Optimal Redistributive Policy under Incentive Constraint: The Value of In-Kind Transfer

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1 Introduction

We live in a world of tradeoffs. This paper explores the optimal design of redistributive policy that faces one type of them: *equality and efficiency tradeoff*. Optimal efficiency, in the Pareto sense, can be achieved in the perfectly competitive market, which is stated in the first fundamental theorem of welfare economics. However, the assumptions of perfect competition rarely hold; thus, many economic policies are devised and implemented to reform the market failure.

Optimal equality, on the other hand, is not achieved in general, even if the assumptions of perfect competition are satisfied. In addition, the term "optimal" is rather controversial when we discuss equality. Criteria for optimality can vary according to the countries, regions or persons. To offer a general statement, this paper attempts to derive Pareto efficient redistributive policy under a given social criterion for equality or poverty. In any circumstances, if equality is valued, or at least abject poverty is considered to be alleviated in a society, redistribution by the government is required. The second fundamental theorem of welfare economics states that any Pareto-efficient allocation of resources can be achieved by a suitable reallocation of endowments among individuals in the competitive market. However, redistributive policy is constrained by incentive constraint that emerges from asymmetry of information on individuals' earning ability between the taxpayers and the government. If the government can observe only individuals' income and make the tax payment contingent on it, individuals have incentives to "self-select" their desirable income level. In other words, one may reduce the labor supply to receive payment or avoid paying taxes, and this "self-selection" will result in social efficiency losses. Hence, the government has to make a mechanism to induce individuals to reveal their true ability types. "The redistribution problem is thus a classic revelation mechanism design problem" (Boadway and Keen, 2000, p.736). Hence, we need to consider the optimal redistributive policy under self-selection constraint, or incentive (compatibility) constraint. When the incentive constraint is binding, redistributive policy cannot be implemented on the first-best frontier, so the optimal redistributive policy has to be a second-best solution. Further redistribution will make the second-best solution far from first-best solution, and this fact generates the equality and efficiency tradeoff.

First of all, we consider whether redistribution should be implemented in cash or in kind. "Economists have traditionally been skeptical about in-kind transfers viewing cash as superior in terms of the recipient's utility: in-kind transfers constrain the behavior of the recipients, while cash transfers do not" (Currie and Gahvari, 2008, p.333). Thus, the main field of discussion on redistribution has been in income taxation theory. The traditional idea of improving work incentives in income tax system is Negative Income Tax (NIT), which is proposed and advocated by both the classic liberal Friedman (1962) and the old Keynesian Tobin (1966). In the NIT scheme, individuals whose income is above a certain amount pay positive income taxes, whereas individuals whose income is under a certain amount receive negative income taxes, which is in fact subsidies. The NIT is originally considered as a linear (flat) income tax combined with a basic income. Linear tax implies constant marginal tax rate; thus the subsidies (the NIT) equals to constant ratio of before-tax income. Hence, the after-tax income rises as before-tax income increases. Compared with the uniform income compensation, which implies 100 percent marginal tax rate for recipients, the linear NIT scheme has a positive work incentive effects. However, as long as the after-tax income rises as before-tax income increases, the NIT schedule needs not to be linear. Moreover, if the utility from one's after-tax income is higher than that from another after-tax income gained by reducing before-tax income, the incentive improving property of the original NIT is remaining in this tax scheme. This is the idea of non-linear optimal income tax framework for redistribution due to Mirrlees (1971), which we employ throughout this paper.

Friedman (1962) and Friedman and Friedman (1980), according to Moffitt (2003), noted the advantages of the NIT besides the improvements of work incentives: getting rid of the problem of stigma, reduction of costs etc. On the other hand, Moffitt (2003) pointed out that the effects of the NIT on the supply of labor might be ambiguous. That is, it is true that the NIT can contribute to solving the self-selection problem, but we cannot solve it perfectly by only applying the NIT. Originally, Friedman (1962) insisted that the NIT has to be implemented as an alternative to all other redistribution policy because of his discredit on the government. However, we will attempt to amend the NIT and offer a better policy. Therefore, taking into consideration the possibility that other policy instruments (e.g. in-kind transfers) can achieve a more efficient redistribution, constructing a better redistribution system by combining the non-linear NIT with other methods is the main purpose of this paper.

We should note here the appropriateness that we assume the government is implementing non-linear income tax. Actually, linear income tax is often advocated because of its low administrative cost (e.g., Atkinson, 1995). Moreover, according to Kaplow (2008, p.78), several simulations suggest that a linear tax can achieve most of the attainable benefits. However, it is rather stringent assumption for our purpose to assume the non-linear NIT is implemented. For it is conjectured that other policy instruments can enhance the efficiency more in linear income tax schedule when they are efficient in non-linear income tax schedule. Thus, we will consider the non-linear income tax, which is the most efficient form of in-cash transfers.

To slacken the incentive constraint, we will focus on categorization as efficiency enhancing method combined with the NIT and investigate two ways of it: "tagging" and "self-targeting." First, we investigate the properties of tagging. Mankiw et al. (2009) states as one of the lessons suggested by optimal tax theory: "Taxes should depend on personal characteristics as well as income" (p.161), that is, tagging improves the income tax system. A "tag" refers to "some observable characteristic...which is correlated with ability" (Akerlof, 1978, p.124); for example, individuals can be tagged by ages, employed or not, and other characteristics. If the government makes the tax payment contingent on tags, individuals cannot mimic or it is very costly to mimic; thus, tagging can slacken the incentive constraint and enhance the efficiency. However, tagging entails several drawbacks. First, tagging is usually imperfect in practice; that is, the government can commit two types of classification errors. That is, some of the individuals who deserve to be subsidized can be untagged (type I) and, those who does not deserve can be tagged (type II). Second, the imperfection of tagging can violate the horizontal equality. Parsons (1996) and Salanie (2002) showed that even there exists a classification errors, it will be optimal to pay a larger basic income to tagged individuals. However, Boadway and Pestieau (2006) show that if we take horizontal equality into account, the efficiency will deviate from optimal that tagging can realize. In other words, the optimal implementation of imperfect tagging will violate the horizontal equality. Third, Jacquet and Van der Linden (2006) point out that the cost of stigma had been neglected in the literature of tagging. To tag individuals correctly, the government may resort to means testing, which causes stigmatization.

Considering the benefits of categorization and the drawbacks of tagging, this paper suggests the other type of categorization: self-targeting mechanism[1]. In contrast to tagging, self-targeting mechanism does not require any additional information, but induce individuals to reveal their private information, or real ability-types, by restricting the recipients. Self-targeting mechanism can take several forms according to what is restricted for the recipients. One of them is in-kind transfer. The government can establish self-targeting mechanism of in-kind transfer program by restricting the recipients to consume a certain commodity bundle. If the demand for a certain good is different between high- and low-ability persons, the government can categorize them by providing the good at the level only low-ability persons will demand. Then, in the case of incentive constraints bind, in-kind transfer can slacken the constraints. Thus, in spite of the arguments in traditional economics, in-kind transfers can play a significant role in redistribution.

In this paper, we will investigate further the property of in-kind transfers. We will focus on incentive effects of in-kind transfers on low-ability persons who are not constrained by incentive constraint. After all, the incentive constraint can induce high-ability persons to reveal real type, but it is not effective against the work disincentive of low-ability persons. Therefore, if it is verified that the in-kind transfers have positive incentive effects on low-ability persons, the implementation of in-kind transfers can be proved to be more reliable.

Lastly, we mention here other work inducement policy instruments because they

[1]This concept was first introduced by Nichols and Zeckhauser (1982) and Blackorby and Donaldson (1988).

should also be examined in our framework to explore the optimal redistributive policy. Firstly, as another way of self-targeting mechanism, there is workfare. Workfare is defined here as the additional work required for the recipients. Thus, it can be recognized as the extreme way of work inducement. Besley and Coate (1992; 1995) solved the cost minimization problem and proved that workfare is also a efficient policy instrument. Secondly, there is wage subsidy, which implies negative marginal tax rate. Kanbur et al. (1994) solve the problem of minimization of poverty and justified the negative marginal tax rate, while Saez (2002) and Chone and Laroque (2005) consider the labor supply at the extensive margin rather than intensive margin, then justify them by introducing probability in the decision of the low-ability person to participate in the labor force. Each method can be reexamined in the optimal non-linear income tax model other than their framework, and we can derive the optimal conditions to implement it. However, they will not be stated in this paper because we will concentrate on the in-kind transfers.

As is clear from the discussion so far, this paper will investigate several policy instruments and derive optimal conditions in the unified Mirrlees' type optimal non-linear income tax model, and then the properties of them will be stated. In chapter 2, we will survey the literature that is related with the self-targeting mechanism and clarify our position in the literature. Chapter 3 describes the model which is used throughout this paper, and the results of non-linear income tax in this model are stated in chapter 4. Then the benefits of categorization are investigated in chapter 5, and the efficacy of in-kind transfer program in chapter 6. Lastly, we conclude the discussion in chapter 7.

2 Related Literature

This chapter presents a survey of literature that is related with self-targeting mechanism, the main theme of this paper. To be specific, we will see the literature on commodity taxation and in-kind transfer programs. Each policy is interpreted as "price controls" and "quantity controls,"[2] respectively. Both policies can distort the market, or individuals' behavior, which is not a desirable property in a first-best world. However, in a second-best world, such distortions can make improvements, and that is the reason why substantial literature has been devoted to these topics. Then the position of our discussion in the literature will be clarified.

First, we will briefly survey the commodity taxation literature. To begin with, the optimal tax theory was developed from Ramsey's (1927) seminal paper on commodity tax. But the optimal commodity tax was considered based on the assumption that individuals face no income tax. If the (non-linear) optimal income tax is implemented, Atkinson and Stiglitz (1976) resulted that the com-

[2] The first insight for the efficiency of quantity controls is due to Guesnerie and Roberts (1984).

modity tax is superfluous if the utility is weakly separable in consumption and labor. This fact often endorses us to consider only optimal "income" tax as a redistributive policy. However, the assumption of the weak separability has been questioned by empirical studies;[3] thus, commodity taxes can be needed to enhance the efficiency.

Another strand of the literature is concerned with redistribution by in-kind transfers.[4] In-kind transfers have been considered under several informational bases of the government, which can be classified into three cases. The first is that the government has no information of income.[5] In this literature, a government in a developing country is supposed, and in-kind transfer program is considered as an alternative way of income tax. The second is that the government is restricted to implement linear income tax. In this case, it is examined the possibility that the government can achieve the efficiency of non-linear income tax by combining in-kind transfer with linear income tax.[6] The third is the case, in which this paper is classified, that the government can implement non-linear income tax. In either case, it is shown that the in-kind transfer program can be an effective instrument for redistribution. We will focus on the last case and investigate further.

Considering in-kind transfer program, there are two ways to implement it. One is a universal provision,[7] where individuals who want to consume more than public provided level can "top up," or supplement. The other is a self-targeted public provision,[8] where individuals who want to consume more than public provided level cannot supplement, so they will be "opt out." In either case, in-kind transfers are welfare enhancing as long as the assumption of separability is violated, same as in commodity tax literature.

The commodity tax and the two types of in-kind transfers are all welfare enhancing; the next question will be which instrument is optimal for a redistributive policy. Blomquist and Christiansen (1998a) derived the condition on whether commodity tax or in-kind transfers achieves more efficiency, while Blomquist and Christiansen (1998b) analyzed whether universal provision or self-targeted provision should be implemented according to the property of the publicly provided good.

As noted in chapter 1, we employ in-kind transfers as a redistributive policy to achieve the categorization other than tagging. Therefore, this paper will focus on the self-targeted public provision, and derive the optimal conditions.

[3]e.g., Browning and Meghir (1991)

[4]For a more detail survey of the literature on in-kind transfers, see Currie and Gahvari (2008).

[5]e.g., Besley and Coate (1991), Gahvari and Mattos (2007)

[6]e.g., Munro (1992), Gahvari (1995)

[7]e.g., Boadway and Marchand (1995), Cremer and Gahvari (1997), Boadway et al. (1998)

[8]e.g., Blomquist and Christiansen (1995)

Along with the literature discussed in this chapter, comparing or mixing each method is one way of finding the optimal policy. But actually, the advantages of each method depend on the property of the publicly provided good, individuals' utility function, and others. Taking all methods into account, the result will vary according to the case. Thus, to obtain common results, the comparison of each method will not be appeared in this paper. Instead, we focus on the optimal implementation of one of the in-kind transfer scheme: self-targeted public provision.

3 The Model

3.1 Assumption and Notation

This chapter describes a model which is used and extended throughout this paper. In this section, assumptions and notation of the model are presented. As noted in chapter 1, the optimal income tax framework for redistribution is due to Mirrlees (1971), but his formulation is quite complicated and requires numerical simulations to derive significant results, we use a simple model for the analyses following Stiglitz (1982; 1987), Tuomala (1999, chapter 4), and Boadway and Keen (2000).

We assume two-class perfectly competitive economy which consists of persons of two types of income-generating ability with wage rates $w_i,\ i = 1, 2$. We assume that type 2 individual is more productive than type 1; that is,

$$w_1 < w_2$$

and each individual earns before-tax income

$$Y_i < w_i L_i$$

where L_i is the labor supply. Each person faces income tax according to the before-tax income:

$$T_i = T(Y_i).$$

When Ti takes a negative value, person i receives subsidy, which implies that this is a non-linear NIT schedule. Next, assume that all individuals have the same utility function, which is strictly quasi-concave and twice differentiable,

$$U(B_i, L_i), i = 1, 2 \tag{3.1.1}$$

where $B_i = Y_i - T(Y_i)$ is the after-tax income, and is equal to the consumption of an individual of type i, and increasing in consumption and leisure:

$$\frac{\partial U}{\partial B} > 0, \frac{\partial U}{\partial L} < 0$$

Besides leisure is a normal good:

$$\frac{\partial L}{\partial B} < 0 \ . \tag{3.1.2}$$

We postulate in this paper that the government can only observe individuals' before- and after-tax income, whereas L_i is an unobservable variable since labor supply is assumed to indicate not only working hours but also the working efforts. To characterize the Pareto optimal bundle of observable variables (B, Y), we rewrite the utility function as

$$u^i(B_i, Y_i) \equiv U(B_i, L_i w_i / w_i) = U(B_i, Y_i / w_i)$$

where increases in Y decrease utility:

$$\frac{\partial u^i}{\partial Y} < 0$$

because increases in before-tax income require more labor. Now, we consider the marginal rate of substitution (MRS) to see the shape of the indifference curve of the utility function:

$$MRS_{YB} = -\frac{\partial u^i / \partial Y}{\partial u^i / \partial B} = -\frac{\left(\partial U^i / \partial Y\right) / w_i}{\partial U^i / \partial B} \ .$$

We assume Spence-Mirrlees single crossing property (agent monotonicity); that is, the marginal rate of substitution between consumption and before-tax income is smaller for more productive individuals:

$$-\frac{\partial u^i / \partial Y}{\partial u^i / \partial B} < -\frac{\partial u^j / \partial Y}{\partial u^j / \partial B} \quad \text{where} \quad w_i < w_j \ . \tag{3.1.3}$$

Hence, the indifference curve of person 2 is flatter than that of person 1. (Figure 1)
Here, we should note an important property of this model: when one mimics the other type, the only difference of the two individuals would be the labor supply. This implies that, since labor supply is unobservable variable, social planner has to distinguish a mimicker by controlling some variables relating to the labor supply. This property is crucial in considering self-targeting mechanism which will be stated in sections 5.2.

Lastly, the Pareto optimal allocation should be formally stated. The individual's utility maximization problem is

$$\max_{\{B_i, Y_i\}} u^i(B_i, Y_i)$$

subject to the budget constraint

$$w_i L_i - T(w_i L_i) \geq B_i \ .$$

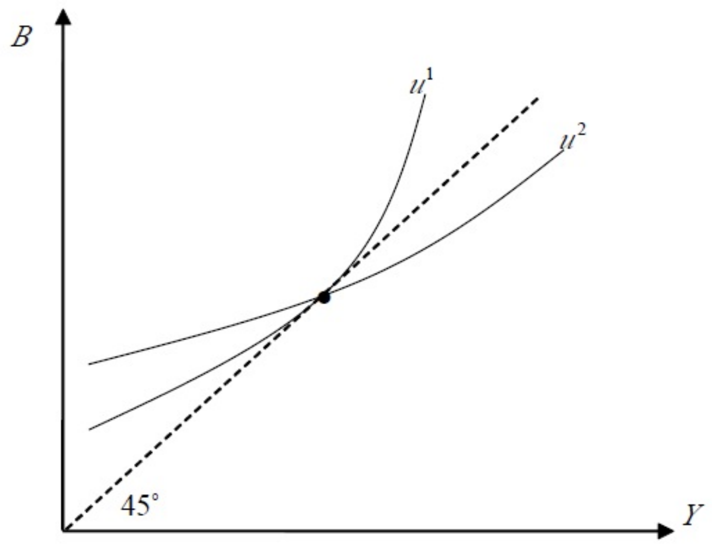

Figure 1: Indifference Curves satisfying Single Crossing Property in Two-Type Mode

If the tax schedule is continuously differentiable, the optimal condition can be written as

$$MRS_{YB} = -\frac{\partial u^i/\partial Y_i}{\partial u^i/\partial B_i} = 1 - Y' \ .$$

Consequently, the marginal tax rate can be expressed as follows:

$$T'(Y) = 1 - MRS_{YB} \ . \tag{3.1.4}$$

Clearly, when individuals face no taxes (subsidies), that is when

$$MRS_{YB} = 1 \ .$$

The graph of the indifference curves can be described as below. (Figure 2)
If the government implement a linear income tax (basic income/ flat tax), where G is a basic income, the graph will be Figure 3. The solid line is the set of allocations (Y, B) that the tax schedule defines. In this case, you can see that after-tax income of person 2 decreases and that of person 1 increases, while before-tax income of both persons decreases. That is, redistribution from person 2 to person 1 is accomplished, but by the work disincentive effects of taxes, both persons decrease the labor supply. This linear income tax represents the original linear-NIT. We can recognize that it has still disincentive effects on individuals. As noted in chapter 1, the tax schedule can be extended to non-linear for efficiency, so that we will consider non-linear tax schedule in the next chapter.

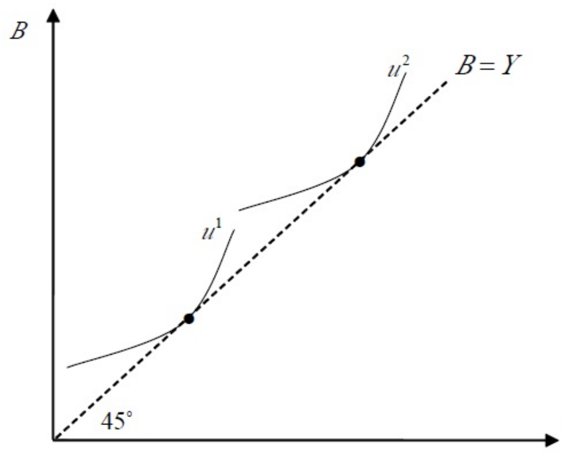

Figure 2: No Transfers (Laissez-Faire)

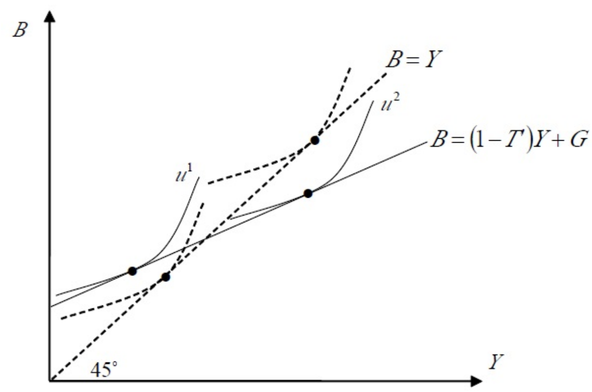

Figure 3: Linear Income Tax Schedule

3.2 Social Objectives

In this section, we discuss the issue of social objectives and how to deal with it in this paper. The government implements redistributive policy taking social objectives into account. This paper offers the Pareto efficient redistributive policy given a certain social objective for equality or poverty.

Here we introduce a function which enables the model to accommodate any social preference

$$W = \int \psi(u(w))dF(w)$$

where ψ is an additive concave Bergson-Samuelson social welfare functional, and $dF(w)$ is the cumulative distribution function. It can be rewritten in our two-type ability model,

$$W = \pi\psi(u^1(w_1)) + (1-\pi)\psi u^2(w_2) \tag{3.2.1}$$

where the proportion of low-ability households in the population is π, and that of high-ability is $(1-n)$. For simplicity, we normalize total population to unity.

ψ can be specified in several ways with the social aversion to inequality ρ, for instance, Salanie (2003) presents

$$\begin{aligned}\psi(u) &= \frac{u^\rho}{\rho} \quad \text{for } \rho \neq 0 \\ &= \ln(u) \quad \text{for } \rho = 0.\end{aligned}$$

When $\rho = 1$, $W = u_1 + u_2$, which implies utilitarian criterion; when $\rho = -\infty$, $W = u_1$, which implies maximin criterion. Similarly, Kaplow (2008) presents

$$\begin{aligned}\psi(u) &= \frac{u^{1-\rho}}{1-\rho} \quad \text{for } \rho \neq 0 \\ &= \ln(u) \quad \text{for } \rho = 0.\end{aligned}$$

In the same way, when $\rho = 0$, $W = u_1 + u_2$, which implies utilitarian criterion; when $\rho = \infty$, $W = u_1$, which implies maximin criterion. In this paper, however, we does not specify the value of ψ because it is not crucial for our discussion.

The social welfare function (3.2.1) can be visually understood by following illustrations of utility possibility frontiers and social indifference curves.[9] Each axis represents each person's utility. The utility possibility frontier is expressed as mountain-shaped graphs, reflecting the equality and efficiency tradeoff. To make it simple illustration, we assume here the marginal utility is constant. Then the frontier is linear as long as the incentive constraint is not binding

[9]See Boadway and Pestieau (2006) for the solid calculation to derive the graphs.

since there is no efficiency loss. Besides, it does not cross 45 degree line because the incentive constraint keeps utility of person 1 to be lower than that of person 2. The social preference to the degree of inequality is reflected on the curvature of the social indifference curves. Three patterns of social preference are shown. When the social objective is utilitarian, the social indifference curve is linear, which will be illustrated as Figure 4.

The thick line represents the optimal solutions. Utilitarian principle requires

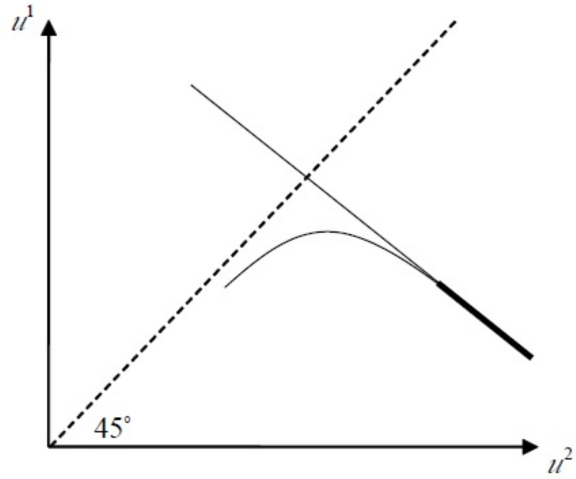

Figure 4: Utilitarian Social Objective

maximizing the sum of the utilities; thus it do not allow any efficiency loss. Therefore, it is optimal as long as the incentive constraint is not binding. And when it is maximin, the social indifference curve is right-angled shape. It requires maximizing the utility of low-ability person as Figure 5 shows. Lastly, when it is somewhere in-between, Figure 6 gives us an example of this case.

Our discussion corresponds to Okun's (1975) metaphor of the "leaky bucket." He wrote: "(T)he money must be carried from the rich to the poor in a leaky bucket. Some of it will simply disappear in transit, so the poor will not receive all the money that is taken from the rich" (p.91). This statement, implying equality and efficiency tradeoff, is reflected on the bending utility possibility frontier. Besides, the acceptable leakages for a society are reflected on the shape of social indifference curve.

In the discussions in the following chapters, the results are mostly derived irrelevant to the social objectives. It might seem to be meaningless to define these social objectives; rather, we can say that the claims are consistent whatever the preference the society has.

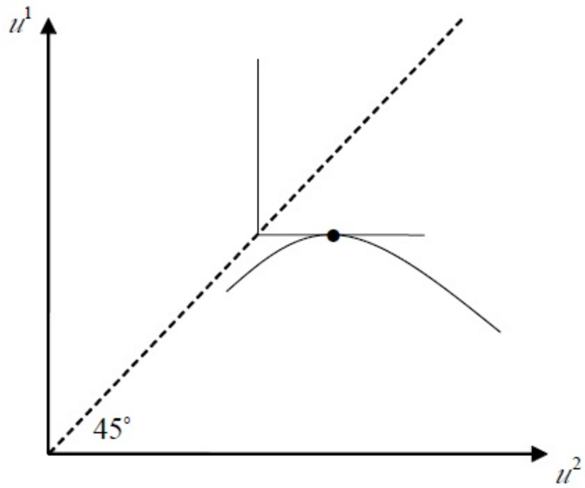

Figure 5: Maximin Social Objectivve

4 Optimal Non-Linear Income Tax

4.1 Benchmark: Perfect Information

This chapter shows the optimal conditions of the non-linear income tax, which is originally verified by Stiglitz (1982, 1987) in the model described in the previous chapter. As a benchmark, the perfect information case is presented in this section; that is, in the case that no incentive constraint is binding. The government's maximization problem is

$$\max_{\{B_1,Y_1,B_2,Y_2\}} \pi\psi\left(u^1\left(B_1,Y_1\right)\right)+(1-\pi)\psi\left(u^2\left(B_2,Y_2\right)\right)$$

subject to the budget constraint

$$\pi(Y_1-B_1)+(1-\pi)(Y_2-B_2)\geq R.$$

Lagrangean expression is as follows

$$L\left(B_1,Y_1,B_2,Y_2,\gamma\right)=\pi\psi\left(u^1\left(B_1,Y_1\right)\right)+(1-\pi)\psi\left(u^2\left(B_2,Y_2\right)\right)+\gamma\left[\pi(Y_1-B_1)+(1-\pi)(Y_2-B_2)-R\right]$$

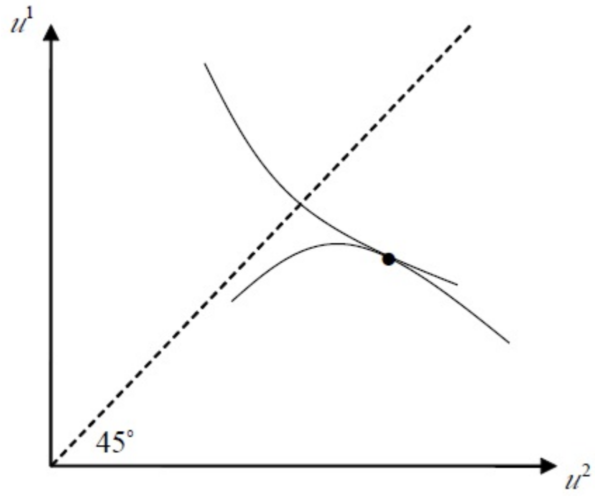

Figure 6: General Social Objective

and the first-order conditions on B_1 and B_2 are

$$\frac{\partial L}{\partial B_1} = \pi\frac{\partial \psi}{\partial u^1}\frac{\partial u^1}{\partial B_1} - \gamma\pi = 0 \tag{4.1.1}$$

$$\frac{\partial L}{\partial B_2} = (1-\pi)\frac{\partial \psi}{\partial u^2}\frac{\partial u^2}{\partial B_2} - \gamma(1-\pi) = 0. \tag{4.1.2}$$

From (4.1.1) and (4.1.2),

$$\frac{\partial \psi}{\partial u^1}\frac{\partial u^1}{\partial B_2} = \frac{\partial \psi}{\partial u^2}\frac{\partial u^2}{\partial B_2} = \gamma\ .$$

Under utilitarian criterion, which implies $\frac{\partial \psi}{\partial u^i} = 1$, each individual's marginal utility should be the same. This corresponds to Edgeworth's (1892) *principle of equimarginal sacrifice.* That is, when the government has the information on individuals' real ability-types, "the richer should be taxed for the benefit of the poor up to the point where complete equality for fortunes is attained" (p.553). When the marginal utility is constant, the utility possibility frontier illustrated in the previous section is linear, and then the frontier and the social indifference curve will coincide (the thick line of the Figure 4).

4.2 Imperfect Information

This section provides the case of imperfect information: optimal non-linear income tax model under incentive constraint. The results are due to Stiglitz

(1982; 1987). Government's maximization problem is

$$\max_{\{B_1,Y_1,B_2,Y_2\}} = \pi\psi\left(u^1\left(B_1,Y_1\right)\right) + (1-\pi)\psi\left(u^2\left(B_2,Y_2\right)\right)$$

subject to incentive constraint

$$u^2\left(B_2,Y_2\right) \geq u^2\left(B_1,Y_1\right)$$

and budget constraint

$$\pi(Y_1 - B_1) + (1-\pi)(Y_2 - B_2) \geq R.$$

Lagrangean expression is

$$\begin{aligned} L\left(B_1,Y_1,B_2,Y_2,\lambda,\gamma\right) &= \pi\psi\left(u^1\left(B_1,Y_1\right)\right) + (1-\pi)\psi\left(u^2\left(B_2,Y_2\right)\right) \\ &+ \lambda\left[\left(u^2\left(B_2,Y_2\right)\right) - \left(u^2\left(B_1,Y_1\right)\right)\right] + \gamma\left[\pi(Y_1 - B_1) + (1-\pi)(Y_2 - B_2) - R\right] \end{aligned}$$

and the first-order conditions are

$$\frac{\partial L}{\partial B_1} = \pi\frac{\partial\psi}{\partial u^1}\frac{\partial u^1}{\partial B_1} - \lambda\frac{\partial u^2}{\partial B_1} - \gamma\pi = 0 \tag{4.2.1}$$

$$\frac{\partial L}{\partial Y_1} = \pi\frac{\partial\psi}{\partial u^1}\frac{\partial u^1}{\partial Y_1} - \lambda\frac{\partial u^2}{\partial Y_1} + \gamma\pi = 0 \tag{4.2.2}$$

$$\frac{\partial L}{\partial B_2} = (1-\pi)\frac{\partial\psi}{\partial u^2}\frac{\partial u^2}{\partial B_2} + \lambda\frac{\partial u^2}{\partial B_2} + \gamma(1-\pi) = 0 \tag{4.2.3}$$

$$\frac{\partial L}{\partial Y_2} = (1-\pi)\frac{\partial\psi}{\partial Y^2}\frac{\partial u^2}{\partial Y_2} + \lambda\frac{\partial u^2}{\partial Y_2} + \gamma(1-\pi) = 0. \tag{4.2.4}$$

To see the optimal conditions on the tax rate of person 2, dividing (4.2.4) by (4.2.3):

$$-\frac{\partial u^2/\partial Y_2}{\partial u^2/\partial B_2} = 1.$$

This implies the marginal tax rate faced by the more able individual is zero. This result is known as *zero-marginal-tax-rate-at-the-top condition.*

Next, we will see the optimal conditions on the tax rate of person 1. Dividing (4.2.2) by (4.2.1):

$$-\frac{\partial u^1/\partial Y_1}{\partial u^1/\partial B_1} = -\frac{\lambda(\partial u^2/\partial Y_1) + \gamma\pi}{\lambda(\partial u^2/\partial B_1) + \gamma\pi}\,. \tag{4.2.5}$$

Define

$$\alpha^i = -\frac{\partial u^i/\partial Y_1}{\partial u^i/\partial B_1} \quad \text{and} \quad \nu = \frac{\lambda(\partial u^2/\partial B_1)}{\gamma\pi}\,.$$

Then (4.2.5) can be rewritten as

$$\alpha^1 = \frac{1+\nu\alpha^2}{1+\nu} = \alpha^2 + \frac{1-\alpha^2}{1+\nu}\,. \tag{4.2.6}$$

Since, by Spence-Mirrlees single-crossing property, $\alpha^1 > \alpha^2$,

$$\alpha^2 < \alpha^1 < 1. \tag{4.2.7}$$

Therefore,

$$-\frac{\partial u^i/\partial Y_1}{\partial u^i/\partial B_1} = -\frac{\lambda(\partial u^2/\partial Y_1) + \gamma\pi}{\lambda(\partial u^2/\partial B_1) + \gamma\pi} < 1. \tag{4.2.8}$$

This implies the marginal tax rate faced by the less able individual will be positive. Thus, the optimal marginal tax rate for each individual is

$$0 < T'(wL) \leq 1.$$

From the above discussion, we have the following proposition which states the common properties derived from Mirrlees' type optimal income tax model.

Proposition 1 (Stiglitz (1982, 1987)):
(1) *The optimal marginal tax rate for high-ability person is zero.*
(2) *The optimal marginal tax rate for low-ability person is positive.*

5 Categorization

5.1 Tagging

In this chapter, the benefit of categorization is demonstrated. Categorization can take two forms: tagging and self-targeting. Tagging is a way of categorization using additional information obtained with a small cost, whereas self-targeting mechanism does not require such additional information but categorize by imposing restrictions and inducing high-ability persons to reveal real type.

Following Salanie (2002; 2003), this section verifies that the categorization by tagging can make it possible to implement more redistribution optimally under incentive constraint. Salanie (2003) presents that perfect tagging can accomplish it in the linear tax model, we show that it is consistent in the non-linear income tax model. We assume that the government is implementing a quasi-linear tax schedule

$$T_i = -G_i + t(Y_i) \tag{5.1.1}$$

where G is the basic income (minimum guarantee). If we can show that the optimal conditions require $G_1 > G_2$, it is verified that the categorization by tagging enables the government to implement further redistribution optimally, which implies the incentive constraint is slackened. Since after-tax income is determined by G and Y, individual's utility function can be described as follows

$$U^i = U(G_i, Y_i).$$

For simplicity, we assume that low-ability person is unable to work, so the before-tax income is zero:

$$Y_1 = 0.$$

Then the government's maximization problem is

$$\max_{\{G_1,G_2\}} = \pi\psi\left(U^1\left(G_1,0\right)\right) + (1-\pi)\psi\left(U^2\left(G_2,Y_2\right)\right)$$

subject to budget constraint

$$(1-\pi)t(wL(G_2,Y_2)) \geq R + \pi G_1 + (1-\pi)G_2.$$

The first-order conditions on G_1 and G_2 are, respectively

$$\pi\psi'(U^1(G_1,0))\frac{\partial U^1}{\partial G_1} - \gamma\pi = 0$$

$$(1-\pi)\psi'(U^2(G_2,Y_2))\frac{\partial U^2}{\partial G_2} + \gamma\left((1-\pi)t'(Y_2)w\frac{\partial L}{\partial G_1} - (1-\pi)\right) = 0$$

or

$$\psi'(U^1(G_1,0))\frac{\partial U^1}{\partial G_1} = \gamma \tag{5.1.2}$$

$$\psi'(U^2(G_2,Y_2))\frac{\partial U^2}{\partial G_2} + \gamma\left(t'(Y_2)w\frac{\partial L}{\partial G_2} - 1\right) = 0. \tag{5.1.3}$$

Since

$$\frac{\partial L}{\partial G_2} < 0 \quad \text{and} \quad t'(Y_2) > 0,$$

we obtain from (5.1.3),

$$\psi'(U^2(G_2,Y_2))\frac{\partial U^2}{\partial G_2} > \gamma. \tag{5.1.4}$$

Substituting (5.1.4) into (5.1.2) for γ,

$$\psi'(U^2(G_2,Y_2))\frac{\partial U^2}{\partial G_2} > \psi'(U^1(G_1,0))\frac{\partial U^1}{\partial G_1}$$

or since the marginal utility of basic income is one because we assume the quasi-linear income tax

$$\psi'(U^2(G_2,Y_2)) > \psi'(U^1(G_1,0)). \tag{5.1.5}$$

Since ψ is concave

$$\psi'(U^2(G_2, 0)) > \psi'(U^2(G_2, Y_2)) \tag{5.1.6}$$

By combining (5.1.5) and (5.1.6),

$$\psi'(U^2(G_2, 0)) > \psi'(U^2(G_2, Y_2)) > \psi'(U^1(G_1, 0))$$

or

$$\psi'(U^2(G_2, 0)) > \psi'(U^1(G_1, 0))$$

Since ψ is concave

$$\therefore G_1 > G_2$$

It is shown that the basic income should be higher for those individuals who have been tagged as low-ability. Therefore, the government can implement more redistribution under incentive constraint. Thus following proposition is verified.

Proposition 2
In the non-linear income tax model, if the government could categorize individuals perfectly by tagging, the government could give larger basic income to the low-ability person.

Now we know from the proposition 2 that the categorization by tagging can enhance the efficiency of redistribution. However, we should also note drawbacks of tagging, as noted in chapter 1. That is, errors which arise from imperfectness of tagging, violation of horizontal equality, and stigmatization. The cost from such drawbacks may be greater than the benefit of tagging (cf. Jacquet and Van der Linden, 2006).

From the ground that the categorization is beneficial for redistributive policy, but tagging often entails problems; in the next section, we will investigate another way of categorization: self-targeting mechanism.

5.2 Self-Targeting Mechanism of In-Kind Transfers

In this section, self-targeting mechanism of in-kind transfers is illustrated. As noted in chapter 2, in-kind transfers can take two types of form: “opting out” and “topping up.” To categorize individuals by self-targeting, in-kind transfers require high-ability person to “opt out,” so we consider only the former type.

We introduce x as a good which can be publicly provided, and indicates the consumption level of the good. We assume that x cannot be resold or supplemented. $\bar{x}$ is the level of x when it is publicly provided. c is the demand of a composite of goods other than x. For simplicity, we postulate that the price of each good is one, and a normal good. As long as the incentive constraint is binding, high-ability person does not mimic low-ability person; thus, the objective function can be expressed as categorized form. Then we can characterize the government's maximization problem as follows

$$\max_{\{B_1,Y_1,G_2,Y_2,\bar{x}\}} = \pi\psi\left(u^1\left(c_1,\bar{x},Y_1\right)\right) + (1-\pi)\psi\left(u^2\left(c_2,x_2,Y_2\right)\right)$$

where

$$c_1 + \bar{x} = B_1, \quad c_2 + x_2 = B_2$$

subject to incentive constraint

$$u^2(c_2,x_2,Y_2) \geq u^1(c_1,\bar{x},Y_1)$$

and budget constraint

$$\pi(Y_1 - c_1 - \bar{x}) + (1-\pi)(Y_2 - B_2) \geq R.$$

To see how the mechanism of self-selection by in-kind transfers works, we focus on the incentive constraint compared with the one in the previous chapters. The optimization problem will be solved in the next chapter. For reference, the incentive constraint in the optimal non-linear tax model without in-kind transfers is as follows

$$u^2(B_2,Y_2) \geq u^2(B_1,Y_1) \Leftrightarrow u^2(c_2,x_2,Y_2) \geq u^2(c_2^m,x_2^m,Y_1)$$

where c_2^m and x_2^m is the optimal choice of the mimicker. Since the l.h.s. of each incentive constraint is the same, the incentive constraint will be slacken if

$$u^2(c_1,\bar{x},Y_1) > u^2(c_2^m,x_2^m,Y_1)$$

or

$$\bar{x} \neq x_2^m. \tag{5.2.1}$$

Therefore, $\bar{x}$ should be set below or above the mimicker's demand of x to establish self-targeting mechanism. To analyze separately each pattern perspicuously, set

$$\bar{x} = x(B_1, Y_1/w_1).$$

As noted in section 3.1., the only difference of the two individuals is be the labor supply when one mimics the other type. Since $x_2^m = x(B_1, Y_1/w_2)$, (5.2.1) can be rewritten as

$$\left|\frac{\partial x}{\partial L}\right| > 0$$

That is, if the demand of x is varied according to the labor supply L, the government can establish self-targeting mechanism of in-kind transfer program by restricting the recipients to consume a certain commodity bundle.

Lemma 1:
To establish the self-targeting mechanism of in-kind transfers, the demand of the publicly provided good x has to be affected by the labor supply L; that is,

$$\left|\frac{\partial x}{\partial L}\right| > 0.$$

6 The Efficacy of In-Kind Transfers

6.1 Optimal Conditions on the Level of In-Kind Transfers

In this section, we consider the optimal conditions on the level of in-kind transfers by solving the optimization problem which was established in section 5.2.

Lagrangean form is as follows:

$$\begin{aligned} L\left(B_1, Y_1, B_2, Y_2, \bar{x}\right) &= \pi\psi\left(u^1\left(c_1, \bar{x}, Y_1\right)\right) + (1-\pi)\psi\left(u^2\left(c_2, x_2, Y_2\right)\right) \\ &+ \lambda\left[u^2\left(c_2, x_2, Y_2\right) - u^2\left(c_1, \bar{x}, Y_1\right)\right] + \gamma\left[\pi(Y_1 - c_1 - \bar{x}) + (1-\pi)(Y_2 - B_2) - R\right] \end{aligned}$$

The first-order conditions on B_1 and $\bar{x}$ are

$$\frac{\partial L}{\partial B_1} = \pi\frac{\partial \psi}{\partial u^1}\frac{\partial u^1}{\partial B_1} - \lambda\frac{\partial u^2}{\partial B_1} - \gamma\pi = 0 \qquad (6.1.1)$$

$$\frac{\partial L}{\partial \bar{x}} = \pi\frac{\partial \psi}{\partial u^1}\frac{\partial u^1}{\partial \bar{x}} - \lambda\frac{\partial u^2}{\partial \bar{x}} - \gamma\pi = 0 \qquad (6.1.2)$$

Combining (6.1.1) and (6.1.2), we obtain

$$\frac{\partial \psi}{\partial u^1}\left(\frac{\partial u^1}{\partial \bar{x}} - \frac{\partial u^1}{\partial B_1}\right) = \frac{\lambda}{\pi}\left(\frac{\partial u^2}{\partial \bar{x}} - \frac{\partial u^2}{\partial B_1}\right)$$

or

$$\begin{aligned} \frac{\partial \psi}{\partial u^1}\left(\frac{\partial u^1/\partial \bar{x}}{\partial u^1/\partial B_1} - 1\right) &= \frac{\lambda}{\pi}\left(\frac{\partial u^2/\partial \bar{x}}{\partial u^1/\partial B_1} - \frac{\partial u^2/\partial B_1}{\partial u^1/\partial B_1}\right) \\ &= \frac{\lambda}{\pi}\frac{\partial u^2/\partial B_1}{\partial u^1/\partial B_1}\left(\frac{\partial u^2/\partial \bar{x}}{\partial u^2/\partial B_1} - 1\right) \\ &= \frac{\lambda}{\pi}\frac{\partial u^2/\partial B_1}{\partial u^1/\partial B_1}\left(\frac{\partial u^2/\partial \bar{x}}{\partial u^1/\partial B_1} - \frac{\partial u^1/\partial \bar{x}}{\partial u^1/\partial B_1}\right) + \frac{\lambda}{\pi}\frac{\partial u^2/\partial B_1}{\partial u^1/\partial B_1}\left(\frac{\partial u^1/\partial \bar{x}}{\partial u^1/\partial B_1} - 1\right) \end{aligned}$$

$$\frac{\partial u^1/\partial \bar{x}}{\partial u^1/\partial B_1} = 1 + \frac{\frac{\lambda}{\pi}\frac{\partial u^2/\partial B_1}{\partial u^1/\partial B_1}\left(\frac{\partial u^2/\partial \bar{x}}{\partial u^2/\partial B_1} - \frac{\partial u^1/\partial \bar{x}}{\partial u^1/\partial B_1}\right)}{\frac{\partial \psi}{\partial u^1} - \frac{\lambda}{\pi}\frac{\partial u^2/\partial B_1}{\partial u^1/\partial B_1}}. \qquad (6.1.3)$$

Formula (6.1.3) corresponds to the optimal conditions on the commodity taxation.[10] We can interpret it for the in-kind transfer argument in the same way. The l.h.s. of (6.1.3) is the MRS of $\bar{x}$ for B_1 of person 1 and its value is determined as follows:

$$sign\left(\frac{\partial u^1/\partial\bar{x}}{\partial u^1/\partial B_1} - 1\right) = sign\left(\frac{\partial u^2/\partial\bar{x}}{\partial u^2/\partial B_1} - \frac{\partial u^1/\partial\bar{x}}{\partial u^1/\partial B_1}\right). \qquad (6.1.4)$$

Since we postulated that the price of $\bar{x}$ is 1, the optimal choice of each individual results in MRS = 1. We define that $\bar{x}$ is over-provided (under-provided) when the marginal utility of $\bar{x}$ is smaller (larger) than that of B_1; that is, MRS of $\bar{x}$ for B_1 is less (more) than one (Figure 7 exhibits this fact.). Formula (6.1.4) determines the optimal level of $\bar{x}$ according to the difference of MRS of person 1 and the mimicker. When r.h.s. of (6.1.4) is positive, or person 2's MRS of $\bar{x}$ for B_1 exceeds that of person 1; the l.h.s. is also positive, or MRS of person 1 should be more than 1,which implies that $\bar{x}$ should be over-provided, and vice versa. When person 2's MRS of $\bar{x}$ for B_1 exceeds that of person 1, it implies that the person 2's (mimicker's) demand of $\bar{x}$ is smaller than that of person 1 when they face the same budget constraint. As stated in section 5.2., the difference of the demand of the recipients and the mimicker stems from the difference of their labor supply. Hence, if $\dfrac{\partial x}{\partial L} > 0$, person 2's MRS of $\bar{x}$ for B_1 exceeds that of person 1, then the optimal condition (6.1.4) requires MRS of person 1 should be more than 1. In the same way, if $\dfrac{\partial x}{\partial L} < 0$, person 1's MRS of $\bar{x}$ for B_1 exceeds that of person 2, then the optimal condition (6.1.4) requires MRS of person 1 should be less than 1. Therefore, we have the following lemma.

Lemma 2:
When $\dfrac{\partial x}{\partial L} < 0 \left(\dfrac{\partial x}{\partial L} > 0\right)$, *optimal public provision of* x *results in over-provision (under-provision) of* x *for low-ability persons.*

We also know, from Lemma 2, that when the government implement the optimal in-kind transfer program of x, low-ability persons' consumption of x will be increased (when $\partial L/\partial x > 0$), or decreased (when $\partial L/\partial x < 0$) to the optimal level.

[10] In the commodity tax context, according to Stiglitz (1982; 1987), whether a particular commodity should be taxed or subsidized relative to another depends on whether the more able individual's MRS of former good for latter exceeds that of the low ability person, or conversely.

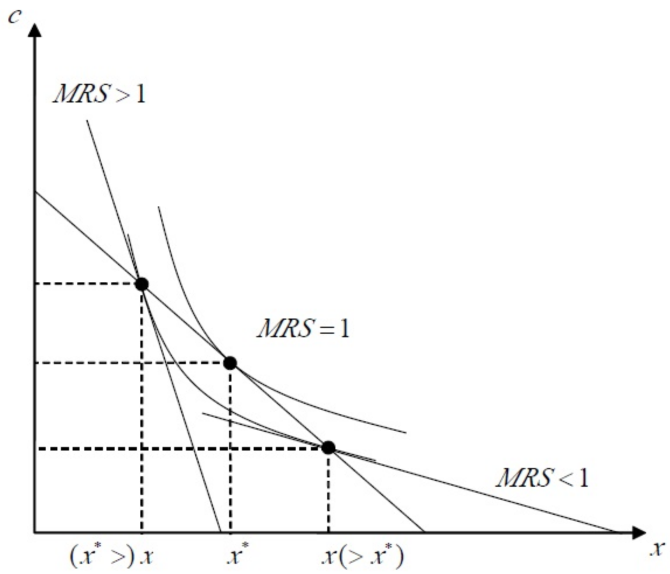

Figure 7: MRS of $\bar{x}$ for B_1

6.2 Effects on Labor Supply

In the previous section, we have presented the optimal conditions on the level of in-kind transfers according to the type of the publicly provided good. Now, we consider the effects of such optimal in-kind transfers on the labor supply of individuals. To analyze the effects on labor supply, we apply and extend Gahvari's (1994) formulation which only states the conditions when a small expenditure of in-kind transfers from cash grants increases the labor supply in a "linear" tax model. This section verifies that the optimal in-kind transfers in the non-linear tax schedule whether the publicly provided good is complement or substitute for leisure, increases the labor supply. In other words, it is shown that the optimal in-kind transfer program has positive incentive effects on low-ability persons.

We state Gahvari's (1994) model, and extend it to derive the propositions on the in-kind transfers' effects on labor supply. To focus on the effect of the change from in-cash transfer to in-kind transfer to the low-ability persons, we consider one consumer economy. The representative consumer has the following utility function which corresponds to (3.1.1):

$$U(c, x, L).$$

We assume the government finances its expenditures through a quasi-linear income tax

$$T = -G + t(wL)$$

which corresponds to (5.1.1). From the Proposition 1, the marginal tax rate $t'(wL)$ is non-negative. In addition to G, the government provides the consumer with in-kind transfers at the level x. So the government's budget constraint is given by

$$p\bar{x} + G = t(wL) \tag{6.2.1}$$

The consumer's problem is to maximize utility subject to

$$x = \bar{x}$$

and

$$c = wL - t(wL) + G = B.$$

The first-order condition is

$$-\frac{\partial U/\partial L}{\partial U/\partial B} = 1 - t'(wL)w. \tag{6.2.2}$$

Equations (6.2.1) and (6.2.2) determine the constrained demand functions

$$L = L(B, \bar{x}, w) \quad \text{and} \quad c = c(B, \bar{x}, w).$$

Substituting the values of the constrained demand functions for L and c in U yields the 'partial' indirect utility function

$$\bar{u} = V(B, \bar{x}, w) = U(c(B, \bar{x}, w), \bar{x}, L(B, \bar{x}, w)).$$

For later reference, also note that the compensated constrained demand for labor can be derived by considering the dual to the above constrained utility maximization problem. The following identity relates L to L^c.

$$L(B, \bar{x}, w) = L^c(\bar{x}, w, \bar{u}) = L^c(\bar{x}, w, V(B, \bar{x}, w)) \tag{6.2.3}$$

Next, consider the unconstrained cost minimization problem

$$\min c + px + t(wL)$$

subject to

$$U(c, x, L) = \bar{u}$$

whose solution yields the compensated unconstrained demand

$$\tilde{L}^c = \tilde{L}^c(\tilde{p}, w, \bar{u}), \quad \tilde{x}^c = \tilde{x}^c(\tilde{p}, w, \bar{u})$$

where $\tilde{p}$ is implicitly defined as

$$\bar{x} = \tilde{x}^c(\tilde{p}, w, \bar{u}). \tag{6.2.4}$$

Differentiate $L = L(B, \bar{x}, w))$ totally with respect to $\bar{x}$ to obtain

$$\frac{dL}{d\bar{x}} = \frac{\partial L}{\partial \bar{x}} + \frac{\partial L}{\partial B}\frac{\partial B}{\partial G}\frac{dG}{d\bar{x}} \tag{6.2.5}$$

where $\dfrac{\partial B}{\partial G} = 1$.

Next, differentiate the government's budget constraint with respect to $\bar{x}$ to obtain

$$p + \frac{dG}{d\bar{x}} = t'(wL)w\frac{L}{\bar{x}}\ . \tag{6.2.6}$$

Substituting from (6.2.6) to (6.2.5) for $\dfrac{dG}{d\bar{x}}$

$$\begin{aligned} \frac{dL}{d\bar{x}} &= \frac{dL}{d\bar{x}} + \frac{dL}{dB}\left(t'(wL)w\frac{dL}{d\bar{x}} - p\right) \\ &= \frac{\dfrac{\partial L}{\partial \bar{x}} - p\dfrac{\partial L}{\partial B}}{1 - t'(wL)w\dfrac{\partial L}{\partial B}} = p\frac{\dfrac{1}{p}\dfrac{\partial L}{\partial \bar{x}} - \dfrac{\partial L}{\partial B}}{1 - t'(wl)w\dfrac{\partial L}{\partial B}}\ . \end{aligned} \tag{6.2.7}$$

From(3.1.2), leisure is a normal good, $\dfrac{\partial L}{\partial B} < 0$,and $t'(wL)$ is non-negative, so the denominator of (6.2.7) is positive. Consequently,

$$sign\frac{dL}{d\bar{x}} = sign\left(\frac{1}{p}\frac{\partial L}{\partial \bar{x}} - \frac{\partial L}{\partial B}\right). \tag{6.2.8}$$

Thus, the effect of the change from in-cash transfers to in-kind transfers can be seen from (6.2.8). Since we assumed that leisure is a normal good (See the formula (3.1.2).), when leisure and x are gross substitutes $(\partial L/\partial x > 0)$[11], the r.h.s. of (6.2.8) and thus l.h.s. are also positive. Therefore, in this case, labor supply will increase. However, when leisure and x are gross complements $(\partial L/\partial x < 0)$, the sign is ambiguous. To establish the sign in this case, we rewrite (6.12). By differentiating (6.2.3) partially with respect to $\bar{x}$ and B to obtain

$$\frac{\partial L}{\partial \bar{x}} = \frac{\partial L^c}{\partial \bar{x}} + \frac{\partial L^c}{\partial V}\frac{\partial V}{\partial B} \tag{6.2.9}$$

$$\frac{\partial L}{\partial B} = \frac{\partial L^c}{\partial V}\frac{\partial V}{\partial \bar{x}}\ . \tag{6.2.10}$$

[11] Leisure and x can be said gross substitutes (complements) if $(\partial L/\partial x > 0)$ $((\partial L/\partial x < 0))$ since both are assumed to be normal goods.

Substituting from (6.2.10) to (6.2.9) for $\dfrac{\partial L^c}{\partial V}$

$$\begin{aligned}\frac{1}{p}\frac{\partial L}{\partial \bar{x}} - \frac{\partial L}{\partial B} &= \frac{1}{p}\frac{\partial L^c}{\partial \bar{x}} + \frac{\partial V/\partial \bar{x}}{\partial V/\partial B}\frac{\partial L}{\partial B} - \frac{\partial L}{\partial B} \\ &= \frac{1}{p}\frac{\partial L^c}{\partial \bar{x}} + \left(\frac{\partial V/\partial \bar{x}}{\partial V/\partial B} - 1\right)\frac{\partial L}{\partial B}\,. \end{aligned} \tag{6.2.11}$$

Therefore, The effect of in-kind transfers on the labor supply is also determined by the r.h.s. of (6.2.11). To identify the first term, note that

$$L^c(\bar{x}, w, \bar{u}) = \tilde{L}^c(\tilde{p}, w, \bar{u}).$$

Differentiate with respect to $\bar{x}$,

$$\frac{\partial L^c}{\partial \bar{x}} = \frac{\partial \tilde{L}^c}{\partial \tilde{p}}\frac{\partial \tilde{p}}{\partial \bar{x}}$$

from (6.2.4),

$$\frac{\partial L^c}{\partial \bar{x}} = \frac{\partial \tilde{L}^c}{\partial \tilde{p}}\frac{\partial \tilde{p}}{\partial \tilde{x}^c} = \frac{\partial \tilde{L}^c/\partial \tilde{p}}{\partial \tilde{x}^c/\partial \tilde{p}}$$

and from the Slutsky matrix,

$$\frac{\partial \tilde{x}}{\partial \bar{p}} < 0\ .$$

Therefore, if x and leisure are Hicks substitutes (complements):

$$\frac{\partial \tilde{L}^c}{\partial \tilde{p}} > 0 \quad \left(\frac{\partial \tilde{L}^c}{\partial \tilde{p}} < 0\right)$$

then

$$\frac{\partial \tilde{L}^c}{\partial \bar{x}} > 0 \quad \left(\frac{\partial \tilde{L}^c}{\partial \bar{x}} < 0\right). \tag{6.2.12}$$

The second term is including the MRS of $\bar{x}$ for B; thus, as is defined in the previous section, if $\bar{x}$ is over-provided (under-provided) when

$$\frac{\partial V/\partial \bar{x}}{\partial V/\partial B} - 1 < 0 \quad \left(\frac{\partial V/\partial \bar{x}}{\partial V/\partial B} - 1 > 0\right) \tag{6.2.13}$$

Now, we can interpret formula (6.2.11) by (6.2.12), (6.1.7) and (3.1.2). That is, if x and leisure are Hicks substitutes (complements) and $\bar{x}$ is over-provided (under-provided), then the r.h.s. of (6.2.11) is positive (negative); that is, the labor supply will increase (decrease). Since x and leisure are Hick substitutes if they are gross substitutes, it is consistent with the interpretation of (6.2.8).

Besides, from the Lemma 2, if x and leisure are gross substitutes (complements); that is, if

$$\frac{\partial x}{\partial L} < 0 \quad \left(\frac{\partial x}{\partial L} > 0 \right),$$

the optimal in-kind transfers leads to over-provision (under-provision) of the publicly provided good. The optimal in-kind transfer requires, if x and leisure are gross substitutes (complements), x should be increased (decreased) from the individual choice to the over-provision (under-provision) level.

Lastly, we consider the case of $\dfrac{\partial x}{\partial L} = 0$. In this case, we can think of two circumstances. One is that the demand of x is irrelevant to leisure (individual's utility is separable of x from leisure); the other is that substitution effect and income effect are offset. In both cases, (6.1.4) requires the optimal level of in-kind transfers coincides with person 1's optimal choice; hence, the second term of r.h.s. of (6.2.11) equals to zero. Therefore, only the sign of the first term of r.h.s. of (6.2.11), which is the substitution effect, should be investigated. In the former case, the first term is also zero because of the separability. Thus, the effect of optimal in-kind transfers on the labor supply is zero. Rather, in this case, there is no need of in-kind transfers. As noted in section 5.2., self-targeting mechanism does not work, and now we know that in-kind transfer does not increase labor supply either. In the latter case, since leisure is a normal good, the income effect on labor supply is always negative. Therefore, the substitution effect has to be positive. Hence, in this case, in-kind transfers increase the labor supply. Now, we have the following proposition.

Proposition 3:
Given that Lemma 1 is satisfied,the implementation of the optimal in-kind transfers of x results in higher labor supply of low-ability persons, compared with the optimal non-linear income tax without in-kind transfers.

The bottom line is that the in-kind transfer program has positive incentive effects on both types of persons. By self-targeting mechanism, high-ability persons have no incentive to reduce labor supply to mimic low-ability persons. Low-ability persons, on the other hand, would have incentive to decrease labor supply since they receive subsidies. This proposition verifies that implementation of optimal in-kind transfers in addition to the non-linear income tax would inhibit this disincentive effects on low-ability persons.

6.3 In-Kind Transfers in Merit Good Arguments

It has been shown that the optimal in-kind transfers have positive incentive effects on low-ability persons rather than in-cash transfers only. However, we know from formula (6.1.2) that if the demand of the publicly provided good is decided irrelevant to the labor supply, the optimal condition leads to no need of in-kind transfers. In this section, we add another aspect of benefit of in-kind transfers which is one of the traditional arguments in favor of in-kind transfer program: paternalism. If the government puts higher values on consumption of a specific good than individual's decision, it can correct individual's preference by taxing or subsidizing and maximize social welfare. Following Besley's (1988) model, we examine the optimal condition of transferring merit goods in the cash-cum-in-kind transfer program.

As usual, individual's maximization problem is

$$\max_{\{c,x,Y\}} u^1(c,x,Y)$$

subject to budget constraint

$$c + x = B_1.$$

Then the optimal condition is

$$-\frac{\partial u^1/\partial x}{\partial u^1/\partial B_1} = 1. \tag{6.3.1}$$

While the government's maximization problem is

$$\max_{\{B_1,Y_1,B_2,Y_2,\bar{x}\}} \pi\psi\left(u^1\left(c_1,\theta^1\bar{x},Y_1\right)\right) + (1-\pi)\psi\left(u^2\left(c_2,\theta^2 x_2,Y_2\right)\right)$$

subject to budget constraint

$$\pi(Y_1 - c_1 - \bar{x}) + (1-\pi)(Y_2 - B_2) \geq R$$

where θ is the social weight on each individual's consumption of x.
The optimal condition is

$$-\frac{\partial u^1/\partial \bar{x}}{\partial u^1/\partial c_1} = \frac{1}{\theta^1} \tag{6.3.2}$$

If the government imposes a tax on x to maximize social welfare, the tax rate can be derived by equating (6.3.1) and (6.3.2),

$$1 + t_1 = \frac{1}{\theta^1}$$

or

$$t_1 = \frac{1-\theta^1}{\theta^1}\ .$$

This is consistent with the Besley's (1988) formula. Next, adding the following incentive constraint to derive second-best solution:

$$u^2(c_2,x,Y_2) \geq u^2(c_1,\bar{x},Y_1).$$

The first-order conditions on c_1 and $\bar{x}$ are

$$\begin{aligned}\frac{\partial L}{\partial B_1} &= \pi\frac{\partial\psi}{\partial u^1}\frac{\partial u^1}{\partial B_1} - \lambda\frac{\partial u^2}{\partial B_1} - \gamma\pi = 0\\ \frac{\partial L}{\partial \bar{x}} &= \pi\frac{\partial\psi}{\partial u^1}\frac{\partial u^1}{\partial \bar{x}}\theta^1 - \lambda\frac{\partial u^2}{\partial \bar{x}}\gamma\pi = 0\end{aligned}$$

Simplifying in the same way as the section 6.1.,

$$\frac{\partial\psi}{\partial u^1}\left(\frac{\partial u^1}{\partial \bar{x}}\theta^1 - \frac{\partial u^1}{\partial B_1}\right) = \frac{\lambda}{\pi}\left(\frac{\partial u^2}{\partial \bar{x}} - \frac{\partial u^2}{\partial B_1}\right)$$

or

$$\begin{aligned}\frac{\partial\psi}{\partial u^1}\left(\frac{(\partial u^1/\partial\bar{x})\theta^1}{\partial u^1/\partial B_1} - 1\right) &= \frac{\lambda}{\pi}\left(\frac{\partial u^2/\partial\bar{x}}{\partial u^1/\partial B_1} - \frac{\partial u^2/\partial B_1}{\partial u^1/\partial B_1}\right)\\ &= \frac{\lambda}{\pi}\frac{\partial u^2/\partial B_1}{\partial u^1/\partial B_1}\left(\frac{\partial u^2/\partial\bar{x}}{\partial u^2/\partial B_1} - 1\right)\\ &= \frac{\lambda}{\pi}\frac{\partial u^2/\partial B_1}{\partial u^1/\partial B_1}\left(\frac{\partial u^2/\partial\bar{x}}{\partial u^1/\partial B_1} - \frac{(\partial u^1/\partial\bar{x})\theta^1}{\partial u^1/\partial B_1}\right) + \frac{\lambda}{\pi}\frac{\partial u^2/\partial B_1}{\partial u^1/\partial B_1}\left(\frac{(\partial u^1/\partial\bar{x})\theta^1}{\partial u^1/\partial B_1} - 1\right)\end{aligned}$$

$$\frac{(\partial u^1/\partial\bar{x})\theta^1}{\partial u^1/\partial B_1} - 1 = \frac{\frac{\lambda}{\pi}\frac{\partial u^2/\partial B_1}{\partial u^1/\partial B_1}\left(\frac{\partial u^2/\partial\bar{x}}{\partial u^2/\partial B_1} - \frac{\left(\partial u^1/\partial\bar{x}\right)\theta^1}{\partial u^1/\partial B_1}\right)}{\frac{\partial\psi}{\partial u^1} - \frac{\lambda}{\pi}\frac{\partial u^2/\partial B_1}{\partial u^1/\partial B_1}} \tag{6.3.3}$$

Same as the discussion in the section 6.1., the level of the publicly provided good is determined by the sign of r.h.s. of (6.3.3), or the difference of each individual's MRS. Thus,

$$sign\left(\frac{\left(\partial u^1/\partial\bar{x}\right)\theta^1}{\partial u^1/\partial B_1} - 1\right) = sign\left(\frac{\partial u^2/\partial\bar{x}}{\partial u^2/\partial B_1} - \frac{(\partial u^1/\partial\bar{x})\theta^1}{\partial u^1/\partial B_1}\right) \tag{6.3.4}$$

When social weight θ is neglected, in the case that (6.3.4) is identical to (6.1.4), the same MRS of each individual means no need of in-kind transfers as noted in the previous section. But when θ is considered, even if MRS is the same, the positive (or negative) value of the social weight θ^1, which implies that the publicly provided good is a merit (demerit) good for low-ability persons, can lead to a need of in-kind transfers and over-provision (under-provision) of the good. Thus, following lemma can be verified.

Lemma 3:
Even if the MRS of low-ability person and the mimicker is the same, if the publicly provided good is a merit (demerit) good, it leads to over-provision (under-provision) of in-kind transfers.

Besides, from Lemma 3 and formula (6.2.11), we have the following proposition.

Proposition 4:
When one considers providing low-ability persons with a merit good whose demand is irrelevant to the labor supply, then the optimal provision of the merit good results in higher labor supply of low-ability persons.

Finally, we should note the case when the demand of the merit good is affected by the labor supply. If the merit good is gross substitutes to leisure; that is, when

$$\frac{\partial x}{\partial L} > 0,$$

then it implies the Hicks substitutes and the degree of over-provision will be higher. Thus, it results in higher labor supply. While if the merit good is complements to leisure; that is when

$$\frac{\partial x}{\partial L} < 0,$$

then it implies the Hicks complements and the degree of over-provision will be lower. Thus, the sign of the labor supply response is ambiguous. The case of demerit good is interpreted in the same way.

To sum up, the conditions on the in-kind transfer program to have positive incentive effects verified by Gahvari (1994) was very restrictive as noted at the beginning of this chapter. We now know from the conditions on the optimal in-kind transfers of x (Lemma 1 and 2), such optimal transfers always have positive incentive effects (proposition 3). Furthermore, even if self-targeting mechanism of in-kind transfers cannot be established, the optimal provision of merit good also results in higher labor supply of low-ability persons (proposition 4).

7 Conclusion

This paper has analyzed redistributive policies mainly concerning its incentive effects. Redistributive policy in theory has been concentrated on income tax in favor of the idea of NIT. But focusing on the instrument of redistributive policy is in-cash or in-kind, this paper investigated the optimal policy mix by solving optimization problem. We will review the results derived in this paper.

Firstly, we examined the benefits of categorization. It was verified that categorization by tagging can optimally increase the subsidies to low-ability persons even when the optimal non-linear income tax is implemented. We advocated the self-targeting mechanism for the drawbacks of tagging: classification errors, violation of horizontal equality, stigmatization. Then we derived the condition on the publicly provided good to establish the self-targeting mechanism.

Secondly, we investigated the self-targeting mechanism by in-kind transfers. The main result is that it has positive incentive effects on low-ability persons. Self-targeting mechanism slackens the incentive constraint, which implies that it has positive incentive effects on high-ability persons. It was verified that the self-targeting mechanism by in-kind transfers also has positive incentive effects on low-ability persons. Besides, we proved that even when the conditions on the optimal in-kind transfers is not satisfied, the provision of a merit good also increase the labor supply of low-ability persons.

We started the discussion by amending the original NIT, hence the relation between our discussion and the NIT should be stated. Compared with the NIT, the schemes we established can achieve more efficient redistribution. However, Milton Friedman, the proponent of the NIT, would oppose this suggestion by asserting the government is not such benevolent social planner. Friedman seems to be solving the minimization problem of such costs relating to government's activity. However, the government seems to be not an evil, nor benevolent, but something in-between. Then the discussion of this paper will contribute the actual policy. This paper suggests that such benevolent (and informative, in sense of income observable) government has an ability to accomplish more efficient redistribution. Thus, the degree of the realization of our results depends on how far the individuals in a society believe the government in a similar way to the social objectives for equality or poverty.

As concluding remarks, we note the possibilities of further studies. As noted in chapter 2, there are other types of in-kind transfers or commodity taxes that can be welfare enhancing. We just examined the efficacy of self-targeted in-kind transfers; hence, one can investigate other instruments or the mixed scheme of them. Then the more general solution to the optimal redistributive policy would be obtained. Moreover, Redistribution involves in many ethical arguments. The new redistributive theory would be not only an extension of the tax theory, but also originated one from the discussion of the normative studies, such as fairness.

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