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Yui Nakamura

Faculty of Economics, Fukuoka University

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Center for Advanced Economic Study  
Fukuoka University  
(CAES)

8-19-1 Nanakuma, Jonan-ku, Fukuoka,  
JAPAN 814-0180  
+81-92-871-6631

# A choice of poverty alleviation programs under double asymmetric information about income and productivity\*

Yui Nakamura<sup>†</sup>

Faculty of Economics, Fukuoka University<sup>‡</sup>

## Abstract

When a government transfers cash to alleviate poverty, policymakers often face the screening problem in identifying individuals who should be supported by the government. It is difficult for policymakers to target low-productivity individuals because of the existence of asymmetric information about individual productivity between the public and the government. The self-selection mechanisms, such as workfare and in-kind transfers are pointed out as solutions of the screening problem and these approaches have been adopted in both developing and developed countries. However, the self-selection systems are useful only when the government can observe individual income. In this paper, we propose a mechanism that enables self-selection, even if individual income cannot be observed. Moreover, this self-selection system enables the government to obtain financial resources through taxation.

JEL classification: D61, J82, P35

Keywords: poverty alleviation, self-selection, asymmetric information

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<sup>†</sup>E-mail: nakamuray@fukuoka-u.ac.jp

<sup>‡</sup>8-19-1 Nanakuma, Jonan-ku Fukuoka 814-0180 Tel: +81-92-864-2904

# 1 Introduction

When a government transfers cash to the poor to alleviate poverty, policymakers often face the screening problem in identifying individuals who should be supported by the government. It is difficult for policymakers to target low-productivity individuals because of the existence of asymmetric information about individual productivity between the public and the government. Since the government cannot observe individual productivity, high-productive individuals may masquerade their types by decreasing their income and apply for a program of cash transfers from the government. Because policymakers cannot exclude such high-productive individuals, this poverty alleviation program is not as cost-effective as it might be. Moreover, the government's inability to identify such individuals for taxes on their hidden income results in its increased dependence on external funds, such as ODA.

Nichols and Zeckhauser (1982), Dye and Antle (1986), and Blackorby and Donaldson (1988) point out that in-kind transfers are a solution to the screening problem.<sup>1</sup> Moreover, Besley and Coate (1992) clarify the mechanism of a work-requirement system as another solution with which to target low-productivity individuals, and this approach has been introduced in many countries. These mechanisms succeed through self-selection by giving high-productivity individuals incentive to reveal their types and not to apply for a program of cash transfer from the government. This self-selection mechanism has been adopted in both developing and developed countries as workfare.<sup>2</sup>

The self-selection system is useful only when the government can observe individual income. However, from the practical standpoint, it is difficult for central governments to observe individual income, especially in developing countries where many individuals are self-employed or in "informal" sectors. Therefore, the government cannot provide cash transfers in the proper quantity, and the poverty alleviation program is no cost-effective. As long as the central government can obtain information about applicants from each community, the government can target the poor and provide them with cash transfers in the proper quantity. However, policymakers in each community

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<sup>1</sup>Nakamura (2007) shows a mechanism that reveals high-productive individuals by providing quasi-public goods.

<sup>2</sup>A workfare system was introduced in the United States in the 1990s, since which time it has expanded to much of the world, including Australia, Belgium, Canada, France, Ireland, New Zealand, the Netherlands, the United Kingdom, India, and Pakistan.

have incentive to acquire cash from the central government beyond necessity because the central government cannot always observe individual income when a community chooses a program with cash transfers. In that case, the extra cash transfers are divided equally among all individuals living in the community.

In this paper, we propose a mechanism that enables self-selection and cost-effective poverty alleviation, even if individual income cannot be observed by the central government. In order to learn the proportions of low-productivity individuals and high-productivity individuals, the government offers two poverty-alleviation programs to all communities and urges each community to choose one of them. One is a cash-transfer program to raise the income of the poor, and the other is a program to install an industrial infrastructure which only high-productive individuals can use to increase their productivity.<sup>3</sup> When a community chooses the second program, the distribution of low and high productivity is revealed because the central government can monitor the number of users of the offered infrastructure and levy tax on income of those users, while providing cash transfers to those who do not use them.

By urging each community to choose the more beneficial poverty-alleviation program for themselves, the central government learns how the poor are distributed, not only in the communities that install the infrastructure, but also in their neighbor communities because they can see the labor migration of high-productivity individuals. This policy makes it possible to allocate cash transfers to the poor effectively and contributes to installing infrastructure effectively since communities where high-productivity individuals are gathered are likely to apply for this program. Finally, this self-selection system enables the government to obtain financial resources through taxation.

## 2 The Model

We assume that individuals are divided into the following two types:  $L$  and  $H$  individuals based on their marginal productivity.  $L$  individuals have low productivity because they have low skills, while  $H$  individuals show high productivity because of their high skills. We assume that the number of the population is  $N$  and the proportion of  $L$  and  $H$  individuals are  $\gamma$  and  $1 - \gamma$

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<sup>3</sup>We consider such infrastructure to be such projects as express ways to factories and equipment for high-skilled jobs.

respectively. There are  $n$  communities in a country. The number of people in community  $j$  is shown as  $N_j$ . The distribution of  $L$  and  $H$  individuals in each community is not revealed outside because individual productivity cannot be observed.

There is asymmetric information about income and productivity between the central government and the public. That is, the central government cannot observe individual income or productivity. On the other hand, residents in each community can observe individual income in their communities because the scale of each community is not so large.<sup>4</sup>

The individual utility function is written as follows:

$$U = a_i l_i + u(l_i), \quad (1)$$

where  $a_i$  indicates that the productivity of  $i$  type people and  $a_L < a_H$  is satisfied, and the function  $u$  indicates disutility of labor hours, which we assume is increasing and convex. The derivative of (1) is

$$\frac{\partial U}{\partial l_i} = a_i + u'(l_i) = 0. \quad (2)$$

From (2), we can find that optimal labor hours of each person is  $l_L^*$  and  $l_H^*$ , and  $l_L^* < l_H^*$  is satisfied because the function  $u$  is convex.

The aim of the central government is to raise the income of  $L$  individuals to  $z$  for poverty alleviation, and  $a_L l_L^* < z < a_H l_H^*$  is satisfied. When the central government adopts cash transfers as a poverty-alleviation program, it provides cash  $g$  to the poor whose income is less than  $z$ . Then,  $g = z - a_L l_L^*$  is satisfied. Since the central government cannot observe individual income or productivity, the government provides cash transfers  $g$  according to the number of applicants for this program reported by policymakers of each community.<sup>5</sup>

First, we consider the situation in which the central government can monitor individual income. That is, there is no asymmetric information between the central government and policymakers in each community. In this case,

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<sup>4</sup>The models clarifying the mechanism of workfare and in-kind transfers assume that individual income can be observed.

<sup>5</sup>This situation resembles the system adopted by Grameen Bank in the People's Republic of Bangladesh. The bank accommodates with a loan individuals who monitor each other in a group. Individuals join groups with other individuals who are trusted in a community. Since the bank cannot observe the character of individuals, it uses this system effectively.

the government provides cash to each community according to its number of applicants for the program. Each community allocates cash  $g$  to  $L$  individuals by observing individual income, although they cannot observe individual productivity. Since cash transfers are allocated to individuals whose income is less than  $z$ , the utility function of  $L$  individuals is formed as

$$U_L = a_L l_L^* + g + u(l_L^*). \quad (3)$$

On the other hand,  $H$  individuals have two choices, the first of which is to reveal their types by earning high income and give up getting cash from the central government. The utility for  $H$  individuals in this case is formed as

$$U_H^r = a_H l_H^* + u(l_H^*). \quad (4)$$

The other choice is to masquerade their productivity levels by decreasing their income and applying for cash transfers. The utility for  $H$  individuals in this case is

$$U_H^m = a_L l_L^* + g + u\left(\frac{a_L l_L^*}{a_H}\right). \quad (5)$$

If (4) is more than (5),  $H$  individuals reveal their types and only  $L$  individuals apply for the program. On the other hand, if (4) is less than (5), all of the public apply to the program and policymakers in each community fail to target the  $L$  individuals. Hence, the government must support all applicants, including  $H$  individuals, and this policy is not cost-effective.

Previous works have pointed out how work-requirement systems and in-kind transfers can solve this problem, by letting  $H$  individuals reveal their types voluntarily so. The central government can target  $L$  individuals by self-selection as observing individual income and the program can be cost-effective. Therefore, the required fiscal expenditure for this program is  $G_r = \gamma N g$ .

Policymakers from each community apply to the central government for the correct number of applicants to a poverty alleviation program if the government can observe individual's income. However, if the government cannot observe individual income, each community may have incentive to disguise the number of legitimate applications in order to get as much cash from the government as possible. Therefore, next, we consider the case in which there is asymmetric information about income and productivity between the public and the government.

While communities can observe individual income, the central government cannot observe individual productivity or income and must provide cash transfers according to the number of applications from each community. Hence, the applications from each community are likely to exceed the necessities. When each community tries to take the maximum cash from the central government, they say that all residents in the community are poor and must be supported. Hence, the fiscal expenditure for this poverty-alleviation program  $G_m$  must be  $G_m = Ng$ , which is not cost-effective. Moreover, the central government cannot levy taxes to the rich adequately in this case because applications from communities say that all residences are poor. Therefore, the central government's tax base is 0 and it must use some exogenous budgets, such as ODA, for financial resources.

These problems happen because of the existence of double asymmetric information about income and productivity between the central government and the public. In the next section, we propose a mechanism for poverty alleviation that solves these problems.

### 3 A choice of poverty alleviation programs

When the central government cannot observe individual productivity or income, it cannot target  $L$  individuals who must be supported by the government. Therefore, the double asymmetric information between the public and the government causes expanded fiscal expenditure, decreased tax income, and failure to achieve the aim that all of the population get income  $z$  and the poor may remain poor because of the limited budget. The central government must depend on exogenous financial resources for the program because it cannot target high-productivity individuals who can pay the taxes required to support the program. To solve these problems, we propose a mechanism that enables the central government to obtain the correct distribution of  $L$  and  $H$  individuals and to levy tax on income of  $H$  individuals through a self-selection system.

When the central government cannot observe individual income, it must give cash transfers according to the application from communities to the poverty-alleviation program. However, the government's financial resources are limited, especially if  $H$  individuals are not paying taxes, and the central government cannot attain the aim of raising the income of all more than  $z$ . In order to obtain the distribution of  $H$  individuals in each community and

to realize an effective poverty-alleviation program, the central government offers two poverty alleviation programs and lets each community adopt one of them. In one program, the central government provides cash transfers to the poor according to the application from each community, as we examined before. We assume that the extra cash transfers are divided to all individuals in the community equally.<sup>6</sup> The other choice is that the central government will provide the kind of infrastructure that will raise productivity of  $H$  individuals.<sup>7</sup> We define infrastructures as public goods that are non-exclusive and non-competitive. Then, the users of the infrastructures are monitored by the central government, levies tax  $t$  on the income of  $H$  individuals who use the infrastructures, and performs income redistribution from  $H$  individuals to  $L$  individuals by taxation. Tax levied on  $H$  individuals raises the income of  $L$  individuals to level  $z$  via cash transfers from  $H$  individuals in identical communities. In this case, tax must be formed as

$$t \geq \frac{\gamma_j g}{1 - \gamma_j}, \quad (6)$$

where  $\gamma_j$  is defined as the proportion of  $L$  individuals in the community  $j$ . The costs of installing infrastructure in a community are shown as  $C_I$ , and it is exogenous.

Communities that choose the infrastructure program lose their chance to get cash transfers from the government because taxes levied on  $H$  individuals in such communities are adequate to support the poor, and the central government does not need to provide cash transfers for poverty alleviation. Thus, self-selection is realized and the central government can target  $L$  individuals who must be supported with cash transfers correctly, regardless of whether the number of applicants for cash transfers from each community is correct.

The central government proposes a public good from an infrastructure that raises the productivity of  $H$  individuals as  $a'_H$  and  $a_H < a'_H$  is satisfied. In this case, the income of  $H$  individuals become  $a'_H l'_H$ . Then the policymaker levies lump-sum tax  $t$  on  $H$  individuals who use the infrastructure. Therefore, the utility of  $H$  individuals who use the infrastructure becomes

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<sup>6</sup>We do not consider the situation where policymakers in communities speculate for extra cash because individual income can be observed in the community.

<sup>7</sup>We use superhighways between factories as an example of how to raise the productivity of  $H$  individuals.

$$U_H^I = a_H' l_H^* - t + v(l_H^*). \quad (7)$$

On the other hand, the utility of  $H$  individuals living in the communities that choose cash transfers is

$$U_H^C = a_H l_H^* + \frac{(1 - \gamma_j)g}{N_j} + v(l_H^*). \quad (8)$$

If (7) is more than (8),  $H$  individuals prefer the infrastructure policy and vice versa.

For  $L$  individuals, the utility brought by the infrastructure program is formed as (3), and the utility formed by a program with cash transfers is

$$U_L^C = a_L l_L^* + \frac{(2 - \gamma_j)g}{N_j} + u(l_L^*). \quad (9)$$

When (3) is more than (9),  $L$  individuals choose the infrastructure program, and vice versa.

Let us consider now a choice of poverty-alleviation programs in a particular community. The lowest level of tax to support the poor in this community is  $\gamma_j g / (1 - \gamma_j)$ , as we see in (6). In this case,  $L$  individuals prefer a policy of cash transfers, even if  $H$  individuals prefer a policy of installing infrastructures, so the community adopts cash transfers when  $\gamma_j > 1/2$ , and the central government fails to make a self-selection system. Therefore, it can be assumed that  $\gamma_j < 1/2$  is a condition for adopting the infrastructure program under the lowest level of tax. If the effect of infrastructures on the productivity of  $H$  individuals is large, the  $H$  individuals accept the increased taxes in order to get the infrastructure program. Therefore, tax is determined endogenously in each community under the condition of (6).

## 4 Migration among communities

We consider the migration of  $L$  and  $H$  individuals among communities in this section. Both  $L$  and  $H$  individuals can migrate among communities, and the cost of migration between community  $i$  and  $j$  is  $\beta |C_i - C_j|$ , where  $\beta > 0$ . We assume that transportation costs are so expensive that  $L$  individuals cannot move to another community where cash transfers are greater than

those where they live currently. On the other hand,  $H$  individuals can afford to move to another community where they can obtain the more utility.<sup>8</sup>

As we considered in the previous section, when a community prefers the infrastructure program and applies to take it, the central government can obtain the distribution of  $L$  and  $H$  individuals in the community and realize income redistribution. Moreover, since the public knows which communities install new infrastructure,  $H$  individuals living in the neighbor communities may move to the community with new infrastructure after the new taxation level is revealed. We assume that tax is determined and announced to other communities at the beginning of each period.

By comparing transportation costs and the tax levels,  $H$  individuals living in communities where cash transfers are adopted determine whether to migrate. Therefore, the central government obtains the distribution of individuals in the neighbor communities because of the remaining residents after migration are all  $L$  individuals who cannot afford to move to another community. After  $H$  individuals migrate to communities with new infrastructure, tax in the communities they come decreases. Therefore,  $H$  individuals' migration continues to an equilibrium where the utility from migration to communities with new infrastructure and the utility made by staying communities they live currently becomes equal.

If the effect of the infrastructure is not large, migration may be observed in a limited area, and the central government may not be able to obtain the distribution of  $L$  and  $H$  individuals in communities where there is no migration and that adopt cash transfers. In this case, the central government expands the scale of the new infrastructure in order to learn the correct proportion of individuals in all communities and to realize effective allocation of cash transfers.

**Proposition 1** *Even if a central government does not observe individual income in a community, it can target low-productivity individuals by letting the public choose a poverty-alleviation program among several options.*

Once the community takes the infrastructure policy, the central government can observe the proportion of  $L$  individuals in the community as well

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<sup>8</sup>The income level of individuals who migrate among communities is controversial. In the poorest areas, the poor tend to move for survival, but in Asia and the Pacific, the poor are the last to move because they cannot afford to pay the costs of transportation (Skeldon 2002). In this paper, we introduce transportation costs and consider that migrants are those who are generally better off.

as in neighboring communities. The distribution of  $L$  and  $H$  individuals is observed in a whole country if the increased utility by the effect of infrastructures is larger than the disutility of transportation costs. The central government can allocate cash transfers to  $L$  individuals in each community after targeting the number of  $L$  individuals. By introducing options for poverty alleviation, the central government can use the self-selection mechanism, and effective poverty alleviation can be realized.

**Proposition 2** *The central government can install new infrastructure effectively where a large number of individuals need it.*

Since the central government cannot observe the distribution of  $L$  and  $H$  individuals, it is difficult to install infrastructure where a large number of individuals need it. In practice, inefficient industrial orientations are observed in many countries when infrastructure are installed at the government's discretion.<sup>9</sup> However, by urging each community to choose more beneficial policies for poverty alleviation, the central government can distribute new infrastructure effectively.

## 5 Fiscal expenditure

Let us consider the fiscal expenditures when the policy lets each community choose a policy that benefits itself. When the central government cannot observe individual income or productivity and cannot obtain the proportion of  $L$  and  $H$  individuals in each community by providing cash transfers, the required fiscal expenditure for poverty alleviation is  $F = Ng$ . On the other hand, after revealing the distribution of  $L$  and  $H$  individuals by introducing some options for poverty-alleviation programs, the needed cash transfers for  $L$  individuals are  $\gamma Ng$ . Since the cost of installing infrastructures is  $C_I$ , the fiscal expenditure becomes

$$F = mC_I + \gamma Ng,$$

where the number of communities that apply for new infrastructure is  $m$ . Whether the fiscal expenditure realized by this policy becomes less than  $Ng$

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<sup>9</sup>There are many reports about Illegitimate debts which developing countries such as G7 impose to developing countries. Then, governments accept plans to set infrastructures where private companies of developed countries get benefits in order to obtain bribes (Pacific Asia Resource Center 2008).

depends on the cost of the infrastructure. However, this mechanism uses self-selection to be able to target  $L$  individuals, even if there is double asymmetric information related to income and productivity between the public and the government. Moreover, this policy enables the policymaker to support the poor by taxation instead of through exogenous financial resources credit.

**Proposition 3** *Offering several poverty-alleviation programs and letting the public choose the best program for themselves enables policymakers to get funding by taxes.*

Apparently, supporting  $H$  individuals is not directly related to poverty alleviation. However, supporting  $H$  individuals for income redistribution is effective in targeting individuals who pay tax and the central government can collect cash endogenously. The system realizes sustainable poverty alleviation.

## 6 Conclusion

In this paper, we clarified the mechanism of poverty-alleviation programs that succeed in self-selection under double asymmetric information related to individual productivity and income between the central government and the public. There are several solutions to the screening problem, which the government often faces when implementing a poverty-alleviation program. However, these policies fail when the policymakers cannot observe individual income. The new mechanism shown in this paper lets the public reveal their types, even if individual incomes are not observed. Hence, the policymaker can allocate cash transfers effectively and also collect funds for poverty alleviation endogenously.

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