Essays on Taxes and Donations

by

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For my family

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Chapter II uses a proprietary micro-level firm data set from the Ministry of Finance (MOF) of Japan, the “Financial Statements Statistics of Corporations by Industry, which covers both public and private firms” and Chapter III uses a proprietary data of FIES (Family Income and Expenditure Survey) provided by the Statistics Bureau, Ministry of Internal Affairs and Communications, Government of Japan. I am grateful to the opportunity to use such proprietary data. Note that the views expressed herein are those of the author and do not reflect the opinions of any organizations.

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Abstract

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This dissertation concerns donation and tax issues, significant for current policy making. Chapter I considers cases where fundraisers reflect donors' preferences for the characteristics of public good. Relying solely on voluntary contributions, public good is always under-provided. Among many countermeasures of this under-provision issue, some fundraisers take into account large donors' preferences. We formalize such a mechanism and prove that this mechanism enhances private contributions because of additional incentive to donate. Moreover, we find that government direct subsidy may not only crowds-out but also crowds-in private contributions under this mechanism. Crowding-in may occur because the influence of one's contribution is leveraged by direct subsidy. Crowding-out may occur because direct subsidy decreases marginal utility of public good. We analytically deduce the condition where crowding-in/crowding-out occurs.

Chapter II is a collaborated work with Hasegawa, Hoopes and Slemrod. The behavioral response to public disclosure of income tax returns figures prominently in policy debates about its advisability. Although supporters stress that disclosure

encourages tax compliance, policy debates proceed in the absence of empirical evidence about this, and any other, claimed behavioral impact. This paper provides the first such evidence by examining the behavioral response to the Japanese tax return public notification system. The analysis suggests that, when there is a threshold for disclosure, a non-trivial number of both individual and corporate taxpayers whose tax liability would otherwise be close to the threshold will under-report so as to avoid disclosure — a response in the opposite direction from that stressed by supporters of disclosure. An analysis of corporations' financial data offers no evidence that these companies' taxable income declined after the end of the disclosure system.

Chapter III finds factors that associate with donations just after the two disastrous earthquakes in Japan, 2011 Tohoku Earthquake and 1995 Hanshin Earthquake, using household-level monthly panel data. The novel finding is that geographical distance from the disaster epicenter negatively associates with private donations, which may indicate that distance negatively correlates with sympathy. Also, one who donated before the earthquakes tends to donate after the earthquake. Moreover, income, saving and age are found to be positive factors.

Chapter I

Vote with their donations: An explanation about crowding-in of government provision of public goods

1. Introduction

1.1 The remedy for the under-provision problem of public goods

It is a painful issue to have under-provision of public goods when the externality of public goods is not internalized. Even though it is socially desirable to build bridges or street lights, for example, the private sector's provision of such public goods is less than the optimal because individuals have an incentive to free-ride other people's contributions (Bergstrom et al., 1986).

Theoretically speaking, this problem is largely solved by a decentralized mechanism (e.g. Groves and Ledyard, 1977; Walker, 1981) without relying on coercive governmental power. However, such a mechanism is difficult to implement in the real world. In reality, instead of adopting such first best (but overly complicated) mechanism, a government implements tax deduction, tax credit, or other tax expenditure schemes for private contributions in order to alleviate issues of under-provision.

Although tax expenditure is a powerful tool to enhance charitable contributions and its effects have been studied thus far (e.g. Clotfelter, 1985; Randolph, 1994; Auten et al., 2002; Bakija and Heim, 2011), the greatest caveat of tax expenditure is that only government can implement such a mechanism. Even government may face difficulty implementing (or modifying) the tax expenditure mechanism because of political resistance.

Therefore, private fundraisers and sometimes even government implement other kinds of instruments which do not rely on the tax mechanism that requires government's coercive power. A “thank you” letter is a typical (and less costly) example that private institutions can provide. Earmarked donations are frequently used to enhance private contributions (e.g. Li et al. 2011) and how much people increase their contribution when earmarking is available has been vigorously studied (e.g. Batista et al., forthcoming; De Arcangelis et al, 2015; Eckel et al., 2014). Not only private institutions (e.g. DonorsChoose.org) but also governments accept earmarked donations; around 80% of local governments in Japan accept earmarked donations under the hometown tax payment system (Konishi, 2015) and the US government has accepted earmarked donations (the federal government of the USA has accepted earmarked donations for reducing the national debt since 1961. (Slemrod, 2003)). Some organizations publish the top donor’s name (e.g. Bureau of Investigative Journalism). These measures are examples where fundraisers reflect the large donors' preference and modify the characteristics of the public goods. Another good example is engraving the top donor’s name on a school building as well as applying it to a business school program (e.g. Ross School of Business in the University of Michigan). Further examples are introduced in a later section.

Considering these examples, one may recall a model where a certain good is a mixture of a pure public good and a private good. Such kind of good is called an *impure public good* and has already been studied (Andreoni, 1989; Andreoni, 1990; Cornes and Sandler, 1994). “Thank you” letters can be understood using the impure public good model. However, if fundraisers modify the characteristics of a public good in response to large donors' preferences, such public good cannot be analyzed under the impure public good model because one's donation may have both positive and negative externality.

Tiebout (1956) suggested in his classic paper that people "vote with their feet." People reveal their preference by choosing where to live. A similar phenomenon can be considered on private provision on public goods. People reveal their preferences, incompletely but to some extent, by choosing where to donate or how to donate. Earmarked donations to local municipalities or universities also reveal donors’ preferences. Therefore, it is natural to imagine that fundraisers, such as government, local government, universities and so on, reflect the revealed preferences of the donors. This reflection may take a variety of forms, e.g. engraving the donor’s name, building a bridge closer to the donor's residence, or facilitating academic research that the donor prefers. The key aspect is that one's donation to a public good makes the whole public good more favorable to the donor, but may make the whole public good possibly less favorable to others[1].

A similar problem is analyzed by Morgan (2000) that analyzes the effect of a fixed prize raffle. His model exploits the structure of a lottery that the lottery revenue minus the amount of prize is used for providing public goods and that the winning probability is proportional to one's donation. In his model, one's donation has a positive externality because it increases the amount of public goods, but has a negative externality because it reduces other people's probability of winning the prize. He theoretically proves that the issue of under-provision is alleviated under this lottery mechanism. Our model is different from but shares ideas with Morgan (2000). For example, different from Morgan (2000), our mechanism has an application limit; too much negative externality may worsen the social welfare. Therefore, in this paper, we first generalize Morgan's (2000) model and show that our model is a special case of this generalized Morgan's (2000) model. Then, we show that the under-provision issue is alleviated under our model as is in Morgan's (2000) model and provide the effective range of our mechanism.

1.2 Explanation of crowding-in in our model

In this paper, we show that government direct subsidy to public goods may not only crowd-out private contributions but also sometimes crowd-in private contributions. This is something different from the model by Morgan (2000), where only the crowding-out effect is shown. The novel finding in this paper is that we provide a new model that explains both crowding-in and crowding-out in the same framework.

A simple model of pure public good provides a dismal prediction that a government direct subsidy for public goods completely crowds out private provision on public goods (Warr, 1982; Roberts, 1984; Bergstrom et al., 1986). If this prediction were true, government direct subsidy would generally not make sense from the viewpoint of fundraising. However, in reality, the situation is not so depressing; the crowding-out effect is generally

[1] In this paper, public good is non-rival and non-excludable ex-post (after collecting individuals' donations). However, "public good" in this paper can be rival ex-ante, because one's donation may make the "public good" less favorable to others.

incomplete (Andreoni, 1993; Payne, 1998; Andreoni and Payne, 2003). To explain this deviation, many scholars assume that each donor not only benefits from the public good but also acquires “warm-glow” utility from his/her act of giving (Becker, 1974; Cornes and Sandler, 1984; Steinberg, 1987; Andreoni, 1989; Andreoni, 1990). Some scholars explain this phenomenon by assuming that people have an incentive to signal their wealth (Glazer and Konrad, 1996; Harbaugh, 1998a; Harbaugh, 1998b; Blumkin and Sadka, 2007). However, in a few cases, government provision may even “crowd-in” private provision of public goods (Rose-Ackerman, 1981; Sugden, 1982; Segal and Weisbrod, 1998; Khanna and Sandler, 2000; Okten and Weisbrod, 2000; Payne, 2001; Andreoni et al., 2014), which cannot solely be derived from the “warm-glow” explanation. Crowding-in may be explained by asymmetric information where a donated grant reveals the quality of the public goods (Romano and Yildirim 2001; Vesterlund, 2003; Potters et al. 2005; Andreoni, 2006). Although this explanation is predominant, there exist other explanations. For example, in a case where a public good comes into effect only when the total contribution exceeds a certain threshold, a large amount of government direct contribution will act as seed money; it may enhance private contribution because government contribution increases the probability that the public good comes into effect (Andreoni, 1998).

Our model provides totally different explanations to understand the crowding-in phenomenon. If fundraisers reflect large donors’ preference on public goods, the influence of one’s donation is leveraged by the government direct subsidy. If this crowding-in effect dominates the crowding-out effect, which government direct subsidy has by nature, a government subsidy crowds-in private contributions.

1.3 Construction of this paper

Our paper is constructed as follows. In the next section, we explain Morgan’s (2000) fixed prize raffle model and its generalization. This generalization connotes our model in Section 3. In Section 3, we will see our basic model without warm-glow and then we will incorporate the warm-glow effect in the model. The model is also extended to multiple individuals and heterogeneity is considered briefly. Examples are provided in Section 4. In the final section, we conclude.

2. Morgan's (2000) model and its generalization

2.1 Explanation of Morgan's (2000) model

Our model formalized in Section 3 shares the basic idea with Morgan's (2000) fixed prize raffle model. Therefore, before introducing our model, we explain the Morgan's (2000) model and generalize it in this section. Note that our model in the following section is a special case of the generalized Morgan's (2000) model established in this section.

Morgan asks in his paper why lotteries are frequently used for the fundraising purpose in spite of the criticism of being inequitable and inefficient compared to tax instruments. He argues that this comparison is not fair because lotteries are often held when tax instruments are not feasible. He then argues that lottery is a more effective instrument for the fundraising purpose than just soliciting voluntary donations.

It is well-known that, when individuals voluntarily contribute to public goods and government does not provide any subsidy, the public goods result in under-provision (Bergstrom et al., 1986). The reason is that each individual does not internalize the positive externality her contribution creates. Morgan (2000) finds that lottery alleviates this problem; if a lottery prize is prefixed, one's contribution increases his expected prize and *decreases* others' expected prizes. Therefore, the lottery mechanism connotes a negative externality mechanism which partially cancels out the positive externality one's contribution creates. The similarity between Morgan (2000) and our model is that one's contribution to public good not only has positive externality but also have negative externality, and the latter (maybe partially) cancels out the former.

In order to describe Morgan's (2000) mechanism formally, let us assume that there are N people, indexed $1, 2, \cdots, N$. Individual i has positive initial endowment w_i. Each individual divides its initial endowment into private consumption and purchase of lottery. The amount of lottery tickets that individual i purchases is g_i. The prize of the lottery, P, is prefixed and the winning probability of the prize is proportional to the amount of lottery tickets she purchases. Therefore, her expected prize is $\frac{g_i P}{\sum_{j=1}^{N} g_j}$. If she wins the prize, she uses the prize for her private consumption. Assuming a quasi-linear utility function and risk neutrality, her expected utility is expressed as

$$U_i = w_i - g_i + \frac{g_i P}{\sum_{j=1}^{N} g_j} + h_i(G) \quad (1)$$

where G is the total amount of public goods and $h_i(G)$ is her utility from public goods. Individuals experience positive but diminishing marginal utility from public goods, hence $h_i'(\cdot) > 0$ and $h_i''(\cdot) < 0$ are assumed. We assume that the utility from public goods is non-negative, i.e. $h_i(G) \geq 0\ \forall G \geq 0$. The total amount of public goods is the sum of individuals' contributions net of the prize, formally

$$G = \sum_{j=1}^{N} g_j - P. \quad (2)$$

Combining individual utility (1) and the public good provision (2), any individual maximizes the following expected utility:

$$U_i = w_i - g_i + \frac{g_i P}{\sum_{j=1}^{N} g_j} + h_i\left(\sum_{j=1}^{N} g_j - P\right). \quad (3)$$

Note that, when the prize P converges to zero, this model converges to a voluntary contribution model. Upon this limit, purchase of lottery tickets is identical to voluntary contribution to public goods.

Under this setting, Morgan (2000) shows that the total amount of public goods, G is a function of prize P (see Proposition 2 in Morgan, 2000), namely $G(P)$. Let G^* be the Pareto optimal amount of public goods, namely $\sum_{j=1}^{N} h_j'(G^*) = 1$ (Samuelson rule[2]). Then, Morgan (2000) shows the following proposition that increasing prize P (1) increases the total amount of public goods $G(P)$, (2) is always welfare improving, and (3) pushes the total amount of public goods to converge to the optimal amount.

Proposition 1

The total amount of public goods is a strictly increasing function of prize P and it converges to optimal amount G^* when prize P increases; formally,

$$G'(P) > 0, \quad (4)$$

and

$$\lim_{P \to \infty} G(P) = G^*. \quad (5)$$

Proof:

See Theorem 1 and Theorem 2 in Morgan (2000).

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[2] In Samuelson (1954), he showed that sum of marginal rate of substitutions is equal to marginal rate of transformation between the public good and private good if the amount of public good is optimal.

Morgan (2000) briefly investigates the effect of government direct subsidy on public goods and concludes that government direct subsidy incompletely crowds out private contributions. Formally, when equation (2) is substituted by $G = \sum_{j=1}^{N} g_j - P + g_G$ where g_G is government direct subsidy, $-1 < \frac{\partial \sum_{j=1}^{N} g_j}{\partial g_G} < 0$ is obtained (See Proposition 3 in Morgan, 2000)[3]. This point is further analyzed in the following subsection.

2.2 Generalization of Morgan's (2000) model

Although Morgan (2000) only analyzes the lottery example in his paper, his idea is fairly easily generalized. There are three aspects to be extended. First, in Morgan's (2000) model, the expected prize one gets is proportional to one's contribution, but this weighting can be generalized; the weight is generalized to be a function of one's contribution divided by total contributions. Second, in Morgan's (2000) model, the prize is solely financed from private contributions, but we can consider that not only the source of the public goods (private contributions) but also the fruits from the public goods can be distributed to contributors. Consider a company collecting investment. It does not distribute the invested money itself to investors but it distributes the profit made from the investment to investors. We can consider such mechanism in fundraising; not only the private contributions but also the fruits from public goods can be the prize for contributors. Third, we incorporate government direct subsidy in the model explicitly. Even with these generalizations, Morgan's (2000) basic idea is valid that negative externality created from the prize is a key feature to alleviate the under-provision problem. With these generalizations, individual expected utility is as follows:

$$U_i = w_i - g_i - \frac{g_G}{N} + \varphi\left(\frac{g_i}{\sum_{j=1}^{N} g_j}\right)\left(P + l\left(\sum_{j=1}^{N} g_j - P + g_G\right)\right)$$
$$+\left(k_i\left(\sum_{j=1}^{N} g_j - P + g_G\right) - \frac{l\left(\sum_{j=1}^{N} g_j - P + g_G\right)}{N}\right), \qquad (6)$$

[3] Although it is not clearly stated in Morgan (2000), we can assume that this government subsidy is financed by lump-sum tax, because, thanks to the quasi-linear utility function, lump-sum tax only affects consumption one-by-one and does not affect at all the size of contribution.

where one's contribution has a weakly negative externality effect (i.e. $\varphi'(\cdot) \geq 0$), the prize is always non-negative for anyone, and the total prize is not affected by who contributed for the public goods. ($\varphi(\cdot)$ is a weighting function, i.e. $\sum_{i=1}^{N} \varphi\left(\frac{g_i}{\sum_{j=1}^{N} g_j}\right) \equiv 1$ and $\varphi(\cdot) \geq 0$). g_G can be considered as government's direct subsidy that is financed by lump-sum tax. The prize consists of two parts, fixed amount P and variable amount $l\left(\sum_{j=1}^{N} g_j - P + g_G\right)$, where Morgan (2000) only considers the former part. It is assumed that the public good effect is non-negative ($k_i\left(\sum_{j=1}^{N} g_j - P + g_G\right) \geq \frac{l\left(\sum_{j=1}^{N} g_j - P + g_G\right)}{N} \forall i$). We also assume that the fixed amount of prize P should be non-negative. The variable amount of prize $l\left(\sum_{j=1}^{N} g_j - P + g_G\right)$ is assumed to be non-negative and its marginal utility is assumed to be non-negative and weakly diminishing as usual. We assume that the variable amount of prize $l\left(\sum_{j=1}^{N} g_j - P + g_G\right)$ is not so progressively increasing; formally we assume that $\frac{P + l(\bar{G} - P + g_G)}{\bar{G}}$ is always a weakly decreasing function of $\bar{G}$ for mathematical convenience. Morgan's (2000) fixed prize raffle model is a special case of this generalization, where $\varphi\left(\frac{g_i}{\sum_{j=1}^{N} g_j}\right) = \frac{g_i}{\sum_{j=1}^{N} g_j}$, $k_i(\cdot) = h_i(\cdot)$, and $l(\cdot) = 0$ hold and government direct subsidy is disregarded.

The novel finding in Morgan (2000) is that, even if the prize is solely financed from private contributions ($l(\cdot) = 0$), the increment of prize P increases not only the total contributions $\sum_{j=1}^{N} g_j$ but also the amount of public goods $\sum_{j=1}^{N} g_j - P$. We can generalize his results as follows. Primarily, under this generalized framework, the size of the public goods $\sum_{j=1}^{N} g_j - P + g_G$ is an increasing function of the fixed amount of prize P if and only if the total contributions $\sum_{j=1}^{N} g_j$ exceeds the size of prize $P + l\left(\sum_{j=1}^{N} g_j - P + g_G\right)$. Morgan's (2000) result is a special case of this; in his model, total contributions $\sum_{j=1}^{N} g_j$ always dominate the size of prize P. Moreover, we can derive the necessary and sufficient conditions that the increase of fixed amount of prize P and the increase of government direct subsidy g_G enhance total contributions $\sum_{j=1}^{N} g_j$. The novel finding here is that, in any case, either fixed amount of prize P or government direct subsidy g_G (possibly both) must enhance total contributions $\sum_{j=1}^{N} g_j$. Therefore, we can adopt at least one measure to enhance private contributions. Finally, increase of the slope of the weighting function $\varphi(\cdot)$ as well as the increment of the variable amount of prize $l\left(\sum_{j=1}^{N} g_j - P + g_G\right)$ always increase the total contribution $\sum_{j=1}^{N} g_j$ and thus increase the size of the public goods $\sum_{j=1}^{N} g_j - P + g_G$.

Proposition 2

(a) If prize $P + l(\cdot)$ is zero ($P = l(\cdot) = 0$), public goods are under-provided.

For later statements in this Proposition, we assume an interior solution, and assume $N \geq 3$ or symmetric contributions in $N = 2$.

(b) The size of public goods $\sum_{j=1}^{N} g_j - P + g_G$ is increasing in the fixed amount of prize P if and only if the total contributions $\sum_{j=1}^{N} g_j$ exceeds the size of the prize $P + l\left(\sum_{j=1}^{N} g_j - P + g_G\right)$. Morgan's (2000) result is a special case of this statement because total contributions always dominate the size of the prize in his model.

(c) The effects of the fixed amount of prize P and government direct subsidy g_G to private contributions are as follows:

(c-1) Total contribution $\sum_{j=1}^{N} g_j$ is increasing in fixed amount of prize P if and only if $(N-1)\varphi'\left(\frac{1}{N}\right) - (N-1)\varphi'\left(\frac{1}{N}\right) l'\left(\sum_{j=1}^{N} g_j - P + g_G\right) - \sum_{j=1}^{N} g_j \sum_{i=1}^{N} k_i''\left(\sum_{j=1}^{N} g_j - P + g_G\right)$ is positive. Therefore, if the variable amount of prize $l\left(\sum_{j=1}^{N} g_j - P + g_G\right)$ is disregarded as in Morgan (2000), fixed amount of prize P always enhances private contributions[4].

(c-2) Total contribution $\sum_{j=1}^{N} g_j$ is increasing in government direct subsidy g_G if and only if $(N-1)\varphi'\left(\frac{1}{N}\right) l'\left(\sum_{j=1}^{N} g_j - P + g_G\right) + \sum_{j=1}^{N} g_j \sum_{i=1}^{N} k_i''\left(\sum_{j=1}^{N} g_j - P + g_G\right)$ is positive. Therefore, the slope of variable amount of prize $l\left(\sum_{j=1}^{N} g_j - P + g_G\right)$ improves the effect of government direct subsidy g_G, the effect of which is totally the opposite of that in (c-1).

(c-3) At least either fixed amount of prize P or government direct subsidy g_G enhances private contributions.

[4] It is natural that a variable amount of prize $l\left(\sum_{j=1}^{N} g_j - P + g_G\right)$ discourages the effect of fixed amount of prize P, because increase of fixed amount of prize P decreases the size of variable amount of prize $l\left(\sum_{j=1}^{N} g_j - P + g_G\right)$.

(d) Increase in $l(\cdot)$ (i.e. by multiplying a fixed number that is more than one) results in an increase of total contribution $\sum_{j=1}^{N} g_j$. The increase of the slope of the weighting function $\varphi(\cdot)$ also results in an increase of total contribution $\sum_{j=1}^{N} g_j$.

(e) Public goods are underprovided if and only if $\varphi'\left(\frac{1}{N}\right)\left(P + l\left(\sum_{j=1}^{N} g_j - P + g_G\right)\right) < \sum_{j=1}^{N} g_j$.[5] Statement (a) is a special case of this.

Proof:

See Appendix I.1

As explained in Proposition 2 (b)-(c), at least either the fixed amount of prize or government direct subsidy enhances private contributions. Morgan (2000) finds a case where the former works very well (The former not only enhances private contribution but also increases the size of the public goods.) but the latter not. My model in the following section finds a case where the latter works well.

Then, the next natural question would be whether this mechanism increases social welfare. It is stated in Proposition 2 (e). The left hand side is the total prize $\left(P + l\left(\sum_{j=1}^{N} g_j - P + g_G\right)\right)$ times the quantity how much fundraiser accounts donor's preference, where the right hand side is the total contribution. Left hand side can be considered as the amount of favor for large donors. Morgan's (2000) model is an extreme case because it is always welfare-improving as $\varphi'(\cdot) = 1$, $P < \sum_{j=1}^{N} g_j$ and $l(\cdot) = 0$ always hold under Morgan's (2000) mechanism. In this generalized model, our mechanism does not always welfare-improving. If fundraiser accounts large donor's preference too much (too large $\varphi'(\cdot)$) and/or if too much prize is made from the fruit from public good (too large $l(\cdot)$), this mechanism works negatively and social welfare decreases under this mechanism. *Too much indulgence for large donors spoils social welfare.* In this respect, Proposition 2 (e), which gives us the necessary and sufficient condition that the mechanism improves social welfare, exhibits the application limit of the mechanism.

[5] If $N \geq 3$, the weighting function $\varphi(\cdot)$ is a linear function (Appendix I.2). Therefore, when $N \geq 3$, $\varphi'\left(\frac{1}{N}\right)$ can be substituted by $\varphi'(\cdot)$ in this statement.

The abovementioned model is too general to obtain a meaningful result. Therefore, in order to answer our problem, we will see another special case of this generalized model. In the following section, we will focus on a case where the prize is solely financed from the fruits from public goods and public goods only appear as the prize ($k_i\left(\sum_{j=1}^{N} g_j - R + g_G\right) = \frac{l\left(\sum_{j=1}^{N} g_j - P + g_G\right)}{N}$ and $P = 0$).

3. Model

3.1 Model setting

In this section, we hereafter see that generalized Morgan's (2000) model formalized in the previous section can be applied to our issue.

For the sake of simplicity, firstly, we assume that there are two people, A and B, privately providing public goods. Let the contribution from A be g_A where that from B be g_B. Government is also able to provide public goods directly. Let the government's direct contribution be g_G, financed by lump-sum tax. The total amount of public goods is assumed to be a simple summation of these provisions, $G = g_A + g_B + g_G$. We assume a quasi-linear utility function depending on one's consumption and public goods for simplicity.

Our main assumption in this model is that one's donation on public goods makes the public goods preferable to the donor. This assumption is an application of Morgan's (2000) idea that one's donation has an aspect of negative externality. This idea is clearly imagined when a bridge, which is large enough to be non-rival, is built where two donors live in separated places. If one donates for the bridge, the bridge will be made closer to the donor and thus farther from the other. This characteristics can be described by a symmetrical function $f(\cdot)$. Imagine that $f(g_A/(g_A + g_B))$ is the accessibility of the bridge from A and $f(g_B/(g_A + g_B))$ is that from B. Accessibility is negatively correlated with the distance from the residence to the bridge. In such a case, it is natural to assume that $f'(\cdot) \geq 0$. We normalize that $1 \geq f(\cdot) \geq 0$ is satisfied and assume symmetricity on $f(\cdot)$, i.e. $f(x) + f(1-x) = 1 \forall x \in [0,1]$. The reason why we assume symmetricity is that we would like to hold the total utility from public goods constant irrespective of who provided the public goods in order to simplify the discussion hereafter. We then assume that individual utility is

$$u_i(c_i, g_i, g_{-i}, G) = c_i + f\left(\frac{g_i}{g_i+g_{-i}}\right)h(G) \qquad (7)$$

where c_i is i's consumption, g_i is i's contribution, g_{-i} is the other person's contribution, and $h(G)$ is the total utility derived from the public goods. Note that $g_i + g_{-i}$ does not include government contribution where $G = g_i + g_{-i} + g_G$ does. We assume that total utility derived from the public goods is weakly positive and strictly increasing with respect to the size of the public goods, and its marginal utility is diminishing; formally $h(\cdot) \geq 0$, $h'(\cdot) > 0$ and $h''(\cdot) < 0$, as usual. The individual budget constraint is

$$w_i - \frac{g_G}{2} = c_i + g_i \qquad (8)$$

where w_i is i's initial endowment. In order to ensure an inner solution, we assume a sufficient initial endowment so that private consumption always takes a strictly positive value.

Note that total utility derived from public goods in Bentham's sense is $h(G)$, independent from who provided the public goods. It is also worth noting that this model converges to the standard model if we assume $f(\cdot)$ to be constant, i.e. $f(x) = 1/2\forall x$.

It is easy to see that our problem is another special case of the generalized Morgan's (2000) model. If we substitute $k_i\left(\sum_{j=1}^{N} g_j - R + g_G\right) = \frac{l\left(\sum_{j=1}^{N} g_j - P + g_G\right)}{N}$, $P = 0$, $l(\cdot) = h(\cdot)$, $\varphi(\cdot) = f(\cdot)$ and $N = 2$ in the generalized Morgan's (2000) model and we can obtain our model.

The well-known fact is that, under the standard model, private donations alone result in under-provision of public goods and government provision completely crowds out private donations (Warr, 1982; Roberts, 1984; Bergstrom et al., 1986).

Proposition 3

If the model in equation (7)-(8) converges to the standard model: $f(x) = 1/2\forall x$,

(a) Private provision $g_A + g_B$ alone results in under-provision of public goods.

(b) Government provision g_G completely crowds out private provision $g_A + g_B$ if $g_A + g_B > 0$. Formally, $\frac{\mathrm{d}(g_A+g_B)}{dg_G} = -1$ if $g_A + g_B > 0$.

Proof:

See Appendix I.3

However, if one's donation makes the public goods more preferable to the donor, the story is not that simple. Under the quasi-linear utility function, the initial endowment only affects private consumption and does not affect private provision. Therefore, there is a reasonable ground to assume symmetric contributions. Then, as stated in the following proposition, private provision will be enhanced and government provision may result in partial crowding-out or even crowding-in.

Proposition 4

Suppose that an inner solution is guaranteed and consider symmetric contributions: $g \equiv g_A = g_B$. Then,

(a) Private provision $g_A + g_B$ is always weakly larger than that under the standard model: $f(x) = 1/2 \forall x$. The inequality is strict if and only if $f'\left(\frac{g_A}{g_A+g_B}\right) > 0$.

(b) Government provision g_G incompletely crowds out private contribution if $0 < f'\left(\frac{1}{2}\right) < -\frac{2gh''(G)}{h'(G)}$ and $g_A + g_B > 0$ hold. Government provision even enhances private contribution if $f'\left(\frac{1}{2}\right) > -\frac{2gh''(G)}{h'(G)}$ holds.

Proof: See Appendix I.4

The intuition of these results is rather simple. With respect to (a), the intuition is as follows: if $f'\left(\frac{g_A}{g_A+g_B}\right) > 0$ holds, there is an additional incentive for A to donate because her donation makes the public goods more preferable for herself (e.g. the bridge will be built closer to her house.).

With respect to (b), we should note that there are two ambivalent incentives for individuals. An individual has an incentive to free-ride as we saw in Proposition 1. However, if $f'\left(\frac{1}{2}\right)$ is large enough, an individual has an additional incentive to donate so as to make the public goods more preferable for him/herself.

Then, let us consider a case where government provides a unit amount to the public goods. It decreases an individual's incentive to donate because it decreases the marginal utility in the public goods (-$\frac{1}{2}h''(G)$). However, it increases an individual's incentive to donate because the effect of one's donation is leveraged by the government provision ($\frac{f'\left(\frac{1}{2}\right)h'(G)}{4g}$). Government provision may result in partial crowding-in or crowding-out due to the comparison of the two ambivalent elements.

3.2 Optimality condition

Perhaps the optimality condition is of interest. The Samuelson rule states that the optimal amount of public goods is given by $h'(G) = 1$. Under a symmetric assumption, the first order condition is given as $f'\left(\frac{1}{2}\right)h(G) + 2gh'(G) = 4g$. Therefore, at the optimal, $f'\left(\frac{1}{2}\right)h(G) = 2g$ with $h'(G) = 1$ and $G \geq 2g$ should be satisfied. Without government subsidy, this condition converges to $f'\left(\frac{1}{2}\right)h(G) = G$ with $h'(G) = 1$ and therefore the optimal slope of f is given by $f'\left(\frac{1}{2}\right) = \frac{h'^{-1}(1)}{h(h'^{-1}(1))}$. With government subsidy g_G, the optimal slope of f is given by $f'\left(\frac{1}{2}\right) = \frac{h'^{-1}(1)-g_G}{h(h'^{-1}(1))}$. As we saw in the generalized model, too much slope in f (i.e. $f'\left(\frac{1}{2}\right) > \frac{h'^{-1}(1)-g_G}{h(h'^{-1}(1))}$) works negatively and actually decreases social welfare.

3.3 Sufficient condition for symmetric solution

The abovementioned propositions hold for symmetric contribution. The necessary and sufficient condition that a symmetric contribution is in Nash equilibrium is described in the following proposition.

In addition, although our consideration is only restricted in symmetric contribution, there may exist asymmetric equilibrium. Therefore, it would be useful to show the application limit of the abovementioned results. We provide a sufficient condition that there exists no asymmetric Nash equilibrium in the following proposition. Under this condition, we may restrict our consideration in symmetric contribution.

Proposition 5

(a) Symmetric contribution $g \equiv g_A = g_B$ is in Nash equilibrium if and only if $2f\left(\frac{g'}{g+g'}\right)h(g+g'+g_G)+2(g-g') \leq h(2g+g_G)\forall g' \geq 0$ is satisfied.

(b) There exists no asymmetric Nash equilibrium if the following system has no roots in $(x,\alpha) \in [0,\infty) \times (\frac{1}{2},1]$

$$\begin{cases} f'(\alpha) = \frac{\left(2-h'(x+g_G)\right)x}{h(x+g_G)}, & (9) \\ \frac{f(\alpha)-1/2}{\alpha-1/2} = \frac{2}{h'(x+g_G)} - 1. & (10) \end{cases}$$

Proof: See Appendix I.5

An example that the condition in Proposition 5 is satisfied is as follows.

Example 1.

Suppose $f(\alpha) = 2\left(\alpha - \frac{1}{2}\right)^3 + \frac{1}{2}\left(\alpha - \frac{1}{2}\right) + \frac{1}{2}$ and $h(G) = \sqrt{G}$. Then, $(g_A, g_B) = \left(\frac{1}{8}, \frac{1}{8}\right)$ is the only Nash equilibrium where government contribution $g_G = 0$.

Proof: See Appendix I.6

This example is the case where government contribution neither crowds out nor crowds in private contribution. If you would like to see a case where symmetric equilibrium is the only Nash equilibrium and government contribution crowds in private contribution, slightly modify the abovementioned example to $h(G) = G^\gamma$ where $\gamma = 0.51$ and you can see that $(g_A, g_B) = \left(\frac{1}{2}\left(\frac{1}{4}+\frac{\gamma}{2}\right)^{\frac{1}{1-\gamma}}, \frac{1}{2}\left(\frac{1}{4}+\frac{\gamma}{2}\right)^{\frac{1}{1-\gamma}}\right)$ is the only Nash equilibrium where government contribution crowds in private contribution. If you choose $\gamma = 0.49$, it will be the only Nash equilibrium where government contribution partially crowds out private contribution.

3.4 Model with warm-glow

The abovementioned model does not incorporate warm-glow effect. However, as Diamond (2006) investigated, warm-glow effect is not disregarded in private donation literature. Then, the natural question would be how our results would change if we would incorporate it into our model. If we incorporate warm-glow effect, which was formalized by Andreoni (1990), government provision only partially crowds out private provisions in the standard model (i.e. $f(x) = 1/2 \forall x$). However, the striking result is that Proposition 2 is still valid even if we incorporate warm-glow effect in the utility function. This statement is formally explained in the following proposition.

To be precise, let us assume that the individual utility function is:

$$u_i(c_i, g_i, g_{-i}, G) = c_i + k(g_i) + f\left(\frac{g_i}{g_i + g_{-i}}\right) h(G), \qquad (11)$$

where $k(g_i)$ reflects a warm-glow effect with the standard assumption $k(\cdot) > 0$, $k'(\cdot) > 0$ and $k''(\cdot) < 0$. Note that our previous model described in equation (7)-(8) is a special case of equation (11) with $k(\cdot) = 0$. It is known that taking into account such an effect improves the description of people's behavior (Andreoni, 1989; Andreoni, 1990). Taking into account warm-glow effect inevitably enhances private donation (Appendix I.7). Moreover, we can see that Proposition 2 is still valid even if warm-glow effect is incorporated.

Proposition 6

Let us consider a case where warm-glow effect is incorporated into our model. Suppose that an inner solution is guaranteed and consider symmetric contributions: $g \equiv g_A = g_B$. Then,

(a) Private provision $g_A + g_B$ is always weakly larger than that under the standard model: $f(x) = 1/2 \forall x$. The inequality is strict if and only if $f'\left(\frac{g_A}{g_A + g_B}\right) > 0$.

(b) Government provision g_G incompletely crowds out private contribution if $0 < f'\left(\frac{1}{2}\right) < -\frac{2gh''(G)}{h'(G)}$ and $g_A + g_B > 0$ hold. Government provision even enhances private contribution if $f'\left(\frac{1}{2}\right) > -\frac{2gh''(G)}{h'(G)}$ holds.

Proof: See Appendix I.7

The reason why warm-glow does not change the main result of Proposition 4 is rather straightforward. It is natural that Proposition 4 (a) still holds with warm-glow effect because this statement is a qualitative statement, rather than a quantitative statement. The reason why Proposition 4 (b) still holds with warm-glow effect is that the mechanism behind this statement is not affected by the warm-glow effect. Proposition 4 (b) compares the two effects, government provision dis-incentivizing private provision and government provision incentivizing private provision. The former effect comes from the decreasing marginal utility of public goods, which is irrelevant to warm-glow effect. The latter comes from the leverage effect of government provision, which is also irrelevant to warm-glow effect. Therefore, warm-glow effect does not affect the condition whether government provision crowds out private provision or crowds it in.

3.5 Multiple individuals

The abovementioned model with two individuals is extended to multiple individuals fairly easily. Suppose there are n individuals indexed by $1,2,\cdots,n$. Let contribution from individual i be g_i, consumption of individual i be c_i, and government's direct contribution be g_G financed by lump-sum tax (each person pays $\frac{g_G}{N}$ as tax). Let g_{-i} be total contributions from individuals other than individual i, i.e. $g_{-i} = \sum_{j=1,j\neq i}^{n} g_j$. The total amount of public goods is assumed to be a simple summation of all contributions, $G = \sum_{i=1}^{n} g_i + g_G$. Individual utility is assumed to be

$$u_i(c_i, g_i, g_{-i}, G) = c_i + f\left(\frac{g_i}{g_i + g_{-i}}\right) h(G) \qquad (12)$$

where $h(G)$, the total utility derived from the public goods, satisfies increasing and diminishing marginal utility, i.e. $h'(\cdot) > 0$ and $h''(\cdot) < 0$, and the non-negative and weakly increasing function $f: [0,1] \to [0,1]$ as a weighting function ($f\left(\frac{g_1}{\sum_{i=1}^{n} g_i}\right) + f\left(\frac{g_2}{\sum_{i=1}^{n} g_i}\right) + \cdots + f\left(\frac{g_n}{\sum_{i=1}^{n} g_i}\right) = 1$holds, i.e. formally $\forall(\alpha_1, \alpha_2, \cdots, \alpha_n) \in [0,1]^n; \sum_{i=1}^{n} \alpha_i = 1 \Rightarrow \sum_{i=1}^{n} f(\alpha_i) = 1$). If $n = 2$, this model converges to the model in equation (7)-(8). In this extension, it should be noted that weighting function f is restricted to a linear function, specifically $f(\alpha) = \beta\left(\alpha - \frac{1}{n}\right) + \frac{1}{n}$ with $\beta \in [0,1]$, if $n \geq 3$ holds (See lemma and Appendix I.8). Also, it should be noted that this is also a special case of a generalized Morgan's (2000) model with $k_i\left(\sum_{j=1}^{N} g_j - R + g_G\right) = \frac{l\left(\sum_{j=1}^{N} g_j - P + g_G\right)}{N}$, $P = 0$, $l(\cdot) = h(\cdot)$, and $\varphi(\cdot) = f(\cdot)$. Similar to the simple model with two individuals, if we focus on the symmetric Nash equilibrium, Proposition 3 and Proposition 4 are extended in the following way.

Proposition 7

(a) If weighting function f converges to a constant function i.e. $f(x) = 1/n \forall x$, private provision $\sum_{j=1}^{n} g_j$ alone results in under-provision of public goods and government provision g_G completely crowds out private provision $\sum_{j=1}^{n} g_j$ if $\sum_{j=1}^{n} g_j > 0$ holds. Formally, $\frac{\mathrm{d}\left(\sum_{j=1}^{n} g_j\right)}{d g_G} = -1$ is satisfied if $\sum_{j=1}^{n} g_j > 0$ holds.

(b) Focusing on symmetric contribution, private provision $\sum_{j=1}^{n} g_j$ is always weakly larger than that under the abovementioned case (a): $f(x) = 1/n \forall x$. The inequality is strict if and only if $f'\left(\frac{g_i}{\sum_{j=1}^{n} g_j}\right) > 0$ holds.

(c) Focusing on symmetric contribution, government provision g_G incompletely crowds out private contribution if $0 < f'\left(\frac{1}{n}\right) < -\frac{n g h''(G)}{(n-1)h'(G)}$ and $\sum_{j=1}^{n} g_j > 0$ hold. Government provision even enhances private contribution if $f'\left(\frac{1}{n}\right) > -\frac{n g h''(G)}{(n-1)h'(G)}$ holds.

Proof: See Appendix I.9

In order to clarify what is stated in the abovementioned proposition, we herein provide an example of multiple individuals. With this example, it is observed that crowding-in is not a rare case. Rather, under this example, when the number of people n gets larger, it may become more probable that government contribution crowds-in private contribution.

Example 2.

Suppose there are n identical individuals. Suppose $f(\alpha) = \beta\left(\alpha - \frac{1}{n}\right) + \frac{1}{n}$ with $0 < \beta < \frac{1}{2}$ and $h(G) = \sqrt{G}$.

Without government contribution, the symmetric contribution equilibrium is $g_i = g = \frac{(2\beta(n-1)+1)^2}{4n^3} \forall i$. Therefore, $h'(G) = \frac{n}{2\beta(n-1)+1} > 1$ holds, implying that public goods are under-provided in this case. Small government contribution partially crowds out private contribution if $\beta < \frac{1}{2(n-1)}$ and crowds in if $\beta > \frac{1}{2(n-1)}$.

Proof: Simple calculation results in $g = \frac{(2\beta(n-1)+1)^2}{4n^3}$, $h'(G) = \frac{n}{2\beta(n-1)+1}$ and $h''(G) = -\frac{2n^3}{(2\beta(n-1)+1)^3}$. Proposition 7 (c) results in the conclusion.

3.6 Heterogeneity

It is natural to ask how heterogeneity can be incorporated into our model. Many scholars considered heterogeneity in wage rate (e.g. Mirrlees, 1971; Blumkin and Sadka, 2007) or in initial endowment (e.g. Bergstrom et al., 1986). However, due to the characteristics of the additively separable quasi-linear utility function, such heterogeneity does not affect anyone's choice of private contribution, unless one or more people's consumption takes the lower bound zero. Instead of considering the heterogeneity in initial endowment, we may slightly modify our model and consider heterogeneity. The example is shown as follows.

Let us assume that there are two groups of people, group A and group B. The former consists of N_A people and the latter N_B. Consider a case where people in group A live in Town A and people in group B live in Town B. They are arguing where to build a bridge. The bridge will be built closer to Town A if total private provision from group A exceeds that from group B and vice versa. In such a case, heterogeneity is taken into account with regard to the number of people in each group. Note that, in such a case, private contribution from a person in group A has both positive and negative externality for people in group B, but it has only positive externality for other people in group A.

Formally, let the total private provision from group A be G_A where that from group B is G_B. We then assume that individual i's utility is

$$u_i\left(c_i, G_{\varphi(i)}, G_{-\varphi(i)}, G\right) = c_i + f\left(\frac{G_{\varphi(i)}}{G_{\varphi(i)}+G_{-\varphi(i)}}\right)h(G) \qquad (13)$$

where c_i is i's consumption, $\varphi(i) = \mathrm{A}$ if individual i belongs to group A and $\varphi(i) = \mathrm{B}$ otherwise. Let $-\varphi(i)$ denote A if $\varphi(i) = \mathrm{B}$ and $-\varphi(i)$ denote B otherwise. Assume G is the total amount of public goods, i.e. $G = G_{\varphi(i)} + G_{-\varphi(i)} + g_G$ where g_G is government's contribution. This model converges to our basic model in section 3.1 if we assume $N_A = N_B = 1$.

Under this model, the first order condition results in the following equation:

$$f'\left(\frac{G_{\varphi(i)}}{G_{\varphi(i)}+G_{-\varphi(i)}}\right)\frac{G_{-\varphi(i)}}{\left(G_{\varphi(i)}+G_{-\varphi(i)}\right)^2}h(G)+f\left(\frac{G_{\varphi(i)}}{G_{\varphi(i)}+G_{-\varphi(i)}}\right)h'(G)=1. \qquad (14)$$

This first order condition is completely parallel to the first order condition in our basic model in section 3.1 (i.e. see equation (4-1) of Appendix I.4) and both G_A and G_B do not depend on the number of people in each group, i.e. increase in the number of a group results in a decrease of private contribution per capita so that total private provision from the group remains constant. Therefore, this model is dealt with similar to our basic model in section 3.1. Note that an increase of a person's private contribution in group A is totally cancelled out by the decrease of other people's contribution in the same group.

4. Examples

There are several examples to which our model may be applied. Our model is easily understood by the bridge metaphor where a bridge made by private contributions constructed closer to large donor (and further from small donors), providing real world examples would be useful. Although we briefly look at such examples in the first section, we will look at such examples deeply.

(1) A typical example to which our model may be applicable is an earmarked donation because it conveys the donor's preference to fundraisers. As is predicted by our model, allowing earmarking donations significantly increases private contributions. For example, Li et al. (2011) report that providing the opportunity to earmark one's donation more than doubles the contribution per capita and the likelihood to give to government organizations. Although there are pros and cons for earmarking, evidence exists that this opportunity enhances private contributions.

(2) Another example is international public goods provided by the International Monetary Fund (IMF). The IMF's financial resources are provided by quota subscriptions from member countries. Quota subscription not only determines the amount member countries have to provide to the IMF, but also determines the voting power of member countries. Therefore, quota subscription has an aspect to contribute for international public goods, and a large contributor has negotiation power to determine the IMF's policy.

This voting share is almost proportional to the quota. Although the quota is determined by the countries' economic statistics such as GDP, openness, economic variability and international reserves, it can be modified by negotiation and consent of an 85% majority of the total voting power. Now that one's contribution increases its voting power compared to other countries, our model predicts that this mechanism greatly enhances the incentive to contribute. Anecdotal evidence to support this prediction is that many countries have incentive to contribute more rather than less; for example, Buira (2005, p.287) writes that "*with the exception of Honduras in 1948, no country has ever requested a reduction in its quota.*"

(3) The other example is the non-price competitive auction adopted by Japanese Government Bond (JGB) auction.

Let me first explain how the auction works. The auction is held twice during the day; the first bidding is held at noon, and this is a price competitive auction. In this first bidding, Primary Dealers (PDs) are obliged to bid for an adequate amount and purchase at least a specified share of the planned total issuance amount. The result of this auction is published at 12:45.

Then, the second bidding is closed at 14:30, and it is a non-price competitive auction. The PDs are eligible to participate in this second bidding, and they are able to purchase JGBs at their average successful bidding price at the first bidding.

Now, each PD can make profit without any risk if the market value of JGBs at 14:30 is greater than the average successful bidding price at the first bidding. The total amount of issuance in a non-price competitive auction (2nd bidding) is predefined and the maximum amount that each PD can buy is proportional to the successful bid in the JGB price competitive auction (1st bidding).

This auction system, which is a combination of a price-competitive and a non-price competitive auction, has the following features.

--- the more one purchases JGBs in the first bidding, the more one can purchase JGBs in the second bidding.

--- the more one purchases JGBs in the first bidding, the less other PDs can purchase JGBs in the second bidding.

Based on these features, the government can enhance the incentive for PDs to purchase more JGBs at the first bidding. My model can explain this.

(4) Finally, our model is applicable to explain the phenomenon reported by Brooks (2000) that a low level of public subsidy for concerts crowds-in private donations where a high level of it crowds-out private donations. Brooks (2000) does not provide any theoretical model to explain this phenomenon. Consider a case where the utility function of public goods $h(G)$ is quadratic, say $\alpha G - \beta G^2$ where $G \in \left[0, \frac{\alpha}{2\beta}\right]$. Let there be n identical people contributing for concerts and let $g(g_G)$ be donation per capita where government direct subsidy is g_G. Since government budget is sufficiently large, people ignore any government budget problem. Assume $f'\left(\frac{1}{n}\right) > -\frac{ng(0)h''(ng(0))}{(n-1)h'(ng(0))} = \frac{2\beta ng(0)}{(n-1)(\alpha - 2\beta ng(0))}$. In such a case, a low level of public subsidy crowds in private donation (See Proposition 7). However, when crowd-in occurs, $-\frac{ng(g_G)h''(ng(g_G)+g_G)}{(n-1)h'(ng(g_G)+g_G)} = \frac{2\beta ng(g_G)}{(n-1)\{\alpha - 2\beta(ng(g_G)+g(g_G))\}}$ is an increasing function of g_G. Therefore, if $f'\left(\frac{1}{n}\right)$ is not large enough, there exists a certain amount of government direct contribution $\overline{g_G}$ such that government contribution neither crowds in nor crowds out private contributions ($f'\left(\frac{1}{n}\right) = -\frac{ng(\overline{g_G})h''(ng(\overline{g_G})+\overline{g_G})}{(n-1)h'(ng(\overline{g_G})+\overline{g_G})}$). Let S be the set of these numbers. Let $\overline{g_G}'$ be the smallest number of S. Since S is closed and lower-bounded, the smallest number exists in S. Then, if government subsidy is smaller than $\overline{g_G}'$, government subsidy crowds in private donation, but (slightly) larger government subsidy crowds out private donation.

This explanation is dependent on the assumption of the utility function of public goods $h(G)$, but clearly interprets the coexistence of crowding-in and crowding-out. In this example, marginal utility for public goods is constantly decreasing. Therefore, the disincentive for private donation caused by government subsidy is always constant. However, the incentive, leverage effect, is decreasing. That is why a low level of government subsidy stimulates private donation where a high level discourages private donation.

5. Conclusion

Although theorists have already come up with several ideas to achieve the first-best public good provision, fundraisers as well as governments tend to rely on simpler measures to enhance private contributions. Among the measures that do not rely on government's coercive power, in order to incentivize individuals and corporate companies to contribute, fundraisers sometimes reflect major donors' preferences on public goods *as if donation has an aspect of voting*. There are many examples where public goods become preferable to donors: engraving a large donor's name, earmarked donation to local municipalities, giving special privileges to large donors when getting access to the public goods, etc. Although related ideas such as impure public goods, warm-glow, prestige etc. have been modeled so far, this idea has not been formalized. We provide a rigorous theoretical framework to reflect our idea, point out the similarity between our model and the fixed prize raffle model by Morgan (2000), and prove that private contribution is enhanced under our framework.

Also, it is known that government direct subsidy, which generally causes partial crowding-out, sometimes results in crowding-in of private contributions. For example, Payne (2001) points out that government subsidy for research universities increments private contributions to the same universities. Our model provides a novel explanation to understand crowding-out and crowding-in under the same framework and finds the conditions where crowding-in/crowding-out occur. In our model, government direct subsidy incentivizes private contribution because the influence on private contribution is leveraged by government subsidy. As is well-known, government direct subsidy causes crowding-out by its nature. If the former effect dominates the latter, crowding-in occurs. This explanation is totally different from preexisting explanations such as asymmetric information or seed money, which explain the crowding-in phenomenon.

The analysis in this paper is largely restricted to symmetric contribution. Further analysis should be conducted when the Nash equilibrium is asymmetric.

Appendices

Appendix I.1 Proof of Proposition 2

(a) When prize is zero, this model converges to a standard private provision problem. Therefore, public goods are under-provided. See Bergstrom et al (1986).

(b) When $N \geq 3$, it is proven that the weighting function $\varphi(\cdot)$ is a linear function from the following lemma.

Lemma

If $N \geq 3$, the weighting function $\varphi(\cdot)$ is a linear function.

Proof: See Appendix I.2

Let the slope of weighting function $\varphi(\cdot)$ be $\beta \geq 0$ (When $N = 2$, $\beta = \varphi'\left(\frac{1}{2}\right)$). Then, an individual's first order condition is

$$\beta\left(P + l\left(\textstyle\sum_{j=1}^{N} g_j - P + g_G\right)\right)\frac{\sum_{j=1,j\neq i}^{N} g_j}{\left(\sum_{j=1}^{N} g_j\right)^2} + \left(\varphi\left(\frac{g_i}{\sum_{j=1}^{N} g_j}\right) - \frac{1}{N}\right) l'\left(\textstyle\sum_{j=1}^{N} g_j - P + g_G\right)$$
$$+ k_i'\left(\textstyle\sum_{j=1}^{N} g_j - P + g_G\right) = 1. \qquad \text{(1-1)}$$

Taking the sum of this equality, the following equation is derived:

$$\beta(N-1)\frac{P + l\left(\sum_{j=1}^{N} g_j - P + g_G\right)}{\sum_{j=1}^{N} g_j} + \sum_{i=1}^{N} k_i'\left(\textstyle\sum_{j=1}^{N} g_j - P + g_G\right) = N. \qquad \text{(1-2)}$$

The second order condition is

$$N - \textstyle\sum_{i=1}^{N} k_i'\left(\sum_{j=1}^{N} g_j - P + g_G\right) - (N-1)\beta l'\left(\sum_{j=1}^{N} g_j - P + g_G\right) -$$
$$\frac{\sum_{j=1}^{N} g_j \sum_{i=1}^{N} k_i''\left(\sum_{j=1}^{N} g_j - P + g_G\right)}{2} \geq 0 \qquad \text{(1-3)}$$

Taking the total difference in equation (1-1), the effect of the increase of fixed amount of prize P to total contributions $\bar{G} = \sum_{j=1}^{N} g_j$ is derived as follows.

$$\frac{\partial \bar{G}}{\partial P} = \frac{(N-1)\beta\left(1 - l'(\bar{G} - P + g_G)\right) - \bar{G}\sum_{i=1}^{N} k_i''(\bar{G} - P + g_G)}{N - (N-1)\beta l'(\bar{G} - P + g_G) - \sum_{i=1}^{N} k_i'(\bar{G} - P + g_G) - \bar{G}\sum_{i=1}^{N} k_i''(\bar{G} - P + g_G)} \qquad \text{(1-4)}$$

Note that the denominator of the right-hand side of equation (1-4) is always positive due the second order condition (1-3).

The right-hand side of equation (1-4) is more than one if and only if $\bar{G} > P + l(\bar{G} - P + g_G)$.

(c) The right-hand side of equation (1-4) is positive if and only if the numerator of it is positive.

Also, taking the total difference in equation (1-1), the effect of the increase of government direct subsidy g_G to total contributions $\bar{G} = \sum_{j=1}^{N} g_j$ is derived as follows.

$$\frac{\partial \bar{G}}{\partial g_G} = \frac{(N-1)\beta l'(\bar{G}-P+g_G) + \bar{G}\sum_{i=1}^{N} k_i''(\bar{G}-P+g_G)}{N-(N-1)\beta l'(\bar{G}-P+g_G) - \sum_{i=1}^{N} k_i'(\bar{G}-P+g_G) - \bar{G}\sum_{i=1}^{N} k_i''(\bar{G}-P+g_G)} \quad (1\text{-}5)$$

The right-hand side of equation (1-5) is positive if and only if the numerator of it is positive.

Since the numerator of the right-hand side of (1-4) plus the numerator of the right-hand side of (1-5) is always positive ($(N-1)\beta$), either fixed amount of prize P or government direct subsidy g_G enhances private contributions and it may occur that both measures enhance private contributions simultaneously.

(d) The left-hand side of equation (1-2) is increasing in β (the slope of the weighting function $\varphi(\cdot)$) and in the variable amount of prize $l\left(\sum_{j=1}^{N} g_j - P + g_G\right)$. This increase is to be compensated by the increase of total contributions $\sum_{j=1}^{N} g_j$. Note that both the first term and the second term in the left-hand side of equation (1-2) are decreasing in total contributions $\sum_{j=1}^{N} g_j$.

(e) The Samuelson condition states that public goods are underprovided if and only if $\sum_{i=1}^{N} k_i'\left(\sum_{j=1}^{N} g_j - P + g_G\right) > 1$. Then, our statement is easily derived. Note that public goods are always underprovided in the original Morgan's (2000) model because $\varphi'(\cdot) = \beta = 1$, $l(\cdot) = 0$, $g_G = 0$ and $\sum_{j=1}^{N} g_j > P$.

Appendix I.2 Proof of Lemma

If $n \geq 3$, note that; $\forall x, y(1 - y \geq x \geq y \geq 0)$; $2\varphi(x) + \varphi(1-2x) = \varphi(x+y) + \varphi(x-y) + \varphi(1-2x) \Rightarrow \varphi(x) = \frac{\varphi(x+y)+\varphi(x-y)}{2}$. Therefore, $\varphi(\cdot)$ is locally point-symmetric everywhere (if we assume C^2 in $\varphi(\cdot)$, it is equivalent to $\varphi''(\cdot) = 0$ everywhere.). Therefore, taking into account that $\varphi(\cdot)$ is a (weakly) increasing function, $\varphi(\cdot)$ must be linear.

Appendix I.3 Proof of Proposition 3

(a) This is a direct consequence of Proposition 2 (a). If you want to see direct proof, see the following.

The optimal level of public goods satisfies the Samuelson condition: $h'(g_A + g_B) = 1$. However, under the standard model, the first order condition satisfies $f'\left(\frac{g_A}{g_A+g_B}\right)\frac{g_B}{(g_A+g_B)^2}h(g_A + g_B) + f\left(\frac{g_A}{g_A+g_B}\right)h'(g_A + g_B) = f'\left(\frac{g_B}{g_A+g_B}\right)\frac{g_A}{(g_A+g_B)^2}h(g_A + g_B) + f\left(\frac{g_B}{g_A+g_B}\right)h'(g_A + g_B) = 1 \Leftrightarrow h'(g_A + g_B) = 2$. Therefore, private provision alone results in under-provision of public goods.

(b) The first order condition of private optimization yields $h'(G) = 2$. Therefore, the total amount of public goods $G = g_A + g_B + g_G$ is always constant.

Appendix I.4 Proof of Proposition 4

(a) The first order condition satisfies

$$f'\left(\frac{g_A}{g_A+g_B}\right)\frac{g_B}{(g_A+g_B)^2}h(g_A + g_B) + f\left(\frac{g_A}{g_A+g_B}\right)h'(g_A + g_B)$$

$$= f'\left(\frac{g_B}{g_A+g_B}\right)\frac{g_A}{(g_A+g_B)^2}h(g_A + g_B) + f\left(\frac{g_B}{g_A+g_B}\right)h'(g_A + g_B) = 1. \quad \text{(4-1)}$$

Since $f'\left(\frac{g_A}{g_A+g_B}\right) = f'\left(\frac{g_B}{g_A+g_B}\right)$ and $f\left(\frac{g_A}{g_A+g_B}\right) + f\left(\frac{g_B}{g_A+g_B}\right) = 1$,

$$h'(g_A + g_B) = 2 - f'\left(\frac{g_A}{g_A+g_B}\right)\frac{h(g_A+g_B)}{g_A+g_B} \leq 2. \quad \text{(4-2)}$$

Therefore, the private provision $g_A + g_B$ is always larger than that under the standard model and this inequality is strict if and only if $f'\left(\frac{g_A}{g_A+g_B}\right) > 0$.

(b) Under the assumption of an inner solution and symmetric contributions[6], the first order condition for individual's optimization is

$$f'\left(\frac{1}{2}\right)h(G) + 2gh'(G) = 4g \quad \text{(4-3)}$$

and the second order condition[7] is

$$2g\{f'\left(\frac{1}{2}\right)h'(G) + gh''(G)\} \leq f'(\tfrac{1}{2})h(G). \quad \text{(4-4)}$$

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[6] Note that $f\left(\frac{1}{2}\right) = \frac{1}{2}$ always holds.

[7] Note that $f''\left(\frac{1}{2}\right) = 0$ because $f(x)$ is point symmetric around $x = \frac{1}{2}$.

Combining the first order condition (4-3) and the second order condition (4-4), we can derive a simple form of the second order condition:

$$-2 + h'(G) + f'\left(\frac{1}{2}\right)h'(G) + gh''(G) \leq 0. \quad \text{(4-5)}$$

Taking the total differential of the first order condition (4-3), we can derive the derivative

$$\frac{d(g_A+g_B)}{dg_G} = \frac{d(2g)}{dg_G} = -\frac{f'\left(\frac{1}{2}\right)h'(G)+2gh''(G)}{-2+h'(G)+f'\left(\frac{1}{2}\right)h'(G)+2gh''(G)}. \quad \text{(4-6)}$$

The second order condition (4-5) guarantees that the denominator of the right-hand side of derivative condition (4-6) is always negative. Therefore, the derivative condition of how government provision affects private provision depends on the sign of the numerator of the right-hand side of derivative condition (4-6). If the numerator is positive ($f'\left(\frac{1}{2}\right)h'(G) + 2gh''(G) > 0$), government provision increases private contribution. If the numerator is negative ($f'\left(\frac{1}{2}\right)h'(G) + 2gh''(G) < 0$), since the denominator is smaller than the numerator[8], government provision crowds out private contribution and this crowding-out is incomplete if and only if $f'\left(\frac{1}{2}\right) > 0$.

Appendix I.5 Proof of Proposition 5

With regard to the statement (a), the definition of Nash equilibrium $f\left(\frac{g'}{g+g'}\right)h(g + g' + g_G) - g' \leq \frac{1}{2}h(2g + g_G) - g \forall g' \geq 0$ directly results in the conclusion. Note that the first order condition of statement (a) is $f'\left(\frac{1}{2}\right)h(2\mathrm{g} + g_G) + 2gh'(2g + g_G) = 4g$ and the second order condition is $2g\left\{f'\left(\frac{1}{2}\right)h'(2g + g_G) + gh''(2g + g_G)\right\} < f'\left(\frac{1}{2}\right)h(2g + g_G)$.

With regard to the statement (b), let $\alpha = \frac{g_A}{g_A+g_B}$ and $x = g_A + g_B$ where $g_A \neq g_B$. Assume $\alpha > \frac{1}{2}$ without loss of generality. Then, the first order condition that (g_A, g_B) is Nash equilibrium is $f'(\alpha) = \frac{\left(2-h'(x+g_G)\right)x}{h(x+g_G)}$ and $\frac{f(\alpha)-1/2}{\alpha-1/2} = \frac{2}{h'(x+g_G)} - 1$. There is no asymmetric Nash equilibrium if the system has no roots.

Appendix I.6 Proof of Example 1

[8] Note that $h'(G) \leq 2$ from the first order condition (1-1).

It is easy to confirm that $(g_A, g_B) = \left(\frac{1}{8}, \frac{1}{8}\right)$ is the only symmetric Nash equilibrium. In order to find out that there is no asymmetric Nash equilibrium, it should be noted that the right-hand side of equation (3), the left-hand side of equation (3), the right-hand side of equation (4), and the left-hand side of equation (4) are all increasing functions where $\alpha > \frac{1}{2}$ is satisfied. Therefore, the infimum value that x takes in equation (3) is $x = \frac{1}{4}$ because $\lim_{\alpha \to \frac{1}{2}+0} f'(\alpha) = \lim_{x \to \frac{1}{4}+0} \frac{\left(2-h'(x+g_G)\right)x}{h(x+g_G)}$ is satisfied. The maximum value that x takes in equation (4) is also $x = \frac{1}{4}$ because $\left[\frac{f(\alpha)-1/2}{\alpha-1/2}\right]_{\alpha=1} = \left[\frac{2}{h\prime(x+g_G)} - 1\right]_{x=\frac{1}{4}}$ is satisfied. Thus, the system, (3) and (4), has no roots, which proves that there is no asymmetric Nash equilibrium.

Appendix I.7 Proof of Proposition 6

First, we will see that incorporating warm-glow effect inevitably enhances private donations.

The first order condition without warm-glow effect is

$$f'\left(\frac{1}{2}\right)\frac{h(2\bar{\bar{g}}+g_G)}{4\bar{\bar{g}}} + \frac{h'(2\bar{\bar{g}}+g_G)}{2} = 1 \qquad \text{(7-1)}$$

where it is

$$k'(g^*) + f'\left(\frac{1}{2}\right)\frac{h(2g^*+g_G)}{4g^*} + \frac{h'(2g^*+g_G)}{2} = 1 \qquad \text{(7-2)}$$

with warm-glow effect. Then, it is obvious to see that private contribution with warm-glow is more than that without warm-glow i.e. $g^* \geq \bar{\bar{g}}$ because both $\frac{h(2g+g_G)}{4g}$ and $h'(2g+g_G)$ are decreasing functions in g [9] where the inequality $k'(g^*) > 0$ always holds.

The following proof is an extension of Appendix I.4.

(a) The first order condition results in

$$k'(g) + f'\left(\frac{1}{2}\right)\frac{h(G)}{4g} + \frac{h'(G)}{2} = 1. \qquad \text{(7-3)}$$

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[9] $\frac{h(2g+g_G)}{4g}$ is decreasing in g. It is easily shown by taking the derivative $\frac{d\left(\frac{h(2g+g_G)}{4g}\right)}{dg} = \frac{8gh'(2g+g_G)-4h(2g+g_G)}{16g^2} \leq 0$. Note that $h'(x) \leq \frac{h(x)}{x}$ is always satisfied due to the assumption on $h(\cdot)$.

Then, private contribution converges to $\bar{g}$ under the standard model ($f'(x) = \frac{1}{2} \forall x$) where

$$k'(\bar{g}) + \frac{h'(2\bar{g}+g_G)}{2} = 1 \qquad \text{(7-4)}$$

is satisfied. If we relax the restriction on $f(\cdot)$, private contribution converges to g^* where

$$k'(g^*) + f'\left(\frac{1}{2}\right)\frac{h(2g^*+g_G)}{4g^*} + \frac{h'(2g^*+g_G)}{2} = 1 \qquad \text{(7-5)}$$

is satisfied. Then, it is obvious to see that private contribution under this model is more than that under the standard model ($f'(x) = \frac{1}{2} \forall x$) i.e. $g^* \geq \bar{g}$ because both $k'(\cdot)$ and $h'(\cdot)$ are decreasing functions where inequality $f'\left(\frac{1}{2}\right)\frac{h(2g^*+g_G)}{4g^*} \geq 0$ is satisfied. The inequality $g^* \geq \bar{g}$ is strict if and only if $f'\left(\frac{1}{2}\right) > 0$ holds.

(b) Under the assumption of an inner solution and symmetric contributions, the first order condition for individual's optimization is

$$4gk'(g) + f'\left(\frac{1}{2}\right)h(G) + 2gh'(G) = 4g \qquad \text{(7-6)}$$

and the second order condition is

$$2g\{2gk''(g) + f'\left(\frac{1}{2}\right)h'(G) + gh''(G)\} \leq f'(\tfrac{1}{2})h(G). \qquad \text{(7-7)}$$

Combining the first order condition (7-6) and the second order condition (7-7), we can derive a simple form of the second order condition:

$$-2 + h'(G) + f'\left(\frac{1}{2}\right)h'(G) + gh''(G) + 2k'(g) + 2gk''(g) \leq 0. \qquad \text{(7-8)}$$

Taking the total differential of the first order condition (4-6), we can derive the derivative

$$\frac{d(g_A+g_B)}{dg_G} = \frac{d(2g)}{dg_G} = -\frac{f'\left(\frac{1}{2}\right)h'(G)+2gh''(G)}{-2+h'(G)+f'\left(\frac{1}{2}\right)h'(G)+2gh''(G)+2k'(g)+2gk''(g)}. \qquad \text{(7-9)}$$

The second order condition (7-8) guarantees that the denominator of the right-hand side of derivative condition (7-9) is always negative. Therefore, the derivative condition of how government provision affects private provision depends on the sign of the numerator of the right-hand side of derivative condition (7-9). If the numerator is positive ($f'\left(\frac{1}{2}\right)h'(G) + 2gh''(G) > 0$), government provision increases private contribution. If the numerator is negative ($f'\left(\frac{1}{2}\right)h'(G) + 2gh''(G) < 0$), since the denominator is smaller than the numerator, government provision crowds out private contribution and this crowding-out is incomplete if and only if $f'\left(\frac{1}{2}\right) > 0$.

Appendix I.8 Characteristics of function f

Since f is weakly increasing and $n \geq 3$, the abovementioned lemma guarantees that it is a linear function in $[0,1]$. Remembering that $f\left(\frac{1}{n}\right) = \frac{1}{n}$, the linear function is described as $f(\alpha) = \beta\left(\alpha - \frac{1}{n}\right) + \frac{1}{n}$ with $\beta \in [0,1]$ where the upper bound of β is derived from the fact: $f(0) \geq 0$ and $f(1) \leq 1$.

Appendix I.9 Proof of Proposition 7

(a) The first order condition for individual i is

$$f'\left(\frac{g_i}{\sum_{j=1}^{n} g_j}\right)\frac{\sum_{j=1,j\neq i}^{n} g_j}{\left(\sum_{j=1}^{n} g_j\right)^2} h(G) + f\left(\frac{g_i}{\sum_{j=1}^{n} g_j}\right) h'(G) = 1. \qquad \text{(9-1)}$$

Taking the sum of (9-1) for $i = 1 \sim n$ and recalling that $\sum_{i=1}^{n} f\left(\frac{g_i}{\sum_{j=1}^{n} g_j}\right) = 1$,

$$h(G)\sum_{i=1}^{n} f'\left(\frac{g_i}{\sum_{j=1}^{n} g_j}\right)\frac{\sum_{j=1,j\neq i}^{n} g_j}{\left(\sum_{j=1}^{n} g_j\right)^2} + h'(G) = n. \qquad \text{(9-2)}$$

Since $f'(x) = 0 \forall x$ is satisfied, $h'(G) = n$ holds and this result implies under-provision as well as complete crowding-out of government contribution.

(b) Due to the first order condition and symmetric condition,

$$f'\left(\frac{1}{n}\right) = \frac{ng(n - h'(G))}{(n-1)h(G)} \qquad \text{(9-3)}$$

is satisfied where $g_i = g \forall i$. If $f'\left(\frac{1}{n}\right) = 0$ holds, $h'(G) = n$ is derived, which implies that the total amount of public goods is the same as in the previous case. If $f'\left(\frac{1}{n}\right) > 0$ holds, $h'(G) < n$ holds, which implies that the total amount of public goods is more than the previous case (a).

(c) Due to the first order condition and symmetric condition,

$$\frac{d(ng)}{dg_G} = -\frac{(n-1)f'\left(\frac{1}{n}\right)h'(G) + ngh''(G)}{(n-1)f'\left(\frac{1}{n}\right)h'(G) - n + h'(G) + ngh''(G)} \qquad \text{(9-4)}$$

holds. Equality (9-3) and $f'(\cdot) \geq 0$ imply the inequality $h'(G) \leq n$, which means that the numerator of the right-hand side of equation (9-4) is weakly larger than the denominator.

Due to the second order condition $-2\left(n-h'(G)\right)+2(n-1)f'\left(\frac{1}{n}\right)h'(G)+ngh''(G)<0$, the denominator is always negative. Therefore, if the numerator is negative, there is partial crowding-out if $f'>0$. If the numerator is positive, government contribution results in crowding-in.

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Chapter II
The effect of public disclosure on reported taxable income: Evidence from individuals and corporations in Japan

1. Introduction

Public disclosure of private income tax return information is an intriguing tax policy instrument. Supporters argue that it improves tax compliance and informs public policy discussion, while detractors deride it as an invasion of privacy that could have negative compliance effects. Public disclosure has a long history in the United States and elsewhere. The U.S. income tax contained disclosure provisions for both corporations and individuals during the Civil War, and again in the 1920's and 1930's; disclosure of corporate tax information received a flurry of attention in 2003, including proposed legislation introduced in the U.S. Congress. Recently, President Barack Obama's 2012 *Framework for Business Tax Reform* calls for elements of corporate income tax disclosure. Similarly, Australia is currently considering implementing a system of income tax disclosure. Norway, Sweden, and Finland all currently require some type of public disclosure of taxable information. In Japan, the focus of this study, public disclosure of both individual and corporation income tax information was required from 1950 until 2004.

The academic literature has extensively examined tax disclosure and privacy (e.g., Lenter, Shackelford and Slemrod, 2003), asserting links between disclosure and compliance.[10] However, these analyses, and the policy debate surrounding them, have proceeded in the complete absence of empirical evidence about the effects of income tax disclosure, so that any arguments supporting or opposing disclosure are necessarily made in complete ignorance of empirical data or actual outcomes — we know essentially nothing about the impact of tax disclosure rules on taxpayer behavior.

In this paper, we begin to fill the vacuum of empirical evidence about the behavioral response to disclosure by offering some evidence from the Japanese experience with public disclosure of private tax information. We analyze data on individual and corporate (both public and private) taxpayers in Japan, focusing in part on the period surrounding the abolition of disclosure in 2004, and look for evidence consistent with a behavioral response to income tax disclosure. First, we examine whether individuals who would otherwise be just over the threshold for required disclosure responded to the disclosure system by manipulating their reported taxable income to fall just below the disclosure threshold.[11] Specifically, we examine the distribution of implied taxable income just above the reporting threshold, and find that a non-trivial number of individual taxpayers manipulated their income so as to avoid disclosure, creating "missing tax returns" in the distribution of reported taxable income. This suggests that part of the response to the Japanese disclosure system was in the opposite direction (i.e., toward *reduced* reports of tax liability) than that stressed by supporters of disclosure. We obtain this result for all of the years of taxable income for which we have data, and the finding is robust to a variety of assumptions about our estimation techniques.

We then extend this analysis to the population of Japanese corporations that were subject to disclosure. We find evidence similar to that found in the individual taxpayer data — many corporations manipulated their income so as to avoid disclosure, suggesting that, at the threshold, income tax disclosure results in decreased reported taxable income. However, while there are no publicly available data to examine the effect of disclosure on the entire distribution of individuals' reported taxable income, the same

[10] For more examples, see Benedict and Lupert (1978), Blank (2009, 2012), Guttman (2000), Kornhauser (2002, 2005, 2010), Laury and Wallace (2005), Linder (1990), Mazza (2003), Pomp (1993), Schwartz (2008), Thorndike (2009a, 2009b), and Zaritsky (1974).

[11] In the absence of the required data (data for individuals below the threshold, or data for the period after disclosure), we are unable to answer questions regarding the effect of disclosure on the reported taxable income of the entire distribution of income.

is not true of corporations. In order to examine the effect of the disclosure system on corporations, we examine Japanese firms' implied taxable income to determine whether the abolition of the disclosure system resulted in a decrease of taxable income. Our analysis of corporations' financial data offers no evidence that these companies' taxable income declined after the end of the disclosure system. In sum, we find that both corporate and individual taxpayers perceive disclosure as costly and want to avoid it but, for corporate taxpayers, the disclosure regime does not appear to increase firms' reported taxable income.

This research makes several contributions. First, it offers what is, to the best of our knowledge, the first evidence regarding taxpayer response to a system of income tax disclosure.[12] It suggests that in regimes where disclosure is not universal, one consequence will be taxpayer efforts to avoid disclosure, implying that both firms and individuals perceive tax disclosure as imposing costs on them. Second, it contributes to the literature on taxable income elasticity by documenting that the taxable income of both individuals and firms in Japan in the neighborhood of the income threshold is subject to manipulation, and therefore somewhat elastic. Indeed, public disclosure is an example of a tax system instrument whose setting affects the elasticity of taxable income to tax rate changes, in line with the observation developed in Slemrod and Kopczuk (2002) that this elasticity is endogenous to a range of tax policy instruments.

The paper proceeds in six parts. In Section II, we motivate the paper and discuss the history of income tax disclosure in both the United States and Japan. Section II discusses the behavioral response we expect to see in response to income tax disclosure. Section IV presents our results regarding the response of individuals to income tax disclosure. Section V provides evidence of the response of firms to tax disclosure. Section VI concludes.

2. Motivation

The debate over income tax disclosure has a long history, particularly in the United

[12] Laury and Wallace (2005) use experimental methods to analyze the relationship between the perceptions of confidentiality and taxpayer compliance, and find some evidence suggesting that when individuals perceive a breach of confidentiality, they increase their level of compliance.

States. Supporters of income tax disclosure have long argued that it improves income tax compliance. One of its early American supporters, progressive Senator Robert LaFollette, Jr., argued in the 1930s that if a person "knows that his return is a matter of public record, he will hesitate a long time before he will resort to any device designed to relieve him of his fair share of the tax."[13] Others have argued that the information provided by public disclosure enriches the public debate about tax policy by revealing, for example, the extent of income inequality.[14] Many other benefits of disclosure have been claimed. For example, H.R. 1556, a bill proposed in April of 2003 which would have mandated corporate income tax disclosure in the United States for public corporations, asserted that its objective was to "facilitate analysis of financial statements, to permit inspection of true corporate tax liability and understand the tax strategies undertaken by corporations, to discourage abusive tax sheltering activities, and to restore investor confidence in publicly traded corporations (U.S. Congress, 2003)."[15]

Opponents of income tax disclosure have objected to the associated invasion of privacy. An opponent of the earlier U.S. disclosure regime, Senator Louis Murphy (D-IA), stated that disclosing income tax data is equivalent to taking "the curtains and shades from the homes of our taxpayers and pull[ing] out the walls of the bathroom to assure that the Peeping Toms shall have full and unobstructed opportunity to feast their eyes on the [tax return] (Leff, 1984, pp. 70–71)." Some who oppose disclosure worry that public access to such information will expose taxpayers, particularly wealthy ones, to those who might take advantage of that information. This was also one of the principal arguments made leading up to the elimination after 2005 of the Japanese system (Tax Advisory Commission, 2005). Similarly, opponents of corporate tax disclosure assert that disclosure would result in unnecessary loss of proprietary information for firms (Lenter,

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[13] Robert LaFollette, Jr., in U.S. Congress, Senate, *Congressional Record*, 73rd Congress, 2nd session, 1934, 78, pt 6:6553, cited in Leff (1984, p. 69).

[14] For example, in the 1980s, the Citizens for Tax Justice used accounting data and calculated the effective tax rates for many public firms, and publicized the result. They decried the fact that many firms were paying very little in corporate income tax. It was the publicity given to this (already public but seldom examined) tax information that enriched the public debate on corporate tax reform, and, in part, brought about the Tax Reform Act of 1986 (Pomp, 1993).

[15] One additional advantage of disclosure is that it could improve private contracting. Instead of relying on information directly shared between contracting parties (which could be subject to manipulation, and has costs related to providing that information), contracting parties concerned with the counterparties' ability to fulfill a contract could obtain some information about the other parties' financial condition via their disclosed tax report.

Shackelford, and Slemrod, 2003).

A. Experience with Disclosure in the United States and Other Countries

Disclosure has figured prominently in the history of the U.S. income tax.[16] The first U.S. income tax, enacted during the Civil War, included publicity features. The 1862 Act permitted the public to examine the names of taxpayers and the amounts of their tax liabilities and, with the Revenue Act of 1864, newspapers started to publish lists of taxpayers, their reported incomes, and the amounts of taxes they paid. In 1871, the income tax was allowed to expire, in part, because of privacy concerns (Pomp, 1993).

The modern U.S. income tax was introduced in 1913, and the Revenue Act of June 2, 1924 made public the names and addresses of individuals and corporations filing returns along with their respective tax payments. Before the 1924 elections, newspapers across the country published the names and tax payments of large companies, celebrities, and local residents. President Calvin Coolidge, elected in 1924, and his Secretary of Treasury, Andrew Mellon, vigorously opposed making tax return information public, citing privacy and safety reasons for individuals, and suggesting that such disclosures could compromise business secrecy.[17] In 1926 the law was changed so that only the names and addresses of taxpayers were public.

After a 1934 Senate committee investigating the 1929 stock market crash revealed that many wealthy owners of financial institutions had paid no income tax in the years after 1929, Congress inserted a publicity provision in the 1934 Revenue Act. This provision generated intense controversy. One month before tax returns were due to be filed (in 1935) a campaign to repeal the disclosure provision urged people — many of whom were not affected by disclosure — to petition their representatives in Congress to oppose disclosure. Soon thereafter Congress repealed the disclosure provisions, which was signed into law before the publicity provisions came into effect (Kornhauser, 2002; Leff, 1984).

No similar disclosure provision has been implemented since that time in the United

[16] A more complete discussion of tax disclosure in the U.S. and other countries is presented in Lenter, Shackelford and Slemrod (2003), on which this discussion draws.

[17] At the time, an article in *The Wall Street Journal* highlighted the problem of firms' proprietary information being released, "The extent to which all kinds of persons, partnerships and corporations are swarming to collector's offices, to obtain supposedly useful information about their business competitors, is already a scandal" ("Income Tax Absurdities," *The Wall Street Journal*, November 3, 1924, p. 1).

States at the federal level,[18] and there are now stringent provisions that limit the dissemination of tax return information, even within the U.S. government.[19] However, although 1935 marked the end of the public disclosure of income tax information in the United States, in the wake of the Enron and WorldCom scandals, there was a renewed burst of interest in the issue of the public disclosure of corporate tax return information. While some tax information had long been revealed in the financial statements filed by public companies (Pomp, 1993), the Enron and WorldCom scandals made the public (and policy makers) more aware of how little can be ascertained about a firm's real tax payments from its financial statements (McGill and Outslay, 2002; Hanlon, 2003).[20] In April, 2003 a bill was introduced into Congress that would have provided for public disclosure of certain corporate tax return information, including information necessary to reconcile the firm's tax information with its financial statement information; it was not enacted. In 2007, U.S. public firms were required to increase their public disclosure of information related to uncertain tax positions.[21] More recently, an article in *The New York Times* (2010) entitled "Should Tax Bills Be Public Information?" has brought this topic back in to the public debate (Bernasek, 2010). President Obama's 2012 *Framework for Business Tax Reform* calls for "improved transparency" through, among other means, "greater disclosure of annual corporate income tax payments" (The White House and The U.S. Department of the Treasury, 2012, p. 10). All of this debate and these policy proposals have occurred in the complete absence of empirical evidence of

[18] A few U.S. states, including Massachusetts and Wisconsin, still have some form of tax disclosure. In Wisconsin, this has recently allowed reporters to discover that SC Johnson, a large private firm, remitted no Wisconsin income tax from 2000 to 2008 (Johnston, 2011). Investigative journalism is one example of a possible use of tax disclosure.

[19] Many of these restrictions on intergovernmental tax disclosure were put in place in response to Richard Nixon's attempts to obtain taxpayer information from the IRS for political purposes not authorized by law (Benedict and Lupert, 1978). Some disclosure within the U.S. government is allowed by §6103(i)(3) of the Internal Revenue Code, which permits disclosure of tax return data by the IRS to other governmental agencies if the information is evidence of the violation of a federal crime.

[20] As noted by McGill and Outslay (2002) and Hanlon (2003), a public firm's financial statements are not fully revealing about a firm's actual tax payments made to the IRS. Among other reasons, this is because accounting under Generally Accepted Accounting Principles (GAAP) and tax accounting under the Internal Revenue Code are not identical.

[21] While FIN 48 (now ASC 740-10) did not mandate the disclosure of actual tax return information, it did increase disclosure of tax information for public U.S. firms. Consistent with the findings in this paper, public firms appear to have taken actions to avoid this mandated disclosure (Blouin et al., 2010). Inconsistent with the findings of our paper but consistent with our hypothesis, there is some preliminary evidence that the increased tax disclosure required by FIN 48 (or potentially the forced calculation of the figures to be disclosed) reduced firm tax aggressiveness, at least at the state level (Gupta, Mills, and Towery, 2013).

taxpayer responses to income tax disclosure.

While the United State has had, then abolished, and recently debated, public income tax disclosure, such systems are in place in several countries. Among Organisation for Economic Co-operation and Development (OECD) countries, Norway,[22] Sweden, Finland, and Japan (until it was abolished in 2005), allow some form of public access to some tax information. Australia is currently considering a new disclosure requirement, which would require firms to disclose taxes payable and taxable income (Commonwealth of Australia, 2013). One important feature of the Australian proposal is that, like the disclosure system in Japan, only taxpayers above a certain income threshold (AUD 100 million) would be subject to the disclosure rule. This proposed feature makes the findings of our study, which studies a disclosure regime that applies only to taxpayers above certain thresholds, especially relevant. Lastly, while few jurisdictions disclose full tax information for their general population, in certain countries, there is public disclosure of information about convicted tax evaders.

B. The Japanese Income Tax Disclosure Regime

Japan, the setting for our study, implemented a system of tax disclosure in 1950. Concern about tax evasion figured prominently in the development of a post-war Japanese income tax system. In the thorough post-war income tax revision of 1947, a third-party reporting system (offering a reward if the information provided contributed to discovering tax evasion) and a tax return inspection system (under which for a fee private citizens could inspect all tax returns) were introduced. However, based on the Shoup Mission report of 1949, the tax return inspection system was abolished and, in 1950, the taxpayer "notification system" for high-income taxpayers was introduced in its place. The third-party reporting system was abolished in 1954, but the high-income taxpayer notification system continued until tax year 2004 for individuals (2005 for corporations). The last notification in 2005 (2006) corresponded to tax year 2004 (2005) information.

[22] Norwegian tax returns have been public information since 1863, but until 2002 it was only possible to see other people's tax information by applying in person at a tax office. In 2002 the information was published, and made easily searchable, on the Internet or through a text-messaging service for mobile phones ("Norwegian Tax Office Tells All Online," BBC News, October 11, 2002, http://news.bbc.co.uk/2/hi/not_in_website/syndication/monitoring/media_reports/2321301.stm). For an analysis of the consequences of moving disclosed tax information to the Internet, see Slemrod, Thoresen, and Bø (2013).

The high-income taxpayer notification system was designed to prevent underestimated tax declarations and tax evasion. The idea was that the system would introduce the possibility that tax evasion would be discovered by third parties if the amount of a declaration was strikingly low compared to the lifestyle and other publicly known information about the taxpayers. Under the notification system, the name, address, and the amount of taxable income (until tax year 1982) or income tax liability (after 1982) of the affected individual taxpayers were publicly posted on a bulletin board in each tax office for a period of about two weeks. The information was often collected and published by private companies, and frequently attracted media attention.

Similar aims motivated the corporate notification system, which was introduced at the same time. Disclosure applied to corporations whose taxable income exceeded the thresholds noted in Table II.1. The information disclosed included the corporate name, taxable income, the tax office to which the tax was remitted, the name of the company's president, and the beginning and ending day of the accounting year. The information was usually posted publicly at the tax office within three months after the company submitted its tax return, and was public for at least one month. Although the corporate tax information apparently attracted less frequent media attention than the individual tax information, it was at times collected and published by private publishing companies.

Notably, under the disclosure system it was possible for individuals to avoid the notification system by filing a corrected income tax declaration in April after underestimating tax liability in an initial return subject to the notification deadline of March 31. This would subject the taxpayer to arguably small penalties for arrears and understatement. There is, however, no evidence about the extent of this behavior. Corporations could not use a similar method because both the initial tax report and any corrected tax report were subject to disclosure. However, any corrections initiated by the tax authority were not subject to disclosure. There is anecdotal evidence that some companies asked the tax authorities to correct their understated tax reports so they could avoid notification. There is, however, no systematic evidence about the extent of this behavior.[23]

[23] Anecdotal evidence gathered from conversations with Japanese tax professionals suggests that companies would occasionally understate their tax liability to escape disclosure with an implicit understanding with the tax office that it would correct the report without penalty, thus undermining the

From the beginning of the notification system, disclosure was required only of taxpayers whose reports exceeded a high threshold of tax liability or taxable income. Until tax year 1982 the threshold for individuals was defined in terms of taxable income, and thereafter it was defined in terms of tax liability.[24] For corporations, the threshold was defined in terms of taxable income for all the years of the disclosure regime. The thresholds were high enough so that, over the course of the disclosure law, only between 0.9 percent and 6.7 percent of individual taxpayers were subject to the notification rule. In 2004, 2.4 percent of all corporations were subject to disclosure. The threshold for disclosure was increased five times over its life. Table II.1 presents relevant statistics about the evolution of the system.

In its 2005 report, the Japanese Tax Advisory Commission recommended the elimination of the notification system, asserting that it "is being utilized in various ways inconsistent with its initial aim, and there are various reports of the disclosure being a factor in causing crimes and harassment … Based on circumstances such as these, the system of disclosure should be abolished."[25] Following this recommendation, the notification system was abolished by the Act on the Protection of Personal Information, which became law on April 1, 2005. This Act stipulated that the last notification date for individuals was May 31, 2005, and was February, 2006 for corporations.[26]

Because the notification process reveals the number and tax liabilities of high-income individual taxpayers (and little other information is publicly released about the tax system, even in aggregated form), some researchers have used the disclosed information to study the effects of tax policies (e.g., Makino, 1997). Others have utilized the longitudinal nature of the data to study the evolution of individual incomes in Japan.[27] Researchers have also used the corporate tax disclosure data to evaluate properties of book-tax differences for Japanese firms (Goto, Hirohisa, and Yamashita, 2007). But the impact of

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disclosure but not underpaying their tax liability.

[24] The Japanese tax year for most individuals is January 1 to December 31.

[25] See Tax Advisory Commission (2005) — translation provided by Lingua Science Corporation of Ann Arbor, MI. The Tax Advisory Commission was established by the Japanese government in 1953 to review the tax system and to formulate annual tax changes as well as long-run tax policy (Ishi, 1993).

[26] Disclosure has returned to Japan. As of March 31, 2010, the Financial Services Agency requires corporate executives with salaries exceeding ¥100 million to publicly disclose their salaries.

[27] For example, see Hashimoto (1995). Moriguchi and Saez (2008), in their study of the evolution of income concentration in Japan from 1885 to 2002, use different data sources. Ichikawa (1991) uses the notification data to analyze earnings patterns by occupation and educational status.

the disclosure system itself on taxpayer behavior has not been studied empirically heretofore.

3. How public disclosure affects taxpayer behavior

Taxpayer responses to disclosure hinge upon whether they consider disclosure to present a cost or provide a benefit. It is possible that taxpayers view disclosure of income as a positive signal of their success, gaining from the publicity of publicly revealed evidence of their high income. If this is the case, we may expect taxpayers to take actions to make disclosure more likely in order to receive the publicity that public disclosure would provide.

Alternatively, in what we consider the more plausible case, if the disclosure system imposed (avoidable) real costs on taxpayers, then one would expect to see a behavioral response to the system of disclosure. This will be the case whether these costs are those claimed by supporters of tax disclosure (increasing the costs of income tax noncompliance by increasing the probability of detection), or those claimed by opponents of disclosure (privacy costs for individual taxpayers or proprietary costs for firms). If, in addition, taxpayers are able to manipulate taxable income so as to avoid disclosure, we would expect that some taxpayers manipulate their reported taxable income so as to fall below the disclosure threshold.

If, as is reasonable, the costs of manipulating one's income are increasing in the amount of manipulation needed to escape disclosure, then the frequency of reports with taxable income or tax liability just above the threshold should be less than what it would be in the absence of a disclosure rule, and the discrepancy should decline as taxable income increases above the threshold.[28] This hypothesis is consistent with the (heretofore untested) claim in Lenter, Shackelford and Slemrod (2003, p. 826) that "if disclosure is costly, then some [taxpayers] will respond to disclosure by [taking actions] to avoid the disclosure requirements."

[28] This is similar to several recent papers that examine taxpayer behavior around notches and kinks, using taxpayers' bunching around thresholds to examine taxpayer behavior (Slemrod, 2010). For example, Saez (2010) uses kinks in both the earned income tax credit and the individual income tax rate schedule to estimate individuals' compensated elasticity of taxable income. As in Saez (2010), we use taxpayer behavior around a threshold to make inferences about taxpayer behavior.

4. Analysis of individual income tax disclosure data

A. Data Source

In order to examine the behavioral response of individual taxpayers to the disclosure system, we analyze data from the tax years 2001, 2002, and 2003. These data include information about tax liability and an estimate of the taxable income corresponding to the tax liability. These data were purchased from General Legal Security, Inc., a Japanese company that compiles the data from the public notification records.[29]

B. Analysis

We begin our examination of the behavioral response to the abolition of the Japanese disclosure system by examining the distribution of taxable income obtained from the disclosure data, and searching for "missing tax returns" immediately above the disclosure threshold. This, of course, requires an assumption about the counterfactual distribution for taxable income. There is considerable evidence that, absent disclosure, income for the top percentiles of the individual income distribution follows a Pareto distribution.[30] Piketty and Saez (2006), and Moriguchi and Saez (2008) for Japan in particular, argue that the Pareto distribution is a reasonable approximation for top incomes.[31] Given this assumption, we analyze the micro-disclosure data to determine whether there is evidence in the disclosure data of "missing tax returns" with taxable incomes corresponding to tax liabilities just above the disclosure threshold.

To do this, we first use a maximum-likelihood procedure to estimate the parameters of a Pareto distribution based on the disclosure information. We then compare the actual number of returns just above the threshold to the predicted number of returns based on the estimated Pareto distribution.[32] Observing "too few" actual tax returns with taxable

[29] The company claimed in its online advertising that the sale of these data online, claiming that the compilation follows the regulations of the Act on the Protection of Personal Information. Note that, although the name and address of the individual taxpayers are included in the public disclosure, they are not part of the database that is available for purchase. Other databases, such as the *Who's Who*, do have this information for some years, but not in electronic form. In scattered cases the publishers supplemented the disclosure data with information about occupation. While ideally we would like to obtain some taxpayer identifier and link taxpayers over time to examine behavior over time, we have not been able to obtain such an identifier.

[30] Pen (1971) discusses the basis for this claim and theories about why it might be true.

[31] Our analysis below is necessarily based on imputed taxable income, a slightly different concept from the one studied by, for example, Piketty and Saez (2006), who focus on gross income (before deductions) reported on tax returns.

[32] Since 1999 the disclosure thresholds have always been higher than the threshold for the top marginal

income immediately above the threshold would be consistent with some taxpayers manipulating their tax liabilities in order to avoid public disclosure. This manipulation may take the form of illegally not reporting taxable income (tax evasion), increasing tax deductions or tax credits and legally decreasing the tax liability (such as increasing the amount of charitable contributions during the year), delaying the receipt of income until the following tax year (timing effects), or simply generating less taxable income (by working less or curtailing business activities).

Below, we report several variations of our estimates of the number of “missing tax returns” due to manipulation, and explain our robustness tests. We find that our results are robust to the use of these alternative procedures. We perform these calculations for tax year 2003, and then briefly summarize similar findings obtained for tax years 2001 and 2002.

1. Estimation Based on Reported Individual Taxable Income

We begin by estimating the distribution of individual taxable income. The advantage of focusing on income is that the prior literature concludes that top incomes follow a Pareto distribution (Moriguchi and Saez, 2008). The disadvantage is that we do not have information on actual reported taxable income, but rather have to estimate taxable income using tax liability. This is done by “grossing up” the tax liability by the applicable statutory tax schedule to arrive at an estimate of taxable income.[33] This assumes a predictable mapping between taxable income and tax liability, which is likely to introduce some error into our measure of taxable income (for example, by ignoring tax credits for individual taxpayers). However, there is no reason to believe that the conversion of tax liability to taxable income would bias our estimate of the extent of “missing” tax returns.

Using these taxable incomes, we estimate the Pareto parameter with a maximum likelihood procedure using all the disclosed tax returns for tax year 2003.[34] This

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tax rate (the top rate has applied to income over ¥18 million from 1999 to 2013), so we are not in danger of conflating responses to marginal tax rates with responses to disclosure rules.

[33] For example, the ¥10 million (approximately $97,000 in 2005) tax liability threshold corresponds to ¥34,432,000 (approximately $332,000 in 2005) of taxable income according to the formula used by the data provider. The general formula is: estimated taxable income = (tax liability + 2,740,000)/0.37, where 37 percent was the top statutory marginal tax rate throughout our sample period.

[34] We performed extensive analyses examining whether the lognormal distribution would be an appropriate alternative to the Pareto distribution. Our analyses revealed that the lognormal distribution does not fit the upper portion of Japanese income well, and that the Pareto distribution achieves a much

produces an estimated Pareto index of 2.213. The top panel of Figure II.1 shows a histogram of taxable income, where the bin width is ¥338,435, as well as the estimated Pareto distribution for taxable incomes between the disclosure threshold of ¥34,432,000 and ¥ 50 million. The comparison suggests that there are fewer returns reported just above the disclosure cutoff in the empirical distribution than in the estimated Pareto distribution.[35]

In order to quantify the extent of this phenomenon, we next compare the estimated Pareto distribution to a non-parametric, kernel density estimation, with a bandwidth of ¥1,037,694, to the actual probability density function.[36] We use the Epanechnikov kernel function and Silverman's optimal bandwidth technique, as used as the default procedure in STATA, and a boundary correction procedure.[37] The estimated Pareto distribution and the kernel density estimate are shown together in the lower panel of Figure II.1. The kernel density estimate lies clearly below the estimated Pareto distribution for disclosed incomes close to the threshold.

We can derive an estimate of the number of "missing" returns by calculating the area between the two curves in the range between the threshold and where the estimated Pareto probability density function first clearly crosses the kernel density function (indicated with a vertical line).[38] When we do so, we get an estimate of 870 missing

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superior fit. The Pareto probability density function is $f(x) = ak^{a}x^{-(a+1)}, x \geq k$. We refer to *a* as the Pareto parameter. The procedure uses the *paretofit* command that can be downloaded from Statistical Software Components (at "Boston College Department of Economics Statistical Software Components," Boston College, http://ideas.repec.org/s/boc/bocode.html).

[35] An extremely useful test would examine the distribution of taxable incomes just below the disclosure threshold. However, because our data are made available as a result of the disclosure requirement, we cannot pursue such an approach.

[36] The kernel density estimator is a generalization of a histogram estimator to obtain smoother density estimates than a histogram density estimator. The kernel density estimates are obtained by choosing a kernel function and a smoothing parameter (bandwidth). See Cameron and Trivedi (2005) for the details of the derivation of the kernel density estimator and the optimal bandwidth choice.

[37] The boundary correction procedure makes use of the *kdens* command that can be downloaded from Statistical Software Components (at "Boston College Department of Economics Statistical Software Components," Boston College, http://ideas.repec.org/s/boc/bocode.html). We also repeated the procedure using twice, and half, the Silverman bandwidth. Using twice the bandwidth generates results that are very similar to the reported results. In some cases, using half the bandwidth approximately halves the estimated number of cases (but keeps the estimated percentage of "missing" returns about the same) because the estimated kernel density first intersects the estimated Pareto distribution at a lower value of taxable income. This is not surprising because reducing the bandwidth reduces the smoothness of the kernel density and so makes it more likely that at some point its density exceeds the density of the estimated Pareto distribution.

[38] The use of the point where the kernel density function and the Pareto distribution intersect is somewhat

returns, which is 4.1 percent of the number of returns predicted by the Pareto distribution. It is important to note that, as previously mentioned, the cost of manipulating one's income to below the threshold is plausibly increasing in the distance from the threshold. This is consistent with the data, as the "missing tax returns" seem to be primarily located near the threshold, and then dissipate as one moves further from the threshold.

The behavioral response to the disclosure system is almost certainly understated by the procedure just described because the Pareto parameter is estimated including the range of returns we hypothesize are affected by the manipulated responses themselves. In other words, the Pareto parameter meant to approximate the counterfactual is based on a distribution of taxable income with some returns that are absent — the returns whose tax liability was manipulated so as not to be disclosed. To investigate this issue, we repeat the previous exercise, but estimate the Pareto parameter using only the reports with tax liabilities that exceed ¥40,039,000 of estimated taxable income, at which point the two curves of the kernel density estimate and the fitted Pareto distribution first intersect. Note that the Pareto parameter estimated in this alternative manner should be higher, if as hypothesized there are "missing" returns just above the threshold. Indeed, the estimate is higher than before, 2.256 compared to 2.213.

Comparing the newly estimated Pareto distribution to the distribution from the kernel density procedure suggests that the number of missing returns is 1,221, or 5.3 percent of the number of returns predicted by the Pareto distribution. Thus, using this procedure produces an estimate of the extent of the missing disclosed returns that is 40 percent higher than the previous method. The relevant graphs are shown in Figure II.2.

While we obtain a point estimate of 870 missing returns using all disclosed tax information, this estimate does not suggest the likelihood that such an estimate could be obtained as a result of random chance. To establish that our results are statistically significant, we perform a bootstrapping test. We use our estimated Pareto parameter, 2.213, and the threshold value, ¥34,432,000, to generate 73,936 observations selected from the Pareto distribution (this is the number of observations in the disclosure data in 2003). We then obtain a kernel density estimate using these data, and calculate the

arbitrary. It may be the case that individuals who are missing from the distribution as a result of the disclosure system would be present in the distribution in the absence of the disclosure system to the right of this intersection, or to the left of it. We calculate using the intersection only for convenience.

implied number of “missing tax returns” by comparing the Pareto distribution to the kernel density estimate. We perform this procedure 1,000 times, and calculate the number of times an estimate as large as the one we obtained from the actual disclosure data, 870, would be obtained from randomly generated observations that truly follow a Pareto density function. Of the 1,000 times we perform this procedure, the maximum number of implied “missing tax returns” is 666, and the minimum is 2, with a mean number of “missing tax returns” equal to 243. This means that in exactly zero out of 1000 draws a random generation of data from a Pareto distribution yields a value greater than the estimate of 870 missing tax returns generated from the actual disclosure data. This translates into a highly significant bootstrapped estimate of a p-value related to our estimate of “missing tax returns”.

We also conduct a Kolmogorov-Smirnov goodness-of-fit test in order to corroborate our bootstrapped estimates. The Kolmogorov-Smirnov procedure tests whether the actual empirical distribution of data is the same as a hypothesized distribution of the data. In our case, our null hypothesis is that taxable income follows a Pareto distribution, which would suggest no manipulation to avoid disclosure. We test this null hypothesis on several portions of the empirical distribution of taxable income. First, in the region between ¥34,432,000 and ¥40,039,000, where our prediction of manipulation to avoid disclosure would be consistent with a rejection of the null hypothesis, it is rejected. The Kolmogorov-Smirnov test suggests that between ¥34,432,000 and ¥40,039,000 the empirical data are statistically different (at a $p=0.011$ level) from a Pareto distribution.

However, we fail to reject the null hypothesis for other portions of the distribution of taxable incomes. For incomes between 40.039 and 50 million, 50 and 60 million, 60 and 70 million, 70 and 80 million, 80 and 90 million, and 90 to 100 million yen, the Kolmogorov-Smirnov test suggests that the empirical distribution found in the disclosures is statistically indistinguishable from the Pareto distribution. These results both confirm our prediction of manipulation near the threshold (resulting in a deviation from the Pareto distribution), and confirm that assuming a Pareto distribution is justified for the unmanipulated portion of the distribution of taxable income.

2. Results for Tax Years 2001 and 2002

To check that the previously described results for tax year 2003 were not an anomaly, we repeated the same tests for tax years 2001 and 2002. The results are summarized in Table II.2, which reveals that we obtain very similar results for 2001 and 2002 as we find for 2003. For each of the two methodologies, the estimated number of missing returns in 2002 is below the estimated number in either 2001 or 2003. The details of these calculations are available from the authors.

3. A False Experiment Robustness Test

As another robustness test we repeat our methodology using four arbitrarily picked threshold levels, all of which exceed the real threshold level of ¥34,432,000.[39] We conduct the exact same analysis as when using the real threshold, discarding all data below our new arbitrary thresholds, and estimating the number of "missing returns" based only on incomes above the arbitrarily chosen thresholds. In all four cases, our method produces a trivially small number of "missing returns." For example, when we use ¥70 million as our false experiment threshold, we obtain a Pareto parameter of 2.229, and estimate a total of three missing returns, compared to 870 using the actual disclosure threshold. We obtain similar results when we examine the false thresholds of 50 million, 60 million, and 80 million yen. This result suggests that our missing returns are not merely a result of our distributional assumption or some other methodological problem.

4. A Potential Alternative Explanation

The presence of some gap in density just over the threshold is also consistent with disclosure causing people to increase their reported income. To see this, imagine that disclosure causes that all taxpayers subject to disclosure to increase their reported income by 100 yen.[40] Then no one would report between, for example (for firms), ¥ 40 million and ¥ 40,000,100, and the density of the rest of the distribution to the right of the threshold would increase imperceptibly. This would occur if taxpayers whose (previously optimal) reported income lay above the threshold would increase reported income if they

[39] Because the data are unavailable due to the nature of the disclosure system, we cannot investigate an arbitrarily lower threshold.

[40] This also requires that taxpayers under the threshold do not over-report to be disclosed (as they could perceive that not being disclosed signals their income is below the threshold, which could increase the threat of reporting by peers who believe the taxpayer to have a true income that merits disclosure). Hasseldine et al. (2007) provides evidence that taxpayers that fall below (non-public) disclosure thresholds may increase their declared income and subject themselves to increased disclosure if subjected to potential tax authority scrutiny.

felt that disclosure increased the probability that understatement would be detected and punished (and if this decrease in probability outweighed the extra tax liability they would incur from reporting additional income). In addition, someone whose optimal reported income had been just above the threshold would need to weigh the benefit of under-reporting enough to avoid disclosure against the cost of deviating from their otherwise-optimal report (i.e., and the associated increase in tax authority scrutiny from under-reporting).

Further, we observe that the hole in the distribution seems to be decreasing in size with the distance from the threshold, which is consistent with the expected cost of under-reporting increasing with its magnitude. Lastly, anecdotal evidence is rich with assertions that taxpayers under-report to avoid disclosure, but we have not heard examples of people over-reporting because of disclosure. Nevertheless, taxpayer over-reporting as a result of disclosure could be part of the explanation for what we observe.[41]

5. Analysis of corporate income tax data

A. Data Source

Our examination of the behavioral response of corporate taxpayers to the system of tax disclosure begins with an analysis of income tax disclosure data from the 2005 calendar year. This data set includes 68,824 observations, with information about taxable income (current and the previous three years if disclosed), corporation name, the tax office to which the tax was remitted, business sector, whether the company is public or private, the name of the company's president,[42] and the beginning and ending month of the accounting year.[43] The corporate data were purchased from Diamond, Inc., a Japanese company that compiles the data from the public notification records and other publicly available information.

[41] We are grateful to Brian Erard for clarifying this issue to us.

[42] All text-based data that we have obtained is available only in Kanji (or the native character system for the foreign firms operating in Japan), which has limited our ability to use these data.

[43] Most companies' accounting periods span one year. The data show that a small fraction of companies (1,608 of 68,824) have accounting periods shorter than one year, of which 289 have a half year or shorter accounting period. For this latter group, the disclosure threshold was ¥20 million rather than ¥40 million. In the analysis that follows we exclude all the companies with an accounting period that is six months or less.

B. Analysis of Disclosure Data

We follow the same procedure as outlined above to analyze the corporate data, assuming that the distribution of disclosed corporate taxable incomes in the upper tail follows a Pareto distribution. We assume a Pareto distribution in order to be consistent with our analysis for individual taxpayers, because doing so seems to fit the data well, and because several corporate-level attributes have been found to be distributed following the Pareto distribution. For example, Axtell (2001) notes that employees, revenue, and market capitalization all follow a Pareto distribution. The estimated Pareto index for reported corporate income in the 2005 calendar year is 0.860 when estimated over all observations, and is 0.900 when using only observations with reported taxable income over ¥75,022,000, at which point the two curves of the kernel density estimate and the fitted Pareto distribution based on the former Pareto parameter (0.860) first intersect (where we argue the "unmanipulated returns" begin).[44] The top panel of Figure II.3 shows a histogram of corporate taxable income, where the bin width is ¥1,111,089, as well as the estimated Pareto distribution of corporate taxable income between the threshold, ¥40 million, and ¥90 million. The lower panel of Figure II.3 compares the estimated kernel density for taxable incomes below ¥90 million, with bandwidth of ¥3,497,544, to the former estimated Pareto distribution, while Figure II.4 does the same for the latter estimated Pareto distribution.

As with the individual data, we find evidence that is consistent with behavior designed to avoid disclosure. The number of missing returns based on the Pareto distribution estimated from all disclosed returns is 1,380 (4.9 percent of the number of returns predicted by the Pareto distribution), while the number based only on the "unmanipulated" returns is 2,449 (7.4 percent of the number of returns predicted by the Pareto distribution); this compares to 68,824 corporations that disclosed taxable income, and 2,915,259 corporations overall. These estimates are almost twice as high as the estimates for individual tax returns calculated above.

The phenomenon of companies understating taxable income to just below 40 million yen in order to avoid disclosure was well-known during the disclosure era, if rarely publicly

[44] We obtained corporate data only for 2005. Thus we cannot pursue the possibility that corporate behavior may have been different in 2005 than in other years (especially years not so close to the abolition of disclosure).

discussed. Indeed, the practice was common enough to have merited a moniker: "39 companies." Anecdotally, these "39 companies" manipulated their taxable income so as to fall below the threshold in part so they could hide their profitability from suppliers who might seek better contractual terms from an apparently more profitable firm.

Note also that most of the companies around the disclosure threshold, where we find evidence of under-reporting to avoid disclosure, are not particularly large and are generally not public corporations that of necessity must provide financial information to the public on a regular basis. For example, of the 1,000 smallest firms on the disclosure list (those that fall just above the threshold) in 2005, only one of them is a public corporation. It is reasonable to expect that, for public firms which face capital markets pressures and must report financial information to the public, the effect of disclosure might be different. For example, Rice (1992) finds that private firms are more tax aggressive than public firms, likely because private firms face fewer constraints on disclosing lower taxable incomes.

C. Analysis of Public Corporate Financial Data

1. Hypothesis and Test Design

To this point all of the analysis has been directed toward the hypothesis that some taxpayers will understate their reports in order to avoid disclosure. Another important issue, one that underlies much of the support for disclosure, is whether taxpayers subject to disclosure will restrain their under-reporting because of a fear that the public nature of their report will raise suspicion about under-reporting, and ultimately increase the chance of detection and punishment for noncompliance. Investigating this hypothesis is, however, hampered by the fact that, by its nature, the disclosure data are not available after the notification system was abolished.

However, for public corporations, the situation is more promising because firms' publicly disclosed financial statements are available both before and after abolition, and from these financial statements it is possible to estimate a firm's taxable income.[45] To

[45] Actual taxable income is not available from financial statements, as the financial reporting system in Japan (as in the United States) does not require taxable income as calculated for the firm's financial statements to conform completely with taxable income from the firm's tax return (although the degree of conformity is much greater than in the United States). As a result, we estimate taxable income by grossing up the current tax expense of the firm by the top corporate statutory rate (Hanlon and Heitzman, 2010). Our estimates of taxable income seem reasonable when compared with the disclosed taxable income figures available under the tax disclosure system; the correlation between the two measures exceeds 0.75.

examine whether public firms altered their taxable income after the abolition of the disclosure system, we next analyze data from Compustat Global, which contains financial statement information about public firms located throughout the world. Our sample consists of the universe of firms covered by Compustat Global incorporated in Japan for which the relevant financial statement data are available for all the years considered.[46]

We estimate the model

(1) $$TIDiff_{it} = b_0 + b_1 Treatment_{it} + b_2 UnemDiff_t + b_3 UnemDiffSq_t + b_4 IndustryFixedEffects_i,$$

where *TIDiff* $_{it}$ denotes firm *i*'s estimated taxable income in year *t* less the firm's estimated taxable income in year *t-1*, scaled by total assets in year *t-1*; *Treatment* is one if the firm was subject to disclosure in year *t-1* but not in year *t*, and zero otherwise; *UnemDiff* is the average monthly unemployment rate, as defined by the OECD, in year *t* minus the average monthly unemployment rate in year *t-1*; *UnemDiffSq* equals $(UnemDiff)^2$; and *Industry Fixed Effects* is a vector of dummy variables indicating membership in a specific industry (where industries are defined by two-digit SIC-type codes)

We define *Treatment* using both the fiscal year end of the firm and the year in which the observation occurs. Our identification strategy relies upon the fact that the law mandated that disclosure would be abolished in February, 2006. However, because firms have two or three (depending on the type of company) months to file their tax returns, and some time is required for the National Tax Authority to process and disclose the returns, we observe that almost no public firms disclosed that had fiscal year ends in November 2005, and that no firms disclosed with fiscal year ends in December and thereafter. Thus, a firm with an October 2005 fiscal year end was likely to face disclosure (subject only to being above the threshold level of taxable income, which is likely for a public firm), while a firm with a fiscal year end of November 2005 and thereafter was not likely to face

While the imputation of taxable income from financial statements introduces some noise into our measure of taxable income, this is unlikely to bias our results because we are identifying our effect from fiscal-year ends and the calendar year in which an observation occurred. We know of no major change in the difference between book and tax accounting that affected firms with certain fiscal year ends differently than firms with other fiscal year ends in 2005.

[46] To minimize the influence of outliers, we winsorize *TIDiff* at the 1 percent and 99 percent levels for all of our specifications. Winsorizing, discussed in Tukey (1962), is a standard procedure in analysis of corporate financial data (Baker, Stein and Wurgler, 2003; Hanlon, Mills and Slemrod, 2007).

disclosure.[47] Therefore, we define *Treatment* as a dummy variable that equals one if *t*=2005 and the fiscal year end of a firm was November or December or if *t*=2006 and the fiscal year end of a firm was between January and October, and equals zero otherwise. The unemployment variables are intended to control for the effect of cyclical and secular economic conditions that would affect true, and therefore possibly reported, changes in corporate earnings. We include industry fixed effects to allow for any other systematic differences in firms from different industries. Given that industry membership is highly correlated with the fiscal month end of a firm, industry effects also partially control for systematic differences in firms with different fiscal year end months.[48]

2. Results from Public Firm Data

We start by presenting the data visually. Figure II.5 depicts the mean and the median *TIDiff* by fiscal year end for the time period for which continuous data are available, from June 1992 to February 2010, with a vertical line indicating roughly where disclosure was no longer required of firms (after October 2005). Figure II.6 focuses on a 24-month window, starting from six months before the end of disclosure to 18 months after it ended. The figures do not provide clear visual evidence of distinctly lower values of *TIDiff* in the year after disclosure was abolished. However, there is a clear trend downward beginning in about 2007. While this downward trend in taxable income may have been in part the result of the abolition of disclosure, we have no way of compellingly identifying that this is the case.

We estimate the above regression with all the data available from Compustat Global, which includes observations from 1992 to 2010. This panel of data includes 59,667 observations and 4,714 unique firms.[49] The results of this regression are shown in Table

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[47] We considered coding the *Treatment* variable using the actual disclosure data to specify which firms actually faced disclosure ex post. However, this has two serious problems. First, it assumes that firms who were ultimately not disclosed anticipated non-disclosure and acted accordingly; this may not be the case. Second, and more importantly, given that some firms did face disclosure because their income turned out to be under the threshold limit of income, coding *Treatment* using ex post disclosure data would mechanically be related to firms having lower income and thus would create an endogeneity problem that would undermine a causal interpretation of the estimated coefficients.

[48] For example, in Japan firms with March fiscal year ends are on average larger than other firms, and there are many more March fiscal year end firms than any other month.

[49] These 4,714 firms over the entire 1992–2010 period contrast to the 68,824 firms that were subject to disclosure in calendar year 2005. The set of firms used for this test and for our distribution fitting are thus fundamentally different sets of firms.

II.3, using the least absolute deviation estimator in Column 1, and ordinary least squares (OLS) in Column 2. Notably the estimated coefficient on the treatment dummy for both specifications is positive; using two-way clustering of standard errors by year and fiscal year end month (for the OLS estimator), this estimated coefficient is statistically different from zero at a one percent level.

The estimated positive sign is inconsistent with the hypothesis that disclosure restrains aggressive tax behavior. There are several possible explanations for this result, which highlight the limitations in interpreting our estimated coefficients. First, because the Japanese accounting system for public firms is highly conformed, the tax situation of public corporations in Japan is effectively disclosed even in the absence of the notification system.[50] This is not inconsistent with our earlier finding that a non-trivial amount of firms understated their taxable income to avoid disclosure, because this finding related to relatively small, mostly non-public corporations. As mentioned above, of the 1,000 disclosed firms with the smallest disclosed tax liability, only one was a public corporation.

Another caveat to our identification strategy is that it relies upon firms being able to perfectly anticipate the end of the disclosure system, and react quickly to it by changing their tax avoidance strategies. Absent this assumption, we would be left with trying to attribute the change in taxable incomes after 2007 to the end of disclosure, which is infeasible. Finally, our strategy assumes that tax disclosure was the only factor differentially affecting treated observations and untreated observations. For example, we rule out the possibility that the Japanese tax authority considered tax disclosure as part of their enforcement policy arsenal and, given its abolition, increased their level of tax auditing, which may have resulted in increased tax compliance (Slemrod, Blumenthal, and Christian, 2001; Hoopes, Mescall, and Pittman, 2012).

We performed many robustness tests to see how sensitive the above results are to different specifications. First, we included year fixed effects, to better control for macroeconomic factors that change by year, and affect all firms the same. Including year

[50] Japan's book and tax systems, while not completely conformed, are more closely conformed than most other countries. Indeed, in a sample of 33 major countries, Atwood, Drake and Myers (2010) find that Japan has the fifth most book-tax conformed system.

fixed effects yields results that are similar to those tabulated.[51] We also estimate the model with pre-tax book income as the dependent variable to account for the fact that estimating taxable income introduces error into the measurement of taxable income by, for example, under-estimating taxable income for firms which have tax credits that decrease their current tax expense. Doing this yields similar coefficients on the treatment indicator.[52]

Finally, we estimated our model using a more limited time series, constraining the control group of untreated firms-years. This may yield different estimates if, for example, there was some large structural change in the Japanese economy not captured by our control variables (including our year fixed effects) that made the earlier portion of the time series incomparable to the later time period. We restrict our sample to the year in which the regime change took place (the Japanese fiscal year 2005, which includes April 2005–March 2006), essentially comparing the differenced taxable incomes of firms with fiscal year ends in March 2005 to October 2005 to firms with fiscal year ends November 2005 to February 2006. This generates a negative and significant estimated coefficient on the treatment indicator, the opposite sign to what we found in the specifications discussed above, which is consistent with the hypothesis that disclosure restrained aggressive tax planning. This result is not definitive because we cannot confidently argue that there was not a large, relevant structural shift in the Japanese economy during our sample period not captured by our control variables.[53] The result does, though, suggest that our baseline result is sensitive to the time period used in the estimation and, as such, should

[51] In order to better control for macroeconomic factors, we also estimate the model controlling for: (1) percentage changes in population; (2) percentage changes in exchange rates between the yen and the dollar; (3) percentage changes in the GDP; and (4) percentage changes in the spot price of west Texas intermediate oil. We also include all of these new controls squared (for a total of 8 additional macroeconomic controls). While 7(4) of these 8 controls load significantly in the median (OLS) regression, they make only moderate improvements to the R-squared, and they do not materially change the coefficient on *Treatment*.

[52] In another related test, we regressed the changes in the difference between book income and estimated taxable income (the book-tax difference, or BTD) on the variables in the baseline model. This variable is a measure of both tax avoidance and financial reporting quality, and large BTDs are interpreted as suggesting either aggressive tax planning, aggressive financial statement reporting practices, or both (Hanlon, 2005; Hanlon and Heitzman, 2010). Regressing differenced BTDs on our treatment variable and controls yields a negative and significant coefficient on *Treatment*. This is inconsistent with increased tax avoidance following the abolition of the disclosure regime.

[53] Absent some structural shift in the Japanese economy, there is little reason to believe that discarding usable data and limiting our sample to only two years is the best sample selection procedure. Further, limiting our time series would not allow the estimation to take into account the true time-series variation in corporate taxable income.

be interpreted with caution.

Our failure to find evidence that the abolition of disclosure leads to decreased taxable income for large public corporations could result from the limitation of our data (public firms only), from our identification strategy, or both. However, why abolishing disclosure might be associated with an *increase* in reported taxable income, as the regression results from Table II.3 suggest, is more difficult to explain.

D. Analysis of Both Public and Private Firm Data

One limitation of studying the public firms in the Compustat Global data is that public firms are arguably the least likely to react to a change in the system of public disclosure, given the widespread availability of financial information on such firms. In this section, we analyze a proprietary micro-level firm data set from the Ministry of Finance (MOF) of Japan, the "Financial Statements Statistics of Corporations by Industry, which covers both public and private firms."[54] This allows us to study the behavior of firms which are not otherwise subject to a large amount of public financial disclosure outside of the tax disclosure system. This proprietary data set can be accessed only after a lengthy application processes, and can only be physically accessed at one location in Tokyo. Firms receive a survey from the Ministry of Finance which collects 133 data items about the firm, most of which come directly from financial statement data (not tax returns).[55] Our panel dataset from the MOF contains observations from 1993 to 2009, and contains 180,049 observations representing 44,196 unique firms (the actual sample size varies based on our choice of dependent variable); 93.7 percent of these firms are private. One key detail of the survey procedure used to collect these data is that the frequency with which firms are subject to these surveys depends on the size of the firm — very large firms are required to respond to the survey annually, while smaller firms are subject to the survey on a random basis. This survey technique chosen by the MOF will affect our identification strategy, as will be explained later.

[54] We would have also liked to use these data to replicate our distributional analysis on the full distribution of taxpayers (i.e., including those below the threshold). This is not possible for two reasons. First, the MOF data are financial statement data, and thus lack an exact measure of taxable income, forcing us to estimate the taxable income of the firm. Distributional analysis requires a precise value for taxable income (a value of ¥39.999 million needs to be differentiated from a value of ¥40.000 million). Second, the MOF data are survey data, and an examination of the data suggests that firms often round their reported figures, yielding numbers that are not precise enough for fitting a distribution.

[55] While response to these surveys is mandated by law, there is little effort put into verifying the accuracy of the responses, and penalties for responding incorrectly are apparently light.

We use this micro-level data to estimate the following regression

(2) $$TI_{it} = b_0 + b_1 After\ \ Disclosure_t + b_2 After\ \ Disclosure * Private_{it} + b_3 Unemployment_t + b_4 UnemploymentSquared_t + FirmFE_i + YearFE_t + After\ \ Disclosure * IndustryFE_{it},$$

where TI_{it} denotes firm *i*'s taxable income in year *t* divided by asset in year *t.* We use the firm's estimated taxable income, pretax income, and tax expense as three different proxies for taxable income. *After Disclosure* is one for the time after the end of the disclosure regime (based on the fiscal year end, November 2005) and *After Disclosure * Private is* one if the firm is private and the time period is after the end of the disclosure regime. [56] *Unemployment* is the average monthly unemployment rate, as defined by the OECD, in year *t* and *UnemploymentSquared* equals (*Unemployment*)^2. *After Disclosure * Industry FE* is a vector of dummy variables indicating membership in a specific industry and the time after the end of the disclosure regime.

The dependent variable in this regression, *TI*, is a proxy for the firm's taxable income. Since we lack actual tax return data, we rely upon three different proxies for taxable income. We winsorize all of the three types of dependent variables. The dependent variable is not differenced, which is different from the dependent variable in Model 1, where the dependent variable is *TIDiff* (differenced taxable income). The reason for this change is that in the micro data available from the Ministry of Finance, smaller firms are not often surveyed every year. Thus, using a differenced dependent variable requires that firms have two years of consecutive data, which effectively eliminates many smaller firms from our sample. Because we believe that smaller, private firms are more likely to exhibit a behavioral response to the abolition of tax disclosure, we instead include firm fixed effects, a procedure that, like differencing, adjusts for firm-specific but time-invariant effects.[57]

Our hypothesis deals with the behavioral response to the abolition of disclosure for

[56] A firm's public/private status is not recorded in the MOF data. We make this determination based on merging the 2005 Shikiho list (a list of all publicly traded firms in Japan) with our dataset based on firm name. This classification is imperfect because the merge relies upon firm name (and not a unique identifier, which is not available in the MOF data), and because it characterizes public/private status as a firm fixed effect (relying upon the firm's public/private status in 2005). Given that firms both go public and go private after having been public, public/private is not, in reality, a firm fixed effect. However, we see no reason why this would bias our results.

[57] While we tabulate only un-differenced taxable income using these data, using differenced taxable income does not change the tenor of our findings. Clustering standard errors by firm also does not change our inference.

firm/years occurring after the end of the disclosure regime (as captured by *After Disclosure*), and we expect this response to be larger for private firms (as captured by *After Disclosure*Private*). This is because, by virtue of financial reporting to investors, we expect the difference in the overall level of public information available about private firms as a result of the end of disclosure to be much greater than the difference for public firms.

Although macroeconomic trends certainly affect the firms' taxable income, our identification strategy requires the assumption that such trends do not differentially impact public and private firms in similar industries (as controlled for using the *After Disclosure * Industry FE* variables). Thus, while relying only on the *After Disclosure* dummy variable to measure a response to the abolition of disclosure would falsely attribute decreasing taxable incomes due to the business cycle (for example), identification achieved using the differential response of public and private firms to abolition requires the assumption that, starting in the treatment year of 2005, general economic conditions impact public and private firms similarly. While this is arguably less of an extreme assumption than assuming that no unobserved macroeconomic trend affected taxable incomes after disclosure, it is nevertheless non-trivial.

We estimate Model 2 using ordinary least squares, and tabulate the results in Table II.4. Columns 1, 2 and 3 use estimated taxable income, pre-tax income, and tax expense as proxies for the taxable income of the firm. The negative sign on *After Disclosure* suggests that, on average, firms did decrease their taxable incomes after the disclosure regime ended. However, the estimated coefficient on *After Disclosure*Private*, contrary to our expectation, is reliably positive across all three proxies for taxable income. This suggests that relative to public firms, private firms' taxable incomes increased after disclosure.[58]

To be sure, this micro level analysis has a number of limitations. Its strength relative to

[58] While inconsistent with our previous results, this finding would be consistent with private firms having substantial proprietary costs associated with tax disclosure. For example, if, absent disclosure, suppliers are no longer able to use information on the firm's profitability in setting prices, we may expect income to rise after the end of disclosure for private firms. This result could also be viewed in combination with our first hypothesis, which suggests that some taxpayers (those just under the threshold avoiding disclosure) will increase their taxable income without disclosure. To examine this possibility, we estimated Model 2 using the MOF data on a sample of firms that are well above the disclosure threshold (taxable income above 80 million yen). We find similar results as when using our full sample, suggesting that disclosure threshold effects do not explain our counterintuitive findings regarding our second hypothesis.

the public-firm-only analysis is that it involves smaller private firms that one might expect to have the most significant reaction to the abolition of disclosure. It also allows firms to take time to implement their tax avoidance technologies, as the identification strategy does not rely upon an immediate response. But, like the prior test, it is limited by its use of an estimate of taxable income instead of actual taxable income. In addition, it uses firm survey data that have not been independently verified or tested. As a result, our inability to find evidence that disclosure resulted in improved compliance should not be considered a closed question but rather one that future research should address.[59]

6. Conclusions

Public disclosure of tax return information is one weapon in the arsenal of tax enforcement policy instruments, one that has been employed historically, is currently in use in several countries, and one that, for corporate returns, has recently been debated in the United States. The potential behavioral response to public disclosure of income tax returns figures prominently in policy debates about its advisability. Strikingly, all debates proceed in the near-complete absence of empirical evidence about the effects of public disclosure on behavior. This paper provides what, to our knowledge, is the first empirical evidence about the behavioral response to a tax return public notification system. Our analysis of data from the Japanese disclosure regime suggests that, when there is a threshold for disclosure, a non-trivial number of both individual and corporate taxpayers whose tax liability would otherwise be close to the threshold will under-report so as to avoid disclosure, provoking a response opposite to that stressed by supporters of disclosure. This suggests that some taxpayers perceive costs associated with disclosure, and they seek to avoid these costs by avoiding disclosure.

However, our analysis of corporate taxpayers in Japan finds no consistent evidence that this cost associated with disclosure is related to the ability of public disclosure to restrain tax avoidance. We are unable to find consistent evidence that firms decreased their taxable income after the abolition of tax disclosure. This suggests that other costs, such

[59] As in our prior test using public firm data, we perform a variety of sensitivity tests where we alter the model estimated, the estimation technique, and the variable calculation procedures. None of our analyses provides consistent support for our hypothesis that the abolition of disclosure resulted in firms decreasing their taxable incomes.

as proprietary costs (which, unlike tax related costs, are increasing in profitability), may be the reason that firms near the threshold took action to get below the disclosure threshold.

These findings will be useful to policymakers in considering enactment of a disclosure policy and designing a specific disclosure policy. For example, our findings suggest that non-universal disclosure will trigger avoidance behavior. If the level of taxable income or tax liability determines whether a taxpayer is subject to disclosure, as it did in Japan, the result can be a perverse revenue effect, as some taxpayers will manipulate their reported taxable income downward, decreasing revenues. If, as was proposed in H.R. 1556 in the United States in 2003, the disclosure system only applies to public firms, then, as Lenter, Shackelford, and Slemrod (2003, p. 826) suggest, some firms "might choose to withdraw from the public capital markets, rather than release their tax information."[60] In short, policy makers need to carefully consider the basis for requiring disclosure, and try to anticipate the consequences resulting from taxpayers trying to avoid disclosure.

There are, to be sure, caveats to generalizing our results. Our strong result applies only to disclosure systems where not all taxpayers must disclose. The behavioral response will also depend on the social stigma or reward from a public disclosure of high taxable income, which arguably varies across countries and cultures. Specifically, results from our study in Japan may not be applicable in other countries, where taxpayers' incentives to make public their private information may be different, where the elasticity of taxable income may be different, or where tax "morale" or norms about tax compliance may be different.[61] Nevertheless, this research does establish with some degree of confidence

[60] Another recent example of taxpayers' efforts to escape increased disclosure (albeit not public disclosure) involves Schedule M-3 in the United States. This new corporate income tax schedule, which requires a reconciliation between book and tax income and has the potential to allow the IRS to more efficiently audit companies, is required of all firms above a certain asset threshold that file Form 1120 and keep financial statements based on Generally Accepted Accounting Principles (GAAP). Dennis-Escoffier (2004) suggests that closely-held firms should consider escaping disclosure by simply ceasing to prepare GAAP financial statements; companies near the margin might also manipulate assets to stay below the asset threshold. Hasseldine et al. (2007) shows that increased perceptions of enforcement may encourage taxpayers to submit to increased disclosure requirements, suggesting that taxpayers' willingness to disclose is also a function of tax authority enforcement.

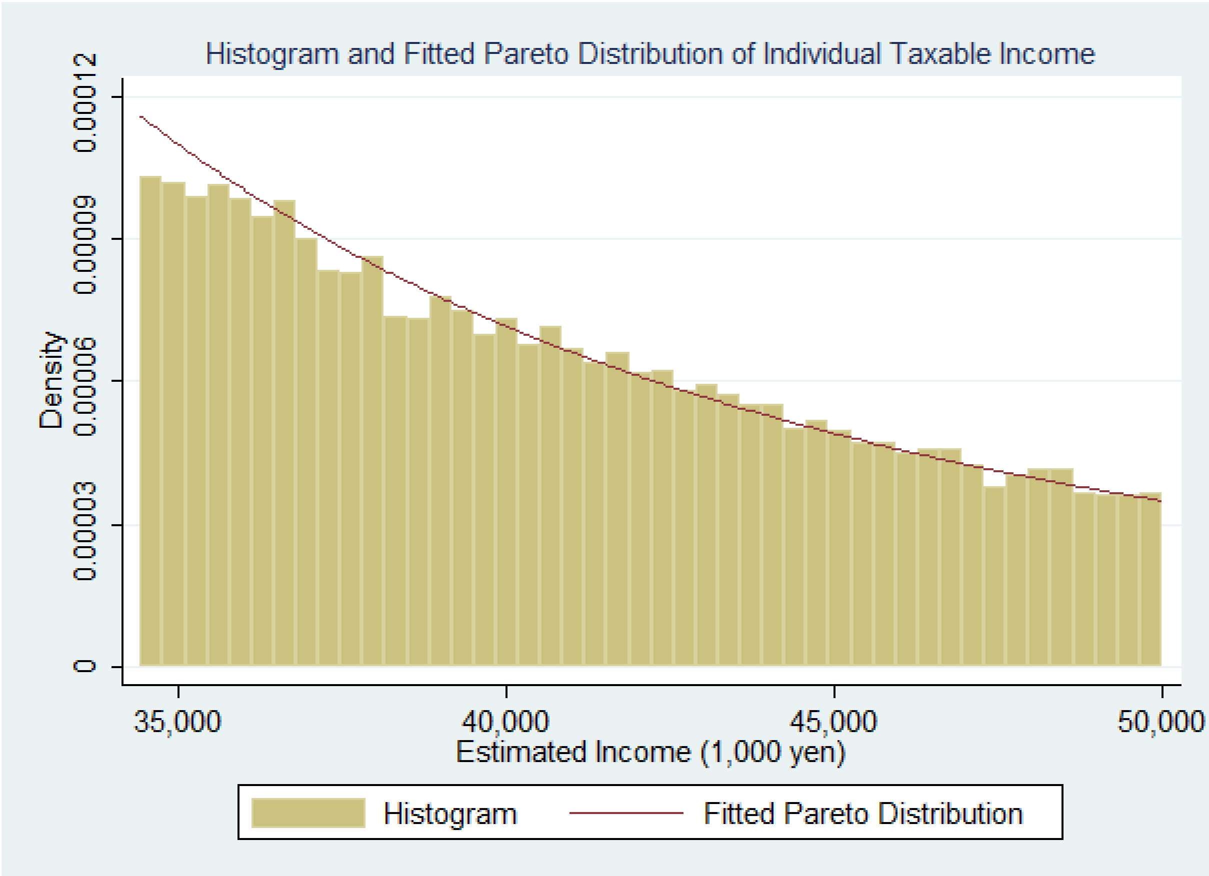
[61] Using survey data on tax compliance compiled by the World Economic Forum, La Porta et al. (1999) report a tax compliance index for Japan of 4.41, and for the United States of 4.47. In a sample with 49 countries with a standard deviation of 1.002, this difference is not statistically significant. However, Torgler (2004) reports that Asian countries, and Japan in particular, generally have higher tax morale than do other OECD countries. He measures tax morale in terms of the willingness of survey participants to justify cheating on their taxes. Thus, while there may not be material differences in tax compliance in Japan and

that public disclosure will change behavior, sometimes in unintended ways, as most tax policy instruments do.

other OECD countries, the Japanese may be less willing to justify what cheating does go on.

Figures

Figure II.1
Comparing the Actual to Fitted Distribution of Individual Taxable Income Using All Returns, Tax Year 2003



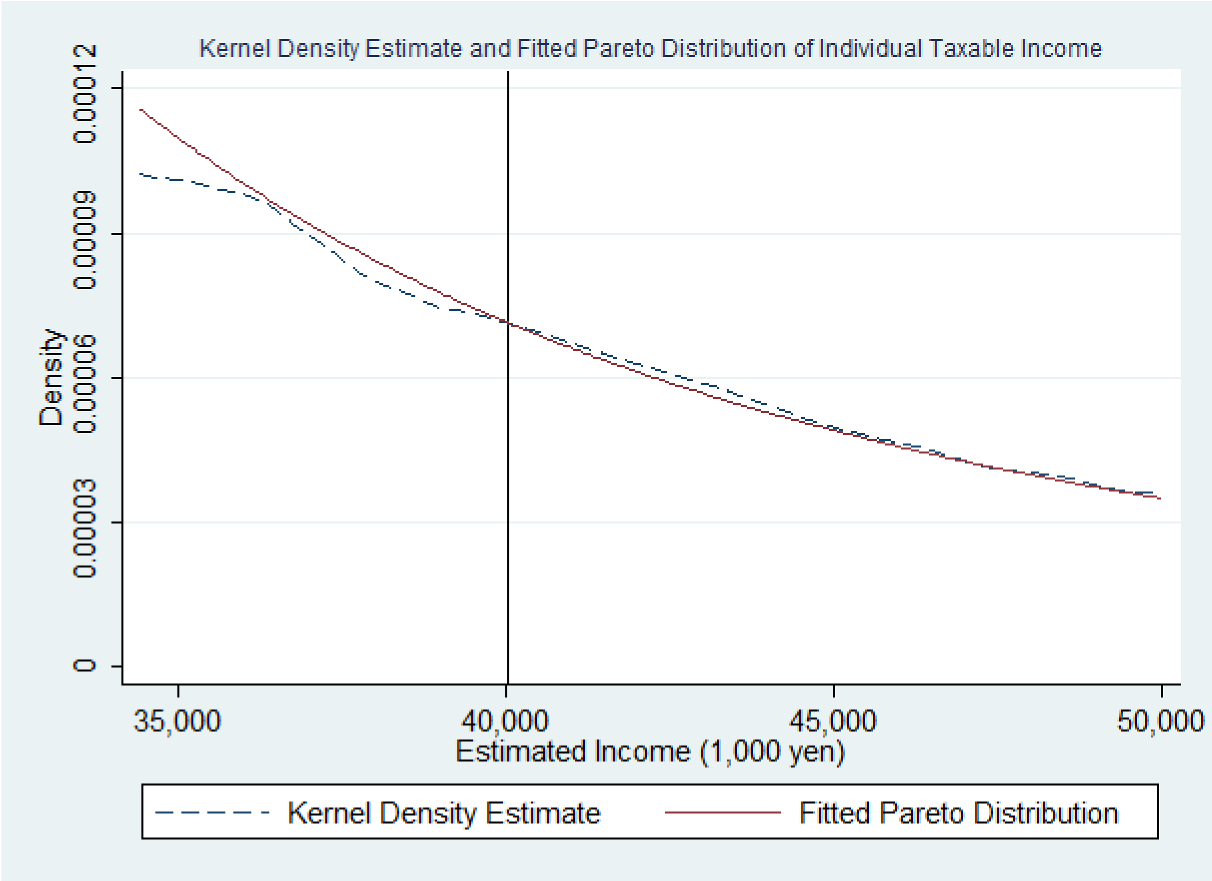
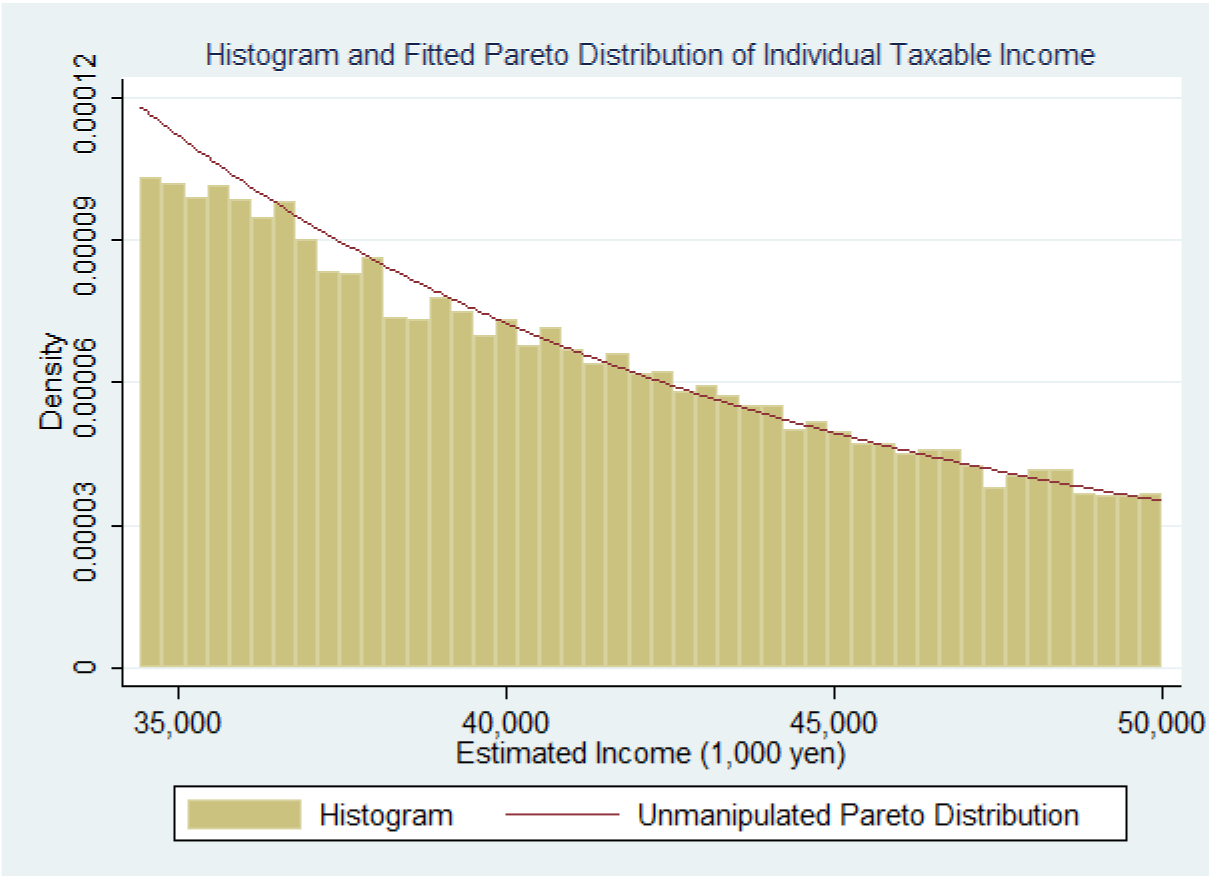

Kernel Density Estimate and Fitted Pareto Distribution of Individual Taxable Income
Density
0
0.00003
0.00006
0.00009
0.00012
35,000
40,000
45,000
50,000
Estimated Income (1,000 yen)
Kernel Density Estimate
Fitted Pareto Distribution

Figure II.2
Comparing the Actual and Fitted Distribution of Individual Taxable Income Using Only "Unmanipulated" Returns, Tax Year 2003



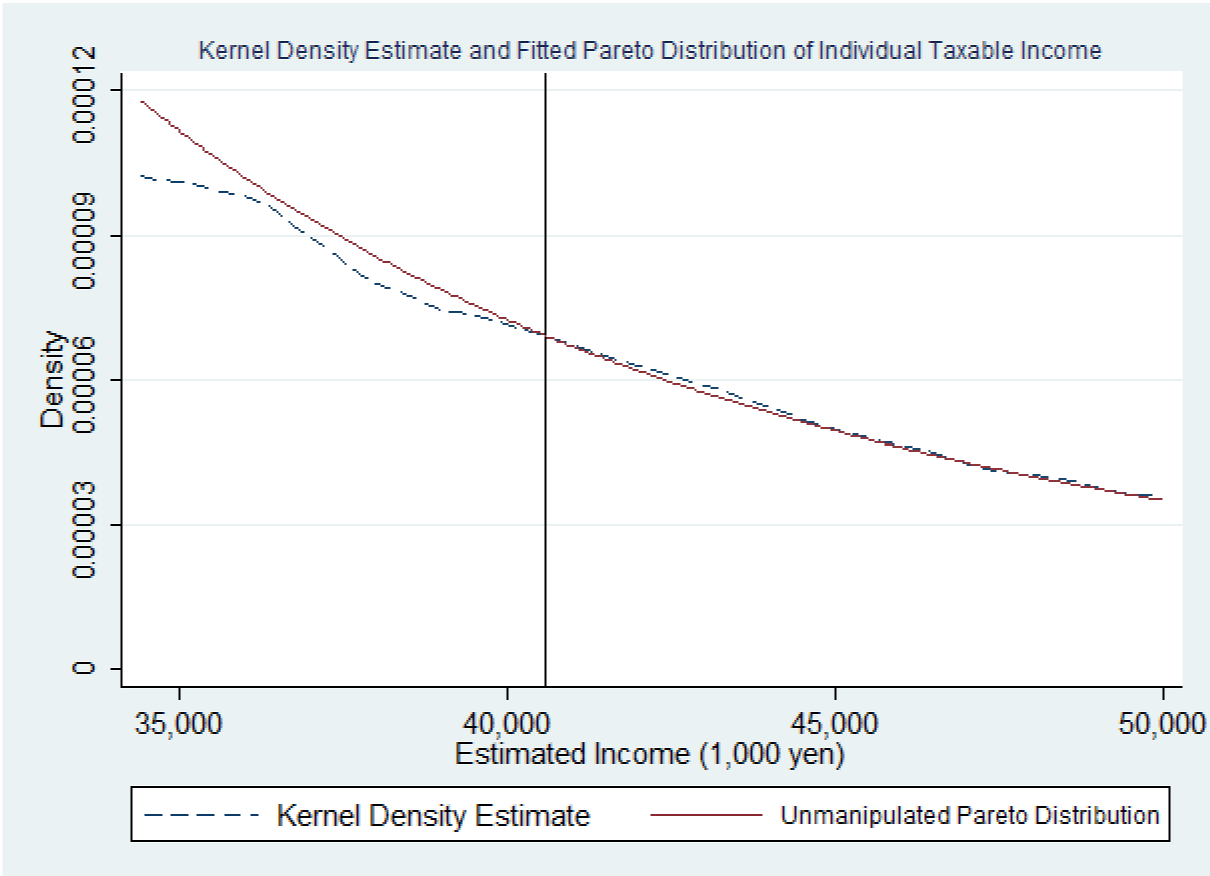
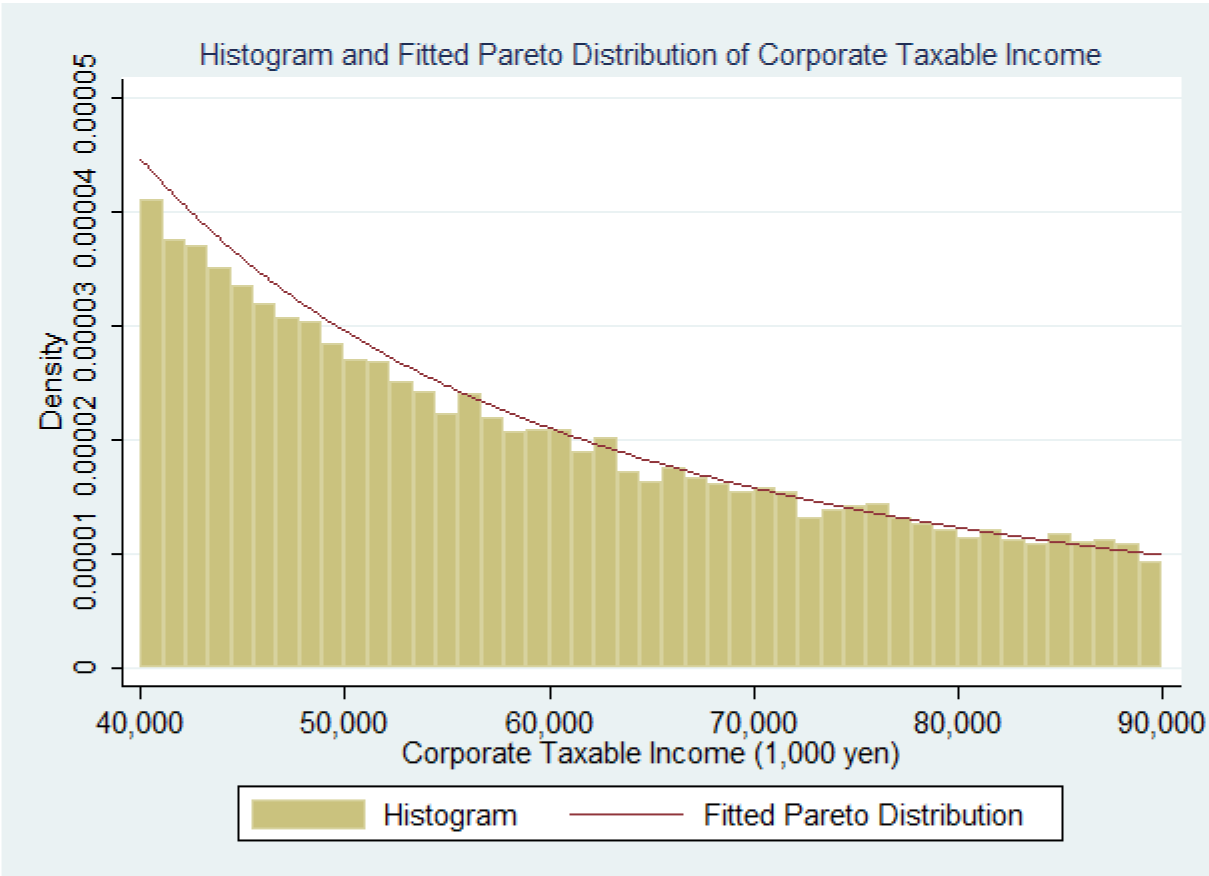

Kernel Density Estimate and Fitted Pareto Distribution of Individual Taxable Income
Density
0
0.00003
0.00006
0.00009
0.00012
35,000
40,000
45,000
50,000
Estimated Income (1,000 yen)
Kernel Density Estimate
Unmanipulated Pareto Distribution

Figure II.3
Comparing the Actual to Fitted Distribution of Corporate Taxable Income Using All Returns, Calendar Year 2005



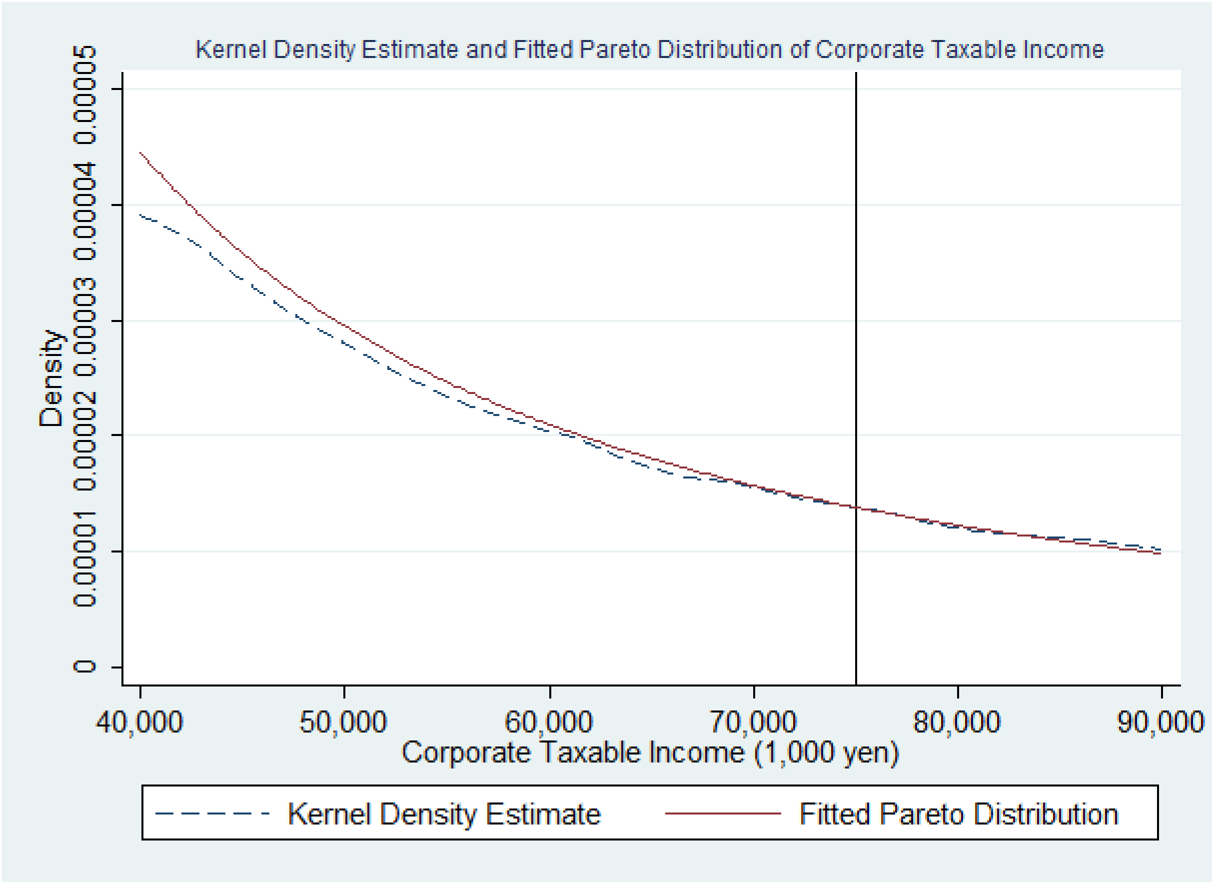
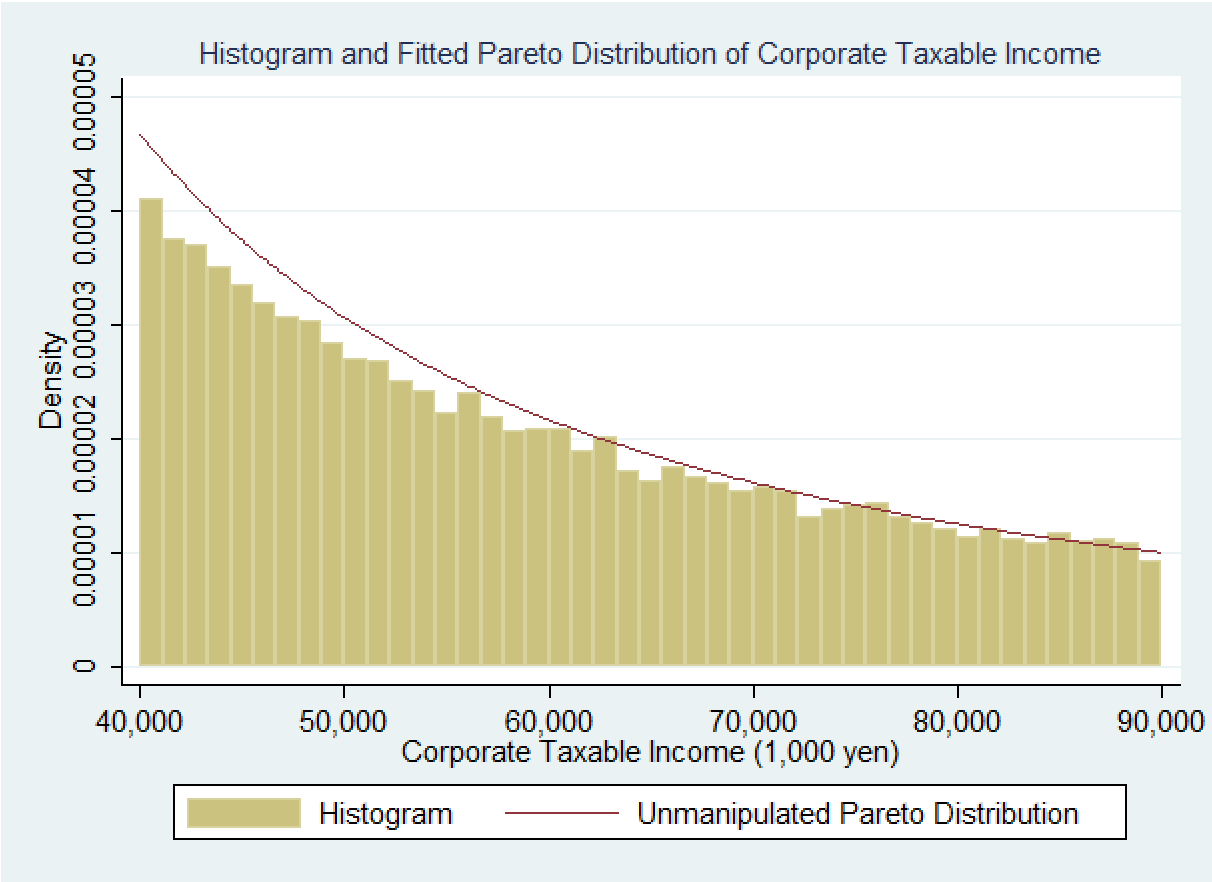

Kernel Density Estimate and Fitted Pareto Distribution of Corporate Taxable Income
Density
0
0.00001
0.00002
0.00003
0.00004
0.00005
40,000
50,000
60,000
70,000
80,000
90,000
Corporate Taxable Income (1,000 yen)
Kernel Density Estimate
Fitted Pareto Distribution

Figure II.4
Comparing the Actual to Counterfactual Distribution of Corporate Taxable Income Using Only "Unmanipulated" Returns, Calendar Year 2005



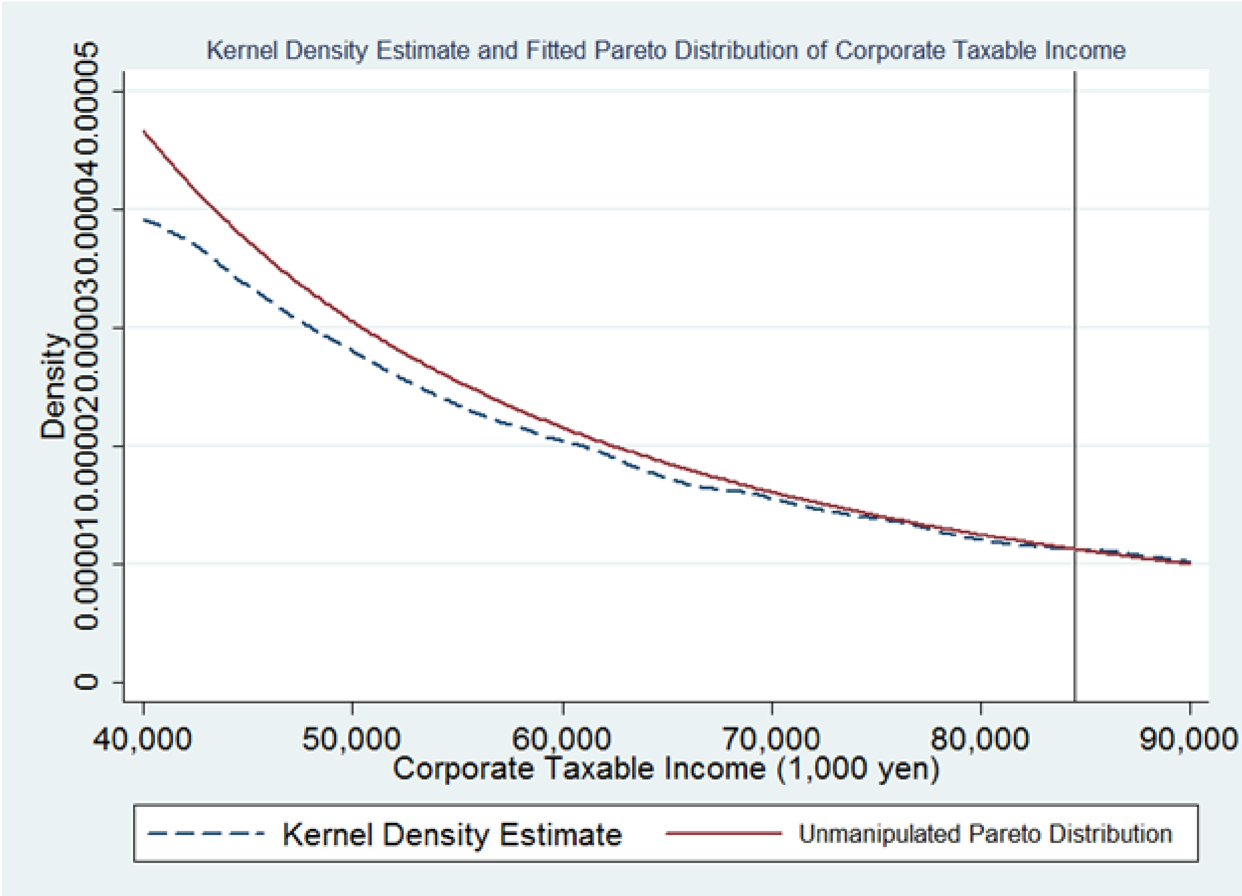
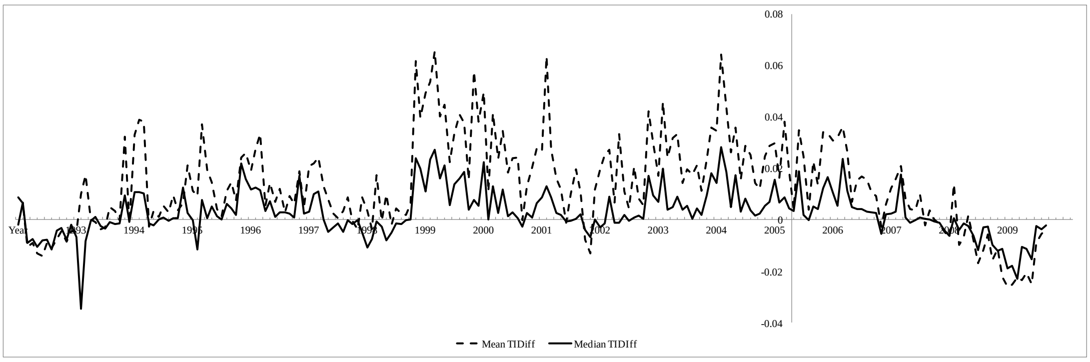

Kernel Density Estimate and Fitted Pareto Distribution of Corporate Taxable Income
Density
0
0.00001
0.00002
0.00003
0.00004
0.00005
40,000
50,000
60,000
70,000
80,000
90,000
Corporate Taxable Income (1,000 yen)
Kernel Density Estimate
Unmanipulated Pareto Distribution

Figure II.5

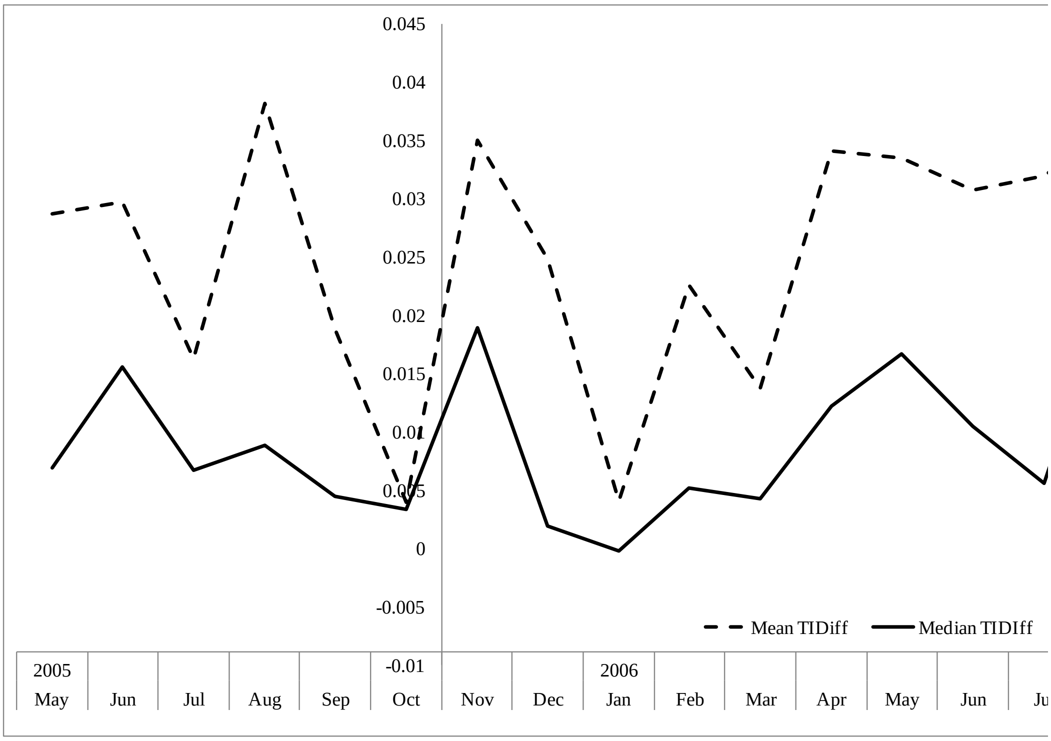
Mean and Median *TIDiff*, by Fiscal Year End, June, 1992 to February, 2010



Notes: This graph displays the mean and median differenced taxable income (TIDiff) from 1993 to 2010 for all Japanese firms available on Compustat Global that meet our sample selection criteria. The vertical line near November, 2005, represents the last fiscal year end date for firms which could reasonable have been assumed to be subject to the corporate tax disclosure regime.

Figure II.6

Mean and Median *TIDiff*, by Fiscal Year End, May, 2005 to April, 2007



Notes: This graph displays the mean and median differenced taxable income (TIDiff) from May, 2005 to April, 2007 for all Japanese firms available on Compustat Global that meet our sample selection criteria. The vertical line near November, 2005, represents the last fiscal year end date for firms which could reasonable have been assumed to be subject to the corporate tax disclosure regime.

Tables

Table II.1

Details of the Japanese Tax Notification System, Tax Years 1950–2004

Panel A. Individual Tax Notification System, Tax Years 1950–2004

Tax Year	Range of Notification	Approximate Number of Taxpayers Subject to Notification	Percentage of Taxpayers Subject to Notification
1950–1951	Taxable Income >500,000 yen	90,000–150,000	2.1–4.3
1952–1956	Taxable Income >1,000,000 yen	30,000–70,000	1.2–3.2
1957–1962	Taxable Income >2,000,000 yen	20,000–150,000	1.1–6.3
1963–1969	Taxable Income >5,000,000 yen	30,000–170,000	1.2–3.9
1970–1982	Taxable Income >10,000,000 yen	80,000–440,000	1.7–6.7
1983–2004	Tax Liability >10,000,000 yen (taxable income ~ 34,000,000)	70,000–180,000	0.9–2.0

Panel B. Corporate Tax Notification System, Tax Years 1950–2004

Tax Year	Range of Notification	Approximate Total Number of Corporations	Approximate Number of Corporations Subject to Notification
1950–1951	Taxable Income >2,000,000 yen	208,000–239,000	
1952–1956	Taxable Income >4,000,000 yen	269,000–424,000	
1957–1969	Taxable Income >20,000,000 yen	449,000–952,000	
1970–2004	Taxable Income >40,000,000 yen	1,000,000–2,915,000	69,000–84,000

Note: As a rough approximation, the yen-dollar exchange rate averaged about 360 from 1950 until 1971, 290 from 1972 to 1977, 230 from 1978 to 1985, 140 from 1986 to 1992, and 110 from 1993 to 2005. These data are from Tax Advisory Commission (2005). The data needed to estimate the approximate number of corporations subject to notification are only available for 1996, 1999–2003 and 2005.

Table II.2

Summary of Findings for Individual Income Tax: Alternative Methodologies for the Tax Years 2001, 2002, and 2003

Tax Year	Based on All Returns		Based on “Unmanipulated” Returns	
	Estimated Pareto Parameter	Estimated Number of Missing Returns	Estimated Pareto Parameter	Estimated Number of Missing Returns
2001	2.2500	982	2.2986	1418
2002	2.2461	754	2.2834	1065
2003	2.2129	870	2.2557	1221

Note: This table documents the estimated Pareto parameter obtained when fitting the disclosure data to a Pareto distribution, and the resulting number of missing returns estimated when using that Pareto parameter. This analysis is done using all the data available (Based on All Returns), and only using returns that are sufficiently above the threshold that they are likely not manipulated (Based on “Unmanipulated” Returns), for the years 2001, 2002, and 2003.

Table II.3

Public Corporation Response to the Abolition of Tax Disclosure

Panel A. Descriptive Statistics

Variable	Observations	Mean	Standard Deviation	25th Percentile	Median	75th Percentile
TIDiff	59,667	0.01	0.05	-0.01	0	0.01
Treatment	59,667	0.07	0.25	0	0	0
UnemDiff	59,667	0.11	0.36	-0.26	0.13	0.32
UnemDiffSq	59,667	0.14	0.19	0.04	0.08	0.16

Panel B. Regression Results

Dependent Variable: TIDiff		
Independent Variables	Coefficient (t-statistic)	Coefficient (t-statistic)
	(1)	(2)
Treatment	0.00298***	0.00592***
	(18.41)	(6.46)
UnemDiff	–0.00284***	–0.00997**
	(–20.73)	(–2.49)
UnemDiffSq	0.00224***	0.00830
	(9.23)	(1.56)
Constant	–0.00011	0.00106
	(–0.25)	(1.60)
Industry Fixed Effects	Yes	Yes
Quantile Regression	Yes	No
Observations	59,667	59,667
R-squared	0.0048	0.035

Notes: The dependent variable, *TIDiff*, is the firm's estimated taxable income less the firm's estimated taxable income in the prior year, scaled by prior year's assets. Treatment is one if the firm was subject to disclosure in year *t*–1 but not in year *t*, and zero otherwise. *UnemDiff* is the average monthly unemployment rate, as defined by the OECD, in year *t* minus the average monthly unemployment rate in year *t*–1. *UnemDiffSq* is the squared value of *UnemDiff*. *Industry Fixed Effects* are defined by two-digit SIC codes. The t-statistics for the OLS regression (included in parentheses) are calculated using standard errors clustered by fiscal year end month, and year. Asterisks denote two-tailed significance at the 1% (***), 5% (**), and 10% (*) levels.

Table II.4

Public and Private Corporation Response to the Abolition of Tax Disclosure

Panel A. Descriptive Statistics

Variable	Obser-vations	Mean	Standard Deviation	25th Percentile	Median	75th Percentile
Estimated Taxable Income	180,049	0.040	0.053	0.003	0.021	0.056
Pre-tax Income	153,896	0.050	0.056	0.013	0.032	0.066
Tax Expense	180,049	0.017	0.022	0.001	0.009	0.024
After Disclosure	202,858	0.268	0.443	0	0	1
After Disclosure * Private	202,858	0.217	0.412	0	0	0
Unemployment	202,858	4.176	0.832	3.389	4.3	4.8
Unemployment Squared	202,858	18.131	6.684	11.485	18.49	23.040

Panel B. Regression Results

Dependent Variable	Estimated Taxable Income	Pre-tax Income	Tax Expense
Independent Variables	Coefficient (t-statistic)	Coefficient (t-statistic)	Coefficient (t-statistic)
	(1)	(2)	(3)
After Disclosure	–0.03413***	–0.01478	–0.01404***
	(–3.89)	(–1.37)	(–3.75)
After Disclosure * Private	0.00668***	0.00337***	0.00289***
	(12.58)	(5.54)	(12.73)
Unemployment	–0.00347	0.00468	0.00115
	(–0.65)	(0.77)	(0.50)
Unemployment Squared	0.00050	–0.00040	–0.00009
	(0.84)	(–0.58)	(–0.36)
Constant	0.04332***	0.03856***	0.01644***
	(4.55)	(3.56)	(4.04)
Year Fixed Effect	Yes	Yes	Yes
After Disclosure * Industry Fixed Effect	Yes	Yes	Yes
Firm Fixed Effect	Yes	Yes	Yes
Observations	180,049	153,896	180,049
R-squared	0.025	0.024	0.019

Notes: The dependent variables, *Estimated Taxable Income*, *Pre-Tax Income* and *Tax Expense*, are three different proxies for the firms' taxable income, and are all scaled by assets. The value of *After Disclosure* is one for the time after the end of the disclosure regime. The value of *After Disclosure * Private* is one if the firm is private and for the time after the end of the disclosure regime. *Unemployment* is the average monthly unemployment rate for Japan, as defined by the OECD, in year *t*. *Unemployment Squared* is the squared value of *Unemployment*. Asterisks denote two-tailed significance at the 1% (***), 5% (**), and 10% (*) levels, calculated using standard errors after including firm fixed effects. Clustering by firm does not change our inference.

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Chapter III

Determinants of Charitable Giving to Unexpected Natural Disasters: Evidence from Two Major Earthquakes in Japan

1. Introduction

Two disastrous earthquakes which happened in Japan, specifically the 2011 Tohoku Earthquake and the 1995 Hanshin Earthquake, are still fresh in our minds. The respective death tolls were 13,135 and 6,402, and the respective economic losses were $20.7 billion and $9.62 billion[62]. Figure III.1 is a map of Japan showing the epicenters.

However, it was truly inspiring that many charity events and volunteer activities were held, and a great amount of donations were collected after these earthquakes. As shown in Figure III.2, quite a few people in Japan worked as volunteers after the Tohoku Earthquake. In terms of donations, the focus of this study, great amounts of donations were collected in Japan just after the earthquakes (Figure III.3), and almost half of the private donations in Japan in 2011 were for the Tohoku Earthquake. Figure III.4 shows that the increase in donation results, from both the effect along the external margin (increase in the

[62] The death toll and economic loss are cited from a website of Cabinet Office, Government of Japan (http://www.bousai.go.jp/kaigirep/hakusho/h23/bousai2011/html/honbun/2b_sanko_siryo_06.htm , http://www5.cao.go.jp/j-j/cr/cr11/pdf/chr11_zu2-2.pdf). Exchange rate is obtained from a website of Bank of Japan.

rate of donors) and the effect along the internal margin (increase in the average amount donation among donors). Then, one can come up with natural questions: who donated to the earthquake victims, and what factors are associated with donors making donations? So far, few studies have been done on the donations for these earthquakes and no study, as far as can be determined, has answered these questions.

These questions are not only avocational, but also of policy interest. In many countries, it is considered that private donations should be enhanced, since a lot of governments already incur enormous amounts of debt. Taxable deductions for certain charitable donations are the examples. An extreme example is the tax credit for private donations in Hungary. Hungarian policy admits tax credits for private donations up to one percent of the individual's tax liability. The reason why Hungary adopted such a policy is that Hungary needed a policy to finance charitable institutions without increasing government expenditure (Bauer, 2004). In Japan, the Cabinet Office of the Japanese Government advocated the importance of private donations, and proposed a policy to increase private donations. This sort of policy is named "New Public"[63]. The characteristics of individuals who made charitable donations, especially after the big earthquakes, should be investigated as a basic data for such a policy. However, such characteristics have not been investigated in detail.

In order to answer the questions "who donated to the earthquake victims, and what factors are associated with donors making donations?" we analyzed micro-level household data sets provided from the Statistics Bureau, Ministry

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[63] "New Public" is explained in the website of the Cabinet Office, Government of Japan (http://www5.cao.go.jp/npc/pdf/torikumi0906.pdf).

of Internal Affair and Communications' "Family Income and Expenditure Survey" (FIES hereafter). FIES contains monthly panel consumption data of households, including data of private donations, as well as demographic features of households such as number of household members, age of the head of household, and savings. About 9,000 households are requested to record their income and expenditure in the Family Account Book every month. This statistic started in 1946 and such a large, detailed and high frequency data is unique to Japan[64].

Historically, the economics of charitable donation has attracted the interest of many economists. In the United States in particular, enormous amounts of donations have been made, but it is difficult to explain the behavior of donation theoretically. The theoretical framework of economy explains human behavior with self-interest, while the behavior of donating seems to be completely unselfish. To take an example from the United States, the amount of donations is $316.23 billion in 2012[65], 2% of GDP. Among these previous studies, most studies especially focus on private donations[66]. This paper hereafter focuses on private donations, also.

There are some threads of previous studies focusing on private donations. Since our study is about the determinants for charitable donations, it is natural to introduce previous studies about the determinants for charitable donations first. Hood et al. (1977), Kitchen (1992), Tiehen (2001), Auten et al. (2002) and Bakija and Heim (2011) pointed out the relationship between income and

[64] Statistics Bureau, Ministry of Internal Affairs and Communications, Government of Japan compares FIES made in G7 countries in its website (http://www.stat.go.jp/data/kakei/pdf/mikata7.pdf) and concludes that the Japanese FIES is the most frequent (monthly) and that only four of G7 countries, including Japan, require households to keep their Family Account Books. Among such four countries, it concludes that Japan surveys the largest number of households (approximately 9,000 households).

[65] Giving USA 2012

[66] In USA, 72% of the donation is contributed by individuals.

donation. Wealth was found to have positive association with donation by Kitchen (1992). Although income and wealth monotonically associate with donation, association by age is not that simple. Glenday et al. (1986) and Kitchen (1992) showed that age has a monotonically positive association with donations, where Gittell and Tebaldi (2006) explained the association is U-shaped; i.e., middle-aged people between ages 35 to 54 donate the least. Tiehen (2001), Gittell and Tabaldi (2006) and Schokkaert (2006) showed that education has a positive association with donation. Religious affiliation also has a positive association (Jackson et al., 1995; Gittell and Tabaldi, 2006). Since tax incentives, which definitely enhance charitable donations, have been studied especially intensively, we introduce these works in a separate paragraph. The effect of government grants, which has also been studied thoroughly, is introduced in the following paragraph.

As explained in the previous paragraph, tax incentives to enhance charitable donations are studied often. One reason why it has been studied is that this is one of the most important measures for government. Feldstein and Clotfelter (1976) estimated price elasticity with respect to private donations. Randolph (1995) estimated both permanent and transitory elasticity. Auten et al. (2002) estimated such elasticity based on a permanent income hypothesis. Although there are relatively fewer studies about Japan, Yamauchi (1997) estimated price elasticity with respect to private donations in Japan. Feldstein (1980) showed theoretically that tax deductibility is more efficient than government direct expenditure for public goods.

Government grants are other important measures for government. Therefore, the effect of government grants on charitable donations has been studied thoroughly. For example, Warr (1982) and Roberts (1984) showed theoretically that government direct expenditure to a public good financed by lump-sum taxes completely cancels out private donations. Bergstrom et al. (1986) extended their model by introducing non-donors; Bernheim (1986) extended their model by introducing multiple public goods; and Andreoni (1988) extended their model to a natural limit. Payne (1998) finds an incomplete crowding-out effect by using non-profit firm data. Gruber and Hungerman (2007) explained how government spending under the New Deal crowded out church spending. Andreoni and Payne (2011) found that the main reason of the crowding-out is the reduced fundraising effort.

Since the commencement of experimental economics in 1948 (Chamberlin, 1948), experiments have been used to explain people's non-rational decision-making. Since donating is *prima facie* non-rational behavior, experiments have been carried out to analyze human behavior. Among these experimental studies, Eckel et al. (2007) share some research interest with us, because they conducted laboratory experiments after Hurricane Katrina to observe how private donations for Katrina victims was affected by the initial endowment, matching subsidy rate and place. These factors are not identical but are somewhat related to wealth, price, and distance. There are other experimental studies. For example, List and Lucking-Reiley (2002) used solicitation by direct mail to see how such efforts enhance charitable donations. Eckel and Grossman (2003) created rebate subsidies for some donors and matching subsidies for others, and tested the equivalency between them. Karlan and List (2007) and Meier (2007) investigated how matching subsidies enhances charitable donations. Eckel and Grossman (2008) investigated the difference between men and women in Public Goods, Ultimatum, and Dictator Experiments.

Finally, Andreoni (2006) provided a great survey on these studies.

These previous works focus on time-homogeneous charitable donations, and most of them disregard a sudden increase in donations following an unexpected event such as natural disasters. One example of research on such increases in donations is Brown et al. (2012), who studied the determinants of charitable donations in the United States for the 2004 Indian Ocean tsunami disaster. They studied the determinants of increases in charitable donations to unexpected natural disasters, and found that a household that already had donated for other purposes tended to donate more for tsunami victims than a household that had not donated previously. Additionally, age was not found to be a significant explanatory variable for tsunami donations whereas it had a positive association with all other charitable donations. In addition, they found that some determinants are associated with both tsunami donations and all other donations; such as households with a female breadwinner, education, and religion.

In the study of Brown et al. (2012), they used biennial panel data, and their study was on donations from US citizens for a natural disaster which happened far away from the United States. In our study, we observe donations just before and after natural disasters using monthly data; we study the data from two natural disasters; and we study the charitable donations for natural disasters which occurred within the country. For this purpose, FIES data is best suited for analyzing charitable donations for natural disasters.

There is a reason for us to analyze a natural disaster which happened within the country. We can investigate whether “distance” from the epicenter of the disaster affected private donations, which may be hardly observed if the natural disaster had occurred outside the country. There is also another reason why we consider “distance” as an important factor. Kimball et al. (2006) found that geographical distance affected unhappiness after Hurricane Katrina. Ishino et al. (2011) pointed out the relationship between donations and happiness after the Tohoku Earthquake. Therefore, it is natural to consider “distance” as a determinant in the analysis; that is, the distance between the residence of donors and the epicenter of the disaster. If distance matters, it is the evidence that geographical distance affects not only happiness but also behavioral response of the donors. One of our novelties is that we investigate whether distance is associated with donations after natural disasters, and reinforce the result by analyzing two donations after two earthquakes.

There is actually a study which has an interest in the association of distance in the context of donation after natural disaster. The laboratory experiment by Eckel et al. (2007) investigated what kind of factors, such as initial endowment, matching subsidy rate, and location, affected private donations after Hurricane Katrina. One location was Texas, which was affected more by Hurricane Katrina than another location, Minnesota. We recognize that their study also reveals the determinants of charitable donations for victims of natural disasters, including distance. However, since their study used laboratory experiments whereas ours uses actual data of donations, there are substantial differences between their study and ours.

This paper proceeds in five parts. The next section explains FIES data in detail. The following two sections analyze data from the Tohoku Earthquake and

Hanshin Earthquake respectively. Then, the following section summarizes the result and the last section will be the conclusion.

2. Data Description

The scope of the survey of FIES is all households in Japan, excluding some households such as single-person student households. Using the three-stage stratified sampling method, 8,076 households of two or more people, as well as 745 single-person households, were requested to report their consumption every month. Households of two or more people were surveyed in six consecutive months, whereas single-person households were surveyed in three consecutive months. One-sixth of the households of two or more people were replaced every month, whereas one-third of the single-person households were replaced every month.

Each household was requested to report their Household Schedule, Family Account Book, Yearly Income Schedule, and Savings Schedule. Household Schedule includes non-monetary statistics, such as number of household members or gender of the head of household. Yearly Income Schedule and Savings Schedule included annual income, savings, and loans, which are available from 2002. Family Account Book included monthly consumption data divided into approximately 600 types of consumptions, including donations. Household Schedule, Yearly Income Schedule, and Savings Schedule were reported only once per household, and the Family Account Book is reported every month. Demographic features of each household were extracted from Household Schedule, Yearly Income Schedule and Savings Schedule.

The micro-level household data of FIES can be accessed at a single location in

Tokyo, Japan after an application process. In order to create panel data from the micro-level household data, we follow the method written in Unayama (2011)[67].

We used the monthly donation amount as a dependent variable, and we used the demographic features of households (age of the head of household, income, gender of the head of household, number of household members, workrate[68], geographical distance from disaster epicenter[69], savings, and loans) as independent variables. A dummy variable "pre-donation"[70] as added to identify households that donated before the month of the earthquake.

The following variables are not included in FIES, and thus were not included in our analysis: religion, ethnicity[71], or years of education[72]. Also, a variable of "price" (= '1- marginal tax rate' if itemized and 1 otherwise) was not included in our analysis. If one donates a unit amount to a certain charity, her disposable income falls by '1- marginal tax rate' if she itemizes, because her tax liability falls due to the 'marginal tax rate'. Thus, many previous studies included "price" as one of the independent variables. However, we considered "price" to be less important in our study. The main reason why "price" is less important in Japan is that fewer people itemize deductions. In actuality, only 10-20% of

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67 The author thanks Takashi Unayama for providing the author with Stata code to create panel data from FIES micro-level data.

68 Workrate is defined as the number of workers in household divided by the number of household member.

69 "Geographical distance" is calculated as the distance from the affected area to the donor's location. Affected area is Iwate Prefecture, Miyagi Prefecture and Fukushima Prefecture in the Tohoku Earthquake; and Osaka Prefecture and Hyogo Prefecture in the Hanshin Earthquake. When calculating geographical distance from the affected area to the donor's location, we calculate the distance from the prefectural capital in which the donor lives, to the prefectural capital of each affected area, and take the minimum value of these. Finally, we drop observations whose value of geographical distance equals zero.

70 pre-donation=1 if a household donated before the month of the earthquake and pre-donation=0 otherwise.

71 Taking into account the fact that Japan is relatively homogeneous in terms of religion and ethnicity, we consider that such data is not crucial in our study.

72 In FIES, education data is not available except for people who are currently studying in educational institutions.

donations enjoy tax deductions in Japan whereas more than 32%[73] in the United States (Cordes et al., 2000; Friedman and Greenstein, 2002; Kato, 2010). Also, FIES does not have data of the marginal tax rate. FIES includes household income statistics. However, since Japanese progressive income tax is imposed on personal incomes, not on household incomes, we have no idea about the marginal tax rate that each household faces. In addition, FIES does not have information about whether a household itemizes its donation or not.

We used the six months panel data from two months preceding the month of the earthquake, to three months after the month of the earthquake; where the earthquake happened in March 2011 in Tohoku, or January 1995 in Hanshin. The summary statistics of the FIES data is shown in Table III.1 and Table III.2. We can observe great increases in donations in the month the earthquakes happened and in the following month. In addition, we can easily see that households which had donated before the month of the earthquake donated for earthquake victims with a higher probability.

We define the terms in Table III.3 for convenience.

The natural logarithm[74] was taken hereafter to donations, income, savings, loans, and distance data[75]. Figure III.5 represents the distribution of the natural logarithm of donations on March 2011, the month the Tohoku Earthquake occurred. 73.3% people took zero in the histogram. The average donation is 1,993 yen whereas it is 7,465 yen among donors. The right histogram of Figure

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[73] 32% of taxpayers used itemized deduction in the United States. Since higher income taxpayers tend to itemize deduction more and higher income people tend to donate more, it is probable that much more than 32% of donations enjoy tax deductions. With this background, price elasticity has attracted great deal of attention in the studies in the United States, and some studies (e.g. Brown et al., 2012) use "price" as an explanatory variable.

[74] Following e.g. Brown et al. (2012)

[75] Natural logarithm of zero is recorded to zero. Since there is no value between zero and one among these nor are there any negative values, any natural logarithm takes zero or positive value.

III.5 explains one of the reasons why we take the natural logarithm for donation statistics. The histogram of donation statistics would be positively skewed if the natural logarithm were not taken.

Next, we analyzed what factors are associated with pre-earthquake donations and earthquake donations. Since the dependent variable, donations, takes numerous zeros and the dependent variable must be non-negative, the Ordinary Least Squares (OLS) regression does not perform accurately. Instead of OLS regression, we used the Tobit regression to fix this issue. We explain the Tobit regression as follows.

Let $y^*_{pre,it}$ be the latent propensity to donate in month t of household i in the pre-earthquake period. We assume that the latent propensity, whose domain is $(-\infty,\infty)$, depends linearly on independent variables:

$$y^*_{pre,it} = \vec{\alpha}_{pre} \cdot \vec{x}_i + \beta_{pre,t} dummy_t + u_{pre,it} \tag{1}$$

where $\vec{x}_i$ is a vector of demographic features of household i, $dummy_t$ is a dummy variable for month t, $u_{pre,it}$ is a normally distributed random variable, and $\vec{\alpha}_{pre}$ and $\beta_{pre,t}$ are coefficients. We further assume that if the latent propensity to donate is positive, the observed donation is equal to the latent propensity to donate ($y_{pre,it} = y^*_{pre,it}$), and otherwise the observed donation is zero ($y_{pre,it} = 0$).

In the post-earthquake period, our hypothesis was that there is a positive association between pre-earthquake donations and post-earthquake donations. This viewpoint is related to the study by Brown et al. (2012), which showed the positive association between planned philanthropy and unplanned giving for the Indian Ocean tsunami disaster. Thus, the latent propensity to donate is expressed as:

$$y^*_{post,it} = \vec{\alpha}_{post} \cdot \vec{x}_i + \beta_{post,t} dummy_t + \gamma \cdot predonate_i + u_{pre,it} \tag{2}$$

where the dummy variable $predonate_i$ takes unity ($predonate_i = 1$) if household i donated in the pre-earthquake period and takes zero ($predonate_i = 0$) otherwise.

These above regressions are Tobit regressions [76] (Tobin, 1958). This regression performs well if the dependent variable is restricted to a non-negative number which frequently takes zero.

In order to investigate the differences in the post-earthquake period between households that donated in the pre-earthquake period and households that did not, we conducted a Tobit regression in the post-earthquake period, restricted to households that donated in the pre-earthquake period on one hand and restricted to households that did not on the other hand. On these regressions, we express the latent propensity to donate as follows:

$$y^*_{predonate,it} = \vec{\alpha}_{predonate} \cdot \vec{x}_i + \beta_{predonate,t} dummy_t + u_{predonate,it} \tag{3}$$

for households that donated in the pre-earthquake period, and

$$y^*_{nonpredonate,it} = \vec{\alpha}_{nonpredonate} \cdot \vec{x}_i + \beta_{nonpredonate,t} dummy_t + u_{nonpredonate,it} \tag{4}$$

for households that did not donate in the pre-earthquake period.

Our hypothesis of the signal condition on Tobit regressions on pre-earthquake donations and in earthquake donations is shown in Table III.4. Our hypothesis on gender, age, income, and savings follows previous studies. Our hypothesis on age's association with earthquake donations follows Brown et al. (2012), which showed that age has no association with tsunami donation. Our hypothesis on distance follows our intuition that sympathy, which may

[76] Following e.g. Brown et al. (2012)

decrease with distance, is positively correlated with earthquake donations.

3. An Analysis of Tohoku Earthquake in 2011

We conducted a Tobit analysis in the pre-earthquake period and the post-earthquake period. The result is shown in Table III.5.

There are three findings which correlated with previous studies. The most significant finding was that the dummy variable "pre-donation" has a positive association with earthquake donations. This fact shows that households that donated before the earthquake tended to donate more for the earthquake victims. This finding meets the result of Brown et al. (2012), which showed that households that had donated before the tsunami disaster tended to donate more for tsunami victims. Another finding is that there is a clear evidence of sudden increases in the amount of donations which sharply declines in the course of time. The other finding was that income, savings, and age are positively associated with both earthquake donations and pre-earthquake donations, which is intuitively plausible. These three findings are consistent with previous studies.

Age's association with donations in the post-earthquake period differs from our hypothesis. This age's association is further studied in Table III.6.

It is of importance to discuss how distance is associated with donations. A positive and significant relationship between distance and donations in the *pre*-earthquake period is observed. The reason is unknown. There may be some correlation between private donations and geographical conditions. However, in the post-earthquake period, earthquake donations beat out the inherent positive relationship and produced the opposite, negative, and significant relationship. This can be evidence that earthquake donations are likely to be a function of geographical distance with a negative coefficient. This may be evidence that sympathy, which positively associates with donations, is negatively correlated with geographical distance[77].

We also conducted a Tobit analysis, restricting to households that donated in the pre-earthquake period and restricting to households that did not donate in the pre-earthquake period, respectively. The result is shown in Table III.6.

There were two findings worth mentioning. FIES data shows that the amount of donations peaked in March 2011, and declined sharply during the post-earthquake period. For donations from those who donated in the pre-earthquake period, however, a significant downward trend with the amount of donation was not observed. For sympathetic individuals (who donated in the pre-earthquake period), sympathy for the earthquake victims might last longer. Additionally, positive association between age and earthquake donations was observed for households that did not donate in the pre-earthquake period, whereas it was not observed for households that did donate in the pre-earthquake period. Previous studies already showed that age has a smaller association with disaster-related donations, and our contribution is a further analysis on two kinds of households: households that donated in the pre-earthquake period and households that did not.

4. An Analysis of the Hanshin Earthquake in 1995

We studied the analysis on the Tohoku Earthquake. By sheer coincidence, we

[77] People may think that people in Osaka and Hyogo prefectures donated more for Tohoku Earthquake victims because they had suffered from the Hanshin Earthquake. However, we could not find such evidence.

can conduct a similar analysis on the Hanshin Earthquake. We conducted a Tobit analysis in the pre-earthquake period and the post-earthquake period for the Hanshin Earthquake. The result is shown in Table III.7.

Several findings in Hanshin Earthquake obtained from Table III.7 are similar to those in Tohoku Earthquake. The dummy variable "pre-donation" has a positive association with earthquake donations. As we saw in the Tohoku Earthquake case, this fact also shows that households that donated before the earthquake tended to donate more for earthquake victims. Moreover, there is a clear evidence of a sudden increase in donations that sharply declines in the course of time. In addition, income, savings, and age are positively associated with earthquake donations and pre-earthquake donations.

It is of importance to discuss how distance is associated with donations. Distance is not a significant explanatory variable in the pre-earthquake period [78]. However, distance becomes a significant variable in the post-earthquake period with a negative coefficient. Therefore, earthquake donations are likely to be a function of geographical distance with a negative coefficient. This finding coincides with our findings in the Tohoku Earthquake case.

We also conducted a Tobit analysis by restricting to households that donated in the pre-earthquake period on one hand and by restricting to households that did not donate in the pre-earthquake period on the other hand. The result is shown in Table III.8.

Two findings follow from Table III.8. The most important is that a positive association between age and earthquake donations was observed for

[78] Consistent with our hypothesis. Note that the epicenter is different between the Hanshin Earthquake and the Tohoku Earthquake.

households that did not donate in the pre-earthquake period, whereas it was not observed for other households. This finding corresponding to age is identical to that of the Tohoku Earthquake case. Additionally, we obtained a different result from the Tohoku Earthquake case: of households that donated in the pre-earthquake period, a significant downward trend in the amount of donations *was* observed after the earthquake.

5. Result

We found several determinants for a sudden upswing in donations following an unexpected event such as a natural disaster. Some determinants are consistent with previous studies, such as Brown et al. (2012). We found three determinants that do not deviate from previous studies. First, there is a strong and positive association between donations before the earthquake and earthquake donations. Second, income and savings are positively associated with earthquake donations and non-earthquake purpose donations. Third, age is positively associated with donations for non-earthquake purposes. These three findings do not detract from previous research. However, age also has a positive association with earthquake donations. This finding is somewhat different from previous studies.

There are several new findings. Earthquake donations are likely to be a function of geographical distance from the epicenter with a negative coefficient. As far as can be determined, such dependence upon the distance from the disaster was first pointed out in our context[79]. This fact may indicate that

[79] As we have seen already, happiness studies (e.g. Kimball et al., 2006) and experiments (e.g. Eckel et al., 2007) are interested in the effect of distance. However, these studies are substantially different from our study in the context.

sympathy for earthquake victims is negatively associated with distance. This geographic distance result may indicate the possibility for reducing the tax burden by having some portion of one's tax go to the local area one chooses[80]. The other finding is that we can observe a positive association between age and earthquake donations for households that did not donate in the pre-earthquake period, whereas we cannot for households that did. Such detailed analysis about the association between age and donation has not been determined before.

6. Conclusion

We conducted an event study on donations before and after disastrous earthquakes. We found significant determinants of private donations for victims of such natural disasters. Among the determinants, three facts are to be noted:

(1) Past experience of donations was positively and significantly associated with earthquake donations;

(2) Income, savings, and age has a positive association with earthquake donations as well as donations for other purposes; and

(3) Earthquake donations are likely to be a function of geographical distance with a negative coefficient.

However, the aforementioned relationship between age and donation disappears when it comes to households that had donated before the earthquakes.

For policy perspectives, it is worth it to understand the trend of behaviors

[80] Such a policy was already implemented in Japan (Hometown tax payment, implemented in 2008).

related to earthquake donations. Briefly, (1) *sympathetic* (those who once donated for other purposes), (2) *rich* (those with high income and savings) and (3) *nearby* (from the epicenter, in the case of earthquake) people tend to donate for the victims of such natural disasters.

Figures

Tohoku Earthquake, Mar 11, 2011 Hanshin Earthquake, Jan 17, 1995

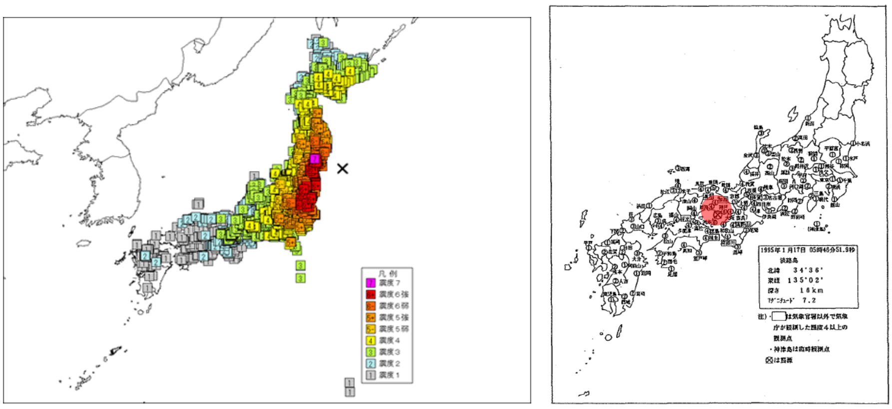

Figure III.1: Maps and epicenters of the Tohoku and Hanshin earthquakes[81]

Figure III.2: Monthly number of volunteers for Tohoku Earthquake; i.e. volunteers in Iwate, Miyagi, and Fukushima Prefectures[82]

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[81] Cited from the website of Ministry of Education, Culture, Sports, Science and Technology, Government of Japan (http://www.mext.go.jp/b_menu/hakusho/html/hpaa201101/detail/1311096.htm) and the website of Cabinet Office, Government of Japan (http://www.bousai.go.jp/kyoiku/kyokun/pdf/101.pdf).The author adds the epicenter of the Hanshin Earthquake on the map.

[82] Data: National Institute of Educational Policy Research (2011)

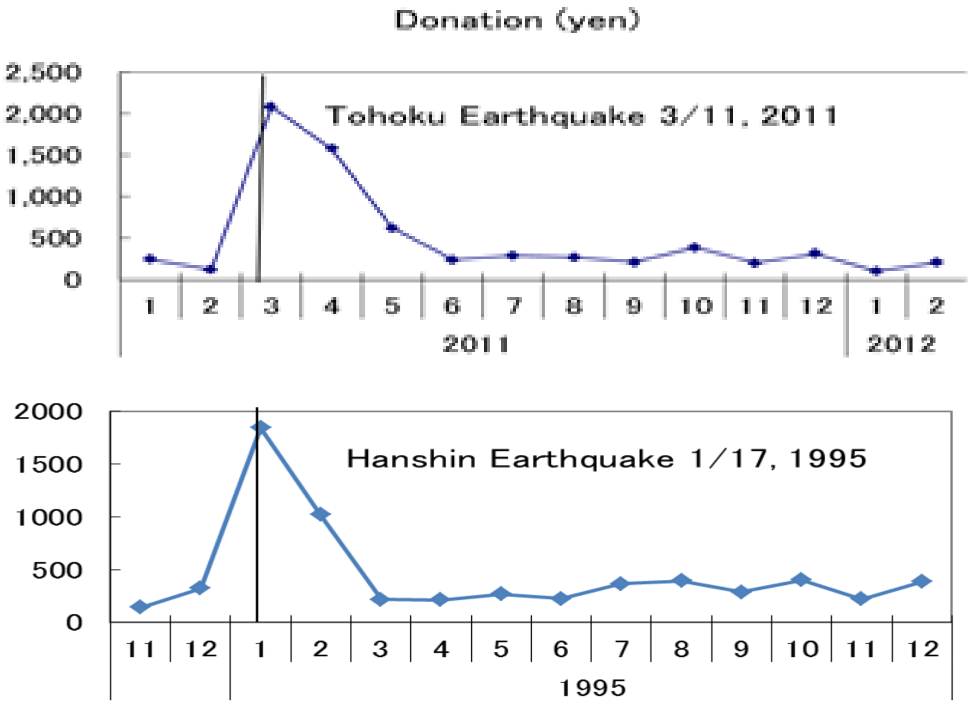
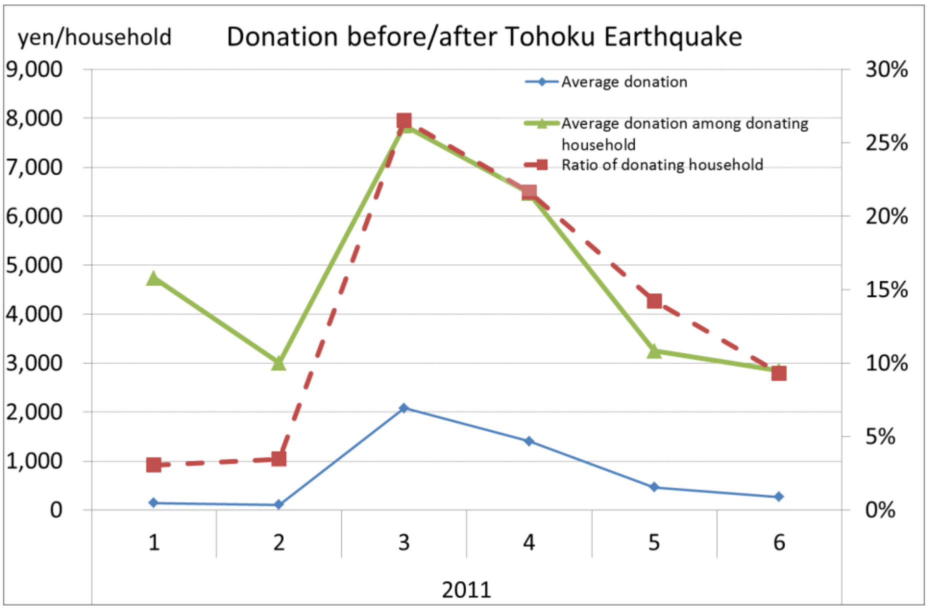


Figure III.3: Monthly private donation per household before and after Tohoku and Hanshin earthquakes[83]

[83] Data: Family Income and Expenditure Survey



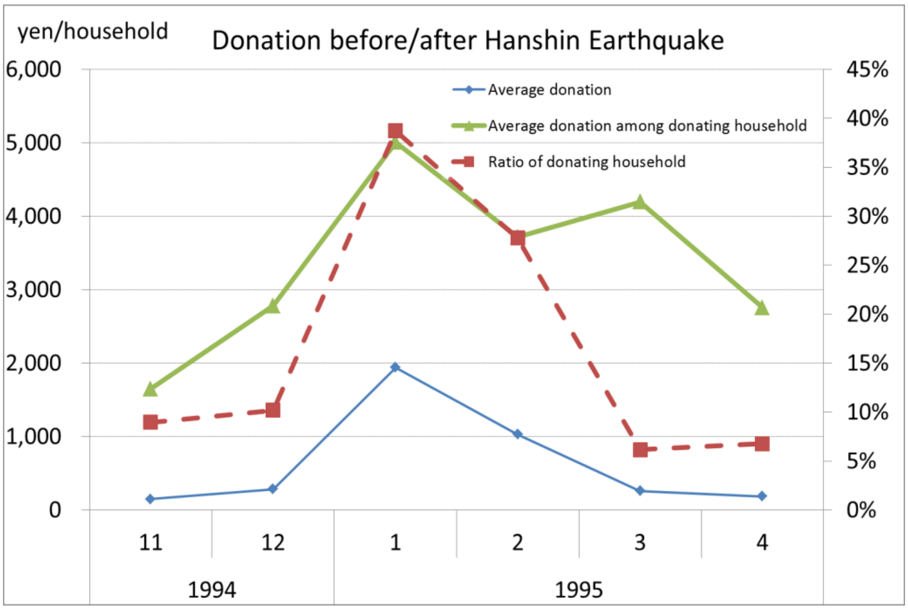


Figure III.4: Donation before/after Earthquakes

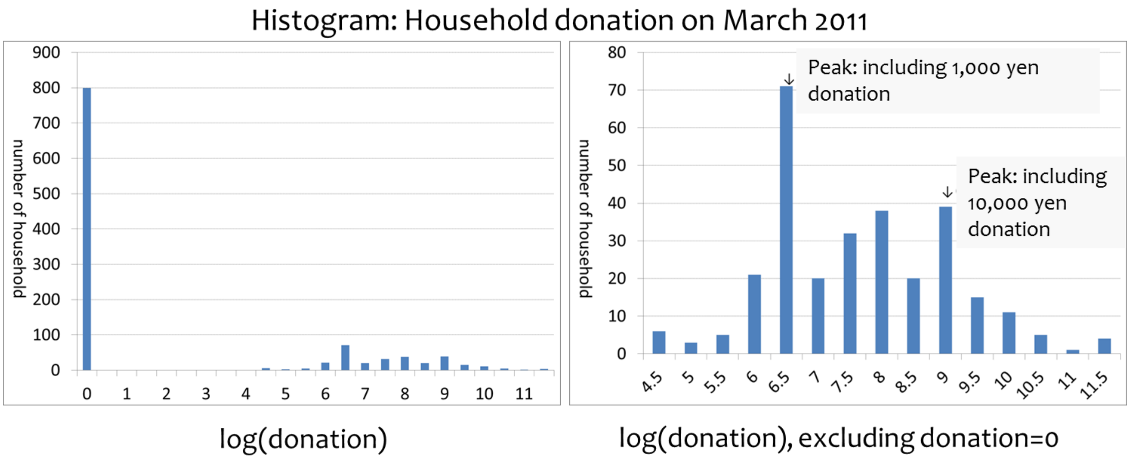


Figure III.5: The distribution of earthquake donation on March 2011

Tables

Table III.1: Summary statistics for Jan-Jun 2011 and Nov 1994-Apr 1995

Tohoku Earthquake					Hanshin Earthquake				
obs. 1156	mean	std. dev.	min	max	obs. 1165	mean	std. dev.	min	max
donation Jan 2011	203	3,211	0	100,000	donation Nov 1994	118	764	0	20,000
donation Feb 2011	189	3,115	0	100,000	donation Dec 1994	262	2,210	0	50,000
donation Mar 2011	1,993	8,275	0	100,000	donation Jan 1995	1,941	6,753	0	116,600
donation Apr 2011	1,589	16,264	0	400,000	donation Feb 1995	782	3,506	0	66,000
donation May 2011	258	1,249	0	20,500	donation Mar 1995	250	2,203	0	50,000
donation Jun 2011	214	1,258	0	21,000	donation Apr 1995	208	1,383	0	20,020
age	57.0	15.1	22	95	age	50.0	13.6	22	90
income	595	368	96	3,696	income	731	466	60	8,270
gender (male:1 female:2)	1.09	0.29	1	2	gender (male:1 female:2)	1.05	0.21	1	2
# of household members	3.00	1.09	2	8	# of household members	3.34	1.16	2	7
workrate	0.42	0.32	0	1	workrate	0.46	0.29	0	1
distance [km]	546	380	45	1,756	distance [km]	404	271	29	1,184
saving	1,247	1,877	0	23,683					
loan	395	1,002	0	14,350					

note: We excluded the data around the epicenter; i.e. data of distance=0. Thus, the minimum of the distance is larger than zero.
unit: [yen] for donation and [10 thousand yen] for income, saving and loan

Table III.2: Summary statistics about donation in every month

Tohoku Earthquake						
	All household			Households that donated before the month of the earthquake (6.7% of all households)		
	Average donation [yen] (A)	Ration of donating household (B)	A/B[yen]	Average donation [yen] (C)	Ration of donating household (D)	C/D[yen]
donation Jan 2011	203	3.7%	5,544			
donation Feb 2011	189	4.3%	4,388			
donation Mar 2011	1,993	26.7%	7,465	7,206	56.2%	12,831
donation Apr 2011	1,589	22.2%	7,159	8,750	56.2%	15,579
donation May 2011	258	15.2%	1,697	1,060	47.9%	2,211
donation Jun 2011	214	9.8%	2,177	828	32.9%	2,517

Hanshin Earthquake						
	All household			Households that donated before the month of the earthquake (21.6% of all households)		
	Average donation [yen] (A)	Ration of donating household (B)	A/B[yen]	Average donation [yen] (C)	Ration of donating household (D)	C/D[yen]
donation Nov 1994	118	12.0%	985			
donation Dec 1994	262	11.5%	2,288			
donation Jan 1995	1,941	38.2%	5,076	3,433	59.8%	5,738
donation Feb 1995	782	26.1%	2,992	1,231	39.3%	3,129
donation Mar 1995	250	5.4%	4,629	682	11.3%	6,040
donation Apr 1995	208	7.1%	2,917	354	12.6%	2,823

Table III.3: Definition of terms

Term	Definition
Pre-earthquake period	months before the month of the earthquake
Post-earthquake period	The month of the earthquake and after
Pre-earthquake donation[84]	donation in pre-earthquake period
Earthquake donation[85]	donation in post-earthquake period

84 The purpose of this donation is irrelevant to the earthquake.
85 It must be a mixture of donation for earthquake victims and other purpose donations. However, we look upon this donation as an earthquake-related donation.

Table III.4: Hypothesis of the signal condition

Sign Condition	pre-earthquake donation	earthquake donation
gender	+	+
age	+	insignificant
income	+ or insignificant	+ or insignificant
saving	+ or insignificant	+ or insignificant
loan	?	?
# of household members	?	?
workrate	?	?
distance	insignificant	-
pre-donation		+

Table III.5: Tobit analysis in pre-earthquake period and post-earthquake period for Tohoku Earthquake

Pre-earthquake donation			
Tobit regression	coef.	std. err.	t stat.
gender	-1.51	2.91	(-0.52)
age<20	(omitted)		
20≤age<30	-4.43	5.98	(-0.74)
30≤age<40	-2.39	2.67	(-0.89)
40≤age<50	-6.59	2.83	(-2.33)
50≤age<60	-0.93	2.08	(-0.45)
log(income)	8.56	1.88	(4.56)
log(saving)	0.57	0.27	(2.09)
log(loan)	0.09	0.26	(0.36)
# of household members	-2.12	0.88	(-2.40)
workrate	-4.88	2.73	(-1.79)
log(distance)	2.99	1.09	(2.76)
dummy (Feb 2011)	1.01	1.45	(0.70)
const.	-90.42	15.76	(-5.74)

Dependent variable: log(donation) in Jan-Feb 2011

Obs.: 2180, P-value: 0.0000, Pseudo R^2: 0.0434

Post-earthquake donation			
Tobit regression	coef.	std. err.	t stat.
gender	1.16	0.78	(1.48)
age<20	(omitted)		
20≤age<30	-4.00	1.65	(-2.42)
30≤age<40	-3.98	0.87	(-4.60)
40≤age<50	-1.69	0.74	(-2.28)
50≤age<60	-1.70	0.67	(-2.54)
log(income)	2.77	0.51	(5.41)
log(saving)	0.41	0.08	(4.92)
log(loan)	-0.02	0.08	(-0.31)
# of household members	-0.99	0.25	(-3.91)
workrate	-1.70	0.80	(-2.12)
log(distance)	-0.65	0.30	(-2.19)
dummy (pre-donation)	8.05	0.75	(10.79)
dummy (Mar 2011)	7.42	0.68	(10.90)
dummy (Apr 2011)	6.04	1.19	5.09
dummy (May 2011)	2.68	0.70	(3.81)
_cons	-25.83	3.81	(-6.78)

Dependent variable: log(donation) in Mar-Jun 2011

Obs.: 4360, P-value: 0.0000, Pseudo R^2: 0.0493

Table III.6: Tobit analysis in post-earthquake period for Tohoku Earthquake pre-donation=0 and pre-donation=1 respectively

Post-earthquake donation restricting pre-donation=0			
Tobit regression	coef.	std. err.	t stat.
gender	0.88	0.88	(1.00)
age<20	(omitted)		
20≤age<30	-4.32	1.83	(-2.37)
30≤age<40	-4.29	0.98	(-4.38)
40≤age<50	-2.16	0.84	(-2.58)
50≤age<60	-1.86	0.77	(-2.43)
log(income)	2.64	0.58	(4.57)
log(saving)	0.50	0.10	(5.20)
log(loan)	-0.05	0.09	(-0.56)
# of household members	-0.98	0.28	(-3.49)
workrate	-1.78	0.90	(-1.98)
log(distance)	-0.76	0.34	(-2.28)
dummy (Mar 2011)	8.01	0.78	(10.24)
dummy (Apr 2011)	6.01	0.78	(7.66)
dummy (May 2011)	2.73	0.81	(3.38)
_cons	-25.41	4.26	(-5.97)

Dependent variable: log(donation) in Mar-Jun 2011

Obs.: 4068, P-value: 0.0000, Pseudo R^2: 0.0366

Post-earthquake donation restricting pre-donation=1			
Tobit regression	coef.	std. err.	t stat.
gender	2.77	1.98	(1.40)
age<20	(omitted)		
20≤age<30	-2.94	4.50	(-0.65)
30≤age<40	-2.13	1.90	(-1.13)
40≤age<50	3.51	2.03	(1.73)
50≤age<60	-0.02	1.42	(-0.01)
log(income)	3.35	1.21	(2.78)
log(saving)	-0.05	0.16	(-0.33)
log(loan)	-0.03	0.17	(0.16)
# of household members	-1.33	0.65	(-2.03)
workrate	-1.40	1.95	(-0.72)
log(distance)	0.61	0.74	(0.82)
dummy (Mar 2011)	4.81	1.30	(3.71)
dummy (Apr 2011)	4.39	1.30	(3.38)
dummy (May 2011)	2.70	1.31	(2.07)
_cons	-25.95	10.00	(-2.60)

Dependent variable: log(donation) in Mar-Jun 2011

Obs.: 292, P-value: 0.0002, Pseudo R^2: 0.0343

Table III.7: Tobit analysis in pre-earthquake period and post-earthquake period for Hanshin Earthquake

Pre-earthquake donation			
Tobit regression	coef.	std. err.	t stat.
gender	-0.57	1.88	(-0.30)
age<20	(omitted)		
20≤age<30	-2.57	1.99	(-1.29)
30≤age<40	-3.18	1.20	(-2.65)
40≤age<50	-1.56	1.14	(-1.37)
50≤age<60	-2.37	1.19	(-1.99)
log(income)	2.67	0.84	(3.17)
# of household members	-0.19	0.39	(-0.49)
workrate	-4.18	1.53	(-2.72)
log(distance)	0.22	0.45	(0.49)
dummy (Dec 1994)	-0.27	0.73	(-0.37)
const.	-26.24	6.44	(-4.07)

Dependent variable: log(donation) in Nov-Dec 1994

Obs.: 2218, P-value: 0.0038, Pseudo R^2: 0.0086

Post-earthquake donation			
Tobit regression	coef.	std. err.	t stat.
gender	0.76	1.03	(0.74)
age<20	(omitted)		
20≤age<30	-2.78	1.19	(-2.34)
30≤age<40	-0.66	0.67	(-0.98)
40≤age<50	-0.36	0.66	(-0.55)
50≤age<60	-0.62	0.67	(-0.92)
log(income)	1.75	0.44	(3.94)
# of household members	-0.49	0.22	(-2.21)
workrate	-2.93	0.86	(-3.42)
log(distance)	-1.13	0.25	(-4.49)
dummy (pre-donation)	4.55	0.48	(9.49)
dummy (Jan 1995)	11.20	0.67	(16.65)
dummy (Feb 1995)	8	0.65	12.3
dummy (Mar 1995)	-1.42	0.78	(-1.83)
_cons	-16.83	3.43	(-4.90)

Dependent variable: log(donation) in Jan-Apr 1995

Obs.: 4436, P-value: 0.0000, Pseudo R^2: 0.0811

Table III.8: Tobit analysis in post-earthquake period for Hanshin Earthquake pre-donation=0 and pre-donation=1 respectively

Post-earthquake donation restricting pre-donation=0			
Tobit regression	coef.	std. err.	t stat.
gender	0.85	1.26	(0.68)
age<20	(omitted)		
20≤age<30	-3.30	1.48	(-2.22)
30≤age<40	-0.89	0.85	(-1.05)
40≤age<50	-0.39	0.85	(-0.45)
50≤age<60	-0.72	0.86	(-0.84)
log(income)	1.90	0.57	(3.35)
# of household members	-0.79	0.28	(-2.87)
workrate	-2.42	1.06	(-2.27)
log(distance)	-1.17	0.31	(-3.73)
dummy (Jan 1995)	11.64	0.88	(13.18)
dummy (Feb 1995)	8.63	0.87	(9.88)
dummy (Mar 1995)	-1.98	1.05	(-1.89)
_cons	-18.11	4.35	(-4.16)

Dependent variable: log(donation) in Jan-Apr 1995

Obs.: 3480, P-value: 0.0000, Pseudo R^2: 0.0715

Post-earthquake donation restricting pre-donation=1			
Tobit regression	coef.	std. err.	t stat.
gender	-0.06	1.95	(-0.03)
age<20	(omitted)		
20≤age<30	-2.52	2.09	(-1.20)
30≤age<40	-0.77	1.15	(-0.67)
40≤age<50	-1.03	1.10	(-0.94)
50≤age<60	-0.61	1.10	(-0.55)
log(income)	1.70	0.72	(2.37)
# of household members	0.40	0.41	(0.97)
workrate	-4.87	1.49	(-3.27)
log(distance)	-0.98	0.43	(-2.25)
dummy (Jan 1995)	10.51	0.99	(10.62)
dummy (Feb 1995)	6.72	0.98	(6.84)
dummy (Mar 1995)	-0.45	1.08	(-0.41)
_cons	-12.12	5.66	(-2.14)

Dependent variable: log(donation) in Jan-Apr 1995

Obs.:956, P-value: 0.0000, Pseudo R^2: 0.0802

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