An Experimental Study on the Crowding-Out Effect with Both Publicly and Privately Provided Public Goods

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Abstract. The theoretical and experimental literature on crowding-out usually assumes that taxes and voluntary contributions are used to fund the "same" public good. Based on this assumption, theoretical models of both pure and impure altruism predict a result of crowding-out that is unable to explain an outcome of crowding-in. This experimental study examines the crowding-out effect when both publicly and privately provided public goods are present. It is found that when both publicly and privately provided public goods are equally valuable to subjects, or when the former is more valuable than the latter, the traditional results of crowding-out occur. However, crowding-in is present if the privately provided public good is relatively more valuable than the publicly provided public good.

1. INTRODUCTION

Many public goods are jointly provided by both the public and private sectors. Education and charitable activities are examples. The theoretical papers by Warr (1982, 1983), Roberts (1984, 1987), and Bergstrom, Blume, and Varian (1986) suggest that government contributions to the public goods provided by the private sector may be neutral. In their models, each individual *i* has an income w_i and pays a lump-sum tax τ_i ($0 < \tau_i \leq w_i$). The government uses the lump-sum tax to fund the public good. After paying the tax, individual *i* voluntarily makes a contribution g_i to the public good and spends the rest of his or her income on private good consumption x_i. Call g_i individual *i*'s voluntary contribution to the public good, and the tax the government's contribution to the public good. The total supply of the public good is the sum of all individuals' voluntary contributions ($G = \sum_i g_i$) and government contributions ($T = \sum_i \tau_i$). Individual *i* maximizes utility $u_i(x_i, G+T)$, subject to his or her budget constraint $x_i + g_i + \tau_i = w_i$. Since voluntary contributions and government contributions to the public good are perfect substitutes in the utility function, if τ_i does not exceed individual *i*'s voluntary contribution in the situation without the tax, individual *i* will simply substitute government contributions for voluntary contributions dollar for dollar as his or her tax increases. As a result, government contributions to the public good will completely crowd out voluntary contributions. That is, government contributions to the public good are neutral.

In the above setting the individual's preference toward the public good is purely altruistic. That is, he or she only cares about the total contribution $G+T$ to the public good, not his or her voluntary contribution, g_i, nor the relative magnitudes of the voluntary and government contributions that make up the total contribution. In an approach differing from the above

model, Andreoni (1989, 1990) assumes that, besides the total contribution, an individual also receives utility from the act of giving, which he refers to as "warm-glow." By adding the warm-glow component g_i to the utility function, the utility function becomes $u_i(x_i, G+T, g_i)$. The government contribution and voluntary contribution are no longer perfect substitutes, and therefore, the voluntary contribution will be incompletely crowded out by the government contribution. The experimental study of Andreoni (1993) and Bolton and Katok (1998) found that the degree of crowding-out is of the order of seventy percent, which is extensive but incomplete. Some empirical studies (Abrams and Schitz, 1978; Reece, 1979; Schiff, 1985; Kingma, 1989; Khanna, Posnett, and Sandler, 1995; Payne, 1998, 2001; Khanna and Sandler, 2000; Okten and Weisbrod, 2000; and Hungerman, 2005) and experimental examinations (Chan, Godby, Mestelman, and Muller, 2002; and Crumpler and Grossman, 2008) have found evidence exhibiting slight or modest levels of crowding-out, sometimes even an outcome of crowding-in, and hence supporting Andreoni's theoretical prediction of partial crowding-out.[1]

Despite the addition of the warm-glow component, similar to previous theoretical and empirical setting, Andreoni (1989) also assumes that the public good consumption comes from the *sum* of government and voluntary contributions. This setting, as commented by Kingma (1989) on previous empirical studies, is based on a broad definition of charity and government support. In his empirical examination, Kingma (1989) estimated the crowding-out effect by using the data consisting of observations on the level of individual contributions to a given charity – public radio – and the observations on the level of fund received from all other sources. Public goods like public radio and public television do receive funds from both the public and

[1] Eckel, Grossman, and Johnston (2005) found mixed results. By informing subjects that the fund allocated to the charity comes from their tax, the level of crowding-out is nearly 100%. On the contrary, the level of crowding-out is close to zero without providing subjects with this information.

private sectors, but many public goods are provided by either the public or the private sector, not both. Although the government often subsidizes private charities and culture-related organizations, many public goods are still funded by the private sector alone, receiving no support from the government. Churches, the Red Cross, private shelters, private dog pounds, private lighthouses and many others are examples. The investigations of Hungerman (2005) and Gruber and Hungerman (2007) on crowding-out between church donations and state government spending are along this line.[2]

Given the assumption that voluntary and government contributions are used to fund the "same" public good, the two types of contributions indeed yield the same marginal benefits to individuals. Hence, this assumption excludes any possibility that individuals may benefit more from the additional contribution of either one than the other, and the subsequent influences that taxes (government contributions) may have on voluntary contributions. Furthermore, when confined to this assumption, both pure altruism and warm-glow based impure altruism can only predict a degree of crowding-out between zero and one (Andreoni, 1989, 1990), and are unable to explain the outcome of a crowding-in found in some empirical studies (Khanna, Posnett, Sandler, 1995; Okten and Weisbrod, 2000). These observations give rise to the consideration as

[2] The data used in empirical studies are diversified. For instance, Roberts (1984) used a broad data set of private charity and public transfers, Schiff (1985) also relied on a broad definition of government spending and charitable contributions. Khanna, Posnett, and Sandler (1995) and Payne (1998) investigated crowding-out in less broad categories. The categories used by Khanna, Posnett, and Sandler (1995) were health, overseas, religion, and social welfare charities and used by Payne (1998) were crime or disaster, employment or youth, food or shelter, and human services. Similar to Kingma (1989), Brunner (1997) also used public radio stations as the example in his examination. Payne (2001) examined crowding-out between private and public donations to research universities and non-research institutions. Borgonovi (2006) examined crowding-out between American theatres that are members of Theatre Communication Group and the public support from federal, state, and local funding.

to under what conditions crowding-in rather than crowding-out will occur.[3]

This paper attempts to examine the crowding-out effect by assuming that taxes (government contributions) and voluntary contributions are used to fund different public goods. Specifically, voluntary contributions are used to fund a privately provided public good (G) and taxes are used to fund a publicly provided public good (T). Total contributions Q are still the sum of G and T, but the two public goods are separable in the utility function. By varying the amount of the tax and the magnitudes of the marginal per capita returns (MPCRs) of the two public goods, the degree of crowding-out or crowding-in can be measured when the privately provided public good is relatively more valuable as compared with the publicly provided public good, and vice versa.

The main findings of this paper are the following. When both publicly and privately provided public goods are equally valuable to subjects, or when the former is more valuable than the latter, the traditional result of crowding-out occurs. On the contrary, the outcome of crowding-in is more likely to take place if the privately provided public good is relatively more valuable as compared with the publicly provided public good. Furthermore, the regression analysis shows that the tax only has a small or insignificant effect on voluntary contributions and voluntary contributions increase significantly with the MPCR of the privately provided public good. The remainder of this paper is organized as follows. Section 2 describes the

[3] Crumpler and Grossman (2008) specifically test the warm-glow motive. Subjects in their experiment played a modified dictator game in which a pure altruist has no incentive to donate. They found that 56.9% of the unconfused subjects contributed a positive amount, significantly different from zero contributions predicted by the pure altruism model. Therefore, they conclude that warm-glow giving exists and is significant. By using functional magnetic resonance imaging to observe subjects' neural activities in a dictator game, Harbaugh, Mayr, and Burghart (2007) split the sample into "altruists" (who care about the total contribution) and "egoists" (who care only about their own contribution) depending on their neural responses to the charity's payoff and their own payoff. They found that altruists gave money nearly twice as often as egoists.

experimental design. Section 3 presents the results of the experiments. Section 4 concludes.

2. EXPERIMENTAL DESIGN

The fundamental experimental design of this paper is similar to those of the experiments on the voluntary-contribution mechanism. In the experiment, each subject receives an exogenous amount of income of 100 points. The subject pays a lump-sum tax, if there is any, by which the amount of the tax is set up by the government. The tax is used to provide a publicly provided public good. After paying the tax, the subject determines how much of the income he or she is willing to contribute to a privately provided public good. Both publicly and privately provided public goods benefit only the members of the subject's group. A subject's income net of the tax and his or her voluntary contribution to the privately provided public good is his or her private good consumption. His or her payoff is the sum of the earnings from both types of public goods and his or her private good consumption.

[Table 1 about here]

Nine treatments were conducted in this research. Table 1 summarizes the magnitudes of the experimental parameters used in the nine treatments. To avoid emotional reactions and prevent subjects' incentives from being disturbed, only neutral terms were used in the experimental instructions. More specifically, "group account Y" was used to denote the publicly provided public good, which was funded by the tax. The term "tax" was avoided in the instructions and was phrased as the amount of the subject's income allocated to the group account Y. The phrase "group account Z" was used to denote the privately provided public good, which was funded by voluntary contributions. The term "voluntary contributions" was also avoided and was phrased as the amount of the subject's income allocated to the group

account Z.

Four to six sessions were conducted for each treatment and twelve subjects were recruited for each session. A total of 564 subjects were used in this study. All subjects were undergraduate students at National Chengchi University in Taiwan. They voluntarily participated in the experiment and had not previously participated in any public goods experiments. They made decisions over twenty rounds. In each round the twelve subjects in the same session were randomly and anonymously divided into three groups of size $n = 4$, and they were randomly re-matched when each new round began to avoid the reputation effect.

No tax was involved in the Only-Z treatment so that only the privately provided public good Z existed in this treatment. Taxes were present in the other eight treatments. The amount of the tax was 20 points in the YZ, HY, HZ, and LY treatments (the low-tax treatments), and was 40 points in the HT-YZ, HT-HY, HT-HZ, and HT-LY treatments (the high-tax treatments). The notation HT denotes the high tax.

In each round of the Only-Z treatment, the MPCR of the privately provided public good Z was set at 0.5. That is, each point voluntarily contributed to Z by a subject yielded a return of 0.5 points to *each* member in the same group. The magnitude 0.5 was used as the benchmark of the MPCR. Notice that the MPCR must meet the condition $1/n < \text{MPCR} < 1$ so that everyone has an incentive to contribute to the public good and to free ride. Both the publicly and privately provided public goods were present in the remaining eight treatments with the tax. In the YZ treatment, the MPCRs of both the publicly provided public good Y and the privately provided public good Z were set at 0.5. By varying either the MPCR of Y or the MPCR of Z, but not both, we can compare the levels of voluntary contributions under various relative magnitudes of the MPCRs of the two public goods. Furthermore, we can investigate whether

the degree of crowding-out depends on the relative favorableness of the two public goods.

The variations in the MPCRs were the following. In the HY (high MPCR of Y) treatment, the MPCR of Y was set at 0.7 and the MPCR of Z remained at 0.5. In the HZ (high MPCR of Z) treatment, the MPCR of Z was set at 0.7 and the MPCR of Y remained at 0.5. In the LY (low MPCR of Y) treatment, the MPCR of Y was reduced to 0.3 and the MPCR of Z remained at 0.5. The MPCRs in the HT-YZ, HT-HY, HT-HZ, and HT-LY treatments are defined similarly.[4]

The experimental procedures were as follows. At the beginning of each round for all treatments, each subject was endowed with an income of 100 points. In the Only-Z treatment, a subject decided to allocate his or her income between a group account Z (a privately provided public good) and a private account X (a private good). In the four low-tax treatments, i.e., the YZ, HY, HZ, and LY treatments, each subject was informed that 20 points of his or her income had been allocated to a group account Y (a publicly provided public good). In the four high-tax treatments, i.e., the HT-YZ, HT-HY, HT-HZ, and HT-LY treatments, this amount was 40 points. The subject's decision was to allocate the remaining 80 points (in YZ, HY, HZ, LY) or 60 points (in HT-YZ, HT-HY, HT-HZ, HT-LY) between the group account Z and the private account X. The number of points remaining in a subject's X account constituted his or her earnings from the X account. A subject's earnings from the Y account was the MPCR of Y times the group contribution to Y (which was 80 points for the low-tax treatments and 160 points for the high-tax

[4] To observe the effect of the relative MPCRs of the publicly and privately provided public goods on crowding-out, varying the magnitude of the MPCR of the publicly provided public good Y will be sufficient. Because a main purpose of this paper is to explore the possibility of crowding-in and a reasonable conjecture for its appearance is when the MPCR of Z is higher than the MPCR of Y, additional HZ and HT-HZ treatments are also conducted, but LZ and HT-LZ treatments are not. The example for HZ in the real world could be that people favor private shelters for stray dogs because private shelters do not euthanatize dogs but public shelters do. The example for LY is that some charitable organizations are less transparent in using donations or use donations not in accordance with donors' perspectives so that people favor charitable activities provided by the public sector.

treatments). A subject's earnings from the Z account was the MPCR of Z times the group contribution to Z.

Given the above procedure, the monetary payoff in each round for each subject *i* was the sum of the earnings from the X, Y, and Z accounts. That is,

$$\pi_i = (100 - \tau - g_i) + MPCR_Y \times n\tau + MPCR_Z \times \sum_{j=1}^{n} g_j, \quad (1)$$

in which τ is the amount of the tax paid by subject *i*, which is 20 points in the low-tax treatments and 40 points in the high-tax treatments, g_i is subject *i*'s voluntary contribution to group account Z, $n = 4$ is the size of the group, and $MPCR_Y$ and $MPCR_Z$ are respectively the MPCRs of group account Y and group account Z. Differentiating equation (1) with respect to g_i yields $-1 + MPCR_Z < 0$, implying that a monetary payoff maximizing subject will contribute zero points to the group account Z.

At the end of each round of the experiment, each subject was informed of an earnings report, which consisted mainly of the following information: the numbers of points allocated to the Y and Z accounts by each of the four members of the subject's group, the total and average points allocated to the Y and Z accounts by the subject's group, the subject's earnings from the X, Y, and Z accounts, the subject's monetary payoff for this round, and the subject's cumulated payoff until this round.[5]

In all sessions, subjects were given written instructions in Chinese. The experimenter read the instructions out loud, performed the calculations for two examples on the whiteboard, and answered any questions raised by the subjects. After reading the instructions, subjects were required to answer one quiz question related to the experiment. None of them answered them

[5] In the Only-Z treatment, since the group account Y did not exist, no information regarding the Y account was provided.

incorrectly. Each session lasted about 80 minutes. At the end of the experiment, very ten points earned by the subject was exchanged to NT$1. The average payoff (including a participation fee of NT$100) for all participants was NT$393.5 (with a standard deviation of NT$50.06, a maximum of NT$512.04, and a minimum of NT$264.4).[6]

3. EXPERIMENTAL RESULTS

[Table 2 and Figure 1 about here]

Table 2 provides some descriptive statistics for the nine treatments. Figure 1 specifically depicts the round averages and the standard errors of voluntary contributions and classifies the nine treatments by the magnitudes of the MPCR of Y and the MPCR of Z.[7] For instance, in Figure 1(a) both the YZ and HT-YZ treatments have the same MPCR of Y and MPCR of Z but have different amounts of the tax. Because the Only-Z treatment is characterized as a no-tax treatment, it is also plotted in Figures 1(a) through 1(c), in which those treatments all have the same MPCR of Z. The Only-Z treatment does not appear in Figure 1(d) as it is not comparable with the HZ and HT-HZ treatments.

Figure 1 shows that average voluntary contributions generally decay across rounds in all nine treatments. Although average voluntary contributions reach the minimum levels in the final several rounds, zero voluntary contributions predicted by monetary payoff maximization are not observed in any of the rounds for the nine treatments. Table 2 also confirms that by

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[6] The instructions were written in Chinese. All sessions were conducted between May 2009 and May 2010. During this period the exchange rate between the NT$ (New Taiwan dollar) and the US dollar was around NT$32 per US$. The part-time hourly wage rate for an undergraduate student in Taiwan was about NT$120.

[7] The standard error of the sample mean is calculated as $\sqrt{\sum_{i=1}^{n}(x_i-\bar{x})^2/(n-1)}\Big/\sqrt{n}$, where x_i is the value of the observation, $\bar{x}$ is the sample mean, and n is the sample size. Since the total contribution is simply the voluntary contribution plus the tax, the trends for average total contributions are not provided.

looking at the average of the twenty rounds, the highest percentage of zero contributions is 54.48 percent in the HT-HY treatment, which is far below the one hundred percent predicted by the theory. These observations are consistent with some experimental studies on voluntary contributions to public goods (Isaac, Walker, and Thomas, 1984; Andreoni, 1988, 1993, 1995; Isaac and Walker, 1988a, 1988b; and Isaac, Walker, and Williams, 1994). The following subsections will take a more detailed look at the experimental data.

3.1. The Effect of MPCRs

Table 2 shows that the two treatments with the high MPCR of the privately provided public good Z (i.e., the HZ and HT-HZ treatments) have the highest levels of average voluntary contributions as compared with the other treatments with the same amount of the tax. By looking at round averages, Figure 1(d) echoes this observation, showing that this fact holds in most rounds, and is enhanced when the tax is high. On the contrary, the two treatments with the high MPCR of the publicly provided public good Y (i.e., the HY and HT-HY treatments) have the lowest average voluntary contributions in almost every round as compared with other treatments with the same amount of the tax.

To have a more rigorous look at the effects of MPCRs on voluntary contributions, we can compare the voluntary contributions of the treatments with the same amount of the tax and the same MPCR of either public good. For the low-tax treatments, a two-sided Mann–Whitney U test shows that voluntary contributions are significantly higher in the YZ treatment than in the HY treatment in only round 1 ($p = 0.078$) and round 5 ($p = 0.055$), and the differences between the two treatments are insignificant in all other rounds.[8] Similarly, voluntary contributions are

[8] As mentioned in the Experimental Design, random re-matching was managed between the twelve subjects in the

significantly higher in the HZ treatment than in the YZ treatment in only round 9 ($p = 0.078$). The differences in voluntary contributions between the YZ and LY treatments and between the HY and LY treatments are insignificant in every round of the experiment.

For the high-tax treatments, the differences in voluntary contributions between the HT-YZ and HT-HY treatments are insignificant in all twenty rounds. Similarly, the differences in voluntary contributions are significantly higher in HT-LY than in HT-YZ ($p = 0.086$) and HT-HY ($p = 0.0275$) in only round 1, and are insignificant in all other rounds. The only dramatic difference is found when comparing the HT-HZ and HT-YZ treatments: voluntary contributions in the HT-HZ treatment are significantly higher than voluntary contributions in the HT-YZ treatment in round 1 ($p = 0.083$), round 9 ($p = 0.021$), round 10 ($p = 0.083$), round 12 ($p = 0.043$), rounds 13, 14, 17, 18 ($p = 0.083$), and by looking at the averages of rounds 11–15 ($p = 0.083$), rounds 16–20 ($p = 0.021$), and rounds 11–20 ($p = 0.043$). The above results are summarized in Result 1:

Result 1: When the tax is low, the change in the MPCR of the publicly or privately provided public good has no significant effects on voluntary contributions. When the tax is high, voluntary contributions are significantly higher when the MPCR of the privately provided public

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same session and therefore their choices may not be independent. Hence, in this and other Mann–Whitney U tests, the average of the twelve subjects' choices in each round is used as the round observation and the average of the round observations over a certain period is used as the observation for that period. These will be referred to as session-level data henceforth. Because session-level data are constructed by using average choices as observations, it is expected that significant differences between any two treatments are less likely to be found than by using individual subjects' choices. Therefore, Mann–Whitney U tests by using the individual subjects' choices as the observations (individual data) are also performed and it is found that the differences between treatments are indeed more profound as compared with those measured by session-level data. The results of using individual data will be reported in footnotes when necessary.

good is at the high level (0.7) than when both the publicly and privately provided public goods have the same MPCR.

The latter result in Result 1 brings about a concern that contributions to the privately provided public good may *not* be crowded out by the tax if the tax is high and if the privately provided public good is relatively more valuable to individuals as compared with the publicly provided public good. This issue will be investigated in Subsection 3.2.

3.2. The Effect of Crowding-out

How voluntary contributions are crowded out by the tax can be examined by comparing the voluntary and total contributions of the treatments with different levels of the tax. Since no tax is involved in the Only-Z treatment, the Only-Z treatment can serve as the control treatment for all other treatments with the tax and the same MPCR of the privately provided public good Z, namely, the YZ, HY, LY, HT-YZ, HT-HY, and HT-LY treatments. Moreover, the degree of crowding-out between any two treatments differing only in the level of the tax can also be examined. That is, the crowding-out effects can also be examined between YZ and HT-YZ, between HY and HT-HY, between HZ and HT-HZ, and between LY and HT-LY.

The degree of crowding-out is measured by $1 - (\mathrm{d}Q/\mathrm{d}T)$, where Q is the total contribution and T is the amount of the tax. Since $Q = G + T$, where G is the voluntary contribution, the degree of crowding-out is also equal to $-\mathrm{d}G/\mathrm{d}T$; that is, how much the amount of the reduction in G is attributed to the change in T. The degrees of crowding-out have the following possible values. First, complete crowding-out means that voluntary contributions are completely reduced by the tax, making total contributions unchanged. In this case the degree of

crowding-out is one. Second, if voluntary contributions are not affected by the tax at all so that total contributions are exactly increased by the amount of the tax, then the degree of crowding-out is zero. Third, the degree of crowding-out with any value between zero and one indicates incomplete crowding-out. Finally, if the tax not only reduces no voluntary contributions at all, but also raises voluntary contributions so that total contributions increase by more than the amount of the tax, then the degree of crowding-out is negative. The last case indicates a crowding-in.

A preliminary sketch of the crowding-out effect can be observed from Figure 1. When the tax increases from zero points to 20 points, the average voluntary contribution in each round of the Only-Z treatment is higher than those of the HY and LY treatments, and is also higher than that in the YZ treatment, except in rounds 10, 18, and 19. However, the differences are all smaller than the amount of the tax (20 points). Similar patterns are observed when the tax increases from zero points to 40 points: in each round the average voluntary contribution of the Only-Z treatment is higher than the average voluntary contributions of the HT-YZ, HT-HY, and HT-LY treatments, but the differences are all smaller than the amount of the tax.

When the tax increases from 20 points to 40 points, it is observed from Figures 1(a) through 1(d) that in most rounds the average voluntary contributions of the high-tax treatments are lower than those of their low-tax counterparts, but the differences are all smaller than the amount of the tax increment. The HT-HZ treatment even reveals higher average voluntary contributions than the HZ treatment in 13 out of 20 rounds. The HT-LY treatment also has higher average voluntary contributions than the LY treatment in rounds 1, 2, 14–18, and 20. These observations suggest that crowding-out is partial, and even a crowding-in occurs when the privately provided public good Z has a relatively higher MPCR than that of the publicly provided

public good Y.

[Tables 3, 4, and 5 about here]

Tables 3 to 5 report the degrees of average crowding-out, which are calculated by contrasting the average total contributions (or the average voluntary contributions) of two comparable treatments for various periods of the experiment. Let us start by looking at the case when the tax increases from zero points to 20 points. The upper half of Tables 3 to 5 provides the results. It is observed that the levels of average crowding-out between any two comparable treatments decrease as we move from rounds 1–20 in Table 3, to rounds 11–20 in Table 4, and further to rounds 16–20 in Table 5. This indicates that on average the levels of crowding-out decrease across rounds. Furthermore, the contrast between the HY and Only-Z treatments yields the highest degrees of average crowding-out, which are 0.561 for all twenty rounds, 0.477 for rounds 11–20, and 0.365 for the last five rounds. The second highest levels of average crowding-out occur in the contrast between the LY and Only-Z treatments: the degree of average crowding-out is 0.383 for all twenty rounds, 0.343 for rounds 11–20, and 0.259 for the last five rounds. The contrast between the YZ and Only-Z treatments yields the lowest levels of average crowding-out: the degree of average crowding-out is 0.221 for all twenty rounds, 0.146 for rounds 11–20, and −0.007 for the last five rounds. The last figure actually indicates a slight crowding-in.

A two-sided Mann–Whitney U test shows that total contributions in the HY treatment do not differ significantly from total contributions in the Only-Z treatment in every round of the experiment. Similarly, total contributions in the LY treatment are significantly higher than total contributions in the Only-Z treatment in only rounds 9, 16, and 19 ($p \leq 0.078$), and the differences between the two treatments are insignificant in all other rounds. Since in most

rounds total contributions do not differ significantly, these results seem to suggest that complete crowding-out exists in the contrast between the Only-Z and HY treatments and the contrast between the Only-Z and LY treatments. However, this assertion is reserved, because the highest degree of average crowding-out is only 0.561, which is far from 1 as indicated by complete crowding-out.[9]

For the contrast between the YZ and Only-Z treatments, a two-sided Mann–Whitney U test shows that total contributions are significantly higher in the YZ treatment than in the Only-Z treatment by looking at round 1 ($p = 0.037$), rounds 16, 17, 18 ($p = 0.078$), round 19 ($p = 0.037$), and the averages of rounds 1–5 and rounds 16–20 ($p = 0.078$). These results provide some evidence that crowding-out is incomplete in the very beginning and the final stage of the experiment. There is even a slight crowding-in by looking at the average of the last five rounds, although the difference in the voluntary contributions between the two treatments is insignificant ($p = 0.873$).[10] The above results are summarized in Result 2:

Result 2: Crowding-out is incomplete when the tax increases from zero to 20 points. Furthermore, the contrast between the HY and Only-Z treatments has the highest degree of average crowding-out.

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[9] The differences in total contributions between two comparable treatments would become dramatically significant by using the individual subjects' choices as the observations. It is shown that total contributions in every round of rounds 5–20 in the HY treatment are significantly higher than those in the Only-Z treatment ($p \leq 0.0161$). Except for round 3, total contributions in each of the other rounds are also significantly higher in the LY treatment than in the Only-Z treatment ($p \leq 0.0361$). These results suggest incomplete crowding-out.

[10] By using the individual data, except for round 3, total contributions in each of the other rounds are significantly higher in the YZ treatment than in the Only-Z treatment ($p \leq 0.0262$). Voluntary contributions are significantly higher in the YZ treatment than in the Only-Z treatment in only round 3 ($p = 0.083$).

When the tax increases from zero points to 40 points, on average the levels of crowding-out for all the contrasts between the Only-Z treatment and other comparable treatments also decrease as we move from rounds 1–20 to rounds 11–20 and to rounds 16–20. The highest degrees of average crowding-out occur in the contrast between the HT-HY and Only-Z treatments (0.345 for rounds 1–20, 0.283 for rounds 11–20, and 0.230 for the last five rounds). The lowest degrees of average crowding-out occur in the contrast between the HT-LY and Only-Z treatments (0.231 for all twenty rounds, 0.199 for rounds 11–20, and 0.113 for rounds 16–20). As reported in Tables 3 to 5, total contributions in the HY-YZ, HT-HY, and HT-LY treatments are all significantly higher than total contributions in the Only-Z treatments, regardless of whether one looks at the averages of rounds 1–20, the averages of rounds 11–20, or the averages of the last five rounds.[11] The above results are summarized in Result 3:

Result 3: Crowding-out is incomplete when the tax increases from zero to 40 points. Furthermore, on average crowding-out is higher (lower) if the MPCR of the publicly provided public good Y is higher (lower) than the MPCR of the privately provided public good Z.

By looking again at Tables 3 through 5, it is shown that the degrees of average crowding-out in the contrasts between the four pairs of high- and low-tax treatments generally decrease across rounds, although there are slight increases in the last five rounds in three out of four pairs of the

[11] This may seem a "natural" result because the amount of the tax (40 points) is higher than the average voluntary contributions of the Only-Z treatment in every round except for rounds 2 and 3. However, by looking specifically at individual subjects' data, on average 44.17 percent of the subjects contributed at least 40 points to the privately provided public good in the first five rounds, and 12.78 percent of the subjects still made such contributions in the last five rounds. Besides, no significant differences in voluntary contributions exist between the Only-Z treatment and other comparable high-tax treatments. This also indicates an incomplete crowding-out.

treatments. More specifically, the highest levels of crowding-out occur in the contrast between the HT-YZ and YZ treatments. The degree of average crowding-out is 0.381 by looking at the average for all twenty rounds, 0.301 for the last ten rounds, and 0.314 for the last five rounds. A two-sided Mann–Whitney U test shows that total contributions are significantly higher in the HT-YZ treatment than in the YZ treatment by looking at the average for rounds 1–5, 6–10, 11–15, 11–20, and 1–20 ($p \leq 0.0881$). These results indicate a significant effect of partial crowding-out.

The degrees of the average crowding-out between the HT-HY and HY treatments are rather small: they are 0.129 by looking at the entire twenty rounds, 0.089 for the last ten rounds, and 0.095 for the last five rounds. A two-sided Mann–Whitney U test shows that total contributions are significantly higher in the HT-HY treatment than in the HY treatment by looking at the average for rounds 1–5 ($p = 0.0550$), 6–10 ($p = 0.0330$), 11–15 ($p = 0.0330$), and 16–20 ($p = 0.0105$). These results also indicate a significant effect of partial crowding-out.

A crowding-in even occurs in the contrast between the HT-HZ and HZ treatments: the degree of average crowding-out is −0.044 for all twenty rounds, −0.141 for the last ten rounds, and −0.084 for the last five rounds. That is, a dollar increase in the tax increases the average of the voluntary contributions by \$0.04 if we look at the entire twenty rounds, by \$0.14 if we look at the last ten rounds, and by \$0.08 if we look at the last five rounds. A two-sided Mann–Whitney U test shows that the differences in total contributions between the HT-HZ and HZ treatments are highly significant in every round ($p \leq 0.0247$), except for round five ($p = 0.1645$) and round six ($p = 0.0550$). For the difference in voluntary contributions between the HT-HZ and HZ treatments, a two-sided Mann–Whitney U test shows that it is insignificant in each of the twenty rounds. Although the latter test result indicates that the crowding-in is

insignificant, the former test result exhibits a significant partial crowding-out and even a zero crowding-out since the measure of the average crowding-out is actually negative.

The last comparison is between the HT-LY and LY treatments. The degree of average crowding-out is 0.078 by looking at the entire twenty rounds, 0.055 for rounds 11–20, and −0.034 for rounds 16–20. A two-sided Mann–Whitney U test shows that total contributions in the HT-LY treatment are significantly higher than total contributions in the HZ treatment in every round of the experiment ($p \leq 0.0446$). This test result indicates that crowding-out is partial and significant. Again, since there is a crowding-in in the last five rounds, it implies that taxes crowds out zero voluntary contributions in these five rounds, and this effect is significant. For testing the significance level of crowding-in, a two-sided Mann–Whitney U test shows that voluntary contributions in the two treatments do not differ significantly ($p = 1.000$). The above results are summarized in Result 3:

Result 4: Crowding-out is incomplete when the tax increases from 20 points to 40 points. There is even a crowding-in if the privately provided public good Z has a higher MPCR than the publicly provided public good Y.

Since the YZ and HT-YZ treatments have the same MPCR for both public good Y and public good Z, comparing the results from the contrasts between the Only-Z, YZ, and HT-YZ treatments with the results from the previous experimental studies (in which Y and Z are tied together as one public good) reveals information that whether taxes and voluntary contributions going to different public goods will alleviate crowding-out. Similar to the experimental design of this paper, Chan, Godby, Mestelman, and Muller (2002) also used three levels of the tax—0%,

15%, and 25% of the income. They found that the degree of average crowding out is 0.704 when the tax rate increases from 0% to 15%, 0.755 when the tax rate increases from 15% to 25%, and 0.724 when the tax rate increases from 0% to 25%. Although crowding-out is incomplete, it is substantial. Comparing these figures with the results reported in Table 3 through Table 5 shows that much lower degrees of average crowding-out (in the range between –0.007 and 0.381) are found in the contrasts between the Only-Z, YZ, and HT-YZ treatments even though higher tax rates (0%, 20%, and 40% of the income) are used in this paper. Although differences other than tax rates and the number and types of public goods exist between Chan et al.'s experimental design and mine, this comparison provides some preliminary thinking that crowding-out may be lower if taxes and voluntary contributions are used to provided different public goods.

Result 2 through Result 4 show that crowding-out is incomplete and modest no matter the tax increases from zero points to 20 points, from 20 points to 40 points, or from 0 points to 40 points, and in some cases a crowding-in occurs. Looking specifically at the last ten rounds, the degrees of average crowding-out are in the range between –0.141 and 0.477. Although these magnitudes are at odds with some studies that found substantial crowding-out (e.g., 0.715 in Andreoni, 1993; 0.737 in Bolton and Katok, 1998), they are consistent with findings from many others. For instance, the degree of crowding-out is 0.28 in Abrams and Schitz (1978), 0.30 in Abrams and Schmitz (1984), 0.135 in Kingma (1989), 0.0105 in Payne (1998), and 0.2 to 0.58 in Hungerman (2005). Khanna, Posnett, Sandler (1995) found a degree of crowding-in on the order of 0.094. Schiff (1985) found that one dollar increase in state government spending crowded in $0.344 private giving, but one dollar increase in local government spending crowded out $0.662 private giving. Payne (2001) also found a mixed result: a dollar increase in the federal research funding raised private donations to research universities by $0.65, but reduced

private donations to liberal arts colleges by $0.45.

The experimental results of this paper also indicate that the levels of crowding-out indeed vary with the MPCRs of the public goods. The highest level of crowding-out occurs in the contrast between the HT-YZ and YZ treatments where both public goods have the same MPCR. The levels of crowding-out are lower if the two public goods have different MPCRs, and even a crowding-in occurs if the privately provided public good has a relatively higher MPCR than the publicly provided public good. Because the existing studies on crowding-out usually assume that taxes and voluntary contributions are used to fund the same public good, each dollar of the tax and each dollar of voluntary contributions will yield the same marginal return. Hence, the levels of crowding-out may be overestimated if individuals indeed value taxes and voluntary contributions differently.

Some may question why the level of crowding-out is lower in the contrast between the HT-HY and HY treatments than in the contrast between the HT-YZ and YZ treatments, since intuitively a more favorable publicly provided public good would discourage contributions to the privately provided public good. A possible explanation is that subjects see through the non-rival benefit of the tax that is used to provide the publicly provided public good. This benefit becomes more attractive when the MPCR of the publicly provided public good is higher and when the tax is higher. If subjects can see through the benefit of the tax, they can also learn from the tax the benefit of voluntary contributions. As a consequence, the tax encourages cooperative behavior.

3.3. Regression Analysis

It has been shown above that taxes will only partially crowd-out voluntary contributions and a

crowding-in occurs between some treatments, but overall it needs to be asked what really drives or discourages voluntary contributions. Is it the level of the tax, the favorableness of the publicly and privately provided public goods, or the relative favorableness of the two public goods? Regression analyses are manipulated to answer this question.

In the regression analyses, the "voluntary contribution" is naturally the dependent variable. By looking at the subjects' decisions on voluntary giving, the data show that in all twenty rounds of all the nine treatments, 4,625 of the 11,280 observations (or 41.22 percent) exhibit a voluntary contribution of zero points and 1,050 of the 11,280 observations (or 9.31 percent) exhibit a voluntary contribution of full disposable income. In the last ten rounds, these magnitudes are 2,814 out of 5,640 observations (or 49.89 percent) and 416 out of 5,640 observations (or 7.38 percent). Therefore, a Tobit maximum likelihood estimation with the consideration of left and right censoring is more appropriate than the ordinary least squares for this type of data. Nonetheless, a consistent upper limit of voluntary contributions for all treatments does not exist due to the various levels of the tax. Hence, only a lower limit of zero can be imposed on the dependent variable "voluntary contribution," and to resolve this problem, another dependent variable, the "contribution rate," is introduced here. The contribution rate is defined as the voluntary contribution divided by the disposable income, which is the endowed income minus the tax. A lower limit of zero and an upper limit of one are therefore imposed on the dependent variable the "contribution rate."

Recall from the experimental design that random re-matching was managed between the twelve subjects recruited for the same session. Hence, besides the usual Tobit estimation, a random-effects Tobit maximum likelihood estimation that assigns "session" to be the panel

variable is also performed. Tables 6 and 7 report the regression results.[12]

By using observations from all rounds, the Tobit estimation results in Table 6 show that the MPCR of Z has a positive and significant effect on voluntary contributions. On the contrary, the MPCR of Y has a negative and significant effect on voluntary contributions. These results are intuitive and straightforward. The effect of the tax on voluntary contributions is also negative and significant, but relatively small: an increase of one point in the tax only crowds out voluntary contributions by 0.18 points. This finding is consistent with the result of partial crowding-out found in subsection 3.2. Voluntary contributions also decrease significantly across rounds, indicating that subjects free ride more as they play more rounds. By using the observations from only the last ten rounds, the results are similar except that the impact of the tax on voluntary contributions is alleviated and the impact of the MPCR of Z on voluntary contributions is enhanced.

Similar results are found by using the "contribution rate" as the dependent variable, except that the impact of the tax on the contribution rate is positive. This finding is attributed to the following two effects. First, by holding voluntary contributions constant, a higher level of the tax means a lower level of the disposable income and hence higher contribution rates. Second, the regression results indicate that the tax has a negative effect on voluntary contributions and thus a negative effect on contribution rates. The positive coefficient of tax on contribution rate implies that the first effect outweighs the second.

The results from the random-effects Tobit maximum likelihood estimation are somewhat

[12] The regression equation with the independent variable "MPCR of Y" replaced by "MPCR of Y/MPCR of Z" is also estimated. The estimated results are similar to those reported in Tables 6 and 7, and hence they are not reported. Due to collinearity, the coefficients of the independent variables "tax," "MPCR of Y," "MPCR of Z," and "MPCR of Y/MPCR of Z" cannot be measured by the fixed-effects Tobit estimation, and hence the results are not reported, either.

different. By looking at Table 7, the variable "tax" now has no significant effects on either voluntary contributions or contribution rates. The variable "MPCR of Y" has negative and marginally significant effects only on contribution rates by using the observations from all twenty rounds ($p = 0.091$). On the contrary, the effects of "MPCR of *Z*" on both voluntary contributions and contribution rates are positive and significant, and these effects are enhanced in both the magnitudes of the estimated coefficients and the significance levels by looking at only the last ten rounds.

Based on the above regression results, we have Result 5 as follows:

Result 5: The tax has a slight or insignificant effect on voluntary contributions and contribution rates. The MPCR of the publicly provided public good has significant effects on both voluntary contributions and contribution rates without taking account of random effects, and it has only a marginally significant effect on contribution rates when random effects are considered. On the contrary, the MPCR of the privately provided public good has significant effects on both voluntary contributions and contribution rates regardless of whether or not random effects are considered.

4. CONCLUSION

As to whether the tax crowds out private donations to philanthropic causes has been extensively examined in the literature on crowding-out. Existing theoretical and experimental studies on crowding-out generally assume that taxes and voluntary contributions are used to fund the "same" public good, and therefore it is implicitly assumed that taxes and voluntary contributions are equally valuable to donors. This setting ignores the fact that many public goods are provided

by the private sector alone and receive no support from the government. There is also the possibility that individuals may value the public good provided by the public sector and the public good provided by the private sector differently.

This paper provides an experimental examination of the crowding-out effect when both publicly and privately provided public goods are present. It is found that when the tax increases from a low to a high level, the degrees of crowding-out are lower if the two public goods have different MPCRs as compared with the treatments in which both public goods have the same MPCR. Even an outcome of crowding-in occurs when the privately provided public good has a higher MPCR than the publicly provided public good. These findings suggest that the levels of crowding-out may be overestimated if individuals value the public good funded by the tax and the public good funded by voluntary contributions differently. The regression results confirm that the tax only has a slight or an insignificant effect on voluntary contributions. What affects voluntary contributions the most is the favorableness or attractiveness of the public good funded by voluntary contributions.

The findings of this paper have some implications for charities. When confronting the competition from the public sector, charities in the private sector should differentiate themselves in order to raise donations. If the public good provided by the private sector is more favorable or more attractive to donors, donations to charities may not be reduced and may even increase when the tax increases.

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Table 1. Experimental parameters

Treatment	Tax	MPCR of Y	MPCR of Z	Number of sessions	Total number of subjects
Only-Z	0	–	0.5	6	72
YZ	20	0.5	0.5	6	72
HY	20	0.7	0.5	6	72
HZ	20	0.5	0.7	6	72
LY	20	0.3	0.5	6	72
HT-YZ	40	0.5	0.5	4	48
HT-HY	40	0.7	0.5	4	48
HT-HZ	40	0.5	0.7	4	48
HT-LY	40	0.3	0.5	5	60

Note: Y is the publicly provided public good and Z is the privately provided public good. In all treatments, twelve subjects were recruited for one session and the size of the group was four.

Table 2. Descriptive statistics

Treatment	Average total contribution	Average voluntary contribution	Percentage of subjects making no voluntary contribution	Percentage of subjects contributing all income	Average earnings (in NT$)
Only-Z	25.756 (26.409)	25.756 (26.409)	39.44% (0.323)	11.25% (0.259)	251.51 (44.72)
YZ	41.334 (19.213)	21.334 (19.213)	37.36% (0.329)	8.96% (0.229)	282.67 (28.86)
HY	34.537 (13.253)	14.537 (13.253)	44.31% (0.331)	2.57% (0.080)	301.07 (21.49)
HZ	42.177 (19.992)	22.177 (19.992)	36.94% (0.333)	10.69% (0.244)	319.84 (31.86)
LY	38.092 (16.363)	18.092 (16.363)	41.74% (0.317)	7.71% (0.179)	244.19 (20.63)
HT-YZ	53.717 (12.574)	13.717 (12.574)	46.56% (0.313)	9.69% (0.187)	307.43 (17.97)
HT-HY	51.948 (11.211)	11.948 (11.211)	54.48% (0.331)	6.35% (0.136)	367.90 (17.38)
HT-HZ	63.066 (17.579)	23.066 (17.579)	31.15% (0.342)	16.77% (0.288)	363.04 (23.73)
HT-LY	56.535 (14.819)	16.535 (14.819)	39.92% (0.315)	11.83 (0.244)	249.07 (22.05)

Note: Except for the statistic "average earnings," the observations for all other statistics are the average values of all subjects' average choices across all twenty rounds. Numbers in parentheses are the standard deviations of all subjects' average choices across all twenty rounds. The average earnings denote the average of subjects' total earnings from twenty rounds, excluding the NT$100 participation fee.

Table 3. Measuring the degrees of crowding-out with observations from rounds 1–20

Treatment	Average total contribution	Average voluntary contribution	Control treatment for measuring the degree of average crowding-out				
			Only-Z	YZ	HY	HZ	LY
Only-Z	25.756 (26.409)	25.756 (26.409)	–	–	–	–	–
YZ	41.334 (19.213)	21.334 (19.213)	0.221 (0.200)	–	–	–	–
HY	34.537 (13.253)	14.537 (13.253)	0.561 (0.262)	–	–	–	–
HZ	42.177 (19.992)	22.177 (19.992)	–	–	–	–	–
LY	38.092 (16.363)	18.092 (16.363)	0.383 (0.337)	–	–	–	–
HT-YZ	53.717 (12.574)	13.717 (12.574)	0.301 (0.055)	0.381 (0.088)	–	–	–
HT-HY	51.948 (11.211)	11.948 (11.211)	0.345 (0.033)	–	0.129 (0.019)	–	–
HT-HZ	63.066 (17.579)	23.066 (17.579)	–	–	–	−0.044 (0.011)	–
HT-LY	56.535 (14.819)	16.535 (14.819)	0.231 (0.018)	–	–	–	0.078 (0.006)

Note: In Tables 3 through 5, the observations are the average values of all individual subjects' average choices across the periods indicated by the title of the table. The numbers in parentheses under the column "average total contribution" and "average voluntary contribution" are the standard deviations of all subjects' average total contributions and average voluntary contributions of the periods indicated. The degree of average crowding-out is positive if taxes crowd out voluntary contributions, and is negative if taxes increase voluntary contributions. The numbers in the parentheses under the degrees of average crowding-out are *p*-values of the differences in total contributions between two comparable treatments and the *p*-values are measured by two-sided Mann–Whitney U tests.

Table 4. Measuring the degrees of crowding-out with observations from rounds 11–20

Treatment	Average total contribution	Average voluntary contribution	Control treatment for measuring the degree of average crowding-out				
			Only-Z	YZ	HY	HZ	LY
Only-Z	19.304 (27.604)	19.304 (27.604)	–	–	–	–	–
YZ	36.393 (19.855)	16.393 (19.855)	0.146 (0.109)	–	–	–	–
HY	29.761 (11.799)	9.761 (11.799)	0.477 (0.200)	–	–	–	–
HZ	38.149 (20.788)	18.149 (20.788)	–	–	–	–	–
LY	32.446 (16.343)	12.446 (16.343)	0.343 (0.262)	–	–	–	–
HT-YZ	50.375 (11.739)	10.375 (11.739)	0.223 (0.033)	0.301 (0.088)	–	–	–
HT-HY	47.985 (11.109)	7.985 (11.109)	0.283 (0.055)	–	0.089 (0.011)	–	–
HT-HZ	60.973 (18.540)	20.973 (18.540)	–	–	–	−0.141 (0.011)	–
HT-LY	51.338 (15.467)	11.338 (15.467)	0.199 (0.045)	–	–	–	0.055 (0.006)

Table 5. Measuring the degrees of crowding-out with observations from rounds 16–20

Treatment	Average total contribution	Average voluntary contribution	Control treatment for measuring the degree of average crowding-out				
			Only-Z	YZ	HY	HZ	LY
Only-Z	15.333 (27.300)	15.333 (27.300)	–	–	–	–	–
YZ	35.481 (21.220)	15.481 (21.220)	−0.007 (0.078)	–	–	–	–
HY	28.036 (12.358)	8.036 (12.358)	0.365 (0.200)	–	–	–	–
HZ	37.181 (21.417)	17.181 (21.417)	–	–	–	–	–
LY	30.161 (16.823)	10.161 (16.823)	0.259 (0.150)	–	–	–	–
HT-YZ	49.204 (13.158)	9.204 (13.158)	0.153 (0.033)	0.314 (0.136)	–	–	–
HT-HY	46.129 (10.607)	6.129 (10.607)	0.230 (0.033)	–	0.095 (0.011)	–	–
HT-HZ	58.85 (19.891)	18.85 (19.891)	–	–	–	−0.084 (0.011)	–
HT-LY	50.833 (16.321)	10.833 (16.321)	0.113 (0.018)	–	–	–	−0.034 (0.006)

Table 6. Results of Tobit maximum likelihood estimation

	Dependent variable			
	Voluntary contribution		Contribution rate	
Independent variable	Rounds 1–20	Rounds 11–20	Rounds 1–20	Rounds 11–20
Constant	9.0428*** (3.59)	−5.2333 (−1.11)	−0.0340 (−0.86)	−0.2366*** (−3.21)
Round	−1.6603*** (−25.99)	−1.6116*** (−8.26)	−0.0250*** (−24.75)	−0.0234*** (−7.70)
Tax	−0.1798*** (−5.48)	−0.1343*** (−2.67)	0.0022*** (4.19)	0.0018** (2.29)
MPCR of Y	−15.5039*** (−7.54)	−15.5780*** (−4.93)	−0.2709*** (−8.38)	−0.2698*** (−5.49)
MPCR of Z	50.2123*** (11.25)	71.7529*** (10.60)	0.8461*** (12.04)	1.1748*** (11.13)
Log-likelihood	−36,698.816	−16,115.022	−9,373.4434	−4,502.3043
Pseudo R^2	0.0124	0.0066	0.0411	0.0216
LR	918.06 (p = 0.0000)	213.55 (p = 0.0000)	802.68 (p = 0.0000)	198.90 (p = 0.0000)
Number of observations	11,280	5,640	11,280	5,640

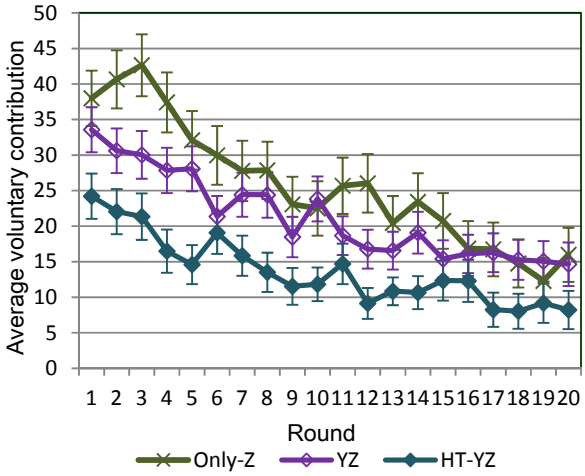
Note: LR is the likelihood ratio test statistic, which is chi-squared distributed with four degrees of freedom. The t-statistics are in the parentheses. The superscripts ***, ** and * denote the 1%, 5%, and 10% significance levels, respectively. In both Tables 6 and 7, the MPCR of Y is set at zero for the Only-Z treatment. The left-censor is used when the dependent variable is "voluntary contribution," and both left- and right-censors are used when the dependent variable is "contribution rate."

Table 7. Results of random-effects Tobit maximum likelihood estimation

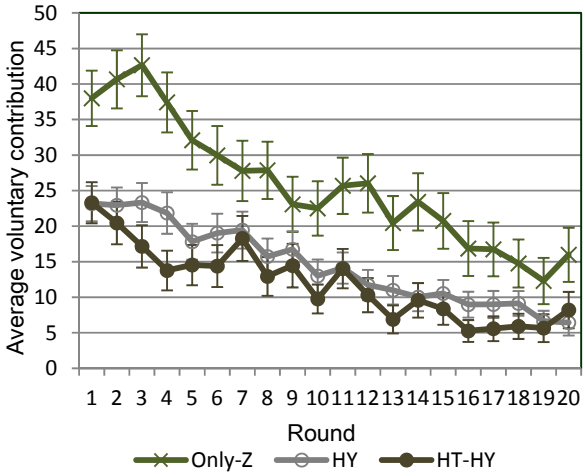
	Dependent variable			
	Voluntary contribution		Contribution rate	
Independent variable	Rounds 1–20	Rounds 11–20	Rounds 1–20	Rounds 11–20
Constant	7.8582 (0.61)	−7.4986 (−0.44)	−0.0466 (−0.24)	−0.2591 (−1.02)
Round	−1.6633*** (−28.00)	−1.6198*** (−9.28)	−0.0250*** (−26.43)	−0.0237*** (−8.59)
Tax	−0.1583 (−0.92)	−0.0998 (−0.45)	0.0023 (0.91)	0.0020 (0.61)
MPCR of Y	−15.5234 (−1.45)	−15.0437 (−1.08)	−0.2715* (−1.69)	−0.2621 (−1.26)
MPCR of Z	50.0040** (2.20)	75.0245** (2.45)	0.8671** (2.45)	1.2135*** (2.65)
Log-likelihood	−36,076.677	−15,674.338	−8,827.8588	−4,110.3417
Wald	792.73 (p = 0.0000)	93.33 (p = 0.0000)	705.81 (p = 0.0000)	81.42 (p = 0.0000)
Number of observations	11,280	5,640	11,280	5,640

Note: Wald is the Wald test statistic, which is chi-squared distributed with four degrees of freedom. The z-statistics are in the parentheses. The superscripts ***, ** and * denote the 1%, 5%, and 10% significance levels, respectively.

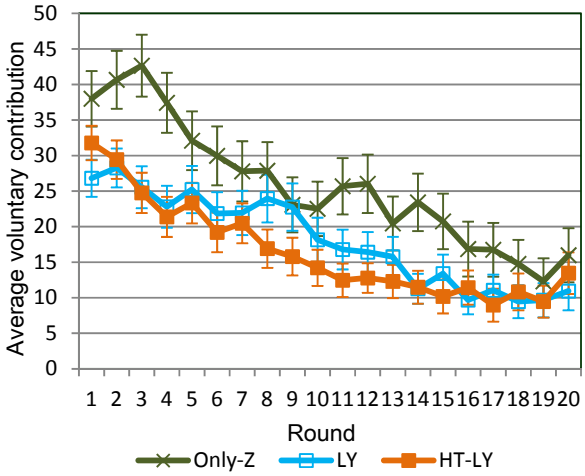
Figure 1. Average voluntary contribution by round



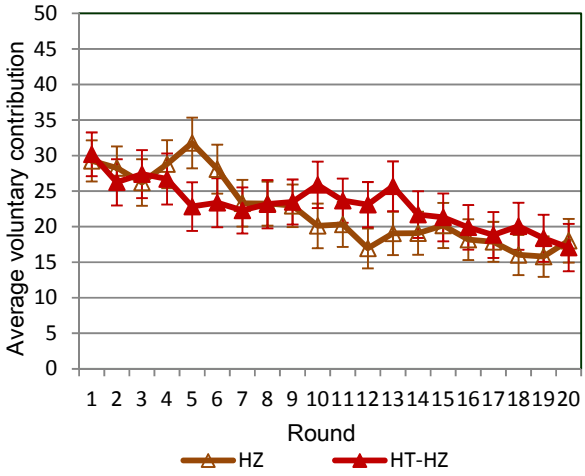
(a) Same MPCR of Y and Z



(b) High MPCR of Y



(c) Low MPCR of Y



(d) High MPCR of Z

公部門與私部門提供的公共財同時存在時的排擠效果的實驗研究

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摘要：排擠效果的理論和實驗文獻通常假設租稅和自願性捐獻用來融通“同一”公共財。基於此一假設，不論是純粹利他還是不純粹利他的理論模型皆預期租稅會排擠自願性捐獻，而無法解釋租稅會擠入（增加）自願性捐獻的結果。本實驗研究檢驗公部門和私部門提供的公共財同時存在時的排擠效果。本文發現當公部門和私部門提供的公共財對實驗參與者有同等價值時，或當公部門提供的公共財較私部門提供的公共財有價值時，傳統的排擠效果會發生。然而當私部門提供的公共財較公部門提供的公共財有價值時，則有擠入效果，亦即租稅不僅不會降低自願性捐獻，還會增加更多的自願性捐獻。

關鍵詞：排擠、擠入、公共財、實驗

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