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Rebate versus Matching, Again: Does Self-selection Matter?

Shusaku Sasaki, Osaka University

Takunori Ishihara, Kyoto University of Advanced Science

Hiroki Kato, Hitotsubashi University

Rebate versus Matching, Again: Does Self-selection Matter?

Shusaku Sasaki[1] **Takunori Ishihara**[2] **Hiroki Kato**[3]

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Abstract

Standard economic theory predicts that matching and rebate will have the same effect on individuals' donation behavior when the donation price is equivalent. However, several experimental studies have reported that their donation behaviors are promoted under matching more than under rebate. This study reveals how treatment effects of matching and rebate change when people can self-select whether to use such schemes or not. Although traditional experimental studies have measured the causal effects of mandatory policy assignment, real-world policies are often applied to only those who accept them. We conduct an incentivized nationwide experiment on 2,400 Japanese residents with four treatments, two 1:1 matching treatments (compulsory / self-selection) and two 50% rebate treatments (compulsory / self-selection), and provide the following findings: Initially selected amount under the compulsory matching is smaller than under the compulsory rebate, while total amount donated to the charity under the former scheme is larger than that under the latter scheme, which is consistent with the existing theories. The treatment effect on the total donation amount among those who self-select to receive the treatment is still larger under the matching scheme than under the rebate scheme, but this difference is further larger than that in the case when using compulsory treatments. The superiority of matching over rebate for the total donation amount becomes more pronounced in the case with a self-selection process.

Keywords: Charitable subsidy, Tax incentive, Public economics, Behavioral economics, Online experiment

JEL classification: D91 · H20 · C90

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[1] Center for Infectious Disease Education and Research (CiDER), Osaka University, Japan (*Corresponding author*: ssasaki.econ@cider.osaka-u.ac.jp).

[2] Kyoto University of Advanced Science, Japan.

[3] Hitotsubashi University, Japan.

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1. Introduction

Standard economic theory predicts that, when the donation price and all other factors are equal, there should be no difference in individuals' donation behavior under matching and rebate schemes. For example, a 1:1 matching is equivalent to a 50% rebate. In the former scheme, when one chooses to donate 5000 JPY to a charity, the same amount will be added to this donation, thus making the total amount donated to the charity 10,000 JPY. In the latter scheme, when one chooses to donate 10,000 JPY to a charity, half of the amount will be refunded, making the actual donation expenditure 5000 JPY. Similarly, a 2:1 matching is equivalent to a 33% rebate, and a 4:1 matching is equivalent to a 20% rebate. However, Eckel and Grossman (2003) experimentally reveal that donation rates and average donation expenditures for matching are higher than for rebate. Sasaki, Kurokawa, and Ohtake (2021) use a Japanese nationwide sample and report the findings consistent with Eckel and Grossman (2003).

This study's purpose is to determine in a randomized controlled trial how treatment effects of matching and rebate change when people can self-select whether to use such schemes or not. Most traditional policy research using randomized controlled trials has measured the causal effects of mandatory policy assignment. However, implementing a policy intervention in a mandatory manner is rare in the real world. This is because mandatory implementation requires a system that enables a policy to be applied to all individuals involved and monitors their adherence to it. Also, a policy must be made mandatory by law, and implementation costs tend to be extremely high. In practice, policies are often applied to only those who choose to accept them, in particular by employing an opt-in scheme, where a policy is not applied by default, but rather only upon request.

Under conditions with self-selection, overall policy impacts will vary depending on the heterogeneous effects across individuals and which individuals self-select to receive the policy. For example, if a policy is widely accepted by people for whom a large (or significant) positive policy effect appears, the overall policy impact will become larger than if the policy intervention was mandated, and thus the policy function more efficiently due to self-selection. Conversely, if those who are likely to experience small or negative effects choose to receive a policy intervention, the overall policy impact will become relatively small, and self-selection will prevent it from functioning efficiently. To accurately understand the real-world implications of policy interventions, it is essential to ascertain the influence of self-selection on policy efficiency. Recent field experimental studies have begun to measure policy intervention effects after considering self-selection in energy saving (Wang et al. 2020; Fowlie et al. 2021; Ito et al. 2021; Ida et al. 2022) and health promotoion (Kurokawa and Sasaki, 2023).

This study adds to this emerging literature stream new evidence in the context of charitable giving by measuring the treatment effects of matching and rebate, while considering self-selection.

2. Experimental Design

2.1.Overview

We conduct an online economic experiment through MyVoice.com Ltd., which offers online surveys and experiments. Around 1 million adults living throughout Japan register the company as response monitors. We conduct a screening survey and sample 2400 participants from the monitors to match the proportions of a national representative sample in terms of age, sex, and residential area. Here, the screening survey includes questions related to sex, age, residential area, knowledge on matching and rebate, calculation problems, willingness to pay for matching and rebate.

The experiment in this study is incentivized using "points," which can be exchanged for gift cards (nationwide gift cards, Amazon gift cards, App Store & iTunes gift cards, book cards, etc.). The participants receive basic points by answering the survey and can earn additional points, which vary depending on their choices in the experiment. Note that the exchange rate is 1 point = 1 JPY.

The structure of this experiment can be divided into three main part. First, we present the participants with questions that capture their behavioral economic characteristics, including social, time, and risk preferences, in addition to questions related to donation experience.

Second, we randomly divide them into matching treatments, rebate treatments, or a control, and conduct the economic experiment to capture their donation behavior under each assigned condition. We construct two groups, respectively for the 1:1 matching treatments (compulsory and self-selection) and the 50% rebate treatments (compulsory and self-selection).

Third, we present participants with questions to capture their socioeconomic attributes, including marital status, number of children, years of education, household income, place of residence, etc., and gather their responses.

2.2.Interventions

We randomly divide participants into matching treatments, rebate treatments, or a control, and conduct the economic experiment to capture their donation behavior under each assigned condition. We construct two groups, respectively for the 1:1 matching treatments (compulsory and self-selection) and the 50% rebate treatments (compulsory and self-selection).

- 1:1 matching (compulsory): All the participants assigned to this group will select their donation amount under the 1:1 matching, where for every donation amount they pass on to the charity, the experimenter will match it with an additional equal amount.

- 1:1 matching (self-selection): Participants assigned to this group are required to apply in advance if they wish to use the 1:1 matching.

- 50% rebate (compulsory): All the participants assigned to this group will select their donation amount under the 50% rebate, where for every donation amount participants pass on to the charity, the experimenter will refund 50% of the amount to you.

- 50% rebate (self-selection): Participants assigned to this group are required to apply in advance if they wish to use the 50% rebate.

2.3.Outcomes

In this economic experiment, participants are informed that, in addition to the basic reward points for answering the survey, one in ten will have a chance to earn another reward, and the additional reward points are worth 1000 JPY. They are then needed to decide how much of the 1000 JPY they are willing to pass on to a social contribution project, assuming they could win and earn this additional reward. If they win and earn 1000 JPY, their donation decision will be carried out as they answer. Our primary outcomes are initially selected amount and total amount donated to the charity.

2.4.Balance Check

Table 1 reports the means and standard deviations of participants' sex, family structure, educational years, household income, and place of residence for each group to check the random allocation of participants between the five groups. We confirm that there is no statistically significant difference in the means of all the variables in the table between the groups.

[**Table 1** is here]

3. Hypothesis Setting and Analytical Procedure

3.1.Hypothesis Setting

Based on Hungerman and Ottoni-Wilhelm (2021), the treatment effect of matching on initially selected amount is always less than that of rebate (please see the Appendix of "Theoretical Background"). We can decompose the effect of matching on the initially selected amount into two components: 1) an effect of decreasing the initially selected amount based on the optimal total donated amount and the amount added by the third party' matching and 2) a positive or negative change in the optimal total donated amount itself. Since the decreasing effect by the added amount always exceeds the change in the optimal total donated amount, the treatment effect of matching on initially selected amount is always less than that of rebate (**Hypothesis 1**).

Second, the treatment effect of matching on the total amount donated to charity is expected to differ from that of rebate (**Hypothesis 2**). The size of the treatment effect for both matching and rebate on the total donated amount is likely to vary, depending on how warm-glow influences substitution effect. Specifically, if warm-glow weakens the substitution effect, the treatment effect of matching is more significant than rebate. On the other hand, if warm-glow strengthens the substitution effect, the treatment effect of matching is smaller than that of rebate. If donors do not have a warm-glow preference, the results of both treatments are equal.

Third, since rebate improves consumer surplus to a greater extent than matching, we can expect that donors are more likely to prefer receiving rebate than matching (**Hypothesis 3-1**). It is especially true for donors who increase their actual donation expenditure as a result of receiving the treatment. Thus, the treatment effect on the initially selected amount for donors who self-select to receive rebate will exceed the treatment effect for donors who self-select to receive matching. Next, the treatment effect is expected to be more significant for donors who voluntarily receive matching/rebate than for those who receive the treatments in a compulsory manner (**Hypothesis 3-2**). Further, the difference in TOT effects on the total donation amount between matching and rebate is vary depending on donors' warm-glow preference (**Hypothesis 3-3**).

3.2.Analytical Procedure

3.2.1. Basic Analysis Plan

We describe our primary analysis. We consider the following linear regression model.

$$y_i = \alpha + \sum_{g \in \{CM, CR, SM, SR\}} \tau_g^{ITT} Z_{ig} + \epsilon_i,$$

y_i represents the total amount donated to the charity or initially selected amount by individual i. In addition, g represents each group in the RCT, where CM, CR, SM, and SR represent the groups receiving the compulsory matching treatment, compulsory rebate treatment, self-selection matching treatment, and self-selection rebate treatment, respectively. Z_{ig} is a dummy variable that takes 1 if individual i is assigned to group g and 0 otherwise. α represents a constant term, and τ_g represents the average treatment effect in each group. In particular, for SM and SR, where treatment is determined by self-selection, τ_g represents the intention-to-treat (ITT) effect since it is the treatment effect for the treatment group as a whole. Finally, ϵ_i represents the error term.

We consider the following two-stage regression model to identify the treatment effect for those who receive treatment (TOT effect: treatment-on-treated effect).

$$\text{1st stage: } D_i = \beta + \sum_{g \in \{SM,SR\}} \gamma_g Z_{ig} + \eta_i,$$

$$\text{2nd stage: } y_i = \alpha + \sum_{g \in \{SM,SR\}} \tau_g^{TOT} \widehat{D}_{ig} + \epsilon_i,$$

where D_i is a self-selection dummy that takes 1 if individual i selects to receive the treatment and 0 otherwise. γ_g represents the probability that an individual will receive the treatment if assigned to group g. Also, η_i represents the error term in the first-stage estimation. A two-stage estimation method is used to estimate these unknown parameters.

We first test the following null hypotheses to analyze differences in the treatment effects of rebate and matching on initially selected amounts and total donation amounts.

$$H_0: \hat{\tau}_{CM}^{ITT} = \hat{\tau}_{CR}^{ITT},$$

From our hypotheses setting, we determine predict the relationship between these treatment effects when the outcome is the total amount donated, but we would expect $\hat{\tau}_{CM}^{ITT} < \hat{\tau}_{CR}^{ITT}$ for initially selected amounts.

Next, we test the following null hypotheses for the probability of selecting a treatment.

$$H_0: \hat{\gamma}_{SM} = \hat{\gamma}_{SR},$$

From the above hypotheses, we can expect $\hat{\gamma}_{SM} \leq \hat{\gamma}_{SR}$, since donors are expected to prefer matching over rebate.

Finally, we examine the following null hypotheses regarding the effects of self-selected rebate treatment and matching treatment.

$$H_0: \hat{\tau}_{CM}^{ITT} = \hat{\tau}_{SM}^{TOT},$$

$$H_0: \hat{\tau}_{CR}^{ITT} = \hat{\tau}_{SR}^{TOT},$$
$$H_0: \hat{\tau}_{SM}^{TOT} = \hat{\tau}_{SR}^{TOT},$$

From the hypotheses, we expect $\hat{\tau}_{CM}^{ITT} \leq \hat{\tau}_{SM}^{TOT}$, $\hat{\tau}_{CR}^{ITT} \leq \hat{\tau}_{SR}^{TOT}$ because donors with higher treatment effectiveness are expected to receive treatments when self-selection is used rather than compulsory treatments. We also expect $\hat{\tau}_{SM}^{TOT} \leq \hat{\tau}_{SR}^{TOT}$ because donors prefer rebate over matching.

3.2.2. Further Analysis Plan (considering the upper limit of donation)

[**Figure 1** is here]

Those who receive the rebate treatment have a different upper limit of donation than the matching or control group. **Figure 1** shows the difference in this upper limit. We assume that the donor is given 1,000 JPY, from which she decides how much to donate. If the donor is assigned to the control group when she initially selects x JPY for the donation, the total amount donated to charity is x JPY, and the actual donation expenditure is $1{,}000 - x$ JPY. Therefore, the maximum actual donation expenditure and the total amount donated is 1,000 JPY.

On the other hand, if the donor receives a 1:1 matching treatment, when she initially selects x JPY for the donation, the total amount donated is $2x$ JPY, and the actual donation expenditure is $1{,}000 - x$ JPY. Since the initially selected amount is x JPY, the upper limit remains 1,000 JPY, but the total amount donated is $2x$ JPY, so the upper limit becomes 2,000 JPY. Also, suppose a donor receives the 50% rebate treatment. In that case, she initially selects x JPY for the donation, the total amount donated is x JPY, and the actual donation expenditure is $1{,}000 - x$ JPY. However, if the donor receives rebate treatment, actual donation expenditure is deducted, so actual donation expenditure is $1/2\, x$ JPY. Therefore, the maximum actual donation expenditure is 500 JPY. Thus, the maximum actual donation expenditure and the total amount donated vary depending on the rebate or matching treatment.

Although the rebate and matching are identical in changing the price of donations, they have different upper limits on actual donation expenditure and the total amount donated to the charity. This difference is problematic when comparing the treatment effects of rebate and matching. If we compare these treatment effects without considering this difference, the impact of the rebate may be underestimated compared to the treatment effect of matching. Therefore, we design our experiment that accounts for this difference in the upper limit of donation.

[**Table 2** is here]

To address this difference, we set the donor's budget at 1,000 JPY and establish two upper limits of donation for the same donor: one with the maximum total amount donation of 2,000 JPY (maximum actual donation expenditure of 1,000 JPY) and the other with the maximum total amount donation limited to 1,000 JPY (maximum actual donation expenditure of 500 JPY) (**Table 2**). We also allow donors in the self-selection condition to decide whether to opt-in or not before determining the initially selected amount under each upper limit. Then, we conduct our analysis after equalizing the upper limit of donation for each donor. **Table 2** shows where each group donates 80% of their maximum donation to the donor under their respective upper limit.

Under this experimental design, we compare the effects of matching and rebate using the areas highlighted in orange in **Table 2**. Specifically, we compare matching versus rebate using a condition with a maximum total amount donated of 2,000 JPY for the control and compulsory rebate groups and a maximum total amount donated of 1,000 JPY for compulsory matching. For the self-selected group, we use an upper limit of 2,000 JPY for rebates. On the other hand, if the same donation limit is used for matching, the upper limit will be different for those who opt-in and those who do not opt-in. Therefore, we will use the upper limit of 1,000 JPY for those who opt-in and the upper limit of 2,000 JPY for those who do not.

4. Results

[**Table 3** is here]

First, we set the initially selected amount as one outcome variable and test Hypothesis 1. The estimation results in column 1 of **Table 3** show that the initially selected amount in the compulsory matching group is 62.71 JPY lower than in the control group (p<.01), and that in the compulsory rebate group is 164.20 JPY higher than in the control group (p<.01). A direct comparison of the two treatment groups shows that the initially selected amount in the compulsory matching group is 226.91 JPY lower than in the compulsory rebate group (p<.01), which supports Hypothesis 1.

Second, we set the total donation amount as another outcome variable and test Hypothesis 2. The estimation results in column 3 of **Table 3** show that the total donation amount in the compulsory matching group is 223.50 JPY higher than in the control group (p<.01), and that in the compulsory rebate group is 164.20 JPY higher than in the control group (p<.01). A direct comparison of the two treatment groups shows that the total donation amount in the compulsory matching group is 59.30 JPY higher than in the compulsory rebate group (p<.05), which supports one mechanism of Hypothesis 2, by which warm glow moderates the substitution effect.

[**Table 4** is here]

Third, we focus on the self-selection groups and conduct multiple tests of Hypothesis 3. When we compare the take-up rate for matching (48.75%) to that for rebate (50.42%), the difference between the two is not statistically significant and does not support the hypothesis that donors prefer rebate over matching. However, the treatment effect on the initially selected amount among those who self-select to receive the treatment is -99.57 JPY (p<.05) for matching and 165.70 JPY (p<.01) for rebate (column 1 of **Table 4**). This TOT effect is still smaller for matching than for rebate (p<.01).

Further, the treatment effect on the total donation amount among those who self-select to receive the treatment is 516.70 JPY (p<.01) for matching and 165.70 JPY (p<.01) for rebate (column 3 of **Table 4**). The hypothesis that this TOT effect will become larger than the ITT of the compulsory treatment is supported for matching (p<.01), but not supported for rebate (p=0.97). As a consequence, the TOT effect on the total donation amount is larger with matching than with rebate (p<.01). While this tendency itself is the same as in the case of the compulsory treatments, the difference between the matching and rebate treatment effects on the total donation amounts is larger in the case with a self-selection process (351.0 JPY) than in the case when using compulsory treatments (59.30 JPY). That is, the superiority of matching over rebate for the total donation amount is more pronounced in the case of a self-selection process. These results are stably observed after controlling for covariates.

5. Conclusions

Standard economic theory predicts that matching and rebates will have the same effect on individuals' donation behavior when the donation price is equivalent. However, several experimental studies have reported that their donation behaviors are promoted under matching more than under rebate. This study reveals how treatment effects of matching and rebate change when people can self-select whether to use such schemes or not. Although most traditional policy research has measured the causal effects of mandatory policy assignment, policies in the real world are often applied to only those who accept them. We conduct an incentivized and nationwide experiment on 2,400 Japanese residents with four treatments, the 1:1 matching treatments (compulsory and self-selection) and the 50% rebate treatments (compulsory and self-selection), and provide the following findings: Initially selected amount under the compulsory matching is smaller than under the compulsory rebate, while total amount donated to the charity under the former scheme is larger than that under the latter scheme, which is consistent with the existing theories (Hungerman and Ottoni-Wilhelm, 2021). The treatment effect on the total donation amount among people who self-select to receive the treatment is larger under the matching scheme than under the rebate scheme, and this difference is further larger than that in the case when using compulsory treatments. That is, the superiority of matching over rebate for the total donation amount gets more pronounced in the case of a self-selection process.

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Tables and Figure

Table 1. Balance Check

	(1) Control	(2) 1 to 1 matching Compulsory	(3) 1 to 1 matching Self-selection	(4) 50% rebate Compulsory	(5) 50% rebate Self-selection	p-val.
Female	0.502	0.502	0.502	0.502	0.502	1.000
	(0.023)	(0.023)	(0.023)	(0.023)	(0.023)	
Married	0.550	0.492	0.517	0.546	0.517	0.350
	(0.023)	(0.023)	(0.023)	(0.023)	(0.023)	
Having children	0.248	0.237	0.258	0.283	0.246	0.547
	(0.020)	(0.019)	(0.020)	(0.021)	(0.020)	
Age	46.398	46.369	45.946	46.108	46.144	0.983
	(0.595)	(0.601)	(0.606)	(0.603)	(0.600)	
Educational years	14.493	14.748	14.634	14.692	14.760	0.274
	(0.097)	(0.096)	(0.097)	(0.094)	(0.093)	
Household income	587.961	566.012	581.190	619.613	609.509	0.124
	(16.838)	(15.179)	(15.092)	(17.060)	(16.418)	
No income information	0.198	0.165	0.169	0.171	0.185	0.655
	(0.018)	(0.017)	(0.017)	(0.017)	(0.018)	
Living in urban areas	0.554	0.556	0.563	0.560	0.571	0.988
	(0.023)	(0.023)	(0.023)	(0.023)	(0.023)	
Number of observations	480	480	480	480	480	

Note: Some participants did not answered annual household income. We imputed the average amout of the income for such respondents while considering that they did not answer it by using the variable of no income information.

Table 2. Experimental Design

	Control	1 to 1 matching Compulsory	1 to 1 matching Self-selection		50% rebate Compulsory	50% rebate Self-selection	
			opt-in	no		opt-in	no
Budget constraint (JPY)	**1,000**						
Upper limit of total amount donated to the charity (JPY)	**2000（Upper limit of actual donation expenditure: 1,000）**						
(i) Initially selected amount (JPY)	800	800	800	800	800	800	800
(ii) Actual donation expenditure (JPY)	800	800	800	800	400	400	800
(iii) Reward to self (JPY)	200	200	200	200	600	600	200
(iv) Total amount donated to the charity (JPY)	800	1,600	1,600	800	800	800	800
Budget constraint (JPY)	**1,000**						
Upper limit of total amount donated to the charity (JPY)	**1,000（Upper limit of actual donation expenditure: 500）**						
(i) Initially selected amount (JPY)	400	400	400	400	400	400	400
(ii) Actual donation expenditure (JPY)	400	400	400	400	200	200	400
(iii) Reward to self (JPY)	600	600	600	600	800	800	600
(iv) Total amount donated to the charity (JPY)	400	800	800	400	400	400	400

Table 3. Intention-to-Treat (ITT) Effects

	(1)	(2)	(3)	(4)
Dependent variable =	**Initially selected amount**		**Total amount donated to the charity**	
CM: 1 to 1 matching	-62.71***	-62.91***	223.5***	221.9***
(Compulsory)	(17.56)	(17.17)	(23.93)	(23.33)
OM: 1 to 1 matching	-48.54***	-47.12***	251.9***	253.0***
(Self-selection)	(18.74)	(18.19)	(27.28)	(26.44)
CR: 50% rebate	164.2***	162.1***	164.2***	160.9***
(Compulsory)	(22.40)	(21.59)	(22.40)	(21.59)
OR: 50% rebate	83.54***	81.99***	83.54***	81.13***
(Self-selection)	(22.44)	(21.86)	(22.44)	(21.98)
Female		53.36***		67.00***
		(12.58)		(16.23)
Married		8.04		2.75
		(16.74)		(21.21)
Having children		(13.71)		(6.36)
		(17.25)		(21.90)
Age		5.045***		6.834***
		(0.53)		(0.68)
Educational years		3.25		6.600*
		(3.06)		(4.00)
Household income		0.0715***		0.0801***
		(0.02)		(0.02)
No income information		-41.86**		-60.03***
		(16.90)		(21.38)
Living in urban areas		8.27		(0.94)
		(12.46)		(16.05)
Constant	349.0***	1.672	349.0***	-132.0*
	(14.84)	(54.27)	(14.84)	(70.19)
Number of observations	2,400	2,400	2,400	2,400
R-squared	0.071	0.132	0.051	0.116
CM v.s. CR	0.000	0.000	0.018	0.012
OM v.s. OR	0.000	0.000	0.000	0.000
CM v.s. OM	0.339	0.273	0.339	0.277
CR v.s. OR	0.001	0.001	0.001	0.001

Notes: *** p<0.01, ** p<0.05, * p<0.1. The numbers in the bottom part show P-values of hypothesis testings.

Table 4. Treatment-on-Treated (ITT) Effects

	(1)	(2)	(3)	(4)
Dependent variable =	**Initially selected amount**		**Total amount donated to the charity**	
TOT of matching	-99.57**	-96.57**	516.7***	520.4***
	(40.80)	(39.62)	(51.97)	(50.71)
TOT of rebate	165.7***	162.7***	165.7***	163.5***
	(39.45)	(38.40)	(50.25)	(49.15)
Covariates	OUT	IN	OUT	IN
Number of observations	2,400	2,400	2,400	2,400
TOT of M = TOT of R	0.000	0.000	0.000	0.000
CM = TOT of M	0.297	0.325	0.000	0.000
CR = TOT of R	0.964	0.986	0.972	0.969

Notes: *** p<0.01, ** p<0.05, * p<0.1. The numbers in the bottom part show P-values of hypothesis testings.

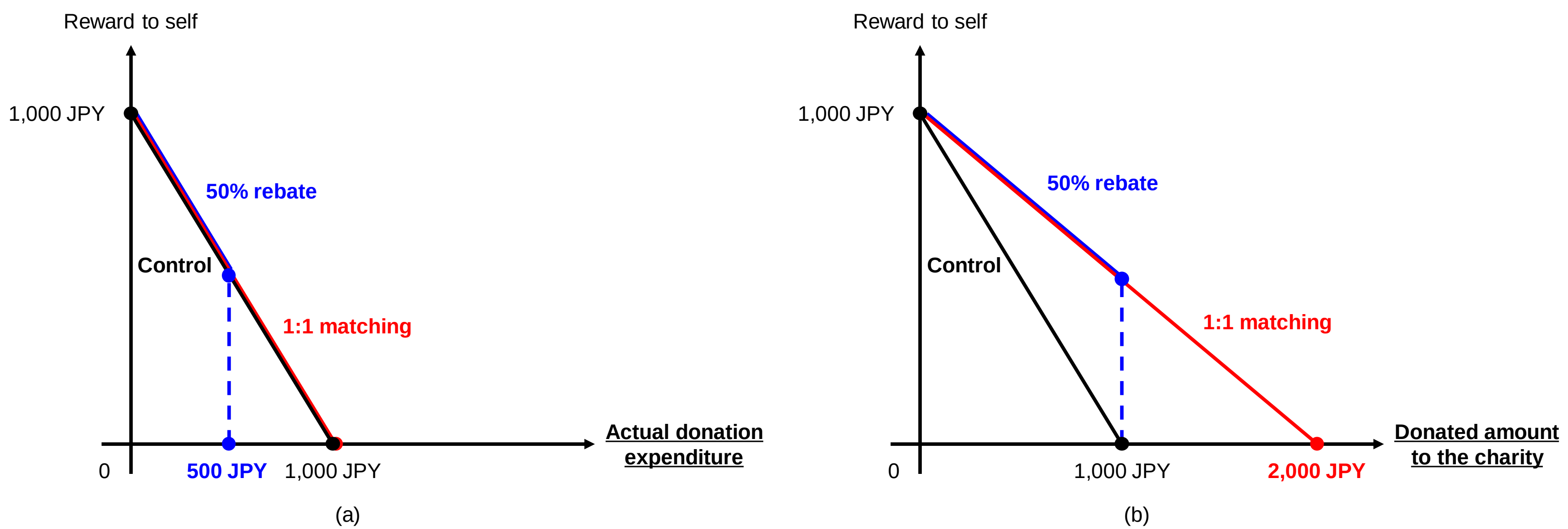

Figure 1. Budget Constraint Lines

Theoretical Background of "Rebate versus matching, again: Does opt-in matter?"

Shusaku Sasaki [1], Takunori Ishihara [2], and Hiroki Kato [3]

[1]Center for Infectious Disease Education and Research (CiDER), Osaka University
[2]Institute for International Academic Research, Kyoto University of Advanced Science
[3]Graduate School of Economics, Osaka University

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1 Theoretical Predictions

1.1 Setup and Optimal Giving

To derive theoretical predictions, we use the impure impact giving model (Hungerman and Ottoni-Wilhelm, 2021). Suppose that a donor obtains utility from private consumption (c), the out-of-pocket gift to the charity (g), and the charity's amount received (G), that is, $U(c, g, G)$. The donor tries to maximize utility subject to two constraints. The first constraint is the budget constraint: $c + g = y + tg$, where t is a rebate rate. The second constraint is the relationship between out-of-pocket gifts and the amount received: $G = (1 + m)g$, where m is a match rate. Using two constraints, we can produce a constraint in terms of the amount received as follows:

$$c + p_t p_m G = y, \tag{1}$$

where the rebate price is $p_t = 1 - t$ and the match price is $p_m = 1/(1 + m)$. Substituting equation (1) into utility, we have

$$U(y - p_t p_m G, p_m G, G). \tag{2}$$

Note that $g = G/(1 + m) = p_m G$.

We determine the amount received G to maximize the utility (2). The first-order condition is

$$-p_t p_m U_c(y - p_t p_m G, p_m G, G) + p_m U_g(\cdot, \cdot, \cdot) + U_G(\cdot, \cdot, \cdot) = 0. \tag{3}$$

This equation depends on three exogenous factors: own income y, the first price term $p_t p_m$, and the second price term p_m. Thus, the optimal amount received is a function of these arguments:

$$G^* = q(y, p_t p_m, p_m). \tag{4}$$

Also, the optimal out-of-pocket gift is

$$g^* = p_m q(y, p_t p_m, p_m). \tag{5}$$

Under the rebate incentive system, the optimal out-of-pocket gift is equivalent to the amount received. However, under the matching inventive system, the optimal out-of-pocket gift is different from the amount received.

1.2 Price Effects

First, we predict the rebate-price effect and the match-price effect. The rebate-price effect is

$$\frac{\partial G^*}{\partial p_t} = \frac{-p_m U_c}{\Delta} - \frac{\partial G^*}{\partial y} p_m G^*, \tag{6}$$

where Δ is the negative of the second-order condition, that is, $\Delta > 0$. Assuming the amount received is normal goods so that the income effect $\partial G^* / \partial y$ is positive, we predict that the rebate-price effect is always negative.

We can decompose the rebate-price effect into the conventional Sltsuky equation:

$$\begin{aligned} e_t &= \frac{\partial G^*}{\partial p_t} \frac{p_t}{G^*} \\ &= \frac{-p_m p_t U_c}{G^* \Delta} - \frac{\partial G^*}{\partial y} p_t p_m \\ &= \frac{-p_m p_t U_c}{G^* \Delta} - \left(\frac{\partial G^*}{\partial y} \frac{y}{G^*} \right) \left(p_t p_m \frac{G^*}{y} \right) \\ &= e_t^H - e_y b_G, \end{aligned} \tag{7}$$

where e_t^H is compensated rebate-price elasticity (negative), e_y is income effect (positive), and b_G

is the amount received as a proportion of income.

Next, the match-price effect is

$$\begin{aligned}\frac{\partial G^*}{\partial p_m} =& \frac{-p_t U_c}{\Delta} - \frac{\partial G^*}{\partial y} p_t G^* \\ &+ \frac{U_g}{\Delta} - \frac{p_m p_t U_{gc} - p_m U_{gg} - U_{Gg}}{\Delta} G^*.\end{aligned} \tag{8}$$

The third and fourth term comes from the warm-glow utility (U_g). We have the Sltsuky decomposition of the match-price effect as follows:

$$\begin{aligned}e_m =& \frac{\partial G^*}{\partial p_m} \frac{p_m}{G^*} \\ =& \frac{-p_m p_t U_c}{G^* \Delta} - \frac{\partial G^*}{\partial y} p_m p_t + \frac{p_m U_g}{G^* \Delta} - \frac{p_m p_t U_{gc} - p_m U_{gg} - U_{Gg}}{\Delta} p_m \\ =& \left(\frac{-p_m p_t U_c}{G^* \Delta} + \frac{p_m U_g}{G^* \Delta} - \frac{p_m p_t U_{gc} - p_m U_{gg} - U_{Gg}}{\Delta} p_m - \frac{\partial G^*}{\partial y} \frac{U_g}{U_c} p_m \right) \\ &- \frac{\partial G^*}{\partial y} p_m p_t + \frac{\partial G^*}{\partial y} \frac{U_g}{U_c} p_m \\ =& e_m^H - \left(\frac{\partial G^*}{\partial y} \frac{y}{G^*} \right) \left(p_t p_m \frac{G^*}{y} - \frac{U_g}{U_c} p_m \frac{G^*}{y} \right) \\ =& e_m^H - e_y \tilde{b}_G\end{aligned} \tag{9}$$

where e_m^H is the compensated match-price elasticity. To compare with the rebate-price elasticity, we rewrite the Sltsuky equation of match-price as follows:

$$\begin{aligned}e_m &= e_t^H + \frac{p_m U_g}{G^* \Delta} - \frac{p_m p_t U_{gc} - p_m U_{gg} - U_{Gg}}{\Delta} p_m - \frac{\partial G^*}{\partial y} p_m p_t \\ &= e_t^H + \left(\frac{p_m U_g}{G^* \Delta} - \frac{p_m p_t U_{gc} - p_m U_{gg} - U_{Gg}}{\Delta} p_m \right) - e_y b_G.\end{aligned} \tag{10}$$

The match-price elasticity is different from the rebate-price one due to the second term. This term comes from the warm-glow part of compensated match-price elasticity e_m^H. Thus, a change of substitution effect due to warm-glow preferences creates the difference between e_m and e_t. We summarize the price effect on the amount received as follows:

Prediction 1 (Effect on Amount Received). (a) If warm-glow preferences weaken the conventional substitution effect, then $e_m > e_t$. (b) On the other hand, if warm-glow preferences strengthen the conventional substitution effect, then $e_t > e_m$. (c) If a donor has pure impact preferences (no warm-glow preferences), then $e_t = e_m$.

The rebate-price elasticity of the out-of-pocket gift is also e_t because the optimal out-of-pocket is same as the optimal amount received for any preference. However, the match-price elasticity of the out-of-pocket gift is different from e_m. By $g^* = p_m G^*$, the match-price effect on the out-of-pocket gift is

$$\frac{\partial g^*}{\partial p_m} = G^* + p_m \frac{\partial G^*}{\partial p_m}. \tag{11}$$

The match-price elasticity of the out-of-pocket gift, $e_{m,o}$ is

$$\begin{aligned} e_{m,o} &= G^* \frac{p_m}{g^*} + \frac{\partial G^*}{\partial p_m} p_m \frac{p_m}{g^*} \\ &= 1 + \frac{\partial G^*}{\partial p_m} \frac{p_m}{G^*} \\ &= 1 + e_m. \end{aligned} \tag{12}$$

Using the equation (10), we rewrite $e_{m,o}$ as follows:

$$e_{m,o} = e_t^H + \left(1 + \frac{p_m U_g}{G^* \Delta} - \frac{p_m p_t U_{gc} - p_m U_{gg} - U_{Gg}}{\Delta} p_m\right) - e_y b_G. \tag{13}$$

the expression in brackets is always positive because $(p_m p_t U_{gc} - p_m U_{gg} - U_{Gg})/\Delta$ is less than one. Thus, we have $e_{m,o} > e_t$.

As an extreme case, consider the match-price elasticity of the out-of-pocket gift for the pure warm-glow donor ($U_G = 0$ for any G). By the first-order condition, we have

$$\begin{aligned} & e_t^H + \frac{p_m U_g}{G^* \Delta} \\ =& \frac{-p_m p_t U_c}{G^* \Delta} + \frac{p_m U_g}{G^* \Delta} \\ =& 0. \end{aligned} \tag{14}$$

Moreover, by the second-order condition, we have

$$\begin{aligned} & \frac{p_m p_t U_{gc} - p_m U_{gg} - U_{Gg}}{\Delta} p_m + e_y b_G \\ =& \frac{p_m p_t U_{gc} - p_m U_{gg} - U_{Gg}}{\Delta} p_m + \frac{\partial G^*}{\partial y} p_t p_m \\ =& \frac{p_m p_t U_{gc} - p_m U_{gg} - U_{Gg}}{\Delta} p_m + \frac{-p_m p_t U_{cc} + p_m U_{gc}}{\Delta} p_t p_m \\ =& 1. \end{aligned} \tag{15}$$

Thus, $e_{m,o} = 0$ for the pure warm-glow donor.

Finally, we summarize the price effect on the out-of-pocket gift as follows:

Prediction 2 (Effect on Out-of-pocket Gift). For any preference, $e_{m,o} > e_t$. That is to say, the matching incentive is less effective than the rebate incentive in terms of the out-of-pocket gift. Especially, the matching incentive does not affect the out-of-pocket gift for the pure warm-glow donor.

1.3 Opt-in Decision

We predict whether donors use the matching or rebate incentive, using the indirect utility. Substituting the optimal amount received (4) into the direct utility (2), we have indirect utility as follows:

$$\begin{aligned} &V(y, p_m, p_t) \\ =&U(y - p_t p_m G(y, p_m p_t, p_m), p_m G(y, p_m p_t, p_m), G(y, p_m p_t, p_m)). \end{aligned} \tag{16}$$

Using the envelope theorem, the effect of the rebate-price on indirect utility is

$$\frac{\partial V}{\partial p_t} = -p_m U_c G^*. \tag{17}$$

The effect of the rebate-price on indirect utility is negative, that is, introducing the rebate incentive scheme increases indirect utility. Since the term $-p_m U_c$ strengthens the rebate-price effect (6), the stronger this effect is, the more sensitive the optimal amount received is.

Also, the effect of the match-price on indirect utility is

$$\frac{\partial V}{\partial p_m} = (-p_t U_c + U_g) G^*. \tag{18}$$

This effect is weaker than the effect of the rebate-price on indirect utility. Especially, for the pure warm-glow donors, this effect is zero because $-p_t U_c + U_g = 0$. Since $-p_t U_c + U_g$ strengthens the match-price effect (8), the stronger this effect is, the more sensitive the optimal amount received is.

Prediction 3 (Opt-in Decision). (a) Let $p_m = p_t$. Then, $\frac{\partial V}{\partial p_m} \geq \frac{\partial V}{\partial p_t}$. That is to say, the rebate incentive scheme strictly prefer or indifferent to the matching incentive scheme for any preferences. In particular, the pure impact donor is indifferent between the two incentives. Also, the matching incentive scheme does not improve the utility of the pure warm-glow donor. (b) The more donors who increase their donations by offering incentives, the more they will use the incentives.