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Income Assistance and Aggregate Disposable Income*

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This paper provides a simple theoretical model to analyze how income assistance affects the aggregate disposable income of recipients when a government cannot observe the recipients' earning capabilities. If the recipients' earning capabilities are uniformly distributed, means-tested linear income assistance benefits do not affect their aggregate disposable income, regardless of the size or reduction rates of the distributed benefits. Under a realistic distribution of earning capabilities, their aggregate disposable income can even decrease.

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I. Introduction

Income-led growth was at the core of the previous South Korean administration's economic policy. The crux of the theory is that increasing the income of the low-income group through various income assistance programs (e.g., minimum wage, subsidy, or tax cuts) would stimulate consumption and the economy, leading to economic growth (Kim, 2019; Ahn, 2019). However, textbook models of the choice between leisure and labor supply demonstrate that income assistance can reduce work incentives and labor income such that individual disposable income (i.e., wage plus benefits) can either increase or decrease (e.g., Moffitt, 2002). However, most policy makers seem to assume that the *aggregate* disposable income of the benefit recipients will increase. In 2016, for example, the US federal government spent $159

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billion in cash aid to people with low income (Falk et al., 2018).[1]

This paper provides a simple theoretical model to analyze whether means-tested income assistance benefits can increase the *aggregate* (or average) disposable income of the benefit recipients when the government cannot observe individual earning capabilities. A large number of empirical literature examine income assistance programs' impact on labor supply (e.g., Moffitt, 2002). However, few theoretical studies have analyzed the impact on the *aggregate* (or average) disposable income of all the benefit recipients.

I first distinguish between earning capability and labor income. Earning capability is the level of wage an individual would earn with no income assistance and is unobservable to the government. Labor income is the level of wage an individual actually earns, considering possible income assistance benefits and is observable to the government.

When income assistance decreases linearly with respect to labor income (i.e., constant benefit reduction rate) and is provided only to those with labor income below an eligibility standard, I show the following: on the one hand, those workers with earning capabilities below the eligibility standard may reduce their labor income after income assistance (called moral hazard problem), but that both the level and the reduction of labor income are relatively small. Thus, their post-transfer disposable incomes increase. On the other hand, those workers with earning capabilities somewhat above the eligibility standard would reduce their labor supply and labor income to be eligible for the income assistance benefits (called adverse selection problem), and both the level and the reduction of wage income are relatively large. Thus, their post-transfer disposable incomes can decrease.

Surprisingly, if the earning capabilities are uniformly distributed, these two effects cancel each other out. That is, the aggregate (or average) disposable income of the benefit recipients does not change despite the income assistance. Intuitively, an individual's (optimal) disposable income is determined by his/her marginal utility of earning disposable income. Then, the aggregate disposable income of the benefit recipients is determined by the integral of marginal utility or the level of utility of the benefit recipient with the highest earning capability. Given that the benefit recipient with the highest earning capability must be the one who is only indifferent between receiving the benefit and not receiving it, the level of utility of that person or the aggregate disposable income of the benefit recipients must be the same with or without the benefits.

Moreover, in a more realistic case where the distribution of earning capabilities is single-peaked (e.g., log-normal distribution) and benefit recipients are distributed

[1] Cash aid programs include Supplemental Security Income (SSI), Earned Income Tax Credit (EITC), Additional Child Tax Credit, Temporary Assistance for Needy Families (TANF), and Pensions for Needy Veterans.

on the left side of the peak, the weights on the adverse selection problem enlarge, and the aggregate disposable income of the benefit recipients decreases.

Most previous theoretical studies have focused on the utility of the benefit recipients, not their disposable income. For example, the literature on optimal taxation attempts to maximize the social welfare, which is often a function of individual utilities (e.g., Mirrlees, 1971; Saez, 2002; Piketty and Saez, 2013). When the government cannot observe individual earning capabilities through a simple revealed preference argument, the utility of every benefit recipient must increase.

In practice, disposable income is the primary measure of economic wellbeing. For example, the poverty line is often measured as 50% of the median household disposable income after social transfers (OECD, 2014). Additionally, if income assistance does not increase aggregate (or average) disposable income, it would not increase aggregate consumption and would not lead to economic growth as hypothesized by income-led growth theory. Therefore, this paper focuses on the aggregate disposable income of the benefit recipients, not the social welfare *per se* because aggregate disposable income is an empirically measurable practical policy goal. Moreover, the underlying social welfare function to support income assistance program with taxes is difficult to define and impossible to measure.

The remainder of the paper is organized as follows: Section 2 describes the basic model. Section 3 provides a benchmark case where earning capabilities are observable. Section 4 analyzes how workers choose the level of benefits and their labor income when earning capabilities are unobservable to the government. Then, section 5 analyzes the effects of income assistance benefits on the individual and aggregate disposable incomes. Section 6 concludes.

II. Basic Model

I consider an economy of risk neutral workers (or households). Their utility function is given as follows:

$$u(w) = w + b - \frac{1}{k}c(w), \tag{1}$$

where w is labor income; b is income assistance benefit; and $\frac{1}{k}c(w)$ is the cost of earning labor income w, where $c(0)=0$, $c'>0$, $c''>0$, $c'(0)=0$, and $c'(\infty)=\infty$. Alternatively, one can interpret w as labor supply (or working hour) with a linear production function. The cost function both captures the cost (or disutility) of workers' efforts to earn labor income and the opportunity cost of leisure.

Note that the (marginal) cost/disutility of earning labor income w decreases in

k. Therefore, I interpret k as *earning capability*. For now, I assume that k is uniformly distributed in the economy over the interval [0, 1]. Later, I will consider other distributions.

Assuming that labor income is the only source of income, $w+b$ can be defined as disposable income, denoted by y. As shown below, both the optimal labor income and the benefit become functions of k. Thus, the aggregate disposable income denoted by Y, can be defined as follows:

$$Y = \int_0^1 (w(k) + b(k))dk .$$

If no welfare benefits exist (i.e., $b(k) \equiv 0$), then, from utility maximization, the optimal labor income (or labor supply) is directly shown as

$$w_N^*(k) = c'^{-1}(k) \equiv g(k) , \tag{2}$$

where $g \equiv c'^{-1}$. That is, without welfare benefits, a worker with earning capability k will work enough to earn labor income equal to $g(k)$, where $g(0) = 0$ and $g' > 0$. Then, without the welfare benefits, the aggregate disposable income is

$$Y_N^* = \int_0^1 g(k)dk . \tag{3}$$

For simplicity, I assume that the main goal of providing income assistance is to guarantee a minimum disposable income level (denoted by $\underline{y}$) for everyone. For example, $\underline{y}$ can represent the extreme poverty line. I also assume that the government provides income assistance to those below the minimum income level only, that is, the benefits are means-tested.[2]

Let us define $\underline{k}$ such that

$$g(\underline{k}) = \underline{y} . \tag{4}$$

Then, from (2), individuals with earning capability less than $\underline{k}$ must be supported by an income assistance program.

As I will show below, when earning capability k is unobservable, some workers with k greater than $\underline{k}$ will reduce their labor income below $\underline{y}$ to receive the income assistance benefits. Throughout the paper, I assume that $\underline{y}$ is small enough so that workers with high enough k will choose not to receive the benefits.

[2] The main results of this paper do not change even if the eligibility standard income is different from the minimum guaranteed disposable income $\underline{y}$.

III. Symmetric Information

As a benchmark, a symmetric information case in which the government can observe each worker's earning capability k is considered. It follows from (2) that workers with earning capability k can earn the labor income $w_N^*(k) = g(k)$ without assistance. One can then consider the following income assistance program:

$$b(k) = \begin{cases} \underline{y} - g(k) & \text{if } k \le \underline{k} \\ 0 & \text{if } k > \underline{k} \end{cases}. \tag{5}$$

$b(k)$ minimizes welfare expenditures while guaranteeing all workers the minimum disposable income $\underline{y}$. Note that because the benefit depends on earning capability k only, $b(k)$ does not change workers' incentives to work or earn wages. Thus, the aggregate labor income W_B^* and the aggregate disposable income Y_B^* with the benefit $b(k)$ is

$$W_B^* = \int_0^1 w_N^*(k)dk = \int_0^1 g(k)dk\,, \tag{6}$$

$$Y_B^* = \int_0^1 (w_N^*(k) + b(k))dk = \int_0^{\underline{k}} (g(k) + \underline{y} - g(k))dk + \int_{\underline{k}}^1 g(k)dk\,. \tag{7}$$

By the definition of $\underline{k}$,

$$Y_B^* - Y_N^* = \int_0^{\underline{k}} (\underline{y} - g(k))dk = c(\underline{y}) > 0\,.^3 \tag{8}$$

That is, the income assistance program $b(k)$ does not change aggregate labor income or labor supply and increases the aggregate disposable income of the benefit recipients by $c(\underline{y})$.

In addition, the aggregate benefit size or the required amount of tax to support the benefit program is

$$B^* = \int_0^1 b(k)dk = \int_0^{\underline{k}} (\underline{y} - g(k))dk = c(\underline{y}) = Y_B^* - Y_N^*\,. \tag{9}$$

To summarize,

Proposition 1 *When workers' earning capabilities* (k) *are observable,* $b(k)$ *does not change aggregate labor income and increases the aggregate disposable income of benefit*

[3] The last equality is from the formula $\int f^{-1}(y)dy = yf^{-1}(y) - F \circ f^{-1}(y) + C$ and $g = c'^{-1}$.

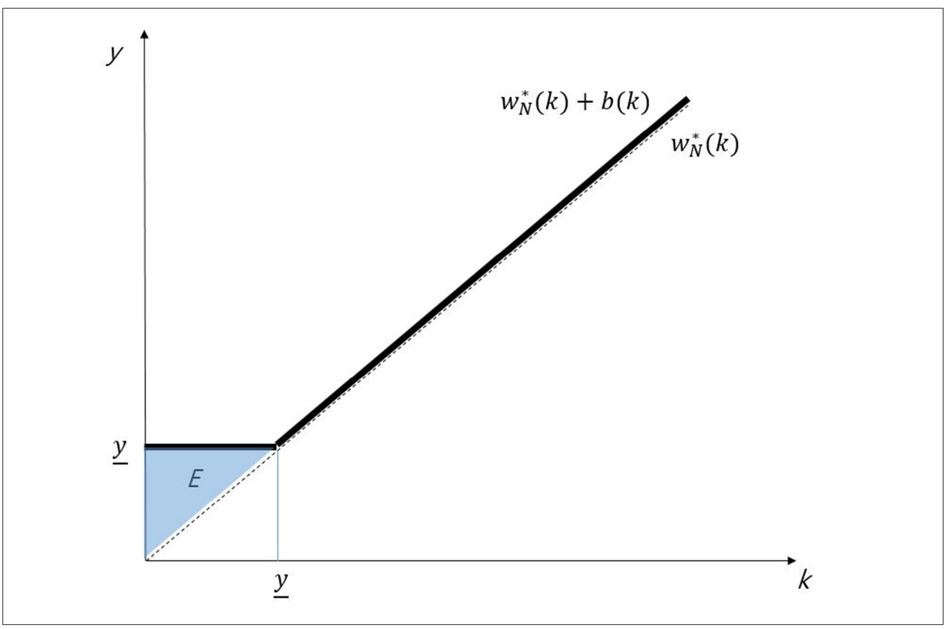
recipients by $c(\underline{y})>0$. *Additionally, the aggregate benefit size is* $c(\underline{y})$.

Proof. From the discussion above. ■

Note that the aggregate benefit size is exactly the same as the increase in disposable income because when k is observable, the benefit $b(k)$ does not distort workers' labor incentives. If k is unobservable, as I will demonstrate below, some workers would intentionally reduce their labor supply to receive the benefit. Thus, the aggregate benefit size will be larger than the increase in disposable income. In fact, the following sections will show that the aggregate disposable income may not increase at all despite income assistance benefits.

Example 1 *(Symmetric Information) Suppose that* $c(w)=\frac{1}{2}w^2$. *Then, from (2),* $w_N^*(k)=k$. *In Figure 1, the dotted line represents* $w_N^*(k)$, *and the thick solid line represents disposable income* $y_B^*(k)=w_N^*(k)+b(k)$. *From Figure 1, both the increase in the aggregate disposable income and the aggregate benefit expenditure can be represented by the size of area* $E=c(\underline{y})=\frac{1}{2}\underline{y}^2$.

[Figure 1] Symmetric Information: Example 1



IV. Asymmetric Information and Labor Income

Now suppose that the government cannot observe workers' earning capability k.

Then, the income assistance program $b(k)$ in (5) is no longer feasible.

4.1. Linear Benefits

Although the government cannot observe earning capability k, it can still observe a worker's labor income w. Thus, I consider the (means-tested) linear income assistance benefit, $\tilde{b}(w)$, given by

$$\tilde{b}(w) = \begin{cases} \underline{y} - rw & \text{if } w \leq \underline{y} \\ 0 & \text{if } w > \underline{y} \end{cases}. \tag{10}$$

where $0 \leq r \leq 1$.[4]

Note that as labor income increases, the benefit decreases by r. Thus, r represents the benefit reduction or phase-out rate. If $r = 0$, the benefit is fixed and does not decrease in labor income (e.g., the basic pension for the elderly in Korea). If $r = 1$, the benefit decreases as much as the labor income increases (e.g., the national basic livelihood security payment in Korea).

4.2. Benefit Choice and Labor Income

With the linear income assistance benefit $\tilde{b}(w)$, given that the government cannot observe k, a worker can choose to receive the benefits by reducing labor income below $\underline{y}$. Thus, let us denote the utility function with the benefits by $u_B(w;k)$ and that without the benefits by $u_N(w;k)$.

Then, a worker's optimization problem is to maximize each utility function as

$$\max_w u_B(w;k) = w + \underline{y} - rw - \frac{1}{k}c(w) \text{ if } w \leq \underline{y}, \tag{11}$$

$$\max_w u_N(w;k) = w - \frac{1}{k}c(w) \text{ if } w > \underline{y}, \tag{12}$$

and to choose the benefit if it provides a higher level of utility. Note that a a worker would choose the benefits if both *the eligibility condition* $(w \leq \underline{y})$ and *the preference condition* $(u_B^* \geq u_N^*)$ are satisfied.

For easier exposition, I will first present a simple case with a quadratic cost function

[4] More general benefit functions are not easily tractable and remain as topics for future research.

$$c(w) = \frac{1}{2}w^2 \,, \tag{13}$$

which yields closed form solutions. Then, I will provide the proofs with a more general convex function $c(w)$ in the propositions.

With the benefits, from (11), the optimal labor income is

$$\tilde{w}_B^*(k) = g((1-r)k) = (1-r)k \,, \tag{14}$$

if the eligibility condition $\tilde{w}_B^*(k) \le \underline{y}$ is satisfied.

Compared with the symmetric information case, if the size of the benefit strictly decreases in labor income (i.e., $r > 0$), $\tilde{w}_B^*(k) < \tilde{w}_N^*(k)$. That is, workers with benefits would work less which is called, a *moral hazard problem*.

Define $\underline{k}_B$ such that

$$\tilde{w}_B^*(\underline{k}_B) = \underline{y} \,. \tag{15}$$

Considering that $\underline{k} = \underline{y}$ when $c(w) = \frac{1}{2}w^2$, it follows that $\underline{k}_B = \frac{\underline{k}}{1-r}$. Thus, $\tilde{w}_B^*(k)$ would meet *the eligibility condition* if

$$k \le \underline{k}_B = \frac{\underline{k}}{1-r} \,. \tag{16}$$

In addition, when the eligibility condition for $\tilde{w}_B^*(k)$ is satisfied, the optimal level of utility with the benefits is

$$\tilde{u}_B^*(k) = \tilde{w}_B^*(k) + \underline{y} - r\tilde{w}_B^*(k) - \frac{1}{2k}(\tilde{w}_B^*(k))^2 = \underline{y} + (1-r)^2 \frac{k}{2} \,. \tag{17}$$

Without the benefits, from (12), the optimal labor income is

$$\tilde{w}_N^*(k) = k \,, \tag{18}$$

if $\tilde{w}_N^* > \underline{y}$ (i.e., $k > \underline{k}$). Without the benefits, the optimal level of utility is

$$\tilde{u}_N^*(k) = \tilde{w}_N^*(k) - \frac{1}{2k}(\tilde{w}_N^*(k))^2 = \frac{k}{2} \,. \tag{19}$$

For the choice of benefits, define $\tilde{k}^*$ such that $\tilde{u}_N^*(\tilde{k}^*) = \tilde{u}_B^*(\tilde{k}^*)$. From (17) and

(19), for a quadratic cost function, $\tilde{k}^* = \frac{2\underline{k}}{(2-r)r}$. Thus, assuming that the eligibility condition (16) is satisfied, *the preference condition* that workers would prefer to receive the benefits is

$$\tilde{u}_B^*(k) \geq \tilde{u}_N^*(k) \Leftrightarrow k \leq \tilde{k}^* = \frac{2\underline{k}}{(2-r)r}. \tag{20}$$

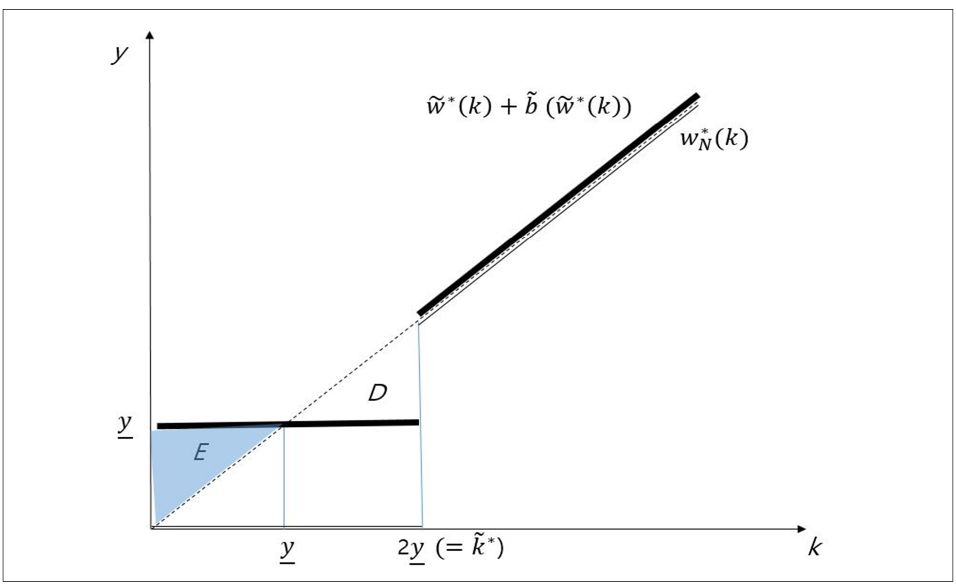
Note that $\tilde{k}^* > \underline{k}$. That is, when the government can observe k, those workers with $\underline{k} < k \leq \tilde{k}^*$ are not eligible for the benefits $b(k)$ in (5). However, when the government cannot observe k, these workers may receive the benefits if the eligibility condition for $\tilde{w}_B^*(\underline{k}_B)$ is met (or $k \leq \underline{k}_B$) which is called, an *adverse selection problem*.

To check whether the eligibility condition for $\tilde{w}_B^*(\underline{k}_B)$ is met for those who prefer the benefits, two cases need consideration.

Case 1 When $\tilde{k}^* \leq \underline{k}_B$ (**or** $2-\sqrt{2} \leq r \leq 1$), **(i)** those workers with $k \leq \tilde{k}^*$ satisfy both the preference condition (20) and the eligibility condition (16). Therefore, they would earn labor income $\tilde{w}_B^*(k) = (1-r)k$ and receive the benefits $\tilde{b} = \underline{y} - r(1-r)k$.

(ii) Those workers with $k > \tilde{k}^*$ prefer not to receive the benefit (i.e., $\tilde{b} = 0$) and will earn $\tilde{w}_N^*(k) = k$, given that $\tilde{k}^* > \underline{k} = \underline{y}$, $\tilde{w}_N^*(k)$ does not satisfy the eligibility condition anyway. Note that for these workers, the eligibility condition for $\tilde{w}_B^*(k)$ does not matter, because they will earn $\tilde{w}_N^*(k)$, not $\tilde{w}_B^*(k)$.

[Figure 2] Asymmetric Information: Example 2



Example 2 *(Decreasing Benefits) Suppose that* $c(w)=\frac{1}{2}w^2$ *and* $r=1$. *That is, the benefits decrease as much as the labor income increases. If a worker receives the benefit, from (11), his utility function is* $u_B(w;k)=w+\underline{y}-w-\frac{1}{2k}w^2=\underline{y}-\frac{1}{2k}w^2$. *Therefore, the optimal wage for the benefit recipient is* $\tilde{w}_B^*(k)=0$ *(which is eligible for benefits), and the utility level is* $\tilde{u}_B^*=\underline{y}$. *If the worker does not receive benefits, from (18) the optimal wage is* $\tilde{w}_N^*(k)=k$ *and from (19) the utility level is* $\tilde{u}_N^*=\frac{1}{2}k$. *Therefore, a worker chooses to receive the benefit if* $\tilde{u}_B^*(k)\geq\tilde{u}_N^*(k)$ *or* $k\leq\tilde{k}^*=2\underline{y}$. *In Figure 2, the thick solid line represents disposable income (= wage + benefit), and the thin solid line represents labor income only. The dashed line represents labor income when there exists no income assistance program.*

Case 2 When $\tilde{k}^*>\underline{k}_B$ **(or** $0\leq r<2-\sqrt{2}$), **(i)** those workers with $k\leq\underline{k}_B$ would satisfy both the eligibility condition (16) and the preference condition (20). Therefore, they would earn labor income $\tilde{w}_B^*(k)=(1-r)k$ and receive the benefits $\tilde{b}=\underline{y}-r(1-r)k$.

(ii) Those workers with $k>\tilde{k}^*$, the results are the same as case 1(ii). That is, these workers will earn $\tilde{w}_N^*(k)=k$ and not receive the benefits (i.e., $\tilde{b}=0$).

(iii) Case 2 also has those workers with $\underline{k}_B<k\leq\tilde{k}^*$. For these workers, the preference condition is satisfied, but the eligibility condition is not. That is, these workers would like to receive the benefits and earn $\tilde{w}_B^*(k)$. However, $\tilde{w}_B^*(k)$ does not satisfy the eligibility condition. Therefore, these workers must choose whether to reduce labor income to $\underline{y}(=\underline{k})$ and receive the benefits $\tilde{b}(\underline{y})=\underline{y}-r\underline{y}$ or to earn $\tilde{w}_N^*(k)$ and not receive the benefits.

When they reduce labor income to $\underline{y}$, their level of utility becomes

$$\tilde{u}_B(\underline{y};k)=\underline{y}+\underline{y}-r\underline{y}-\frac{1}{2k}\underline{y}^2=(2-r)\underline{k}-\frac{1}{2k}\underline{k}^2. \tag{21}$$

Therefore, the *preference condition* for these workers to choose the benefits is

$$\tilde{u}_B(\underline{y};k)\geq\tilde{u}_N^*(k)\Leftrightarrow k\leq\overline{k}^B=\underline{k}\left(2-r+\sqrt{(1-r)(3-r)}\right). \tag{22}$$

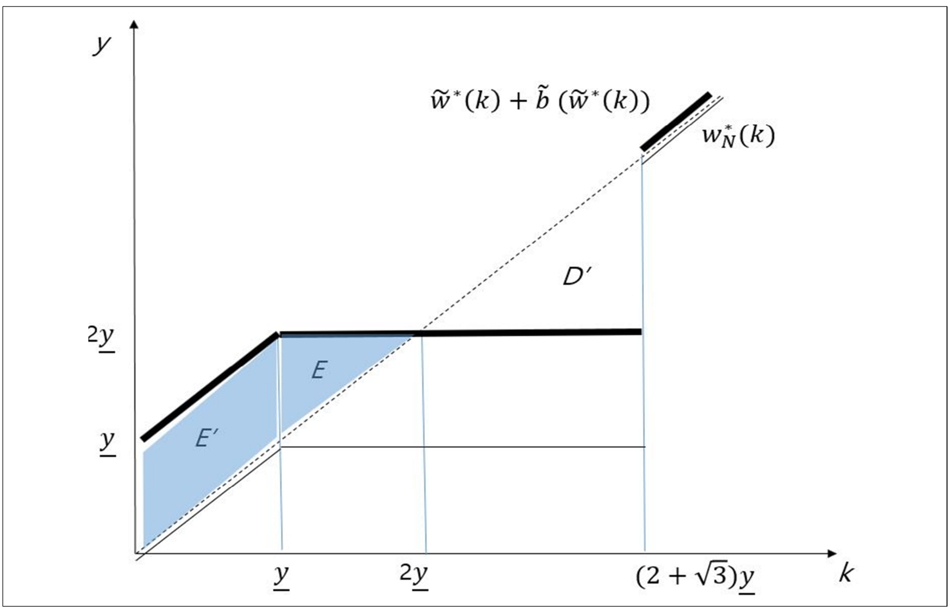
Additionally, $\underline{k}_B<\overline{k}^B\leq\tilde{k}^*$. Then,

(iii-a) If $\underline{k}_B<k\leq\overline{k}^B$, the workers would reduce their labor income to $\underline{y}$ and receive the benefit $\tilde{b}(\underline{y})=\underline{y}-r\underline{y}$.

(iii-b) If $\overline{k}^B<k\leq\tilde{k}^*$, the workers would earn $\tilde{w}_N^*(k)=k$ and not receive the benefit ($\tilde{b}=0$).

Example 3 *(Fixed Benefits) Suppose that* $c(w)=\frac{1}{2}w^2$ *and* $r=0$. *That is, benefits do not decrease in labor income as long as the wage is less than* $\underline{y}$. *If a worker receives the benefit, his utility function is* $u^B(w;k)=w+\underline{y}-\frac{1}{2k}w^2$. *Therefore, the optimal wage for the benefit recipient is* $\tilde{w}_B^*(k)=k$. *In addition, if* $k\le\underline{y}$, $\tilde{w}_B^*(k)$ *is eligible for the benefits. If* $k>\underline{k}^B=\underline{y}$, *to receive the benefits, workers would earn only* $\underline{y}$, *and their utility level is* $\tilde{u}_B(\underline{y};k)=\underline{y}+\underline{y}-\frac{1}{2k}\underline{y}^2$. *From (19), without the benefit, the utility level is* $\tilde{u}_N^*=\frac{1}{2}k$. *Therefore, a worker would reduce their wage to* $\underline{y}$ *to receive the benefit if* $\tilde{u}_B(\underline{y};k)\ge\tilde{u}_N^*(k)$ *or* $k\le\bar{k}^B=(2+\sqrt{3})\underline{y}$. *In Figure 3, the thick solid line represents disposable income (= wage + benefit), and the thin solid line represents labor income only. The dashed line represents labor income when income assistance program is lacking.*

[Figure 3] Asymmetric Information: Example 3



The following proposition summarizes and shows that these results hold for a general convex cost function $c(w)$.

Proposition 2 *For a convex cost function* $c(w)$ *and a linear benefits* $\tilde{b}(w)$ *in (10),* $r_0\in(0,1)$ *exist such that the labor income of a worker with earning capability* k, *denoted by* $\tilde{w}^*(k)$, *is determined as follows:*

(i) If $r_0\le r\le 1$, *then,* $\underline{k}\le k_B\le\tilde{k}^*<1$ *exist such that*

$$\tilde{w}^*(k)=\begin{cases} g((1-r)k) & \text{if } k\le\tilde{k}^* \\ g(k) & \text{if } k>\tilde{k}^* \end{cases}. \tag{23}$$

(ii) If $0 \le r < r_0$*, then,* $\underline{k} \le \underline{k}^B < \overline{k}^B < \tilde{k}^*$ *exist such that*

$$\tilde{w}^*(k) = \begin{cases} g((1-r)k) & \text{if } k \le \underline{k}^B \\ \underline{y} & \text{if } \underline{k}^B < k \le \overline{k}^B \\ g(k) & \text{if } k > \overline{k}^B \end{cases}. \tag{24}$$

where $g \equiv c'^{-1}$*; and* $\underline{k}$*,* $\underline{k}^B$*,* $\tilde{k}^*$*, and* $\overline{k}^B$ *are defined by (4), (15), (20), and (22), respectively.*

Proof. See appendix. ■

Note that as long as $r > 0$, income assistance benefits strictly decrease in labor income. Therefore, those who receive the benefits earn lower labor income than in the symmetric information case, known as the *moral hazard problem*. Moreover, both $\tilde{k}^*$ and $\overline{k}^B$ in Proposition 2 are larger than $\underline{k}$. Therefore, those workers who could earn labor income greater than $\underline{y}$ without the benefits are receiving the benefits and earning labor income less than $\underline{y}$, known as the *adverse selection problem*. Given that both the moral hazard and the adverse selection problems reduce the labor income of benefit recipients, whether disposable income (i.e., the sum of labor income and the income assistance benefits) would increase for a benefit recipient is *a priori* ambiguous.

V. Income Assistance and Disposable Income

5.1. Change in Disposable Income

From Proposition 2, the disposable income of a benefit recipient is $\tilde{y}(k) = \tilde{w}^*(k) + \tilde{b}(\tilde{w}^*(k)) = \tilde{w}^*(k) + \underline{y} - r\tilde{w}^*(k)$. Considering that labor income without benefits is $\tilde{w}_N^* = g(k)$, the change in *individual* disposable income due to income assistance benefits can be defined as

$$\Delta(k) = \tilde{w}^*(k) - g(k) + (\underline{y} - r\tilde{w}^*(k)). \tag{25}$$

For example, if $c(w) = \frac{1}{2}w^2$ and $r_0 (= 2 - \sqrt{2}) \le r \le 1$, from the previous section, those workers with $k \le \tilde{k}^* = \frac{2\underline{k}}{(2-r)r}$ will receive the benefits, and the change in disposable income is $\Delta(k) = (1-r)k - k + \underline{k} - r(1-r)k = \underline{k} - 2rk + r^2 k$. Note that $\Delta(k)$ is positive for $k < k_0 = \frac{\underline{k}}{r(2-r)}$ but negative for $k_0 = \frac{\underline{k}}{r(2-r)} < k \le \tilde{k}^* = \frac{2\underline{k}}{(2-r)r}$. That is, among the benefit recipients, the disposable income increases for those with relatively lower earning capabilities $(\underline{k} \le \underline{k}_0)$ but decreases for those with relatively higher earning capabilities $(\underline{k} > \underline{k}_0)$. See also Figure 2 in Example 2 where $\underline{k}_0 = \underline{y}$ and Figure 3 in Example 3, where $\underline{k}_0 = 2\underline{y}$. These results can be generalized as in the following proposition:

Proposition 3 *Among the benefit recipients,* $\underline{k}_0$ *exists such that* $\Delta(\underline{k}) \ge 0$ *if* $\underline{k} \le \underline{k}_0$ *and* $\Delta(\underline{k}) < 0$ *if* $\underline{k} > \underline{k}_0$, *where* $0 < \underline{k}_0 < \tilde{\underline{k}}^*$ *if* $r_0 \le r \le 1$ *or* $0 < \underline{k}_0 < \overline{\underline{k}}_B$ *if* $0 \le r < r_0$.

Proof. See appendix. ■

Intuitively, workers with relatively lower earning capability were earning smaller wages before the benefits were introduced. Thus, the moral hazard problem caused by income assistance benefits (i.e., the decrease in labor income) is smaller in absolute magnitude. Additionally, the benefit is larger for lower wage earners. Therefore, disposable income increases for workers with relatively lower earning capability. By the same logic, disposable income decreases for workers with relatively higher earning capability.

5.2. Change in Aggregate Disposable Income

For the aggregate disposable income, the increase in disposable income for relatively lower earning capability workers can be cancelled out by the decrease in disposable income for relatively higher earning capability workers. For example, if $c(w) = \frac{1}{2}w^2$ and $r_0 (= 2 - \sqrt{2}) \le r \le 1$, the change in the aggregate disposable income due to the benefits is

$$
\begin{aligned}
\int_0^{\tilde{\underline{k}}^*} \Delta(\underline{k}) d\underline{k} &= \int_0^{\underline{k}_0} (\tilde{w}^*(\underline{k}) - w_N^*(\underline{k}) + (\underline{y} - r\tilde{w}^*(\underline{k})))d\underline{k} \\
&\quad + \int_{\underline{k}_0}^{\tilde{\underline{k}}^*} (\tilde{w}^*(\underline{k}) - w_N^*(\underline{k}) + (\underline{y} - r\tilde{w}^*(\underline{k})))d\underline{k} \\
&= \int_0^{\frac{\underline{k}}{(2-r)r}} (\underline{k} - 2r\underline{k} + r^2\underline{k})d\underline{k} + \int_{\frac{\underline{k}}{(2-r)r}}^{\frac{2\underline{k}}{(2-r)r}} (\underline{k} - 2r\underline{k} + r^2\underline{k})d\underline{k} \\
&= \frac{1}{2}\frac{\underline{k}^2}{r(2-r)} - \frac{1}{2}\frac{\underline{k}^2}{r(2-r)} = 0\,.
\end{aligned} \tag{26}
$$

Thus, surprisingly, the aggregate disposable income of the benefit recipients does not increase at all. This result can also be observed in Figures 2 and 3. In Figure 2 in Example 2, when $r = 1$, the aggregate disposable income increases for those with $0 \le \underline{k} \le \underline{y}$ by the size of area E. However, the aggregate disposable income decreases for those with $\underline{y} < \underline{k} \le 2\underline{y}$ by the size of area D. Given that both the sizes of area E and D are $\frac{1}{2}\underline{y}^2$, the aggregate disposable income of the benefit recipients does not change despite the income assistance benefits. Moreover, in Figure 3 in Example 3, when $r=0$, the aggregate disposable income increases for those with $0 \le k \le 2\underline{y}$ by the size of area $E+E'(=\frac{3}{2}\underline{y}^2)$. However, the aggregate disposable income decreases for those with $2\underline{y} < k \le (2+\sqrt{2})\underline{y}$ by the size of area $D'(=\frac{3}{2}\underline{y}^2)$. Thus, again, the aggregate disposable income of the benefit recipients does not change.

The following proposition shows that these results hold for a general convex cost function $c(w)$ when k is uniformly distributed.

Proposition 4 *If k is uniformly distributed, for all $\underline{y}$ and $r \in [0,1]$, linear income assistance benefits $\tilde{b}(w)$ do not change the aggregate disposable income of the benefit recipients.*

Proof. See appendix. ■

Note that Proposition 4 holds for all $\underline{y}$ and $r \in [0,1]$.[5] If the government relaxes the eligibility condition for income assistance benefits by raising $\underline{y}$, other workers will receive the benefits. Thus, one might surmise that the aggregate disposable income of all benefit recipients would increase. However, Proposition 4 states that regardless of the level of benefits $(\underline{y})$ or the slope of the benefit function (r), the addition of income assistance benefits does not increase aggregate disposable income.

Proposition 4 also implies that the size of the aggregate income assistance benefit (or total welfare expenditure) is cancelled out by the decrease in the aggregate labor income due to moral hazard and adverse selection problems.

Corollary 1 *If k is uniformly distributed, for all $\underline{y}$ and $r \in [0,1]$, the decrease in the aggregate labor income of the benefit recipients is the same as the size of the aggregate income assistance benefits.*

For example, if $c(w)=\frac{1}{2}w^2$ and $r_0(=2-\sqrt{2}) \le r \le 1$, the change in the aggregate disposable income of the benefit recipients in (26) can be rewritten as the sum of the change in aggregate labor income and the size of aggregate benefits as follows:

$$\int_0^{\tilde{k}^*} \Delta(k)dk = \int_0^{\tilde{k}^*} (\tilde{w}^*(k) - w_N^*(k))dk + \int_0^{\tilde{k}^*} \tilde{b}(\tilde{w}^*(k))dk \tag{27}$$

[5] Recall, however, that throughout the paper, I assume $\underline{y}$ is low enough that some workers do not choose the benefits, that is, $k^* < 1$ and $\bar{k}^B < 1$.

$$= \int_0^{\frac{2\underline{k}}{(2-r)r}} ((1-r)k - k)dk + \int_0^{\frac{2\underline{k}}{(2-r)r}} (\underline{k} - r(1-r)k)dk$$

$$= -2\frac{\underline{k}^2}{r(2-r)^2} + 2\frac{\underline{k}^2}{r(2-r)^2} = 0\,.$$

This result contradicts the symmetric information outcome seen in Proposition 1. When workers' earning capabilities are observable, greater income assistance benefits can further increase the aggregate disposable income because the aggregate labor income does not change. However, when workers' earning capabilities are unobservable, aggregate disposable income does not increase regardless of the size of benefits because aggregate labor income decreases as much as the aggregate benefits.

To gain intuition, one can make two observations. First, both (2) and (14) hold that individual labor income is determined by the marginal utility (or inverse marginal cost) of earning labor income. Given that income assistance benefits are determined by individual labor income as in (10), one can observe that *individual* disposable income is determined by the *marginal* utility of earning labor income. It follows that the *aggregate* disposable income, which is the integral of individual disposable income, must be determined by the level of utility of the highest capability benefit recipient ($k = k^*$ or $\overline{k}^B$ in Proposition 2).

Second, because earning capability is unobservable, workers can choose whether or not to receive the benefits. Thus, the highest capability benefit recipient is the one who is exactly indifferent between receiving and foregoing benefits. That is, the level of utility of the highest capability benefit recipient is the same whether they receive the benefits or not. Following the first observation above, the aggregate disposable income with income assistance benefits must be the same as that without benefits.

To put it differently, in Example 2 $(r = 1)$, individual benefits decrease as much as labor income. Thus, a worker who receives the benefits would make zero labor income. That is, with larger r, relatively more severe moral hazard problems arise. In Example 3 $(r = 0)$, benefits do not decrease in wages. Thus, benefit recipients would like to earn up to their earning capability. That is, less of a moral hazard problem exists. However, given that the benefits do not decrease in income, those who have relatively higher ability would reduce their labor income just enough to qualify for the benefit. That is, with smaller r, the moral hazard problem is less severe, but the adverse selection problem is more severe. Therefore, the aggregate disposable income does not increase regardless of the benefit reduction rate r.

5.3. Distribution of k

Proposition 4 depends on the key assumption that k is uniformly distributed in the economy. More realistically, suppose that the distribution of k, with a probability density function, denoted by $f(k)$, is single-peaked (e.g., normal or log-normal). In addition, suppose that the benefit recipients are distributed on the left side of the peak. Then, relatively more high ability workers should be among the benefit recipients. That is, $f'(k) > 0$ for all benefit recipients (i.e., $0 < k < \tilde{k}^*$ if $r_0 \leq r \leq 1$ or $0 < k < \overline{k}_B$ if $0 \leq r < r_0$).[6]

Recall that when k is uniformly distributed (i.e., $f'(k) = 0$), from Proposition 4, income assistance benefits do not change the aggregate disposable income. From the proof of Proposition 3, given that disposable income decreases more for relatively higher ability workers, if relatively more high ability workers exist, income assistance benefits must decrease the aggregate disposable income.

Proposition 5 *If* $f'(k) > 0$ *for all benefit recipients, income assistance benefits decrease the aggregate disposable income.*

Proof. From the discussion above. ■

For example, Figure 4 shows that the distributions of annual Korean household disposable income in 2019 and 2020 are practically single-peaked. Moreover, the eligibility condition for a basic livelihood security payment, for example, is 30% of the median household income or roughly 1.45 ten million KRW in 2020[7] which is on the left side of the peak (= roughly 2 ten million KRW). Although Figure 4 shows the distribution of disposable income, not of earning capability, it suggests that the distribution of earning capability would have a single-peak, and that most of the benefit recipients would be distributed on the left side of the peak, as I have assumed.

Although one of the immediate goals of an income assistance program is to increase the disposable income of benefit recipients, Propositions 4 and 5 show that the aggregate (or average) disposable income of all benefit recipients does not increase and may well decrease. If one measures poverty by the average disposable income of benefit recipients, these results suggest that offering income assistance or welfare would not reduce poverty (e.g., Borjas, 2016).

On the other hand, the disposable income of the least capable workers (i.e., the original target group in the symmetric information case) does increase due to the income assistance program (e.g., $k < \underline{y}$ in Figures 2 or 3). Thus, if a society cares

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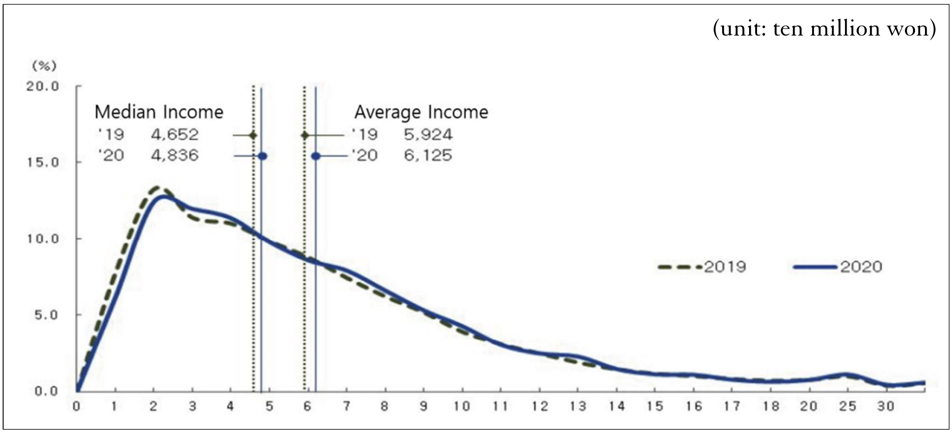
[6] This is a sufficient condition.

[7] The exact eligibility standard differs by the number of household members.

enough regarding the disposable income of its least capable citizens or those living in extreme poverty, income assistance programs can still be justified.

[Figure 4] Distribution of Korean Household Income



Source: Statistics Korea Press Release (2021.12.16).

VI. Conclusion

It is well-known that income assistance or welfare benefits can decrease labor supply and labor income because of the moral hazard and adverse selection problems. Therefore, income assistance benefits can increase disposable income for some but decrease it for others. However, whether or when the aggregate disposable income of all benefit recipients will increase has been theoretically unclear, although many policy makers seem to assume it will as seen in the recent income-led growth policy of South Korea.

This paper shows that the extent of the moral hazard and adverse selection problems can be far more severe than one might have expected. Thus, if earning capabilities are uniformly distributed, the *aggregate* disposable income of the benefit recipients does not increase regardless of the size of the benefits. Moreover, if the distribution of earning capabilities is single-peaked, the aggregate disposable income can even decrease.

As emphasized in the beginning, these results do not necessarily imply that income assistance programs are ineffective. From Proposition 3 (and Examples 2 and 3), for those benefit recipients with relatively lower capabilities, income assistance benefits do increase their disposable income. However, this paper shows that a policy maker cannot simply assume that welfare benefits will increase the aggregate (or average) disposable income of benefit recipients.

These results may also explain the ambiguous effect of income assistance/welfare benefits on poverty. From Figure 3 for example, if one defines poverty by disposable income less than $\underline{y}$, (fixed) income assistance benefits would reduce the number of people in poverty. However, if one defines poverty by disposable income less than or equal to $2\underline{y}$, (fixed) income assistance benefits would increase the number of people in poverty.

Note that this paper intentionally avoids the discussion on the *optimality* of income assistance benefits or the tax revenues to finance the benefits. To discuss these issues, one must define the social welfare function and the tax systems when society has implicitly agreed earlier on the income assistance programs. While such an exercise would be theoretically interesting, it can often be ambiguous and beyond the scope of this paper. This paper focuses on more clearly defined and practically relevant *aggregate disposable income* and shows that the findings are surprisingly unambiguous.

Another caveat is that these results are based on a linear benefit function and risk-neutral workers. Future research could determine how these results can extend to more general benefit/utility functions. In particular, an analysis on the dynamic effects such as human capital accumulation from working would be interesting, as it is an important rationale for the EITC. Empirical evidence suggests that workers do not adjust taxable income to changes in marginal tax rates as much as economic theories predict (e.g., Lee, 2004; Saez, 2010; Saez et al., 2012). Such frictions can be institutional, psychological, or dynamic. To fully understand the incentive effects of welfare benefits, both theoretical and empirical understanding of such frictions would be important as well.

Appendix

Proof of Proposition 2 The proof follows the same logic as the computations in the main text with a quadratic cost function but now with a general convex function $c(w)$.

First, the preference condition Eq. (20) in the main text can be generalized as in the following lemma:

Lemma 1 $\tilde{k}^* \in (\underline{k},1)$ *exists such that* $\tilde{u}_B^*(k) \geq \tilde{u}_N^*(k)$ *if and only if* $k \leq \tilde{k}^*$.

Proof. Define $F(k)$ such that

$$F(k) \equiv \tilde{u}_N^*(k) - \tilde{u}_B^*(k). \tag{A.1}$$

Then, from the envelope theorem, $\frac{\partial F}{\partial k} = \frac{1}{k^2}(c(g(k)) - c(g((1-r)k)) > 0$. If $\underline{y}$ is small enough, $F(1) > 0$ given that $\tilde{u}_N^*(k)$ is the maximum of $w - \frac{1}{k}c(w)$. Additionally, $\lim_{k\to 0} F(k) = -\underline{y} < 0$ given that $g(0) = 0$ and $\lim_{k\to 0}\frac{1}{k}c(g(k)) = \lim_{k\to 0}\frac{c'g'}{1} = \lim_{k\to 0}\frac{kg'}{1} = 0$ from L'Hospital's rule. Therefore, a unique $k^* \in (0,1)$ exists such that $F(\tilde{k}^*) > 0$ if and only if $k > \tilde{k}^*$.

In addition, $\tilde{k}^* \geq \underline{k}$ given that $F(\underline{k}) = -(1-r)g((1-r)\underline{k}) - \frac{1}{k}(c(g(\underline{k})) - c(g((1-r)\underline{k})) < 0$. ■

Second, the preference condition Eq. (22) can be generalized as follows:

Lemma 2 *If* $\underline{k}^B < \tilde{k}^*$, $\overline{k}^B \in (\underline{k}^B,1)$ *exists such that* $\tilde{u}_B(\underline{y};k) \geq \tilde{u}_N^*(k)$ *if and only if* $k \leq \overline{k}^B$.

Proof. Define $H(k)$ such that

$$H(k) \equiv \tilde{u}_N^*(k) - \tilde{u}_B(\underline{y};k) = g(k) - \frac{1}{k}c(g(k)) - \left(\underline{y} + (1-r)\underline{y} - \frac{1}{k}c(\underline{y})\right). \tag{A.2}$$

Notably, from (4), $\frac{\partial H}{\partial k} = \frac{1}{k^2}(c(g(k)) - c(\underline{y})) > 0$ if $k > \underline{k}$. From (4) and (15), $\underline{k}^B \geq \underline{k}$. Therefore, $\frac{\partial H}{\partial k} > 0$ for $k \geq \underline{k}^B$.

If $\underline{k}^B < \tilde{k}^*$, then, from (15) $H(\underline{k}^B) = F(\underline{k}^B) < 0$. Moreover, $H(\tilde{k}^*) > 0$ given that $\tilde{u}_B^*(\tilde{k}^*) > \tilde{u}_B(\underline{y};\tilde{k}^*)$ by definition of $\tilde{u}_B^*$. Therefore, if $\underline{k}^B < \tilde{k}^*$, $\overline{k}^B \in (\underline{k}^B, \tilde{k}^*)$ exist such that $H(k) > 0$ if and only if $k > \overline{k}^B$. ■

Finally, to check if and when $\underline{k}^B < \tilde{k}^*$,

Lemma 3 $r_0 \in (0,1)$ *exists such that* $\underline{k}^B < \tilde{k}^*$ *if and only if* $r < r_0$.

Proof. Given that $\frac{\partial F}{\partial k} > 0$ and $F(k^*) = 0$, $\underline{k}^B < \tilde{k}^*$ if and only if $F(\underline{k}^B) < 0$. Considering that $\underline{k}^B$ is a function of r from (15), define

$$F_r(r) \equiv F(\underline{k}^B(r)) = g(\underline{k}^B(r)) - \frac{1}{\underline{k}^B(r)} c(g(\underline{k}^B(r))) - \underline{y} - (1-r)\underline{y} + \frac{1}{\underline{k}^B(r)} c(\underline{y}).$$

If $r = 0$, then, $g(\underline{k}^B) = \underline{y}$. Thus, $F_r(0) = -\underline{y} < 0$. In addition, if $r \to 1$, then, from (15), $\underline{k}^B \to \infty$. Thus, $\lim_{r \to 1} F_r(r) > 0$ if $\underline{y}$ is small enough, given that $g(k) - \frac{1}{k} c(g(k)) > 0$ and increasing in k for all $k > 0$. Given that $\frac{\partial F_r}{\partial r} = \frac{1}{k^2}(c(g(\underline{k}^B)) - c(\underline{y})) + \underline{y} > 0$, $r_0 \in (0,1)$ exists such that $F(\underline{k}^B) < 0$ if and only if $r < r_0$.

Then, the rest of the proof follows the same arguments as in the computations with a quadratic cost function in the main text.

Proof of Proposition 3 It is sufficient to prove that $\Delta(0) > 0$, $\Delta'(k) < 0$, $\Delta(\tilde{k}^*) < 0$, and $\Delta(\overline{k}^B) < 0$. Suppose that $r \geq r_0$. For the benefit recipients (i.e., $k \leq \tilde{k}^*$), from Proposition 2(i), $\Delta(k) = (\underline{y} + (1-r)g((1-r)k) - g(k)$. Note that $\Delta'(k) = (1-r)^2 g'(k) - g'(k) < 0$ given that $r \geq r_0 > 0$. Additionally, $\Delta(0) = \underline{y} > 0$ and $\Delta(\tilde{k}^*) = -\frac{1}{k}(c(g(k)) - c(g((1-r)k)) < 0$.

Suppose that $r < r_0$. For $k \leq \underline{k}^B$, $\Delta(k) = (\underline{y} + (1-r)g((1-r)k) - g(k)$. From above, $\Delta(0) > 0$ and $\Delta'(k) < 0$. For $\underline{k}^B < k \leq \overline{k}^B$, $\Delta(k) = (\underline{y} + (1-r)\underline{y}) - g(k)$. Thus, $\Delta'(k) = -g'(k) < 0$ and, from the definition of $\overline{k}^B$, $\Delta(\overline{k}^B) = -\frac{1}{k}(c(g(\overline{k}^B)) - c(g(\underline{k}))) < 0$ given that $\overline{k}^B > \underline{k}$. ■

Proof of Proposition 4 First, suppose that $r \geq r_0$. Notably,

$$\int_{\tilde{k}^*}^{1} g(k)dk = G(1) - \tilde{k}^* g(\tilde{k}^*) + c(g(\tilde{k}^*))$$

where $G(\,) = \int g(k)dk$. Likewise,

$$\begin{aligned}\int_0^{\tilde{k}^*} [\underline{y} + (1-r)g((1-r)k)]dk &= \underline{y}\tilde{k}^* + (1-r)\int_0^{\tilde{k}^*} g((1-r)k)dk \\ &= \underline{y}\tilde{k}^* + \int_0^{(1-r)\tilde{k}^*} g(z)dz\end{aligned}$$

$$= \underline{y}\tilde{k}^* + (1-r)\tilde{k}^* g((1-r)\tilde{k}^*) - c(g((1-r)\tilde{k}^*)).$$

Therefore, from the definition of $\tilde{k}^*$, aggregate disposable income with benefits is

$$\tilde{Y}_B^* \equiv \int_0^{\tilde{k}^*} [\underline{y} + (1-r)g((1-r)k)]dk + \int_{\tilde{k}^*}^1 g(k)dk = G(1) = Y_N^*,$$

where $\tilde{Y}_N^*$ is the disposable income when no benefits exist as defined in (3).

Second, now suppose that $r < r_0$. Notably,

$$\int_{\bar{k}^B}^1 g(k)dk = G(1) - \bar{k}^B g(\bar{k}^B) + c(g(\bar{k}^B))$$

$$\int_{\underline{k}^B}^{\bar{k}^B} [\underline{y} + (1-r)\underline{y}]dk = [\underline{y} + (1-r)\underline{y}](\bar{k}^B - \underline{k}^B)$$

$$\begin{aligned}\int_0^{\underline{k}^B} [\underline{y} + (1-r)g((1-r)k)]dk &= \underline{y}\,\underline{k}^B + (1-r)\int_0^{\underline{k}^B} g((1-r)k)dk \\ &= \underline{y}\,\underline{k}^B + \int_0^{(1-r)\underline{k}^B} g(z)dz \\ &= \underline{y}\,\underline{k}^B + (1-r)\underline{k}^B g((1-r)\underline{k}^B) - c(g((1-r)\underline{k}^B)).\end{aligned}$$

From the definitions of $\underline{k}^B$ and $\bar{k}^B$, the aggregate disposable income with the benefits is

$$\tilde{Y}_B^* \equiv \int_0^{\underline{k}^B} [\underline{y} + (1-r)g((1-r)k)]dk + \int_{\underline{k}^B}^{\bar{k}^B} [\underline{y} + (1-r)\underline{y}]dk + \int_{\bar{k}^B}^1 g(k)dk = G(1) = Y_N^*.$$

Therefore, for all r and $\underline{y}$, the linear income assistance benefit $\tilde{b}(w)$ does not increase or change the aggregate disposable income at all. ■

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소득지원정책과 총가처분소득*

권 일 웅**

초 록 본 논문은 정부가 소득지원정책 수혜자들의 근로능력을 관찰할 수 없을 때, 소득지원이 수혜자들의 총가처분소득에 미치는 영향을 이론적으로 분석하였다. 단순하지만 표준적인 모형에서 근로능력이 균일분포를 따르는 경우, 선형(linear) 소득지원정책은 수혜자들의 총가처분소득을 증대시키지 못하는 것으로 나타났다. 이러한 결과는 소득지원의 크기, 소득자격요건, 소득 감소율에 상관없이 성립하였다. 또한 근로능력이 보다 현실적인 분포를 따르는 경우에는 수혜자들의 총가처분소득은 오히려 감소할 수 있는 것으로 나타났다.

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