Grants Vs. Investment Subsidies

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Preliminary: Comments Welcome

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Abstract

How should a government intervene to help the credit constrained poor in an economy where productivity and wealth are unobserved? We show that the efficient policy typically consists of offering *both* a grant and an investment subsidy. Everybody will take the grant and only the relatively productive will take the subsidy. Such a policy will not eliminate investment distortions. We provide a justification for programs such as the Grameen Bank in Bangladesh or Progresa in Mexico that subsidize investment instead of giving lump-sum grants.

1 Introduction

Many believe that credit market imperfections prevent the poor from making profitable investments, such as starting businesses or sending their children to school.[1] In response, governments often subsidize credit and education. Two prominent examples from developing countries are described below:

1. The Grameen Bank lends to over a million borrowers in rural Bangladesh. It receives 11 cents in subsidies from the government and donors for every dollar it lends and charges a real interest rate of 10% (Morduch [8]). So a borrower who makes, say, 15 cents for every dollar invested will still take a loan from Grameen, even though this will involve a deadweight loss (of 6 cents). If this borrower were given the 11 cent subsidy as a grant instead, she would choose not to invest and be better off as a result. Should the funds used to subsidize Grameen's loans therefore be given as lump-sum grants?

2. Progresa reaches 2.6 million families in rural Mexico through a program of conditional cash and food transfers. The cash transfers are made to families only if they send their children to school. These

[1] Several empirical studies such as Paulson and Townsend [10] for Thailand and Petersen and Rajan [11] for the U.S. have shown that wealth is positively associated with entrepreneurship.

transfers offset over half the private costs of attending school and increase average attendance by two-thirds of a year, which translates into an average return of roughly 8% per year in increased adult wages (Schultz [12]). Families may differ in their net returns from investment in schooling, however. A family with a low return or high costs may invest in schooling because of the subsidy but would not have done so with an equivalent grant. For such a family, the government may well have a negative return on its educational subsidies. Should Progresa replace its educational subsidies with grants and eliminate the distortion?

In this paper we analyze whether a (constrained) efficient government intervention should include programs such as Grameen or Progresa that potentially distort investment decisions. We study a two-dimensional screening problem where productivity and wealth are unobserved. Left on their own, banks will only lend to agents who can post sufficient collateral, and so the productive poor will be credit constrained. The government has the same information and enforcement constraints as banks. Unlike banks, however, the government wishes to maximize social welfare and can raise funds at a cost to do so. How should the government spend these funds? A lump-sum grant to all agents is expensive since money will be spent on rich agents who do not need it, as well as unproductive poor agents who will not invest. Offering only investment subsidies will induce unproductive borrowers to invest when they should not. We show that the efficient mechanism consists of offering *both* a grant and an investment subsidy. All agents will take the grant but only relatively productive agents will choose to invest (and receive the subsidy). This policy sorts between productive and unproductive borrowers, and will typically involve some deadweight loss (where the social cost exceeds the return from investing). In a special case when the government is extremely inequality averse, it would prefer to completely eliminate investment subsidies and offer only grants.

Several papers including de Meza and Webb[5], Hoff and Lyon [6], and Innes [7] have studied how governments should intervene to correct for credit market failures. Hoff and Lyon's work is the most closely related to the questions we ask. They compare grants and loan subsidies in an adverse selection model and argue that grants dominate loan subsidies because they improve the quality of borrowers that banks lend to. In our paper we do not restrict the government's choice of intervention to one of these two instruments. Instead we take a mechanism design perspective, and solve for the constrained efficient intervention.

Subsidized rural credit programs have been criticized in the past because loans were diverted to the rich (Adams et al [1]). Grants of course can also be diverted. Since it is difficult to target the poor in developing countries, we abstract from techniques such as the work requirements (Besley and Coate [3]) or differences in preferences (Blackorby and Donaldson [4]) to sort between rich and poor. Even though the rich and poor have the same preferences, and productivity and wealth is not necessarily correlated in our model, grants and investment subsidies have different distributional consequences. Grants favor the poorest households while investment subsidies favor the relatively less poor who can post sufficient collateral to take a loan. So the commonly accepted policy view that microcredit organizations like the Grameen Bank should become financially sustainable makes sense in our model only if governments or donors are almost Rawlsian in their objectives.[2] Otherwise Grameen and Progresa should still be subsidized (in conjunction with a program that provides lump-sum grants) even if they exclude the poorest.

The paper is organized as follows. In section 2 we describe the economy. In section 3 we show that a simple policy of giving a grant and a subsidy is welfare maximizing. In section 4 we analyze the mix between grants

[2] Morduch [9] discusses this policy debate and Amin et al [2] study Grameen's targeting performance.

and investment subsidies, first in a discrete example and then in the more general case. And in section 5 we discuss extensions.

2 The Economy

Consider an economy with risk neutral agents and a competitive credit market. Each agent has a project which requires one dollar of investment. Agents have no money of their own, so they must borrow on the credit market in order to invest. An agent's type is (ρ, w) where ρ is the return on the agent's project and w is the agent's wealth. The wealth is not liquid and so cannot be invested directly. It is an asset such as land which can be posted as collateral.[3] We assume ρ and w are independent random variables, where $\rho \in [\rho_L, \rho_H]$ with distribution F and $w \in [w_L, w_H]$ with distribution G. The agent's type is his private information. In particular, agents can hide their wealth (but they cannot exaggerate it). Assume that the project itself can be revealed by the agent. For example, an agent could rent factory space or attend school. Thus a contract where an agent receives a loan conditional on investing in his project is enforceable: the agent will simply be asked to

[3] Allowing agents to have liquid wealth instead which can be directly invested does not change the main arguments. In our model, w can be equivalently interpreted as liquid wealth if $w_H = 1$.

show that he is indeed operating a project.[4] On the other hand, if an agent does not invest, there is no way for him to prove that he has not invested, since he can hide his project.

For simplicity and without loss of generality, there is no discounting and the interest rates on loans are zero. Thus the repayment on a loan of size x obtained from a bank is just x. We assume $1 > \rho_L$ and $1 > w_L$ to make the problem non-trivial. For any $r \leq \rho_H$ define $\phi(r)$ as the average return for agents with $\rho \geq r$

$$\phi(r) \equiv E[(\rho - r)|\rho \geq r] = \frac{1}{1 - F(r)} \int_r^{\rho_H} (\rho - r) dF(\rho)$$

To obtain a loan of size x, an agent must post collateral which is worth x, otherwise the agent would never repay. Without collateral, the bank cannot prevent the agent from simply absconding without repaying.[5]

Suppose there is no intervention. Agents with $\rho < 1$ will not borrow to invest even if they can take a loan, since the repayment 1 would exceed the project return ρ. Agents with $\rho \geq 1$ and $w < 1$ would like to take a loan but

[4] For instance, an agent could attend school or start a shop to demonstrate investment. The case where it is costless for agents to pretend that they have made an investment when they have not will be discussed in Section 5.

[5] Other justifications of collateral could be considered. For example, if actual project returns are unobserved, then an agent can always claim that the project yielded no surplus so that he cannot repay. In this case, collateral can be used to make him report his returns truthfully. These complications would not add anything to the analysis, however.

cannot come up with the required collateral. They are credit constrained. Only agents with $\rho \geq 1$ and $w \geq 1$ are both willing and able to invest in a project. This is illustrated in figure 1. The expected surplus for a typical investor would be $\phi(1)$. The total surplus in this economy would be

$$\int_1^{\rho_H} \int_1^{w_H} (\rho - 1) dF(\rho) dG(w) = (1 - G(1))(1 - F(1))\phi(1) \tag{1}$$

Notice that $(1 - G(1))(1 - F(1))$ is the fraction of agents who invest in the absence of any intervention.

Now we introduce a principal (donor or government) with shadow cost of public funds $\lambda > 1$. The principal has no information or enforcement advantages over the credit market. Like the agents, the principal can borrow on the financial market at zero interest rate. Like the banks, the principal cannot observe an agent's type or his realized project return. She cannot enforce repayment on loans that are not collateralized. Moreover, the principal cannot force an agent to participate in her scheme. Thus, the principal's mechanism must respect incentive compatibility, individual rationality, and enforcement constraints. The principal wants to maximize the expected welfare of the average agent (before the agent realizes his type). A policy which solves the principal's problem subject to the constraints is *ex ante* *constrained efficient.*

3 Simple Policies

Using the revelation principle, we can restrict attention to the following type of mechanism. Each agent reports his type (ρ, w) to the principal. The principal then tells the agent whether or not he should invest, and gives him a transfer $x(\rho, w)$. Let $i(\rho, w) = 1$ if the agent of type (ρ, w) is required to invest, and $i(\rho, w) = 0$ otherwise. Since agents are risk neutral, it will not be useful assign probabilities of investment strictly between zero and one. This mechanism is feasible because an agent who is told to invest ($i(\rho, w) = 1$) can be required to verify that she actually is operating a project. An agent with $i(\rho, w) = 0$ is free to do what she wants. However, it is clearly without loss of generality to assume that all agents with $i(\rho, w) = 0$ prefer not to invest.[6]

We assume that agents who are told to invest but have insufficient funds to finance the investment will take a loan from a bank. This is without loss of generality. We could allow the principal himself to give loans, but since the principal can obtain funds at the interest rate of zero which is also

[6] Suppose there is a mechanism where some type (ρ, w) is not told to invest but prefers to invest (and therefore does so). That mechanism can be replaced by an equivalent mechanism where type (ρ, w) is told to invest.

the bank lending rate, there is no advantage in doing this. Whether or not the principal observes the agent taking a loan from the bank is immaterial. Instead it is important that the principal be able to verify if agents with $i(\rho, w) = 1$ are actually operating projects.

The principal's mechanism must respect individual rationality, enforcement and incentive compatibility constraints. Individual rationality requires that transfers are non-negative: $x(\rho, w) \geq 0$ for each (ρ, w). If an agent of type (ρ, w) is told to invest, then he must have sufficient collateral to do so (the enforcement constraint). For each (ρ, w) if $i(\rho, w) = 1$ then $w + x(\rho, w) \geq 1$.

Incentive-compatibility requires that an agent of type (ρ, w) prefers to announce his type truthfully. Let $c(t^*, t)$ denote the consumption of an agent whose true type is $t^* = (\rho^*, w^*)$, but who claims to be type $t = (\rho, w)$, where $w \leq w^*$. If $i(\rho, w) = 1$ then the agent will need a loan of size $1 - x(\rho, w)$, assuming $x(\rho, w) \leq 1$. This loan can be obtained at a zero interest rate. Moreover, since $i(\rho, w) = 1$ type t must have enough collateral to borrow this amount, hence type t^* also has enough. The agent produces ρ^* and his final consumption will be

$$c(t^*, t) = \rho^* - (1 - x(\rho, w)) = \rho^* + x(\rho, w) - 1$$

If instead $x(\rho, w) > 1$, then the agent needs no loan. He will invest one dollar and consume $x(\rho, w) - 1$. His final consumption is again $c(t^*, t) = \rho^* + x(\rho, w) - 1$. If $i(\rho, w) = 0$ then the agent will simply consume his transfer, $c(t^*, t) = x(\rho, w)$. Thus, more generally, for any (ρ, w) we will have

$$c(t^*, t) = x(\rho, w) + i(\rho, w)(\rho^* - 1) \tag{2}$$

The incentive compatibility condition is: for all $t^* = (\rho^*, w^*)$ and all $t = (\rho, w)$ with $w \leq w^*$

$$c(t^*, t^*) \geq c(t^*, t) \tag{3}$$

First we show the that any incentive compatible and individually rational intervention can be implemented by a simple policy:

Proposition 1 *Any incentive compatible and individually rational intervention can be implemented by the following type of policy. Each agent gets a wealth-dependent grant $g(w) \geq 0$. Those agents who invest also receive (in addition to the grant) a wealth-dependent subsidy of $s(w) \geq 0$. The functions $g(w)$ and $g(w) + s(w)$ must be non-decreasing in w.*

Proof. If either $i(\rho, w) = i(\rho^*, w^*)$, then the incentive-compatibility condition (3) reduces to

$$x(\rho^*, w^*) \geq x(\rho, w)$$

Thus, for any two agents who take the same action (invest or not), the transfer must be non-decreasing in the agent's wealth. Now, suppose $i(\rho, w) = i(\rho^*, w^*)$ and $w = w^*$. Then, (3) is

$$x(\rho^*, w) = x(\rho, w)$$

That is, two types with the same wealth, but different productivity levels, who take the same action (invest or not), must get the same transfer. This allows us to write the transfer as

$$x(\rho, w) = \hat{x}(w, i(\rho, w))$$

That is, the transfer depends only on your wealth and your action. Moreover, suppose $w = w^*$ and $\rho^* \neq \rho$. Then,(3) implies both $c(t^*, t^*) \geq c(t^*, t)$ and, reversing the roles of t and t^*, $c(t, t) \geq c(t, t^*)$. These two conditions can be written as

$$\hat{x}(w^*, i(\rho^*, w^*)) + i(\rho^*, w^*)\,(\rho^* - 1) \geq \hat{x}(w^*, i(\rho, w^*)) + i(\rho, w^*)\,(\rho^* - 1)$$

and

$$\hat{x}(w^*, i(\rho, w^*)) + i(\rho, w^*)\,(\rho - 1) \geq \hat{x}(w^*, i(\rho^*, w^*)) + i(\rho^*, w^*)\,(\rho - 1)$$

If we add the two conditions, we get

$$(i(\rho^*, w^*) - i(\rho, w^*))\,(\rho^* - \rho) \geq 0$$

Thus, $\rho^* > \rho$ implies $i(\rho^*, w^*) \geq i(\rho, w^*)$. So, if two agents t and t^* have the same wealth but type t^* is more productive, then either they take the same action or agent t^* invests while agent t does not. Therefore, there is, for each wealth level w, a cut-off level $\hat{\rho}(w)$ such that type (ρ, w) invests if and only if $\rho \geq \hat{\rho}(w)$. Now, consider types $(\hat{\rho}(w), w)$ and $(\hat{\rho}(w) - \delta, w)$. The IC conditions are

$$x(\hat{\rho}(w), w) + \hat{\rho}(w) - 1 \geq x(\hat{\rho}(w) - \delta, w)$$

$$x(\hat{\rho}(w) - \delta, w) \geq x(\hat{\rho}(w), w) + \hat{\rho}(w) - \delta - 1$$

Thus,

$$\hat{\rho}(w) - 1 \geq x(\hat{\rho}(w) - \delta, w) - x(\hat{\rho}(w), w) \geq \hat{\rho}(w) - \delta - 1$$

so that as $\delta \to 0$,

$$x(\hat{\rho}(w) - \delta, w) - x(\hat{\rho}(w), w) \to \hat{\rho}(w) - 1$$

But

$$x(\hat{\rho}(w) - \delta, w) = \hat{x}(w, 0)$$

since $\hat{\rho}(w)$ is the cut-off value, and

$$x(\hat{\rho}(w), w) = \hat{x}(w, 1)$$

Thus,

$$\hat{x}(w, 0) - \hat{x}(w, 1) = \hat{\rho}(w) - 1$$

or

$$\hat{x}(w,1)+\hat{\rho}(w)-1=\hat{x}(w,0)$$

Now, define $g(w) \equiv \hat{x}(w,0)$ and $s(w) \equiv \hat{x}(w,1)-\hat{x}(w,0)$. Notice that we have shown that $g(w)$ and $g(w)+s(w)$ are both non-decreasing in w. Individual rationality implies $g(w) \geq 0$ (agents who do not invest will not show up to "pay a tax"). Also, the fact that it cannot be verified that an agent does *not* invest forces $\hat{x}(w,1) \geq \hat{x}(w,0)$, that is $s(w) \geq 0$.

Consider the following policy. Each agent reveals his wealth w to the principal. The principal immediately gives him a grant $g(w)$ and asks if the agent wants to invest If no, the agent consumes his grant. If yes, the agent receives an additional "investment subsidy" of $s(w)$ and then goes to the bank, obtains a loan of $1-g(w)-s(w)$, and starts his project. This policy gives exactly the same outcome as the initial mechanism. First of all, notice that no agent wants to hide his wealth since $g(w)$ and $g(w)+s(w)$ are both non-decreasing in w. Second, an agent will prefer to invest in the project if and only if

$$\rho+g(w)+s(w)-1 \geq g(w)$$

that is,

$$\rho \geq 1 - s(w) = 1 - \hat{x}(w,1) + \hat{x}(w,0) \equiv \hat{\rho}(w)$$

as in the original mechanism. Finally, agents who invest consume

$$\rho + g(w) + s(w) - 1 = \rho + \hat{x}(w,1) - 1$$

and those who do not invest consume

$$g(w) = \hat{x}(w,0)$$

as in the original mechanism. ■

Let $V[c, \rho, w]$ denote the social value of giving c units of consumption to type $t = (\rho, w)$. The social welfare function in this economy is

$$W = \int_{w_L}^{w_H} \int_{\rho_L}^{\rho_H} V\left[c(\rho, w), \rho, w\right] dF(\rho) dG(w) - \lambda \int_{w_L}^{w_H} \int_{\rho_L}^{\rho_H} x(\rho, w) dF(\rho) dG(w) \tag{4}$$

Assume V is non-increasing in w. It is straightforward to see that the principal will never choose transfers $g(w)$ and $g(w)+s(w)$ that are increasing in w. Giving a dollar extra to rich agent who is taking the same action as a poor agent costs the principal $\lambda > 1$ but yields no additional benefit. So if the principal is weakly inequality-averse, then we may restrict attention to very simple policies. The government gives *each* agent a lump-sum transfer or *grant* $g \geq 0$. In addition, *agents who invest* get an *investment subsidy* $s \geq 0$.[7]

Proposition 2 *Suppose the social welfare weight given to individuals is non-increasing in their wealth. Then, any social welfare maximizing, incentive compatible and individually rational intervention can be implemented by the following type of policy. Each agent gets a grant* $g \geq 0$*. Those agents who invest also receive (in addition to the grant) a subsidy of* $s \geq 0$*. (The grants and the subsidies do not depend on wealth levels).*

For the rest of the paper, we will assume $V[c, \rho, w]$ is of the form

$$V[c, \rho, w] = ch(w)$$

where $h'(w) \leq 0$ for all w, and

$$\int_{w_L}^{w_H} h(w) dG(w) = 1$$

[7] Notice that the principal could equivalently offer agents a *choice* between a grant of g and a subsidized loan of size $1 - g$ with repayment $1 - s - g$ that is conditional on investment. The principal could also equivalently offer a choice between a unconditional transfer g and a transfer $g + s$ that is conditional on investment.

Here $h(w)$ is a "welfare weight" given to the consumption of agents with wealth w.

Thus, the social welfare function is

$$W = \int_{w_L}^{w_H} \int_{\rho_L}^{\rho_H} c(\rho, w) h(w) dF(\rho) dG(w) - \lambda \int_{w_L}^{w_H} \int_{\rho_L}^{\rho_H} x(\rho, w) dF(\rho) dG(w) \tag{5}$$

4 Optimal Intervention

4.1 Discrete Case

The following example provides much of the intuition for the trade-off between grants and investment subsidies. Suppose there is an agent who needs a dollar to invest. The productivity (the return on a dollar invested) of the agent is either ρ_L or ρ_H. The wealth is either 0 or w. These are independently drawn and private information. The probability that the agent's productivity is high is π, the probability his wealth is high is p. Thus, there is an unproductive rich type (ρ_L, w), a productive poor type $(\rho_H, 0)$ etc. Assume $0 < w < \rho_L < 1 < \rho_H$. The social weight given to poor agents is h_0, the weight given to rich agents is h_w, where the average weight is 1:

$$ph_w + (1 - p)h_0 = 1$$

So, if we let $h = h_0$ then

$$h_w = \frac{1-(1-p)h}{p}$$

By proposition 2, we can focus on policies of the following type: the government gives a lump-sum transfer $g \geq 0$ to all agents, and an investment subsidy $s \geq 0$ to all agents who invest.

Policy 1: $g = 1 - w$ and $s = 0$. The type (ρ_H, w) agents will take the grant, borrow w to invest, and consume $\rho_H + g - 1 = \rho_H - w$. All others will consume the grant $g = 1 - w$. The total welfare is

$$\begin{aligned} W_1 &= p\pi h_w (\rho_H - w) + p(1-\pi)h_w (1-w) + (1-p)h_0 (1-w) - \lambda (1-w) \\ &= p\pi h_w (\rho_H - 1) - (\lambda - 1)(1-w) \end{aligned}$$

Policy 2: $g = \rho_L - w$, $s = 1 - \rho_L$. The type (ρ_H, w) agents will invest, and consume $\rho_H + g + s - 1 = \rho_H - w$. All others will consume the grant $g = \rho_L - w$. The total welfare is

$$\begin{aligned} W_2 = {} & p\pi h_w (\rho_H - w) + p(1-\pi)h_w (\rho_L - w) \\ & + (1-p)h_0 (\rho_L - w) - \lambda (\rho_L - w) - \lambda p\pi (1-\rho_L) \\ = {} & p\pi h_w (\rho_H - \rho_L) - (\lambda - 1)(\rho_L - w) - \lambda p\pi (1-\rho_L) \end{aligned}$$

It can be checked that $W_2 > W_1$ if and only if

$$p\pi h_w + \lambda - 1 > \lambda p\pi$$

$$\frac{\lambda - 1}{\lambda - h_w} > p\pi$$

Notice that if the principal is not inequality averse, then policy 2 is strictly preferred. If the principal cares about poor then $h_w < 1$. Then, the left hand side is strictly between 0 and 1. The inequality can also be written as:

$$h_w > \lambda - \frac{\lambda - 1}{p\pi} = \frac{1 - (1 - p\pi)\lambda}{p\pi} \tag{6}$$

Thus, suppose

$$\lambda < \frac{1}{1 - p\pi}$$

Then, the right hand side of (6) is positive. Hence, if the principal cares enough about the poor, so that h_w is small, then she prefers a straight grant to a policy that mixes grants and subsidies. The explanation is that a grant-subsidy mix gives a lower consumption to those agents who do not invest (a lower grant). But, the agents who do not invest are disproportionately poor. Hence, she prefers the grant which is higher and the same for everybody.

4.2 Continuous Case

By proposition 2, the optimal policy is of the form (g, s). Let the agents who choose the investment subsidy be called investors: they consume $\rho+g+s-1$. Let the agents who choose the grant be called consumers. Type (ρ, w) invests in his project if and only if

$$w \geq 1 - s - g$$

and

$$\rho \geq 1 - s$$

We can think of $\rho-(1-s)$ as his net return on the project. The expected net return of investors is, then, $\phi(1-s)$. Thus, the fraction of investors is $(1 - G(1-s-g))(1 - F(1-s))$. Their average productivity is $\phi(1-s)$.

Figure 2 shows how an intervention that involves $g > 0$ and $s > 0$ partitions investors and consumers. Such an intervention induces some agents who were previously credit constrained to invest. But it also allows investment by relatively unproductive agents for whom the social cost of the subsidy, λs, exceeds the net return of their project, $\rho - 1$.

From equation (5) social welfare can be written as

$$\begin{aligned} W &= \int_{1-s-g}^{w_H} \int_{1-s}^{\rho_H} \left(h(w)\left(\rho + g + s - 1\right) - \lambda s\right) dF(\rho) dG(w) + \int_{w_L}^{1-s-g} h(w) g dG(w) \\ &\quad + F(1-s) \int_{1-s-g}^{w_H} h(w) g dG(w) - \lambda g \end{aligned}$$

which can be rewritten as

$$\begin{aligned} & \int_{1-s-g}^{w_H} h(w) \int_{1-s}^{\rho_H} \left(\rho - (1-s)\right) dF(\rho) dG(w) \\ & -\lambda s (1 - G(1-s-g))(1 - F(1-s)) + g \int_{w_L}^{w_H} h(w) dG(w) - \lambda g \\ = \; & \left(1 - F(1-s)\right)\left(1 - G\left(1-s-g\right)\right)\left[\phi(1-s)\Psi\left(1-s-g\right) - \lambda s\right] - \left(\lambda - 1\right) g \end{aligned}$$

where

$$\Psi(z) \equiv E\{h(w) \mid w \geq z\} = \frac{1}{1 - G(z)} \int_{z}^{w_H} h(w) dG(w)$$

Notice that $\Psi(w_L) = 1$.

Thus, the principal must set s and g to maximize this expression. The first order conditions for an interior solution are

$$\begin{aligned}\frac{\partial W}{\partial g} &= (1-F(1-s))G'\left(1-s-g\right)\left[\phi(1-s)\Psi\left(1-s-g\right)-\lambda s\right] \\ &\quad -(1-F(1-s))\left(1-G\left(1-s-g\right)\right)\phi(1-s)\Psi'\left(1-s-g\right)+1-\lambda \\ &= 0\end{aligned} \tag{7}$$

and

$$\begin{aligned}\frac{\partial W}{\partial s} &= 0 = \\ &\quad -(1-F(1-s))\left(1-G\left(1-s-g\right)\right) \\ &\quad \left[\phi'(1-s)\Psi\left(1-s-g\right)+\phi(1-s)\Psi'\left(1-s-g\right)+\lambda\right] \\ &\quad +\left[F'(1-s)\left(1-G\left(1-s-g\right)\right)+(1-F(1-s))G'\left(1-s-g\right)\right] \\ &\quad \left[\phi(1-s)\Psi\left(1-s-g\right)-\lambda s\right]\end{aligned} \tag{8}$$

Interpreting these first-order conditions helps clarify the trade-off between spending an additional dollar on grants or on subsidies. The condition

(7) can be rewritten as

$$
\begin{aligned}
& (1-F(1-s))G'(1-s-g)\left[\phi(1-s)\Psi(1-s-g)-\lambda s\right] && (9)\\
& -(1-F(1-s))(1-G(1-s-g))\phi(1-s)\Psi'(1-s-g) && (10)\\
= \; & \lambda - 1 && (11)
\end{aligned}
$$

Recall that type (ρ, w) invests in his project if and only if $w \geq 1-s-g$ and $\rho \geq 1-s$. If g is increased, a number $(1-F(1-s))G'(1-s-g)$ of agents can now invest, and the expected return on their projects is $\phi(1-s)$. A dollar to agents with wealth greater than $1-s-g$ has welfare weight $\Psi(1-s-g)$. Moreover, all investors receive the subsidy s at social cost λ. This explains (9). The term in (10) is due to the fact that lowering the wealth levels of investors raises the average social value of each dollar going to the investors, since $\Psi' \leq 0$. Thus, this term is non negative. The right hand side is the net social cost of giving 1 dollar to all agents.

The condition (8) can be rewritten as

$$
\begin{aligned}
& \left[F'(1-s)(1-G(1-s-g))+(1-F(1-s))G'(1-s-g)\right]\left[\phi(1-s)\Psi(1-s-g)-\lambda\right] && (12)\\
= \; & (1-F(1-s))(1-G(1-s-g))\left[\phi'(1-s)\Psi(1-s-g)+\phi(1-s)\Psi'(1-s-g)+\lambda\right] && (13)
\end{aligned}
$$

If s is increased the number of investors increases by

$$F'(1-s)\left(1-G\left(1-s-g\right)\right)+\left(1-F(1-s)\right)G'\left(1-s-g\right)$$

As before, each additional investor raises social welfare by

$$\phi(1-s)\Psi\left(1-s-g\right)-\lambda s$$

This explains (12). On the other hand, each of the $(1-F(1-s))\left(1-G\left(1-s-g\right)\right)$ investors will benefit from the increased subsidy. Now, the average surplus of investors falls because less productive investors are attracted by the subsidy: the social cost of this is $\phi'(1-s)\Psi\left(1-s-g\right)$. On the other hand, the lower wealth levels of investors raises the average value of the surplus earned by the investors: this is the term $\phi(1-s)\Psi'\left(1-s-g\right)<0$. Finally, each dollar has a cost λ - this explains (13).

The following lemma gives a sufficient condition for intervention:

Lemma 1 *The principal will intervene (give grants and/or make subsidized* *loans) if $\lambda < \widehat{\lambda}$, where $\widehat{\lambda}$ is defined by*

$$\widehat{\lambda} \equiv 1 + (1 - F(1))G'(1)\,\phi(1)\Psi(1) - (1 - F(1))\,(1 - G(1))\,\phi(1)\Psi'(1) > 1 \tag{14}$$

Proof. At $g = s = 0$

$$\frac{\partial W}{\partial g} = (1 - F(1))G'(1)\,\phi(1)\Psi(1) - (1 - F(1))\,(1 - G(1))\,\phi(1)\Psi'(1) + 1 - \lambda$$

which is strictly positive if $\lambda < \hat{\lambda}$ ■

The following proposition gives a sufficient condition for the efficient intervention to involve subsidies:

Proposition 3 *Suppose $\lambda < \hat{\lambda}$ and*

$$F'(1)\phi(1) > (1 - F(1))\left[\phi'(1) + \lambda\right]$$

Then, the efficient contract involves $s > 0$.

Proof. Suppose $g > 0 = s$. Then, the first order conditions are

$$\begin{aligned}
\frac{\partial W}{\partial g} &= (1-F(1))G'(1-g)\,\phi(1)\Psi(1-g) - (1-F(1))(1-G(1-g))\,\phi(1)\Psi'(1-g) + 1 - \lambda \\
&= 0
\end{aligned}$$

and

$$\begin{aligned}
\frac{\partial W}{\partial s} &= -(1-F(1))(1-G(1-g))\left[\phi'(1)\Psi(1-g) + \phi(1)\Psi'(1-g) + \lambda\right] \\
&\quad + \left[F'(1)(1-G(1-g)) + (1-F(1))G'(1-g)\right]\phi(1)\Psi(1-g) \\
&\leq 0
\end{aligned}$$

Now $\frac{\partial W}{\partial g} = 0$ implies

$$\begin{aligned}
& (1-F(1))G'(1-g)\left[\phi(1)\Psi(1-g)\right] + 1 - \lambda \\
= \; & (1-F(1))(1-G(1-g))\,\phi(1)\Psi'(1-g)
\end{aligned}$$

Using this we get

$$\begin{aligned}\frac{\partial W}{\partial s} &= -(1-F(1))\left(1-G\left(1-g\right)\right)\left[\phi'(1)\Psi\left(1-g\right)+\phi(1)\Psi'\left(1-g\right)+\lambda\right] \\ &\quad +F'(1)\left(1-G\left(1-g\right)\right)\phi(1)\Psi\left(1-g\right)+(1-F(1))G'\left(1-g\right)\phi(1)\Psi\left(1-g\right) \\ &= -(1-F(1))\left(1-G\left(1-g\right)\right)\left[\phi'(1)\Psi\left(1-g\right)+\lambda\right] \\ &\quad +F'(1)\left(1-G\left(1-g\right)\right)\phi(1)\Psi\left(1-g\right)-1+\lambda\end{aligned}$$

$$= \left(1-G\left(1-g\right)\right)\left\{F'(1)\phi(1)\Psi\left(1-g\right)-(1-F(1))\left[\phi'(1)\Psi\left(1-g\right)+\lambda\right]\right\}-1+\lambda$$

which is strictly positive if

$$F'(1)\phi(1)\Psi\left(1-g\right) > (1-F(1))\left[\phi'(1)\Psi\left(1-g\right)+\lambda\right]$$

But this condition is implied by

$$F'(1)\phi(1) > (1-F(1))\left[\phi'(1)+\lambda\right]$$

because $\Psi\left(1-g\right)\geq 1$. ■

5 Extensions

5.1 Observed Wealth

Agents have been allowed to costlessly hide their wealth. So rich agents can take the grants or investment subsidies intended for the poor. If wealth was observed (but collateral was still necessary to secure loan repayment), then the poor would still be credit constrained as in figure 1 in the absence of any intervention. The efficient intervention would now be wealth dependent and targeted only to those who cannot access credit market. It would take the form of a grant $g(w)$ and an investment subsidy $s(w)$, where $g(w) = s(w) = 0$ if $w \geq 1$. It is now incentive compatible for both the grant and the investment subsidy to increase in w. For a given wealth level, though, by offering both a positive grant and a positive investment subsidy the principal will typically be able to do better than by offering only one of the two. If λ is high, the principal may choose to give only grants to the very poor.

5.2 Unobserved Investment

Agents have implicitly not been allowed to save after taking a loan from the principal. Suppose the interest rate on savings is given by $\delta < 1$. The difference $1 - \delta$ can be thought of as arising from financial market imperfections (such as transactions costs). If agents could save after taking a loan from the principal, and savings and projects were unobserved, even unproductive rich agents could take the loan and then save the money in a savings account rather than invest it. Of course, the principal can prevent such behavior if she can observe investment. If she cannot, then it becomes more difficult to screen unproductive rich.

When investment is non-verifiable, then a subsidy can only be contingent on receiving a loan. It is not difficult to show that again the optimal policy consist of a lump-sum grant g plus a subsidy s, where the subsidy is given to all agents who take a loan. To prevent non-investors from taking the loan and not investing, we need the additional constraint

$$s \leq 1 - \delta$$

Unlike the case where investment was observed, the principal will now need to observe if an agent has taken a loan in order to give the subsidy s.

6 Conclusions

In this paper we study the problem faced by a government that cannot observe which households are credit constrained, and which households are not. Subsidized loans and grants when offered by themselves are too blunt to distinguish between the two. But by offering both, the government can induce unproductive agents to reveal their type. This raises welfare by reducing inefficient investments (where the return is lower than the social cost), but does not eliminate such investments completely.

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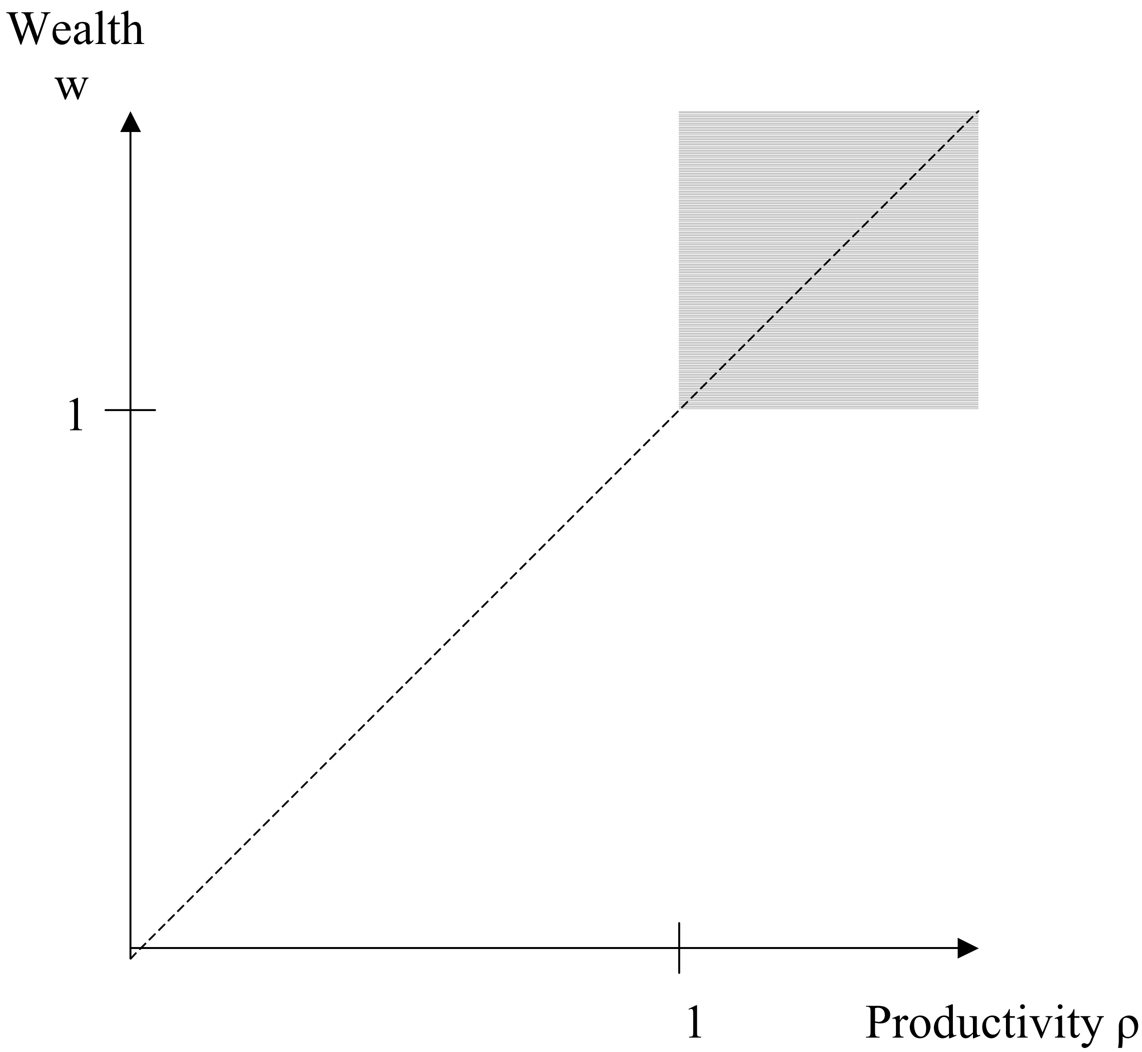

FIGURE 1: NO INTERVENTION

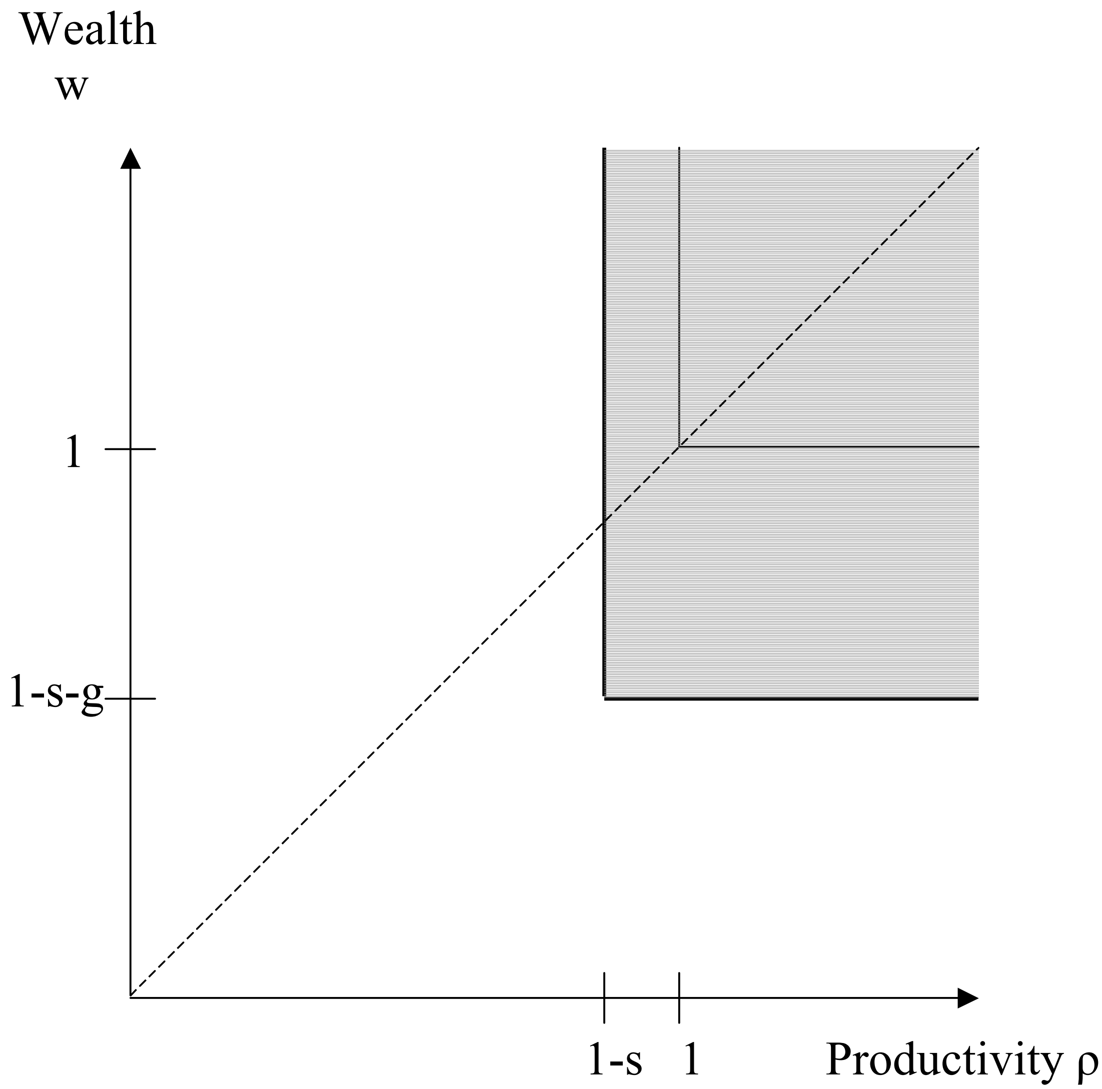

FIGURE 2: GRANT AND SUBSIDY