{(BB)} \qquad \theta \overline{Y}_{\mathrm{I}}\,(\overline{p}) + (1-\theta)Y_{\mathrm{NI}} = \theta\,(\overline{p}\,T - 1) - \frac{B}{(1-p_*)} \tag{5.2}$$

Using the budget balance equation, the incentive to monitor condition (given by 4.1) and the investment cutoff condition 4.2 can be written as:

$$(\text{IC}_{\text{M}}) \qquad \theta(\overline{p}\,T - 1) - \frac{B}{(1-p_*)} - C \;\geq\; \theta\,\overline{Y}_{\mathrm{I}}\,(\overline{p}) + (1-\theta)\,\overline{Y}_{\mathrm{I}}\,(\alpha\,\overline{p}) \tag{5.3}$$

$$(\text{PC}_{\text{I}}) \qquad \frac{(1-p_*)}{p_*}\left(\theta(\overline{p}\,T - 1) - \frac{B}{(1-p_*)} - C\right) \;=\; \theta\Big(p_*(R(2-\alpha) - T) - (1-\alpha)\Big) \tag{5.4}$$

From the above constraint, if ${Y_{\mathrm{S}}}^*$ or ${Y_{\mathrm{F}}}^*$ is strictly positive, then $(\overline{Y}_{\mathrm{I}}\,(\overline{p}), \overline{Y}_{\mathrm{I}}\,(\alpha\,\overline{p})) > 0$, and this only makes it harder to satisfy both the no-successful-bribe constraint (5.1) as well as the incentive to monitor constraint. Thus the optimal contract involves ${Y_{\mathrm{S}}}^* = {Y_{\mathrm{F}}}^* = 0$ as before.

Setting $p_* = p_{\mathrm{fb}}$, and solving equation 5.3 for T, the optimal value of T is obtained as a function of B. Let $T^*(B)$ denote this solution. This is given by

$$T^*(B) = T^*(0) + \frac{2B}{\theta({p_{\mathrm{sb}}}^2 + 1)},$$

where $T^*(0)$ is simply the value of T^* obtained in the last section which implicitly set $B = 0$. Thus $T^*(0)$ is given by equation 4.6. Now, from limited liability, the payoff of the monitor (net of B) must be positive. Using $\mathrm{PC_I}$ above, this implies

$$p_{\mathrm{sb}}(R(2-\alpha) - T^*(B)) - (1-\alpha) \geq 0.$$

Thus the largest possible value of $T^*(B)$ is that for which the above holds with equality. Thus

$$T^*(B)_{\max} = \frac{1+C}{p_{\mathrm{sb}}} = \frac{(1+C)(2-\alpha)}{2-\alpha+C} R > R,$$

where the last inequality follows from the fact that $2 - \alpha > 1$.

Now, since ${Y_{\mathrm{S}}}^* = {Y_{\mathrm{F}}}^* = 0$, the no-successful-bribe condition is given by $Y_{\mathrm{NI}} \geq \alpha\overline{p}(R - T)$. Thus if B is set so that $T = T^*(B)_{\max}$, then since $T^*(B)_{\max} > R$, the no-successful-bribe condition ceases to bind and coincides with the limited liability condition that $Y_{\mathrm{NI}} \geq 0$. Thus setting T to $T^*(B)_{\max}$ would remove the extra constraint posed by collusion and reduce the case to the one considered in the previous section.

The only remaining question is whether setting $B > 0$ alters the power of the mechanism (i.e. whether $R_{\min}$ changes). The following result shows that B has no influence on $R_{\min}$.

Let $B_{\max}$ solve $T^*(B_{\max}) = \frac{1+C}{p_{\mathrm{sb}}}$. It can be easily checked that for any $B \in [0, B_{\max}]$, $R_{\min}$ does not change. This also shows that the implicit assumption of $B = 0$ in the last section is without loss of generality.

THEOREM 3. *Under collusion, the transfer scheme* $(\mathbf{Y}^*, T^*)$ *described below attain second best whenever* $R > R_{\min}(\mathbf{Y}^*, T^*)$*, where* $R_{\min}(\mathbf{Y}^*, T^*)$ *is given by equation 4.9. The transfer scheme is as follows.*

- *Each investor pays* $(1+C)/p_{\mathrm{sb}}$ *in the success state, and zero otherwise.*
- *Whenever investment does not take place, a monitor receives* ${Y_{\mathrm{NI}}}^*$ *given by the solution for* Y_{NI} *from (BB) above (using the optimal value of* T*), and* ${Y_{\mathrm{S}}}^* = {Y_{\mathrm{F}}}^* = 0$ *otherwise.*

Thus collusion does not cause any extra inefficiency.

6 A Gatekeeping Mechanism

By saying "NO" the gatekeeper can always earn Y_{NI}, thus to make him say yes, an investor might need to make a side payment so that the payoff of the monitor by allowing an investment is at least Y_{NI}.

If the private cost is high, an investor would want to produce with a low level of private inputs and effort. Such an investor can offer at most $(R-T)$ as side payment to the gatekeeper to seek permission to proceed with investment.

If a gatekeeper says 'YES' to a project that offers at most $(R-T)$ in the success state, he receives at most $\left(\alpha\,\overline{p}\,Y_{\mathrm{S}}+(1-\alpha\,\overline{p})\,Y_{\mathrm{F}}\right)+\alpha\overline{p}(R-T)$. By saying 'NO' he receives Y_{NI}. For the latter to be incentive compatible,

$$Y_{\mathrm{NI}} \geq \left(\alpha\,\overline{p}\,Y_{\mathrm{S}}+(1-\alpha\,\overline{p})\,Y_{\mathrm{F}}\right)+\alpha\overline{p}(R-T). \tag{6.1}$$

Now, it must be incentive compatible to say 'YES' when the investor intends to invest and take high effort. Let S denote the side payment in this case. Thus need:

$$Y_{\mathrm{NI}} \leq (1-\theta)Y_{\mathrm{NI}}+\theta\overline{p}\left[\left(\overline{p}\,Y_{\mathrm{S}}+(1-\overline{p})\,Y_{\mathrm{F}}\right)+S\right].$$

Under competition, the equilibrium side payment just ensures incentive compatibility:

$$S^{*}=\frac{Y_{\mathrm{NI}}}{\overline{p}}-\overline{Y}_{\mathrm{I}}\,(\overline{p}). \tag{6.2}$$

This implies that irrespective of whether investment takes place, the payoff of a gatekeeper is given by Y_{NI}[2].

To ensure participation by a monitor, Y_{NI} must be positive.

$$Y_{\mathrm{NI}} \geq 0. \tag{6.3}$$

[2]Note that the above allows S to be negative. Unrestricted side contracting between investors and gatekeepers and competition among gatekeepers imply that if $\left(\overline{p}\,Y_{\mathrm{S}}+(1-\overline{p})\,Y_{\mathrm{F}}\right) > Y_{\mathrm{NI}}$, the gatekeepers should pay investors in equilibrium. However, this is by no means necessary. A constrained side payment system that constrains S to be non-negative also delivers the same results.

Given (6.1), S^* from (6.2), and (6.3), only low-effort-cost investors apply to the gatekeeper and the gatekeeper says YES to all such projects.

The cutoff p_* is given by the indifference condition of the marginal investor:

$$\theta\left[p_*(R(2-\alpha)-T-S^*)-(1-\alpha)\right]=\frac{1-p_*}{p_*}Y_{\mathrm{NI}}, \tag{6.4}$$

where S^* is given by equation (6.2). Given any such cutoff p_*, all types $p \geq p_*$ invest, and all types $p < p_*$ become monitors.

The budget balance equation is given by

$$(1-\theta)Y_{\mathrm{NI}}+\theta\big(\overline{p}\,Y_{\mathrm{S}}+(1-\overline{p})\,Y_{\mathrm{F}}\big)=\theta\left(\overline{p}T-1\right) \tag{6.5}$$

where p_* is the induced cutoff. Thus

$$Y_{\mathrm{NI}}=\frac{\theta}{(1-\theta)}\bigg(\overline{p}\left(T-\overline{Y}_{\mathrm{I}}\left(\overline{p}\right)\right)-1\bigg).$$

To implement first best, set $p_*=p_{\mathrm{fb}}={}^{1}\!/_{R}$ in equation 6.4, and solve for the optimal transfer function. This is given by $T^*(\overline{Y}_{\mathrm{I}}\left(\overline{p}\right))$. Now set $\overline{Y}_{\mathrm{I}}\left(\overline{p}\right)$ such that condition 6.1 holds exactly. This gives the optimal value of $\overline{Y}_{\mathrm{I}}\left(\overline{p}\right)$. Using this, the optimal T is given by

$$T^*=\frac{2R}{R+1}\left(1+\frac{\theta(1-\alpha)}{(R+1)(\alpha+\theta(1-\alpha))}\right). \tag{6.6}$$

THEOREM 4. *The gatekeeping mechanism with the transfer scheme* $(\mathbf{Y}^*, T^*)$ *described below attains first best for any* $R > 1$.

- *Each investor pays* T^* *given by (6.6) in the success state, and zero otherwise.*
- *Each monitor receives* ${Y_{\mathrm{NI}}}^*$ *whenever investment does not take place,* ${Y_{\mathrm{S}}}^*$ *in the success state, and* ${Y_{\mathrm{F}}}^*$ *otherwise.* $({Y_{\mathrm{NI}}}^*, {Y_{\mathrm{S}}}^*, {Y_{\mathrm{F}}}^*)$ *are given by the following.*

$${Y_{\mathrm{NI}}}^* = \frac{\theta(R-1)}{1+R^2} \tag{6.7}$$

$${Y_{\mathrm{S}}}^* = {Y_{\mathrm{F}}}^* = \frac{(R-1)(\alpha(R^2-1)-2\theta(1-\alpha)}{(1+R^2)(\alpha+R(2+\alpha))} \tag{6.8}$$

Thus gatekeeping attains first best and dominates monitoring.

References

Armendáriz de Aghion, B. (1999): "On the Design of Credit Agreement With Peer Monitoring," *Journal of Development Economics*, 60, 79–104.

Banerjee, A., T. Besley, and T. Guinnane (1994): "Thy Neighbor's Keeper: the Design of a Credit Cooperative with Theory and a Test," *Quarterly Journal of Economics*, 109, 491–515.

Laffont, J.-J., and T. N'Guessan (2000): "Group Lending with Adverse Selection," *European Economic Review*, 44, 773–784.

Stiglitz, J. E. (1990): "Peer Monitoring and Credit Markets," *World Bank Economic Review*, 4, 351–366.

Varian, H. (1990): "Monitoring Agents with Other Agents," *Journal of Institutional and Theoretical Economics*, 146, 1–18.