An Experimental Study of Basic Income Guarantee

Toshiji Kawagoe*

Abstract
In this paper we show economic analysis of Basic Income Guarantee (BIG), which guarantees a constant income for each individual regardless of ages, gender, or any geographic characteristics. We address moral hazard and adverse selection problems that may arise in BIG scheme. As for moral hazard problem, we compare Negative Income Tax (NIT) with BIG in the laboratory experiment. In a setting where NIT and BIG are identical, we found that BIG reduces more labor incentive than NIT does. As for adverse selection problem, we analyze a simple evolutionary game model in order to check whether introduction of BIG does increase the exercises of freedom and self-maintenance of the people who are in weaker position in the household, such as women, children, person of advanced age and people with disability. We show that with a certain condition, women are willing to get married in order to get higher income for the household even if such decision keep them in their weaker position.

Keywords: Basic income, negative income tax, moral hazard, adverse selection

JEL Classification: C73, C91, D31, H24, H53, J22

Phone: +81-138-34-6424, fax: +81-138-34-6301, e-mail: kawagoe@fun.ac.jp
1. Introduction

Basic Income Guarantee (BIG) is an income maintenance program which guarantees a constant income for each individual regardless of ages, gender, or any geographic characteristics\(^1\). Each individual is only required to pay income tax for additional income other than the BIG\(^2\). Ozawa (2002) estimates that 80 thousands yen can be provided as BIG to each individual in the Japanese current financial condition when 50% flat income tax is imposed on the income other than the BIG.

Advocators of the BIG basically agree with about three benefits coming from introduction of BIG; (1) BIG alleviates supply-demand condition in the labor market and goes forward work-sharing because giving BIG may cause a shift from labor to leisure. (2) Each individual can withdraw from labor and has enough leisure time for self-development when they receive BIG. (3) As an income is guaranteed not for household but for individual in BIG scheme, the right and dignity of the people who are in weaker position in the household, such as women, children, person of advanced age and person with disability, can be respected\(^3\).

So far BIG is discussed in the fields of public finance, social security, and political science. But in these discussion about BIG, it seems that economic analysis has not been made at satisfactory level. In the literature, mainly discussed issue concerning economics is moral hazard. That is, if BIG is guaranteed for everyone without any condition or reservation, incentive for labor supply declines significantly. But other aspects concerning BIG scheme are little or not touched.

In this paper, we will report an experimental result that we conducted in order to check how introduction of BIG scheme does affect labor supply significantly. Though the experiment was conducted in the laboratory, task assigned for experimental subjects were not fictitious but real labor effort. In this sense, this is a laboratory experiment with the flavor of field experiment as in Cadsby et al. (2007).

In this experiment, we compared BIG scheme with identical negative income tax (NIT) scheme. So both schemes are essentially same for labor incentive. In economic theory, the following argument is frequently stated; that is, agent with low income has little incentive to raise his labor supply in NIT scheme, because subsidy he can receive decreases gradually when his income increases. There is no such an effect expected in BIG scheme. So, BIG scheme is superior to NIY. But, in our experiment,

\(^1\) If a constant income is guaranteed conditional on participation in social activity as a citizen, it is called Participation Income (Atkinson, 1995; Bowles and Gintis, 1998).

\(^2\) Usually flat tax is assumed. Progressive tax is proposed by Murphy and Nagel (2002).

\(^3\) For these issues, see Fitzpatrick (1999) and Werner (2006).
contrary to the above argument, there was significant difference between BIG and NIT schemes on the effect on labor supply in opposite direction. Namely, whereas there was no significant effect on labor supply when NIT was introduced, there was significant effect was observed when BIG was introduced.

Another problem to be mentioned, though it has not been touched in the literature, is an adverse selection problem. That is, there could be an incentive for household to make more children in order to increase income for household. In this case, women are willing to get married in order to increase total income for household, even though it could be oppressive for them for keeping them under husbands’ control. If so, contrary to the opinion of the advocates of BIG, scheme introduction of BIG scheme makes women of numerous offspring increase and prevents them from advancing into workplaces and freedom. For analyzing adverse selection problem of this type, we develop a game theoretic model and analyses it by evolutionary game theory. In an ESS, with a certain condition, our conjecture was confirmed that women are willing to get married even if such decision get them into under oppressive situation.

The organization of the paper is as follows. In the next section, models of BIG and NIT schemes are introduced. Experimental design and results are also reported. In the section 3, adverse selection problem and its evolutionary game analysis are given. In the final section, we conclude.

2. Moral hazard in BIG scheme
Here we compare BIG with NIT scheme with respect to moral hazard. As this is a highly empirical question, experimental examination is required, just as a series of social experiments were conducted for NIT scheme. In fact, a special issue was published in a specific journal, Basic Income Studies, Volume 1, No.2, with the title “Toward a Basic Income Experiment?” by the lead of Groot (2006).

Among papers in this issue, Peeters and Marx (2006) and Noguera and Wispelaere (2006) deserve mentioning. Peeters and Marx (2006) propose that a lottery named “Win for Life” in Belgique can be used a means for testing BIG scheme in a social experiment. With this lottery, a winner can receive 1,000 euros a month for his/her lifetime. Even though different tax scheme is supposed, they insist that it can be regarded as BIG scheme and we will have a good sample by monitoring the winner’s behavior for forecasting the change in labor supply when BIG is introduced.

Noguera and Wispelaere (2006) propose that a controlled laboratory

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4 For social experiments of NIT scheme, see Robins (1985) and Widerquist (2005).
5 Other papers in this issue are Widerquist (2006) and Virjo (2006).
experiment should be conducted for measuring the effect of BIG on labor supply directly. But they didn’t conduct any experiment, and proposed no concrete experimental design for testing BIG scheme.

Then for measuring the effect of BIG scheme on labor supply directly, we conducted an experiment of BIG in a fashion of field experiment even the experiment was conducted in the laboratory, which was inspired by Cadsby et al. (2007)\(^6\). Next we will show you our models of BIG and NIT schemes.

First, for NIT scheme, post-tax income \(Z\) is determined by earned income \(Y\), a target income \(G\), and marginal tax rate \(T\) as follows.

\[
Z = \begin{cases} 
Y + T(G - Y) & \text{if } Y \leq G \\
Y - T(Y - G) & \text{if } Y > G 
\end{cases}
\]

For BIG scheme, post-tax income, \(z\), is determined by a guaranteed income, \(g\), and marginal tax rate, \(t\), as follows.

\[z = g + (1-t)Y.\]

Here if we set \(T = t\) and \(TG = g\), then \(Z = z\), thus BIG and NIT schemes are identical\(^7\).

Figure 1 shows the relationship between earned income, \(Y\), and post-tax income, \(Z\), when \(T = 0.5\) and \(G = 50\) (\(g = 25\)).

Then, our questions are as follows. Facing this type of BIG or NIT scheme, what response does a worker show? As advocates of BI said, as an income \(g\) is guaranteed, does the worker reduce his/her labor supply than these schemes are not introduced? In addition, is there any difference of impact on labor supply between BIG and NIT schemes? For all these questions concerning moral hazard, the following laboratory experiment has been conducted on March 2009 at Future University - Hakodate.

Each subject was asked to work out a series of multiplication exercises of 2 digits and 1 digit natural numbers (for example, 24x6=?). The task was set as a work demands enough concentration. In fact, 25 questions were selected at random in each round, and subject had to answer each question within 4 seconds. In the pilot experiment, average points marked were 60 of 100. This point was regarded as \(Y\), then \(Z\) was calculated according to BIG or NIT scheme, then subject was paid 4 yen for each 1

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\(^6\) For controlled field experiment of labor supply, see Gneezy and List (2006).

\(^7\) Basic features of these models are same with Ozawa (2002) and Tondani (2008).
point. Average rewards for one and a half hour experiment was 3,000 yen (approximately, $30).

In this experiment, ABA design was employed for separating subject’s experience or learning effect and the effect caused by the introduction of each scheme. In the condition A, no scheme was introduced. In the condition B, either BIG or NIT scheme was introduced. We also adopted between subject designs; There were 2 groups in the experiment, and each group consists of 30 subjects. BIG scheme was introduced in the one group and NIT scheme was introduced in the other group. In the experiment of the condition A, subject’s payoff was determined by \( Z = (1 - t)Y \).

Our hypothesis to be tested in this experiment is as follows. Agent with low income, that is, less than \( G \), has little incentive to raise his labor supply in NIT scheme, because subsidy he can receive decreases gradually when his income increases. There is no such an effect expected in BIG scheme.

Table 1 is here.

Table 1 shows average earned income, \( Y \), in the conditions A and B. The numbers in the parentheses are standard deviations. The data shows that average labor supply is monotonically increasing in both cases.

According to the standard economic analysis that the introduction of NIT or BIG scheme reduces incentive for labor supply, it seems to be strange to see that average labor supply is increasing. But it can be understandable because the learning effect caused by subject’s experience and the effect of the introduction of the scheme might be confounding, especially in early rounds.

On the other hand, in the condition A2 after B, after taken away the institution, average labor supply increase was observed. This means that BIG and NIT might reduce labor supply incentive.

Figures 2 and 3 are here.

To measure the reduction of labor supply incentive, we compare the the distributions of labor supply in the condition B and A2. Figures 2 and 3 shows the distribution of earned income \( Y \) in both schemes. In NIT scheme, there is no significant difference between conditions B and A2, but for BIG scheme the distribution of \( Y \) is apparently shifted to the right-hand side (t-test and Kolmogorov-Smyrnov test, \( p<0.05 \)). This means that BIG scheme did reduce more labor supply incentive than does NIT.
scheme. This is opposite conclusion against our initial hypothesis. This is a bit surprising because both scheme are essentially same.

To explain this counterintuitive result, we have to mention about two observations. One is that in NIT scheme, while agent with lower income has little incentive to increase labor supply because it reduces subsidy, agent with relatively high income has incentive to increase labor supply in condition B because he want to keep his income same in the condition B as in the condition A. This explains that there was no significant difference observed between condition B and A2 in NIT scheme. The other observation is that in BIG scheme, as income $g$ was guaranteed uniformly for every subjects, many of them were satisfied with their income level including $g$, so this explains significant labor supply reduction observed in the condition B than in the condition A2.

3. Adverse selection in BIG scheme

Next we examine adverse selection problem in the BIG scheme by evolutionary game theory.

First, suppose that there are two types of agents in a society. $M$ type is an agent who is willing to get married and is content with obtaining only income guaranteed in BIG scheme, and $B$ type is an agent who is willing to participate in the labor market in order to gain more income than BIG scheme guaranteed. It is assumed that in order to enter the labor market, each agent should take training for skilled labor. Let additional income gained by skilled labor be $T$, the probability of getting a skilled labor job $p$ ($0 \leq p \leq 1$), and training cost $c$. We also assume that flat tax has been extracted from $T$. There are infinitely many agents in the society and they are matched at random. They are all selfish and don’t care about future state of their children, or don’t demand cares for themselves in their old ages.

If both matched agents are type $Ms$, we assume that they agree to get married mutually, and deliver $q$ children in average. For each child, they suffer cost $g$ for needed care and education for the child. Of the average amount of income guaranteed by BIG scheme, $qBIG$, these parents use a proportion $a$ ($0 \leq a \leq 1$) for needed care and education for the child respectively. Then each M type agent receives $BIG + aqBIG - qg$. If both matched agents are type $Bs$, they don’t get married, but take training for skilled labor, and get into the labor market. Then they receive $BIG + pT - c$. If a type $M$ and a type $B$ are matched, they don’t agree to get married. As the type $M$ agent cannot enter the labor market and deliver no children, he/she receives only income guaranteed by $BIG$. 

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The type B agent receives \( BIG + pT - c \).

Table 2 is here.

Table 2 shows payoff matrix of this game. In analyzing this game, we use the ESS (Evolutionary Stable Strategy). First, if \((aBIG - g)q > pT - c\), then type \( M \) strategy is an ESS. If \( pT > c \), then type \( B \) strategy is an ESS. If neither condition holds, that is, if \( pT < c \) and \((aBIG - g)q < pT - c\), then there exists a mixed strategy ESS. In the mixed strategy ESS, the proportion of type \( M \) strategy is as follows.

\[
\frac{c - pT}{(g - aBIG)q}.
\]

If the expected value of additional income \( T \) is greater than training cost \( c \), that is, \( pT > c \), the proportion of type \( M \) increases. In other words, if women have little prospect for net gain from additional income \( T \), agents who are willing to get married and deliver children likely increase. Further, if \( BIG \) and \( g \) are constant, as average delivery rate \( q \) increases, then population grows, so the probability of getting a skilled labor job likely decreases. This makes this condition for the existence of mixed strategy ESS more likely. So type \( M \) increases in the population at least in the short run. But when type \( M \) increases, type \( B \) relatively decreases, then productivity in the society as a whole may decrease, and population has grown, it should be impossible to provide \( BIG \) for budget balance of the society cannot be maintained. So sooner or later, government intervention will be made to reduce birth rate. This may reduce the proportion of \( M \) type in the population.

On the other hand, when cost for care and education for the child, \( g \), is greater than income gained from the child, \( aBIG \), the proportion of type \( M \) decreases. The more frequently women participates in the labor market, the more \( g \) increases. Then type \( M \) decreases in the short run, and type \( B \) increases and productivity in the society as a whole increases. But this increases \( BIG \), then the society come to the point where \( aBIG \) is exceeds \( g \), again type \( M \) increases.

Thus, introduction of \( BIG \) scheme does not necessarily promote freedom and participation into the labor market of oppressed people such as women, children, person of advanced age and people with disability, but with a certain condition, women are willing to get married in order to get higher income for the household even if such decision keep them in their weaker position.
5. Conclusion
In this paper, we examined Basic Income Guarantee (BIG) as an income maintenance program by laboratory experiment and evolutionary game theory.

We investigate the moral hazard by comparing BIG scheme with identical Negative Income Tax (NIT) scheme in the laboratory. In our experiment, we found that BIG reduces more labor incentive than NIT does. This is opposite conclusion against the widely accepted hypothesis that NIT reduces more labor incentive than BIG. For the parameter values, especially marginal tax rate and the level of guaranteed income, they are given rather arbitrarily in our experiment. In the future research, we have to reconsider these setting using optimal tax design theory.

Further, though it has not been mentioned in the literature, we develop and analyze an adverse selection problem with a simple game theoretic model. The analysis showed that with a certain condition, contrary to the opinion of the advocates of BIG scheme that women will enjoy more freedom and self-determination, there exists an equilibrium in which women are willing to get married in order to increase total income of the household even though they are under oppressive situation under husbands’ control. As for the adverse selection problem, we made an ad hoc assumption about timing of entering marriage and labor markets. It is necessary to refine this model by using matching theory in the future research.
References


Figure 1. The relationship between earned income, $Y$, and post-tax income, $Z$.

Figure 2. The distribution of earned income in NIT scheme.
Figure 3. The distribution of earned income in BIG scheme.
### Table 1. Average earned income in the condition A and B.

<table>
<thead>
<tr>
<th></th>
<th>Condition A1 (Baseline) Round 1-5</th>
<th>Condition B (with scheme) Round 6-10</th>
<th>Condition A2 (Baseline) Round 11-15</th>
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### Table 2. Payoff matrix of the BIG game.

<table>
<thead>
<tr>
<th></th>
<th>M</th>
<th>B</th>
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<tbody>
<tr>
<td>M</td>
<td>BIG+aqBIG-gq</td>
<td>BIG+aqBIG-gq</td>
</tr>
<tr>
<td></td>
<td>BIG+qT-c</td>
<td>BIG+qT-c</td>
</tr>
<tr>
<td>B</td>
<td>BIG+pT-c</td>
<td>BIG+pT-c</td>
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<tr>
<td></td>
<td>BIG</td>
<td>BIG+pT-c</td>
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