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22 July 2020

Online at <https://mpra.ub.uni-muenchen.de/102348/>
MPRA Paper No. 102348, posted 13 Aug 2020 07:55 UTC

The Impact of Taxes and Wasteful Government Spending on Giving

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July 22, 2020

Abstract

We examine how taxes impact charitable giving and how this relationship is affected by the degree of wasteful government spending. In our model, individuals make donations to charities knowing that the government collects a flat-rate tax on income (net of charitable donations) and redistributes part of the tax revenue. The rest of the tax revenue is wasted. The model predicts that a higher tax rate increases charitable donations. Surprisingly, the model shows that a higher degree of waste decreases donations (when the elasticity of marginal utility with respect to consumption is high enough). We test the model's predictions using a laboratory experiment with actual donations to charities and find that the tax rate has an insignificant effect on giving. The degree of waste, however, has a large, negative and highly significant effect on giving.

JEL Classifications: C93, D64, H21

Keywords: charitable giving, tax, waste, redistribution, experiment, public goods provision, neutrality, income inequality

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We thank two anonymous referees and the Editor of this journal for their valuable suggestions. We thank James Alm, Yan Chen, Rachel Croson, Emel Filiz-Ozbay, Enda Hargaden, Charles Holt, Rowell Huesmann, Daniel Hungerman, Steve Leider, John List, Charles Longfield, Yusufcan Masatlioglu, Yesim Orhun, Laura Razzolini, Anya Samek, Joel Slemrod, Nat Wilcox, seminar participants at the University of Chicago, the University of Michigan, the 2015 Economic Science Association Conference, and the 2015 Science of Philanthropy Initiative Annual Conference. We thank the John Templeton Foundation, the Science of Philanthropy Initiative, and the University of Maryland for financial support. Andrew Card, Yulia Chhabra, Juyeon Ha, Zedekiah Higgs, and Ethan McCall provided excellent research assistance. We also thank John Jensenius and Pak Ho Shen for their help with programming the experiment.

1. Introduction

Polls conducted in the US show that people believe that part of tax revenue is wasted by the government. According to a 2014 Gallup Poll, Americans estimate that the federal government wastes 51% of each dollar collected through taxes.¹ Similarly, according to a HuffPost/YouGov poll conducted in 2013, 69% of Americans think that most of the federal budget deficit could be eliminated by cutting “waste and fraud,” examples of which include “wasteful spending” on salaries and perks for government employees, foreign aid, and military spending.²

In this paper, we investigate how taxation affects charitable giving in the presence of a redistributive government that wastes part of the tax revenue it collects from individuals. Our paper makes two novel contributions to the literature. First, while a sizable literature studies the relationship between tax rates and (tax-exempt) donations using empirical data, to our knowledge we are the first to study the impact of the tax rate on charitable giving using a controlled experiment with actual donations. Moreover, we study the relationship between the tax rate and charitable giving by systematically varying how much of the tax revenue is redistributed back to individuals, ranging from no redistribution to full redistribution.³ Second, we study the impact of wasteful government spending on giving. We show that when part of the tax revenue is wasted (instead of being redistributed back to individuals), both the price of giving and the net income of individuals depend not only on the tax rate but also on the degree of waste. By keeping the tax rate constant, we study the effect of changing the rate of waste on donations.

To examine how taxes impact giving and how this relationship is affected by the wastefulness of government spending, we provide a game-theoretic model. In our model, a public good is provided through private contributions by individuals. The government’s role is to collect a flat-rate tax on income net of contributions to the public good and to redistribute the tax revenue. During redistribution, part of the collected tax revenue is wasted (*e.g.*, the government spends this money on things that the individuals do not value). As the tax rate increases, both the price of tax-deductible charitable giving and the income of contributors decrease, creating an ambiguous effect on donations.

Consistent with previous theoretical and empirical literature, our model predicts that under weak assumptions the substitution effect dominates the income effect and, hence, there is a positive relationship between charitable donations and the tax rate (keeping the level of waste constant). In

¹ See <http://www.gallup.com/poll/176102/americans-say-federal-gov-wastes-cents-dollar.aspx>. The estimated rate of waste differs across Republicans and Democrats, with Republicans estimating 59 cents and Democrats estimating 42 cents per dollar. To isolate the effect of waste on giving, we consider a simple model with individuals being homogeneous with respect to their perceptions of the rate of waste.

² See http://www.huffingtonpost.com/2013/03/18/wasteful-spending-poll_n_2886081.html. Based on the survey responses the article argues that “for many, waste is indeed defined as ‘money spent on some government program I don’t like’.” Note that these perceptions may exogenously change over time depending on government actions or even through simple debates (*e.g.*, discussions of wasteful government spending during elections may heighten individuals’ perceptions about waste).

³ To our knowledge, previous theoretical and empirical models on the impact of tax rates on donations assume one of the two extreme cases. For example, when calculating the price of giving, empirical studies typically make the simplifying assumption that individuals do not receive any return from their paid taxes. Previous models are, therefore, special cases of our model.

other words, our model shows that the results of the previous literature regarding the relationship between tax rate and giving continues to hold even if there is wasteful governmental spending. Moreover, our model allows us to study the relationship between the level of waste and donations to charities. A change in the rate of waste also creates opposing substitution and income effects. While one might expect donations to the privately provided public good (charity) to increase as the government wastes more of the tax revenue, our model demonstrates the opposite might be true. We show that although increasing the degree of waste creates a small decrease in the price of giving, the negative income effect might be sizable. Depending on the elasticity of marginal utility with respect to consumption, the income effect may dominate the substitution effect when the rate of waste increases. In addition, our model shows that, in large economies, the income effect always dominates the substitution effect when the degree of waste increases, leading to a negative relationship between the rate of waste and donations.

We test our model using a laboratory experiment with actual donations to charities. As opposed to naturally occurring data, our controlled environment removes several potential confounding factors, such as differences in beliefs about how tax revenue is used, changes in income over time, as well as other potential confounds which one usually needs to control for when estimating the impact of taxes on charitable donations.⁴ In our experiment, participants earn income, part of which they can donate to a charity. Participants choose their donations knowing that a flat-rate tax will be applied to their remaining income, with part of the collected tax revenue going back to the experimenter and the remaining portion being evenly redistributed among the participants. By systematically varying the level of taxes and how much of the tax revenue is wasted (*i.e.*, money received neither by charities nor by participants), we are able to isolate and test the impact of the tax rate and wasteful spending of tax revenue on giving.

Our experimental data indicate that the tax rate has an insignificant effect on giving. The degree of waste, however, has a large, negative and highly significant effect on giving. Consistent with our theoretical predictions, we find that the relationship between giving and waste depends on the elasticity of marginal utility. In addition, we show that our results do not depend on the initial income distribution.⁵ Moreover, we conduct an additional experiment as a robustness check

⁴ Field data suffer from measurement and identification challenges (*e.g.*, Andreoni, 2006; List, 2011; Andreoni and Payne, 2013; Vesterlund, 2016; Duquette, 2016). Itemizers have an incentive to overstate their donations to evade taxes, while non-itemizers have no incentive to report any donations at all. The price of giving is correlated with taxable income and might endogenously change with the donated amount. It is hard to disentangle the permanent impact of taxes on donations from the transitory impact. Wasteful government spending may provoke tax evasion which might in turn affect charitable donations (Barone and Mocetti, 2011; Alm *et al.*, 2016). There is also the possibility that tax rates affect labor supply decisions; see Saez *et al.* (2012) for a survey of this literature. Our design eliminates these types of measurement and identification challenges by: (1) exogenously varying the price of giving and the level of waste, (2) using actual donations data from our controlled laboratory experiment, (3) automatically taxing all participants in the experiment and (4) by assigning income to participants prior to informing them about the specifics of income taxation and the tax rate.

⁵ Our paper also contributes to the literature on income inequality and public goods provision (*e.g.*, Chan *et al.*, 1996, 1999; Anderson *et al.* 2008; Uler, 2011; Maurice *et al.*, 2013; Duquette and Hargaden, 2019). We find qualitative support for the neutrality result of Bergstrom *et al.* (1986).

and confirm that charitable giving is insensitive to the tax rate even when subjects are given the opportunity to learn through repetition and feedback.

Our study has important policy implications. We find that, on average, the relationship between the tax rate and donations is economically small and statistically insignificant, suggesting that changes in taxes may not affect charitable giving as suggested by previous literature. In addition, the degree of waste plays a large role in giving decisions. Our experiment shows that even for very small economies, the effect of wasteful government spending on giving is negative. Our theory predicts that for larger economies the effect of wasteful government spending will be even more negative. Our results suggest two potential mechanisms through which policymakers might generate a substantial increase in charitable giving: (1) increasing the efficiency with which the tax revenue is used (that is, decreasing “waste”), and/or (2) providing individuals with better information on the benefits of the public services financed by tax revenues and on the effective use of the tax revenue (that is, decreasing perception of waste). Finally, it is important to recognize that tax rates themselves might endogenously affect perceptions about wasteful government spending. For example, if individuals perceive that higher taxes imply more waste, then we may actually see a decrease (not an increase) in charitable donations as taxes increase. Our results imply that empirical studies estimating price and income elasticities of giving would benefit from controlling for the confounding effect of perceptions about wasteful government spending.

Before we discuss the previous literature, we want to comment on three important points. First, for simplification purposes, this paper focuses on the redistributive role of the government, *i.e.*, we assume that the tax revenue is being redistributed. Since redistribution is a special form of a (publicly provided) public good, it is not difficult to generalize the model to allow for the government to provide any public good, as long as the public good provided by the government is different than that provided by the charity. The only difference is that, in the latter case, our results would condition on the utility over the public good provided by the government (instead of on the consumption utility). Second, our theoretical results rely on the assumption that the charity and the government provide different public goods. If the government uses tax revenue to provide the same public good as the charity (or to provide a grant to the charitable organization), then a higher tax rate leads to lower donations to the charity when the level of waste is fixed, and a higher rate of waste by the government leads to higher donations to the charity when the tax rate is fixed.⁶ While this case is also interesting, this paper focuses on the case where government and the charity provide different public goods.⁷ This allows us to predict a positive relationship between donations and the tax rate, consistent with the large empirical literature on this topic.⁸ Third, one might argue that individuals simply do not think about receiving a direct return from their paid taxes and

⁶ These predictions follow immediately from the crowding-out literature (*e.g.*, Andreoni, 1993; Bolton and Katok, 1998; Eckel et al., 2005; Li et al., 2011), since this case implies governmental provision and charitable provision are perfect substitutes.

⁷ One important example of public goods in which individuals make donations, but the government does not, is giving to religious organizations.

⁸ See Section 2 for a discussion of the major findings of the empirical literature on this topic.

consider their taxes as forgone money. This interpretation is actually a special case of our model (*i.e.*, redistribution rate is 0%).

We discuss related literature in Section 2. In Section 3, we present our theoretical model and develop testable hypotheses. Section 4 discusses our experimental design and procedures. Section 5 provides the results of the experiment. Section 6 provides the results of an additional experiment designed to check the robustness of our results. Section 7 provides a short discussion and our conclusions.

2. Literature Review

In the United States, individual (private) donations constitute one of the major sources of revenue for many charities. Since most charitable donations are tax-deductible, a higher tax rate affects charitable giving in two major ways. On the one hand, because of deduction benefits, higher taxes decrease the price of giving, which leads to a positive effect on giving (the substitution effect). On the other hand, higher taxes reduce after-tax net income, which has a negative effect on donations (the income effect). The empirical literature generally finds the net effect to be positive, but provides mixed findings regarding its magnitude, with the net effect ranging from zero to substantial levels (Clotfelter, 1985, 1990; Randolph, 1995; Auten et al., 2002; Pelozo and Steel, 2005; Bakija and Heim, 2011; Duquette, 2016; Hungerman and Ottoni-Wilhelm, 2018).⁹

Earlier empirical studies using cross-sectional data argue that a tax cut leads to a decrease in charitable giving. In particular, Clotfelter (1985, 1990) estimates the price elasticity to be greater than one in absolute value and the income elasticity to be less than one. Using panel data, Randolph (1995) finds that charitable giving is relatively insensitive to price changes, suggesting that permanent changes in the price of giving have a small effect on voluntary contributions. In contrast, Auten et al. (2002) find a substantially larger permanent-price elasticity using a different estimation technique. More recently, Bakija and Heim (2011) and Duquette (2016) find that the price elasticity of giving is greater than one in absolute value, while Hungerman and Ottoni-Wilhelm (2018) report a price elasticity of 0.2. Estimates of price and income elasticities like those discussed above are very sensitive to the estimation techniques and the data sets being used. Since observational data suffer from problems of identification and measurement, the net effect of taxation on charitable donations is still not clearly understood (Andreoni, 2006; List, 2011; Andreoni and Payne, 2013; Vesterlund, 2016).

A theoretical foundation for the impact of redistributive taxation on charitable giving has been provided by Warr (1982) and Bergstrom et al. (1986). These papers show that purely redistributive taxation (that does not change the set of contributors) should have no effect on total

⁹ Some of these papers study a related (but different) question. They ask, for a given tax rate, how responsive total giving is to tax-deductibility and focus on estimates of price-elasticity only. Theoretically, it is easy to show that the impact of tax-deductibility on donations is (unambiguously) positive, since tax-deductions make it cheaper to donate and individuals enjoy higher levels of spendable income for a given level of donation. In other words, there are no opposing forces when it comes to the effect of tax-deductibility on donations.

public goods provision.¹⁰ Uler (2009) extends the standard model by assuming that charitable donations to the public good are tax-deductible and, therefore, redistribution takes place over income net of contributions. The model demonstrates that, under a general class of utility functions, the substitution effect dominates the income effect. Hence, charitable giving increases when the tax rate increases. These models, however, have not addressed the case of wasteful government spending (*i.e.*, the case when part of the tax revenue is wasted).

In addition to these empirical and theoretical studies, a number of experimental papers have analyzed how price and income affect individuals' giving. Most experimental studies find that, as predicted by economic theory, giving moves inversely with price (Andreoni and Vesterlund, 2001; Andreoni and Miller, 2002).¹¹ For example, Eckel and Grossman (2003) conduct a laboratory experiment in which participants choose how much to contribute to a charity under different rebate and match rates and find that contributions (received by the charity) move inversely with price.¹² Eckel and Grossman (2008) replicate their laboratory findings in a natural field setting. Similarly, Karlan and List (2007) find a negative relationship between price and giving (within a certain range of prices). In particular, they find that offering to match contributions (\$1:\$1) increases individual giving, but further lowering the price by offering larger match ratios (\$3:\$1 and \$2:\$1) has no additional impact on giving (not including the match).¹³ Huck and Rasul (2011) report price elasticities between -0.53 and -1.12 and Filiz-Ozbay and Uler (2019) find price elasticities in the range of -0.3 to -0.9. Experimental evidence about the relationship between income and giving is mixed. Eckel and Grossman (2003, 2008), Eckel et al. (2007) and Rey-Biel et al. (2018) find a positive relationship between income and giving, while others find a negative relationship (Erkal et al., 2011) or no significant relationship at all (Andreoni and Vesterlund, 2001; Buckley and Croson, 2006).¹⁴

None of these experimental studies are in the context of taxation, however. While previous experimental literature is helpful to understand how individuals' charitable donation decisions react to changes in prices and incomes, it is hard to extrapolate from these studies to how individuals will react to changes in tax rates or wasteful government spending. The impact of the rebate or match rate on total donations received by the charity is different than the impact of the rate of tax or waste.¹⁵ Moreover, individuals might respond to lower income very differently when lower income is a consequence of a higher tax rate.

¹⁰ This result would not hold if individuals are impure-altruists (Andreoni, 1990). Impure altruism models explain why crowding-out is not complete when government provides public funds to charities. Interestingly, Hungerman (2014) shows that when individuals hide income, this creates a deadweight loss and leads to a surprising finding: warm-glow implies more crowding-out in a setting where individuals can evade taxes.

¹¹ Andreoni and Vesterlund (2001) focus on gender differences in altruism and show that men are more price sensitive. Andreoni and Miller (2002) show that preferences for altruism can be explained by rational models.

¹² They also find that subjects are sensitive to how a subsidy is framed. Other studies comparing subsidy types include Davis et al. (2005), Davis and Millner (2005), Eckel and Grossman (2006a, 2006b), and Blumenthal et al. (2012).

¹³ Duquette and Hargaden (2019), on the other hand, find a positive relationship between the match rate and donations even for very large values of the match rate.

¹⁴ Auten et al. (2000) argue that the relationship between income and donations is U-shaped.

¹⁵ Theoretically, assuming a concave consumption utility, when considering rebates or matches offered by a third party, an increase in the rebate or match rate always leads to higher *total* donations received by the charity (including

In the study most related to ours, Uler (2011) examines the relationship between the tax rate and individual contributions within a laboratory public goods setting. In public goods game experiments, donations have explicit monetary benefits for each participant, while charitable contributions in the field do not usually generate analogous monetary benefits. More importantly, a public goods game enforces a particular payoff structure and does not allow for estimation of the actual net effect of a tax rate change on donations to real charities. As such, the results of Uler (2011) may not be generalizable to charitable giving decisions in the real world (Levitt and List, 2007). Our paper provides a more realistic set-up in which subjects make actual charitable donations and allows for the possibility of wasteful government spending. In addition, we study the impact of the rate of waste on donations (keeping the tax rate constant).

3. The Theoretical Model and Hypotheses

3.1. The Model

We consider an environment with one private good, one pure public good, and $n > 1$ agents. The public good is provided privately through *charitable* contributions. Each agent i has an income of y_i units of a private good, and contributes (donates) g_i to the public good. One unit of the public good can be produced by one unit of the private good. Therefore, the level of public good provision is equal to total contributions, *i.e.*, $G = \sum_{i=1}^n g_i$. The total income in the economy is denoted by $Y = \sum_{i=1}^n y_i$.

The government collects a flat-rate tax t , $0 \leq t \leq 1$, on income net of charitable contributions towards the public good and redistributes the tax revenue equally across the n agents. During redistribution, part of the collected tax revenue w , $0 \leq w \leq 1$, is wasted.¹⁶ Therefore, individual i 's private consumption c_i , after contributing to the public good, paying his/her taxes and receiving any refund from the government, is given by:

$$c_i = (1 - t)(y_i - g_i) + (1 - w) \frac{t \sum_{j=1}^n (y_j - g_j)}{n}. \quad (1)$$

Individual preferences are represented by an additively separable utility function $u(c_i) + v(G)$, where $u(\cdot)$ and $v(\cdot)$ are strictly increasing, strictly concave, twice continuously differentiable functions and satisfy the Inada conditions. Finally, to simplify the analysis, we assume everyone contributes to the public good in the equilibrium. This assumption is reasonable as long as the ex-ante wealth inequality between agents is not very large (Bergstrom et al., 1986; Uler, 2009).

the matches). To see why increasing the rebate/match rate does not lead to ambiguous effects on donations received by the charity the way increasing the rate of tax or waste does, consider the following examples. When the rebate (or match) rate increases, an individual might still choose to donate nothing and consume his/her available wealth. When a tax rate increases, however, the individual's net income strictly decreases even when he/she does not donate anything to the charity. Alternatively, when the rebate (or match rate) increases, an individual can donate the same (total) level as before and enjoy a higher net income. In contrast, when the tax rate increases, if the individual donates the same level as before, then he/she will definitely have a lower net income.

¹⁶ One can think of the "waste" as either the government funding programs that the individuals do not care for, or inefficient spending.

Each individual chooses their contribution level, g_i , by taking other individuals' contributions as given. The first-order condition for an individual i is given by:

$$u'(c_i) \left(1 - \left(1 - \frac{1-w}{n}\right)t\right) = v'(G). \quad (2)$$

Since the right hand side of this equation is the same for each individual, we can infer that, in equilibrium, all agents consume the same amount of the private good. Note that this implies that the “neutrality” result of Bergstrom et al. (1986) also holds in this model: total public goods provision does not depend on the initial income distribution.¹⁷ The first-order condition simplifies to:

$$u' \left((1 - wt) \left(\frac{Y-G}{n} \right) \right) \left(1 - \left(1 - \frac{1-w}{n} \right) t \right) = v'(G). \quad (3)$$

This condition is intuitive. Each agent chooses the level of contribution that would equalize the marginal benefit of contributing to the marginal cost of an additional unit of contribution. Note that the equilibrium is uniquely determined.¹⁸

The first question we seek to address is what happens to contributions when the tax rate increases for a given degree of waste. Equation (3) shows that higher taxes have two opposing effects on the equilibrium level of contributions: (i) a higher tax rate implies a lower price of giving, which has a positive effect on contributions (the substitution effect), and (ii) a higher tax rate implies lower net income, which has a negative effect on contributions (the income effect). To solve for the net effect of taxes on giving, we differentiate equation (3) with respect to the tax rate t and then solve for $\frac{\partial G}{\partial t}$:

$$\frac{\partial G}{\partial t} = - \frac{u''(b)w \left(\frac{Y-G}{n} \right) (1-at) + u'(b)a}{v''(G) + u''(b) \left(\frac{1-wt}{n} \right) (1-at)}, \quad (4)$$

where $a = \left(1 - \frac{1-w}{n}\right)$ and $b = (1 - wt) \left(\frac{Y-G}{n} \right)$. Since the denominator is always negative, the sign of the numerator determines the sign of the partial derivative of G with respect to t .

When $w = 0$, the income effect disappears (*i.e.*, $u''(b)w \left(\frac{Y-G}{n} \right) (1 - at)$ becomes zero) and the positive relationship between G and t holds without any additional assumptions about the curvature of consumption utility (also see Uler, 2009). When $w > 0$, however, whether the relationship between total public goods provision and the tax rate is positive or not depends on the curvature of the consumption utility. Our first theorem, generalizing the findings of Bergstrom et al. (1986) and Uler (2009), follows:

¹⁷ Similar to Bergstrom et al. (1986), this result holds only when the set of contributors does not change as the initial income distribution changes. If the set of contributors changes when the initial income distribution changes, then the model would predict higher contributions when income inequality increases. Hence, similar to Bergstrom et al. (1986) and Uler (2009), there is a trade-off between contributions and (initial) income equality.

¹⁸ This can be seen by using equation (1) and the fact that each individual consumes the same amount of the private good.

Theorem 1. For a given degree of waste, $0 \leq w < 1$, if $u(x)$ satisfies $-\frac{u''(x)x}{u'(x)} \leq 1$, then the total public good provision G is a strictly increasing function of the tax rate t . When $w = 1$, G is a strictly increasing function of the tax rate, if $-\frac{u''(x)x}{u'(x)} < 1$.

To simplify the presentation of the paper, all proofs are provided in an online appendix (see Appendix A). Theorem 1 shows that whether individuals increase their donations when the tax rate increases depends on the *elasticity of marginal utility* with respect to consumption, given by $-\frac{u''(x)x}{u'(x)}$.¹⁹ Note that in environments that involve risk, the elasticity of marginal utility corresponds to the *relative risk aversion coefficient*.

Corollary 1. If the agents' consumption preferences are defined by the *Constant Relative Risk Aversion* (CRRA) utility function, $u = \frac{x^{(1-\theta)}}{(1-\theta)}$ for $0 < \theta \neq 1$ and $u = \ln(x)$ for $\theta = 1$, then, for a given degree of waste $0 \leq w < 1$ and for $\theta \leq 1$, public good provision strictly increases as the tax rate increases. When $w = 1$, public good provision strictly increases as the tax rate increases, if $\theta < 1$.

The conditions provided in Theorem 1 and Corollary 1 are mild. In fact, as we explain in Sections 3 and 4, we approximate individuals' elasticities of marginal utility with respect to consumption by using data from a risk elicitation task in our experiment. We find that only three percent of subjects have an elasticity coefficient greater than one. Therefore, one would expect the substitution effect to dominate the income effect as the tax rate increases. Theorem 1 and Corollary 1 are, however, silent regarding the magnitude of the net effect.

Next, we study whether $\frac{\partial G}{\partial w}$ is smaller or larger than $\frac{\partial G}{\partial t}$. Equation (3) shows that a higher degree of waste has two opposing effects on the equilibrium level of contributions: (i) a higher degree of waste implies a lower price of giving, which has a positive effect on contributions (the substitution effect), and (ii) a higher degree of waste implies a lower net income, which has a negative effect on contributions (the income effect). The substitution effect is always higher for the tax change than the wasteful spending change, which can be seen by examining the relative change in the price of giving generated by these two variables. The effect of a small change in the tax rate on the price of giving is given by $\left(1 - \frac{1-w}{n}\right)$, whereas the effect of a small change in the rate of waste on the price of giving is given by $\frac{t}{n}$. Since $\left(1 - \frac{1-w}{n}\right)$ is always greater than $\frac{t}{n}$ for any

¹⁹ Note that $\frac{u''(x)x}{u'(x)} = \frac{\frac{du'(x)}{dx}x}{u'(x)} = \frac{\frac{dw'(x)}{dx}}{\frac{w'(x)}{x}}$. The elasticity of marginal utility with respect to consumption can also be interpreted as the sensitivity of the marginal rate of substitution between private consumption and public good consumption to price changes: the derivative of the marginal rate of substitution with respect to the price of private consumption (see Mirrlees, 1971). We are grateful to Daniel Hungerman for this insight.

t and w , the substitution effect in the case of waste w is smaller than the substitution effect in the case of tax rate t . It is also easy to see that the income effect of increasing the degree of waste is at least as large as the income effect of increasing the tax rate when $t \geq w$. Therefore, for any $t \geq w$, the net effect of the tax rate on public goods provision is always larger in the *relative* sense than the net effect of the rate of waste.²⁰ It is, however, challenging to see how $\frac{\partial G}{\partial w}$ compares with $\frac{\partial G}{\partial t}$ for $t < w$. Theorem 2 shows that, if the elasticity of marginal utility function with respect to consumption is less than or equal to one, then the marginal effect of increasing the tax rate on giving is larger than the marginal effect of increasing the degree of waste on giving, independent of the degree of waste and the tax rate.

Theorem 2. If $u(x)$ satisfies $-\frac{u''(x)x}{u'(x)} \leq 1$, then $\frac{\partial G}{\partial t} > \frac{\partial G}{\partial w}$ for any $0 < t \leq 1$ and $0 \leq w \leq 1$.

While Theorem 2 provides us with the relative comparison of the marginal effects of t and w , it does not inform us regarding the sign of $\frac{\partial G}{\partial w}$. To solve for the net effect of w on giving while fixing the tax rate, we differentiate equation (3) with respect to w and then solve for $\frac{\partial G}{\partial w}$:

$$\frac{\partial G}{\partial w} = -\frac{u''(b)t\left(\frac{Y-G}{n}\right)(1-at)+u'(b)\frac{t}{n}}{v''(G)+u''(b)\left(\frac{1-wt}{n}\right)(1-at)}. \quad (5)$$

Since the denominator in equation (5) is always negative, the sign of the numerator determines the sign of the partial derivative of G with respect to w . Theorem 3 provides the sufficient condition for the substitution effect to dominate the income effect. Given the result in Theorem 2, one would expect to have a more restrictive sufficient condition in order to have a positive relationship between G and w , and this is exactly what we see in Theorem 3.

Theorem 3. For a given tax rate $0 < t \leq 1$, if $u(x)$ satisfies $-\frac{u''(x)x}{u'(x)} \leq \frac{1}{n}$, then the total public good provision G is a strictly increasing function of the degree of waste w .

Note that the sufficient condition in Theorem 3 does not hold for any $n \geq 2$, if $u(x)$ is a CRRA utility function with $\theta > \frac{1}{2}$ (see Corollary 2).

Corollary 2. If the agents' consumption preferences are defined by the CRRA utility function $u = \frac{x^{(1-\theta)}}{(1-\theta)}$ for $0 < \theta \neq 1$ and $u = \ln(x)$ for $\theta = 1$, then giving strictly increases when the degree of waste increases if $\theta \leq \frac{1}{n}$.

²⁰ For example, if $\frac{\partial G}{\partial t} = 0$ and $\frac{\partial G}{\partial w} = -4$, then the partial derivative of G with respect to t is greater than the partial derivative of G with respect to w in the relative sense.

We also see that as n increases it becomes harder to satisfy the sufficient condition provided in Theorem 3 and Corollary 2.²¹ For example, for agents with a CRRA utility function, this condition will not hold for any positive θ as $n \rightarrow \infty$. This important result suggests that, in large economies, the income effect dominates the substitution effect and leads to a negative relationship between the rate of waste and donations to the public good.

While Theorem 3 and Corollary 2 are useful in providing the sufficient condition for a positive relationship between donations and the rate of waste, they do not inform us when to expect a definite negative relationship. Theorem 4 derives a necessary and sufficient condition for the income effect to dominate the substitution effect for CRRA utility functions. It shows that, assuming the CRRA utility function, donations decrease in the degree of waste if and only if $\theta > \frac{(1-wt)}{(1-at)n}$. Note that the condition in Theorem 4 is satisfied for any positive θ in very large economies.

Theorem 4. Suppose the agents' consumption preferences are defined by the CRRA utility function. Then, $\frac{\partial G}{\partial w} < 0$ if and only if $\theta > \frac{(1-wt)}{(1-at)n}$.²²

Corollary 3 shows that if individuals have logarithmic consumption utility, then charitable donations increase when the tax rate increases and decrease when the degree of waste increases, *independent* of the size of the economy.

Corollary 3. If the agents' preferences are given by $\ln(c) + v(G)$, then (i) for a given $0 \leq w < 1$, public good provision increases when t increases, and (ii) for a given $0 < t \leq 1$, public good provision decreases when w increases.

Note that (i) is true because the sufficient condition in Theorem 1 is satisfied, and (ii) comes from Theorem 4, since $\frac{(1-wt)}{(1-at)n} < 1$ for any $n \geq 2$. Corollary 3 illustrates a simple example where the substitution effect is stronger than the income effect as the tax rate increases, while the income effect dominates the substitution effect as the degree of waste increases.

Theorem 4 and Corollary 3 are surprising. They show that, when a change in the degree of waste is considered, the income effect dominates the substitution effect under common utility functions. The intuition behind these results is the following: increasing the degree of waste has only a small effect on lowering the relative price (or opportunity cost) of donations, because individuals do not expect to get much direct return from paying their taxes. This is especially true when the size of the economy is large, since individuals mostly consider their paid taxes as lost money and governmental waste has little positive impact on the price of donations. On the other

²¹ In the experiment, we have three people in our experimental society. If this condition does not hold for $n = 3$, then we do not expect it to hold with $n > 3$.

²² Note that $\frac{1}{n} \leq \frac{(1-wt)}{(1-at)n} < 1$ for any $0 \leq w \leq 1$, and $0 \leq t \leq 1$. $\frac{(1-wt)}{(1-at)n}$ equals $\frac{1}{n}$ when $w = 1$.

hand, taxes are used to provide a governmental public good (*i.e.*, redistribution). But, if the government is wasting the tax revenue, individuals receive lower transfers and therefore get poorer. Given that individuals are poorer, they have less money to donate to charities. The income effect has a strong negative effect on donations.

Before discussing our hypotheses, we first mention that our results are not limited to purely altruistic agents. Alternatively, individuals might have warm-glow preferences, *i.e.*, receive utility only from their own donations to the charity (Andreoni 1989, 1990). By using a CRRA formulation, it is not hard to show that all of our results continue to hold if the agents have warm-glow preferences.²³ In addition, our results on the effects of the tax rate and the degree of waste on giving also do not depend on the assumption that everyone contributes to the public good.²⁴

3.2. Hypotheses

We derive five testable hypotheses. According to our model, total donations and individual donations move in the same direction.²⁵ We state our hypotheses at the individual level in order to utilize our data set more effectively and to conduct robustness checks by controlling for individual-specific variables such as income and demographics.

Based on Theorem 1, we conjecture that individual donations increase when the tax rate increases (see Hypothesis 1).²⁶ Note that Hypothesis 1 is also consistent with the previous empirical literature that suggests a positive relationship between charitable giving and the tax rate.

Hypothesis 1. Individual giving increases when the tax rate t increases.

Second, based on Theorem 2, we provide a hypothesis regarding the relative impact of the effects of the tax rate and the degree of waste on individual giving.

Hypothesis 2. The marginal effect of the tax rate on giving is larger than the marginal effect of the degree of waste on giving.

²³ We assume individual i 's utility function is given by: $\frac{c_i^{1-\theta}}{1-\theta} + \frac{g_i^{1-\theta}}{1-\theta}$ for $0 < \theta \neq 1$ and $\ln(c_i) + \ln(g_i)$ for $\theta = 1$. We find that total public goods provision, G , is equal to $\frac{(1-wt)Y}{(1-at)^\theta + (1-wt)}$. It is not difficult to calculate $\frac{\partial G}{\partial t}$ and $\frac{\partial G}{\partial w}$, and confirm

that all of our results continue to hold. Future research could generalize our findings beyond a CRRA formulation.

²⁴ Our main results do not change when we allow for non-contributors. In particular, the sufficient conditions provided in Theorems 1-3 stay the same. For example, take Theorem 1. Under the sufficient condition provided in Theorem 1, for a given degree of waste, it is possible to show that (i) as t increases, the set of contributors (weakly) increases and (ii) $\frac{\partial G}{\partial t} > 0$ for any t . Similarly, all of our corollaries continue to hold. The only adjustment that needs to be done is for Theorem 4. While the threshold provided in Theorem 4 becomes larger when we allow for non-contributors, it can be shown that it is still strictly less than 1. In addition, it is not difficult to show that, for a given rate of tax, (i) as w increases, the set of contributors (weakly) decreases, and (ii) $\frac{\partial G}{\partial w} < 0$ for any w .

²⁵ This can be easily seen from equation (1) and the fact that, in equilibrium, all individuals enjoy the same net consumption. In the case of corner solutions, total donations and *average* individual donations move in the same direction.

²⁶ Recall that the condition provided in Theorem 1 is very mild and that only three percent of subjects did not satisfy this condition.

Recall that Theorem 3 predicts that if the elasticity of marginal utility is smaller than or equal to $\frac{1}{n}$, then giving is an increasing function of the degree of waste. Theorem 4 states that if individuals have CRRA preferences and the elasticity of marginal utility is larger than $\frac{(1-wt)}{(1-at)n}$, then giving should *decrease* when the degree of waste increases.²⁷ Assuming our participants' elasticity of marginal utility is large enough, we conjecture that the relationship between giving and w is negative.

Hypothesis 3. Individual giving decreases when the degree of waste w increases.

While our model considers homogeneous agents, we also derive predictions for heterogeneous agents assuming that individuals believe others to have similar preferences to themselves (*i.e.*, they believe everyone has the same utility function as themselves). For example, there is a large literature in psychology (and recently economics) showing that individuals demonstrate a false consensus bias, which implies that, even when actual preferences are heterogeneous, individuals may not realize this and they may be considering a relatively homogeneous environment.²⁸ Therefore, we predict that a participant that has an elasticity of marginal utility smaller than or equal to $\frac{1}{n}$ increases their donations as w increases, and a participant that has an elasticity of marginal utility larger than $\frac{(1-wt)}{(1-at)n}$ decreases their donations as w increases. Note, however, that, the elasticity coefficients of individuals are not directly observable. We use a risk elicitation task to approximate these coefficients, since our elasticity condition capturing the curvature of consumption utility corresponds to the relative risk aversion coefficient in an environment that involves risk.

We used a series of 15 binary lottery choices, as shown in Table 2, to elicit individuals' coefficients of risk aversion (also see Section 4 for additional details). The coefficient of risk aversion is determined by the number of safe choices. Assuming a CRRA utility function, an individual with seven or more safe choices is risk averse. For example, seven safe choices corresponds to a relative risk aversion coefficient θ between 0.26 and 0.50, and eight corresponds to a relative risk aversion coefficient θ between 0.50 and 0.74. An individual who makes six safe choices is either slightly risk averse or risk neutral. An individual who makes five safe choices is either risk neutral or slightly risk loving. An individual with less than five safe choices is risk loving.

It is important to highlight that we do not expect elicited risk aversion coefficients to be a perfect measure of the elasticity parameters and, therefore, we treat these coefficients as

²⁷ When the parameters of our experiment are used, $\frac{(1-wt)}{(1-at)n}$ varies between 0.33 and 0.67. Therefore, if $\theta > 0.67$, then giving is a strictly decreasing function of w . If $0.33 < \theta < 0.67$, then giving may sometimes increase and sometimes decrease depending on the parameters (see Tables C.1 and C.2 in Appendix C).

²⁸ See Selten and Ockenfels (1998) and Charness and Grosskopf (2001) for a review of this literature.

approximations.²⁹ Below we provide Hypotheses 4 and 5 that approximate our theoretical predictions:

Hypothesis 4. Individual giving increases as w increases for participants who choose less than seven safe choices in the risk elicitation task.

Hypothesis 5. Individual giving decreases as w increases for participants who choose more than seven safe choices in the risk elicitation task.

By conducting an experiment with real donations, we have the needed controls to test our hypotheses and examine the net effects of changing the tax rate and the degree of waste on charitable donations.

4. Experimental Design and Procedures

The data come from an experiment conducted at the University of Michigan from August–November 2015. A total of 204 students were recruited using the ORSEE software (Greiner, 2015). There were 12 sessions in total. Each session lasted one hour and fifteen minutes, on average, and had either 12 or 18 participants. The experiment proceeded in four parts and it was programmed using z-tree software (Fischbacher, 2007). The currency used in all parts of the experiment was US dollars. Upon completion of the experiment, earnings from all parts of the experiment were added to a show-up payment of \$5. Participants received their payments in private and in cash, ranging from \$15.50 to \$57.75.

At the beginning of each part of the experiment, all participants were given written instructions (see Appendix B), and an experimenter read the instructions aloud. In part 1, participants took a 20-minute cognitive test containing 10 multiple-choice questions. The questions were drawn from a Graduate Record Examination (GRE) test preparation book (Seltzer, 2009). All were of moderate-to-high difficulty. Participants were told that they would gain one point for each correct answer and zero for an incorrect answer. Participants were also informed that, upon completion of part 1, they would receive earnings which might depend on their relative performance in the test.³⁰

²⁹ The elasticity of marginal utility with respect to consumption may not be captured by the estimated relative risk aversion coefficient from the lottery task if agents are not expected utility maximizers or if the risk elicitation task used in the study does not correctly capture risk preferences. Nevertheless, in the absence of a better tool to capture the elasticity coefficient, approximating the curvature of the consumption utility based on our risk elicitation task allows us to test the model in a stronger fashion. Since, in our experiment, donation decisions and risk elicitation tasks are performed under very similar conditions (including payoff levels for a given subject), it is not unreasonable for the behavior in the risk elicitation task to shed light on subjects' behavior regarding donation decisions.

³⁰ Specifically, participants were told that the amount earned “may be the same for everyone in this room, or each participant’s earnings may depend on their relative performance in the test.” We used this language to facilitate comparison between our two treatments: *Equal* versus *Unequal*. In addition, before the experiment started, subjects were told that they may lose part of the money they earn in part 1. They received explicit instructions for part 2 after they finished part 1 (see Appendix B).

In part 2, participants were randomly and anonymously matched into groups consisting of 3 participants. We chose $n = 3$ for two important reasons. First, it allows us to minimize mistakes/errors of participants by creating the simplest possible environment for them while still keeping the environment rich enough to incorporate all the important factors that might influence their behavior. Second, it provides a strong test for the theory. For small values of n , the model makes different predictions depending on the elasticity of marginal utility.

Each group was randomly assigned to a different charity.³¹ Participants in a given group could simultaneously donate any amount to this charity, ranging from \$0 to the amount earned in part 1, in increments of 5 cents. In the *Equal* treatment, all members of the group received \$30. In the *Unequal* treatment, participants who scored the highest in part 1 received \$45, participants in the middle received \$30, and participants who scored the lowest received \$15. Note that the total amount of income is fixed across *Equal* and *Unequal* treatments (\$30 + \$30 + \$30 versus \$45 + \$30 + \$15). While the *Equal* treatment provides a simple environment to test our predictions, the *Unequal* treatment provides a relatively more realistic set-up. It is important to stress that the focus of our study is the effect of changing the tax rates and degrees of waste on giving, but we are also able to study how income inequality affects giving decisions (keeping the rate of tax and waste constant).

Participants were asked to make 10 donation decisions at once under different combinations of the tax rate and the redistribution rate ($r = 1 - w$), as shown in Table 1. To avoid negative framing, we did not use the word “waste” in the experimental instructions. Participants were told that, at the end of the experiment, the computer would randomly implement one decision for payment, applying the appropriate tax and redistribution rates to compute the participant’s payout. After the experiment, the experimenters sent a check to each charity for the total amount donated to that charity in that randomly determined decision.³²

Participants knew that we would apply a tax (which was either 0%, 25%, 50%, or 75%) on each participant’s remaining income and collect the corresponding amount of money. They also knew that we would evenly redistribute a share of the collected money among the participants within the same group, while the rest of the collected money (which was either 0%, 50%, or 100%) would be returned back to the experimenter.³³ After learning their initial income, all participants made their donations simultaneously and anonymously.³⁴ All ten donation situations were presented on the same screen. Given that we are primarily interested in the changes in donations as a response to the changing tax and waste rates (as opposed to the absolute donation amounts),

³¹ We used the following charities: American Cancer Society, American Red Cross, Doctors Without Borders, Feeding America, Food for the Poor, and Save the Children.

³² Participants were told that, if requested, they would receive a confirmation email from the charity to verify that the experimenters sent their donations to the charity.

³³ As an alternative design, we could have used the collected money to fund a cause that would be perceived as wasteful by most subjects. Due to the difficulty of identifying a cause that would simultaneously be perceived as wasteful by subjects, while also not being a waste of limited research funds, we chose to avoid this alternative design.

³⁴ Tables C1 and C2 in Appendix C give theoretical predictions of giving for each t and w assuming specific utility functions.

we made the changes as obvious as possible to the subjects. The subjects were free to make decisions in any order and revise their decisions before submitting them.

To minimize calculation mistakes, participants were provided with a pre-programmed “calculator”. A participant could enter the tax rate, redistribution rate and the potential donation decisions by themselves and the other participants in their group. The calculator would then show the group donation, pre-tax income, tax payment, after-tax income, redistribution amount and the final income of the participant. Participants could use the calculator as many times as they liked.

In part 3, we elicited participants’ risk preferences (which we use as an approximation for their elasticity of marginal utility). Over a series of 15 binary choices, as shown in Table 2, participants were asked to choose between a risky option A (\$9.0 or \$1.0 with 50% chance each) and a safe option B (increasing monotonically from \$0.5 to \$7.5 in increments of \$0.50). One of the 15 choices was randomly selected to be paid out at the end of the experiment. The parameters in this task were carefully designed to elicit a wide range of risk preferences.

In part 4, we elicited social preferences. Each participant was randomly matched with another participant. Participants were asked to choose one of the four options (\$2.00; \$2.00), (\$1.75; \$3.00), (\$2.25; \$1.00) and (\$2.00; \$1.75), where the first entry corresponds to their own payoff and the second entry corresponds to their paired participant’s payoff. After both participants made their decisions, the computer randomly determined whose decision to implement, and the earnings of both participants were determined accordingly.

At the end of the experiment, participants filled out a demographic questionnaire. After the computer displayed outcomes from all parts of the experiment and calculated individual earnings, participants received their payments in private.

5. Results

Table 3 shows the average donation and the fraction of participants giving \$0 for different levels of tax and waste for both the equal and unequal income distributions. The left panel corresponds to the *Equal* treatment in which all participants received \$30 and could donate part of this income to a charity. The right panel corresponds to the *Unequal* treatment in which participants received either \$45, \$30, or \$15 (as determined by their relative performance in part 1).³⁵ Note that, unless otherwise mentioned, we only consider the case of $t > 0\%$, since when $t = 0\%$, waste is no longer a consideration for participants (*i.e.*, $w = N/A$).

We begin by examining how giving changes when t changes. In the *Equal* treatment, when there is no waste ($w = 0\%$), giving slightly increases from \$3.97 when $t = 25\%$ to \$4.06 when $t = 50\%$, and increases to \$4.18 when $t = 75\%$. None of these differences are significant based on pair-wise Wilcoxon signed-rank tests, however. Looking at the effect of higher taxes on giving at $w = 50\%$ and $w = 100\%$, we first see a decrease in giving and then an increase. While the first decrease at $w = 50\%$ is significant at the 1% significance level, none of the other cases are

³⁵ Seven participants (3 in the *Equal* and 4 in the *Unequal* treatment) received a score of zero in part 1. These subjects might have failed to submit their answers on time or simply chose not to work on the task. Our results are robust to inclusion or exclusion of these 7 participants and are available upon request from the authors.

significant at the 5% significance level. Pooling across all levels of waste, the left panel of Figure 1 shows no significant relationship between average giving and the tax rate t in the *Equal* treatment (none of the three pair-wise comparisons are significant at the 5% significance level).

Similar responses to changes in the tax rate are observed when examining the *Unequal* treatment. When there is no waste (i.e., $w = 0\%$), giving slightly increases from \$4.75 when $t = 25\%$, to \$4.90 when $t = 50\%$ (p-value = 0.56), and decreases to \$4.57 when $t = 75\%$ (p-value = 0.03). Similarly, for $w = 50\%$, there is no monotonic relationship between the tax rate and giving. These differences are not significant based on pair-wise Wilcoxon signed-rank tests. For $w = 100\%$, giving increases when the tax rate changes from 25% to 50%, and from 50% to 75%, but none of these increases are statistically significant. The right panel of Figure 1 shows that the line representing the relationship between the average donation and the tax rate in the *Unequal* treatment is virtually flat, suggesting no significant correlation (none of the three pair-wise comparisons are significant at conventional statistical levels).

Next, we examine how giving changes with w . In the *Equal* treatment, when the degree of waste increases from $w = 0\%$ to $w = 50\%$, giving significantly decreases from \$3.97 to \$3.02 when $t = 25\%$ (p-value < 0.01), from \$4.06 to \$2.53 when $t = 50\%$ (p-value < 0.01), and from \$4.18 to \$2.85 when $t = 75\%$ (p-value < 0.01). When the degree of waste increases from $w = 50\%$ to $w = 100\%$, giving further decreases from \$3.02 to \$2.06 when $t = 25\%$ (p-value < 0.01), from \$2.53 to \$2.04 when $t = 50\%$ (p-value < 0.01), and from \$2.85 to \$2.58 when $t = 75\%$ (p-value = 0.06). Pooling across all tax rates, the left panel of Figure 2 shows a clear negative and significant relationship between average giving and the degree of waste w in the *Equal* treatment (all three pair-wise comparisons are significant at the 1% significance level).

A similar response to changes in waste is observed when examining the *Unequal* treatment. When the degree of waste increases from $w = 0\%$ to $w = 50\%$, giving significantly decreases from \$4.75 to \$3.58 when $t = 25\%$ (p-value < 0.01), from \$4.90 to \$3.67 when $t = 50\%$ (p-value < 0.01), and from \$4.57 to \$3.48 when $t = 75\%$ (p-value < 0.01). When the degree of waste increases from $w = 50\%$ to $w = 100\%$, giving further decreases from \$3.58 to \$2.83 when $t = 25\%$ (p-value < 0.01) and from \$3.67 to \$2.85 when $t = 50\%$ (p-value < 0.01), but it increases (although not significantly) from \$3.48 to \$4.25 when $t = 75\%$ (p-value = 0.12). The right panel of Figure 2 shows that there is a clear negative and significant relationship between average giving and the degree of waste in the *Unequal* treatment (all three pair-wise comparisons are significant at the 1% significance level).

We now supplement the above nonparametric analysis with a series of regression analyses. Table 4 reports Tobit regressions with standard errors clustered at the participant level.³⁶ The dependent variable is *giving*. Regression (1) uses the data from the *Equal* treatment, and the independent variables are the tax rate t and the rate of waste w . Consistent with the non-parametric tests, the coefficient on t is not significant (p-value = 0.68). Also, consistent with the non-parametric tests, the coefficient on w is negative and significant (p-value < 0.01), confirming that

³⁶ We choose to present Tobit regression analyses in the main text, since roughly half of the participants gave \$0. Our qualitative results are robust to using OLS regressions (see Appendix D).

giving decreases in the degree of waste. Regression (2) uses the data from the *Unequal* treatment, and the independent variables are the tax rate t , the rate of waste w , and *Income* (to control for the different income levels that participants earned in part 1 of the experiment). As in the *Equal* treatment (regression 1), the coefficient on t is not significant (p-value = 0.96). Also, as in the *Equal* treatment, the coefficient on w is negative and highly significant (p-value < 0.01). Pooling the data from both treatments, as shown in regression (3), corroborates this result. Note that regressions (1)-(3) only consider data for $t > 0\%$ (since $w = N/A$ for $t = 0\%$). Alternatively, we can impose an assumption that $w = 0\%$ when $t = 0\%$. While this assumption is restrictive and may not accurately describe how participants perceive the case of $t = 0\%$, as a robustness check, we redid our analysis by imposing this assumption. Our results do not change (see regressions (4)-(6) in Table 4). The only difference is that the coefficient of the tax rate is now positive, but it remains statistically insignificant. We provide additional robustness checks in Appendix D (see Tables D1-D4).³⁷

Given our analysis, we can conclude that our data are consistent with Hypothesis 3, but not consistent with Hypothesis 1. Both nonparametric tests and regression analysis fail to find a significant effect of the tax rate on giving. In contrast, we see a large and statistically significant negative effect of the degree of waste on donations in both nonparametric tests and regression analysis.

In order to test Hypothesis 2, which states that the marginal effect of the tax rate on giving is greater than the marginal effect of the degree of waste on giving, we compare the coefficients on the tax rate and the rate of waste. Recall that, while the coefficient on the tax rate is not significantly different from zero, the coefficient on the rate of waste is negative and significant. Wald tests, formally testing Hypothesis 2, show that the coefficient on t is significantly larger than the coefficient on w in all regressions (p-values in all of the tests are less than 0.01). We summarize our findings in Results 1-3:

Result 1: In contrast to Hypothesis 1, giving does not change when the tax rate t increases.

Result 2: Consistent with Hypothesis 2, the marginal effect of the tax rate on giving is significantly larger than the marginal effect of the degree of waste.

Result 3: Consistent with Hypothesis 3, giving significantly decreases when the degree of waste w increases.

Recall that our experimental design also gives us an opportunity to see how initial income inequality affects the level of contributions. We find that the coefficient of the dummy variable *Unequal* is not significant, suggesting that initial income distribution does not matter for giving decisions (see regressions (3) and (6) in Table 4). We get a similar result when performing non-parametric Wilcoxon rank-sum tests to compare giving between equal and unequal income

³⁷ Appendix D also provides an analysis of heterogeneity among individuals.

distributions at each tax and waste level—p-values for all pairwise comparisons range between 0.20 and 0.77. This finding is consistent with the neutrality result of Bergstrom et al. (1986), which states that total public goods provision does not change with initial income inequality.³⁸ It is important to note, however, that while the theory makes correct qualitative predictions at the aggregate level, it does not predict the levels of individual giving. While the model predicts that the high income individuals (who received \$45) should contribute more than the middle income individuals (who received \$30) and the middle income individuals should contribute more than the low income individuals (who received \$15), our regression analyses show that this does not hold in the data. Although the *Income* coefficient in regressions (2) and (3) is positive, it is not significant (also see Tables D2-D3 in Appendix D). In addition, when we run Tobit and OLS regressions with dummies for high and low income, none of our results change (see Tables D5-D6 in Appendix D). The insignificant effect of income on giving may not be surprising given that several other studies also find that high income individuals often under-contribute, while low income individuals often over-contribute relative to predicted levels (e.g., Chan et al., 1996, 1999; Uler, 2011; Maurice et al., 2013).

Next, we test Hypotheses 4 and 5. Recall that one of the theoretical predictions of our model is that the relationship between giving and the degree of waste depends on the curvature of subjects' utility functions with respect to consumption (or, more formally, the elasticity of marginal utility). The relationship between giving and the tax rate also changes sign depending on the elasticity of marginal utility with respect to consumption, but only for extremely high elasticity parameters (which are unlikely to be observed in practice). Recall that we used a risk elicitation task in order to approximate individual elasticity parameters.

We find that the average number of safe choices in the risk elicitation task is 7.20, with a standard deviation of 1.84. Hypothesis 4 states that individuals who choose less than seven safe choices will—on average—increase their giving as the degree of waste increases. Hypothesis 5 states that individuals who choose more than seven safe choices will—on average—decrease their giving as the degree of waste increases.

Table 5 reports the same regressions as in Table 4, but considering only participants with more than 7 safe choices in regressions (1)-(3), and less than seven safe choices in regressions (4)-(6).³⁹ Regressions (1)-(3) show that subjects with more than seven safe choices decrease their giving in the rate of waste w .⁴⁰ Regressions (4)-(6) show that the magnitude and the significance of this relationship are greatly reduced when we consider subjects with less than seven safe

³⁸ The neutrality result relies on the assumption that the set of contributors stays the same as income inequality increases. Otherwise, Bergstrom et al. (1986), as well as our model, predict that total giving increases as initial income inequality increases. Therefore, a stronger test of neutrality result requires to have a within-subject variation of income (see Duquette and Hargaden, 2019), but since this is not the main aim of the paper, our research design does not incorporate such variation.

³⁹ One participant in our experiment has missing data after part 2 due to health reasons. Therefore, when we add variables from parts 3 and 4 and the questionnaires to the regression analysis, this participant gets automatically dropped from the regression analysis.

⁴⁰ The negative impact of w on giving is robust to including the subjects with seven safe choices.

choices. These results are not consistent with Hypothesis 4, but they are consistent with Hypothesis 5.⁴¹ In Appendix D, we provide additional robustness checks (see Table D7).

Result 4: In contrast to Hypothesis 4, giving does not increase as the degree of waste increases for subjects who have a small elasticity of marginal utility (*i.e.*, those that pick less than seven safe choices in a risk elicitation task).

Result 5: Consistent with Hypothesis 5, giving decreases as the degree of waste increases for subjects who have a relatively large elasticity of marginal utility (*i.e.*, those that pick more than seven safe choices in a risk elicitation task).

While we fail to find support for Hypothesis 4, it is important to note that the negative relationship between w and giving completely disappears in regressions (5) and (6). This provides moderate support for the model, showing that curvature of the consumption utility affects the relationship between w and giving.

Finally, we show that our results are robust to including other covariates. Table 6 reports Tobit regressions, in which the dependent variable is *giving*. For comparison purposes, regression (1) in Table 6 is the same as regression (3) in Table 4. Regression (2) in Table 6 uses two additional explanatory variables, *Egalitarian* and *Generous*. *Egalitarian* is a dummy variable that takes value 1 if a subject picked the fair option in part 4, and *Generous* is a dummy variable that takes value 1 if a subject picked the welfare maximizing option in part 4. Note that the estimated coefficients on w and t in regression (2) are fairly similar to those in regression (1). In addition, we find that participants who are classified as *Generous* give more to charity (p-value < 0.01). Regression (3) adds other variables that were elicited at the end of the experiment using a survey. The positive and significant coefficient on *Female* suggests that, on average, women give more than men (p-value < 0.01). Finally, regression (4) adds an additional control for the participant's score in part 1. Importantly, none of these controls change our main qualitative results. Table D8 in Appendix D confirms similar results using OLS regressions.

Result 6: Our results are robust to inclusion of control variables.

6. An Additional Experiment for Robustness Check

An important question is why we do not see a positive relationship between the tax rate and charitable giving as predicted by our model. Perhaps we fail to find support for our hypothesis because we did not give our subjects an opportunity to learn. In this section, we test this possibility

⁴¹ As a robustness check (not shown here for brevity), we have repeated our analysis by eliminating the 14 subjects that made less than six safe choices. Our qualitative results do not change.

with an additional experiment and show that our results are robust to learning through repeated play and feedback.⁴²

We conducted an additional experiment with 90 new subjects during October 2019. This additional experiment also took place at the University of Michigan and consisted of five sessions. Each session lasted approximately one and a half hours and had 18 participants. Subjects were randomly divided into groups of three and the composition of the groups stayed the same throughout the sessions.

Both the design and the instructions for this additional experiment deviated as little as possible from those utilized in the original study (see Appendix B for the instructions). The main differences can be summarized in three points: (i) in order to give subjects an opportunity to learn and respond to the tax rate, the additional experiment focused only on changing the tax rate while keeping the rate of waste constant at 50%, (ii) subjects played 15 rounds of the game, with each tax rate (25%, 50% or 75%) randomly repeating five times, and (iii) after subjects simultaneously and anonymously entered their charitable giving decisions for a given round, they were provided with feedback (*i.e.*, subjects were informed of the total amount of donations made to the assigned charity by their own group, as well as their pre-tax income, tax payment, after-tax income, redistribution amount and final income). Similar to the original experiment, only one decision was randomly selected and implemented at the end of the experiment.

Since in the additional experiment subjects made donation decisions one round at a time and feedback was provided between each round, the order in which different tax rates appeared could have affected behavior. We controlled for possible order effects by using the following mechanism: For each group, one of the possible tax rates was randomly selected for round one. Then, for the second round, a tax rate was randomly selected from the two remaining unused tax rates, and the other tax rate then appeared in round three. This process repeated itself four more times to determine the tax rate for rounds 4-15. This mechanism allowed each group to face a random sequence of tax rates, such that each tax rate appeared five times and different tax rates were distributed evenly over rounds.⁴³

Table 7 shows, for a given tax rate: the mean donation, standard error and proportion of zero-donations, first calculated using the individual donations data from all 15 rounds, then using only the first three or only the last three rounds. Consistent with our previous finding, we do not see a positive effect of the tax rate on donations. If anything, the effect seems to be negative (when considering the first three or all rounds). When we look at the last three rounds, where subjects are the most experienced with the game, there does not appear to be a monotonic relationship between the tax rate and donations. In addition, Figure 3, which shows average donations over the five repetitions for each tax rate, similarly confirms the lack of a positive relationship.

⁴² We thank Charles Noussair, who suggested that studying repeated decisions with feedback is essential to understanding whether the failure of donations to respond to the tax rate is a transitory phenomenon that would go away with better comprehension of the task or whether it is a durable and solid pattern of behavior.

⁴³ Hence, we can effectively control for order effects and guarantee that the level of experience and different tax rates cannot be correlated.

In order to test whether the differences in donations across tax rates are statistically significant, we conduct Wilcoxon signed-rank tests. We use data averaged at the group level as our independent observations.⁴⁴ Table 8 shows the results. There is no evidence that donations significantly change as the tax rate changes when we consider all 15 rounds, the first three rounds or the last three rounds. In other words, our results from the additional experiment support our conclusions from the original experiment.

We provide further support by conducting a regression analysis (see Table 9). Regressions (1) and (2) of Table 9 report Tobit regressions with and without controls, respectively. Regressions (3) and (4) repeat the analysis in regressions (1) and (2) using OLS. Robust standard errors are clustered at the group level. All specifications show that contributions decline over rounds, which is a common result in public goods experiments. More importantly, donations do not increase either with the tax rate or income. These results are consistent with our findings in Section 5.

Result 7: We fail to find a significant impact of the tax rate on giving, even when subjects have an opportunity to learn through repetition and feedback.

7. Discussions and Conclusion

We provide a theoretical model and conduct a laboratory experiment to study how tax rates and waste impact individual giving.⁴⁵ Our model demonstrates that the tax rate and the rate of waste create different effects on prices (the opportunity cost of giving). The effect of an increase in the tax rate on the price of giving is stronger than the effect of an increase in the rate of waste on the price of giving. We show that the model predicts that the marginal effect of the tax rate on giving is greater than the marginal effect of the degree of waste on giving. The theory shows that, while the relationship between charitable giving and the tax rate is positive, donations may increase or decrease when the rate of government waste increases (depending on the elasticity of marginal utility with respect to consumption). Our experiment provides strong qualitative support for the model regarding the differential effects of the tax rate and waste on donations. The data show that changes in the tax rate t have a weak and insignificant effect on giving. This finding is robust even when subjects have an opportunity to learn through repetition and feedback as shown by our additional experiment. We also find that the degree of waste w has a large, negative and highly significant effect on giving. Consistent with our theoretical predictions, the relationship between giving and w changes across low and high levels of elasticity of marginal utility.

One might question why we fail to find support for Hypothesis 1 even though both Hypotheses 2 and 3 are consistent with the data. There are several competing explanations for this. First, it is possible that the elasticity of marginal utility with respect to consumption is greater than one. Second, subjects may not be willing to reduce the resources to be shared with their group members, even when the price of giving to charity decreases (as the tax rate increases). Third, the

⁴⁴ Note that there are 30 independent groups.

⁴⁵ To isolate the effects of tax and waste on donations, our paper focuses on the demand side of giving. A related literature studies the factors that affect the supply side (*e.g.*, Krasteva and Yildirim, 2016). Future research could incorporate how the supply side might also be affected from changes in the tax rate and the rate of waste.

negative income effect may be more salient than the positive substitution effect. Fourth, participants may harbor negative emotions towards taxation, such as anger and distrust, since the money they earned is being “wasted”, which may then lead to lower altruism towards charitable causes.

It is possible to rule out the first explanation, as very few subjects seem to have an elasticity of marginal utility higher than one (approximated by their coefficient of relative risk aversion). The second explanation can also be ruled out, since we do not find a statistically significant increase in giving even when the rate of waste is constant at 100%.⁴⁶ But we cannot rule out the third and fourth explanations.⁴⁷ It is possible that the saliency of income loss and negative emotions due to waste create behavioral biases that cancel out the positive effect predicted by the model and Hypothesis 1. The same reasoning can be used to explain why Hypothesis 4 is not supported. In addition, these explanations imply that the negative effect of increasing the degree of waste might be even stronger than suggested by our model.

Our findings have important policy implications. In a controlled environment, we show that the tax rate does not have a significant effect on charitable donations. This suggests that charities should not scale down their fundraising efforts when there is an increase in the tax rate and the government should not rely on increasing the tax rate as an effective policy to increase charitable donations. In addition, since our results imply that the average effect of “waste” on donations is negative in large economies, we conjecture that policies increasing the efficiency with which tax revenue is used are likely to increase charitable donations. Moreover, donations are likely to increase if individuals perceive tax revenue to be spent on services they value rather than things they do not care for. Silverman et al. (2014) argue that individuals evade taxes less if they are given a satisfying explanation for being taxed. Similarly, our findings suggest that it might be worthwhile to make an effort to convince individuals that their taxes are being used efficiently and that there are large benefits of publicly provided public goods to the society as a whole. Finally, our results imply that empirical studies estimating price and income elasticities of giving would benefit from controlling for the confounding effect of perceptions about wasteful government spending, since perceptions regarding waste might exogenously or endogenously change over time.

⁴⁶ For each income distribution, we have run regressions (both Tobit and OLS) to study whether the impact of tax rate on donations is statistically significant when $w = 1$. None of the regressions show a statistically significant effect of tax rate on donations at a 5% significance level. When the data from different income distributions are pooled, then a significant impact can be seen when using an OLS regression (p-value = 0.04), but not when using a Tobit regression (p-value = 0.79).

⁴⁷ Our experiment was not designed to differentiate between these alternative explanations. Future research could address this research question.

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Table 1: Donation decisions in the experiment

Decision line	Tax rate, t	Waste, w
1	0%	N/A
2	25%	0%
3	50%	0%
4	75%	0%
5	25%	50%
6	50%	50%
7	75%	50%
8	25%	100%
9	50%	100%
10	75%	100%

Participants choose how much to donate given the tax rate and the waste rate. Note that, in the experiment, to prevent negative framing, the rate of waste was presented as the “redistribution rate” (*i.e.*, $1 - w$).

Table 2: Elicitation of risk preferences

Decision Line	Option A	Option B	Choose A or B
1	\$9.00 with 50% chance	\$1.00 with 50% chance	\$0.50 for sure
2	\$9.00 with 50% chance	\$1.00 with 50% chance	\$1.00 for sure
3	\$9.00 with 50% chance	\$1.00 with 50% chance	\$1.50 for sure
4	\$9.00 with 50% chance	\$1.00 with 50% chance	\$2.00 for sure
5	\$9.00 with 50% chance	\$1.00 with 50% chance	\$2.50 for sure
6	\$9.00 with 50% chance	\$1.00 with 50% chance	\$3.00 for sure
7	\$9.00 with 50% chance	\$1.00 with 50% chance	\$3.50 for sure
8	\$9.00 with 50% chance	\$1.00 with 50% chance	\$4.00 for sure
9	\$9.00 with 50% chance	\$1.00 with 50% chance	\$4.50 for sure
10	\$9.00 with 50% chance	\$1.00 with 50% chance	\$5.00 for sure
11	\$9.00 with 50% chance	\$1.00 with 50% chance	\$5.50 for sure
12	\$9.00 with 50% chance	\$1.00 with 50% chance	\$6.00 for sure
13	\$9.00 with 50% chance	\$1.00 with 50% chance	\$6.50 for sure
14	\$9.00 with 50% chance	\$1.00 with 50% chance	\$7.00 for sure
15	\$9.00 with 50% chance	\$1.00 with 50% chance	\$7.50 for sure

Table 3: Individual giving by treatment

Treatment		<i>Equal</i>		<i>Unequal</i>	
Tax rate, t	Waste, w	Average giving	Fraction of \$0	Average giving	Fraction of \$0
0%	N/A	\$3.69 (0.52)	0.50	\$3.83 (0.64)	0.50
25%	0%	\$3.97 (0.57)	0.46	\$4.75 (0.65)	0.39
50%	0%	\$4.06 (0.55)	0.44	\$4.90 (0.66)	0.39
75%	0%	\$4.18 (0.59)	0.46	\$4.57 (0.66)	0.39
25%	50%	\$3.02 (0.44)	0.47	\$3.58 (0.51)	0.43
50%	50%	\$2.53 (0.39)	0.50	\$3.67 (0.60)	0.46
75%	50%	\$2.85 (0.54)	0.52	\$3.48 (0.61)	0.50
25%	100%	\$2.06 (0.38)	0.61	\$2.83 (0.54)	0.56
50%	100%	\$2.04 (0.45)	0.67	\$2.85 (0.58)	0.58
75%	100%	\$2.58 (0.60)	0.70	\$4.25 (0.93)	0.61

Standard error of the mean is in parentheses.

Table 4: Tobit regression of giving

Treatment	For $t > 0\%$			For all t		
	<i>Equal</i>	<i>Unequal</i>	<i>Pooled</i>	<i>Equal</i>	<i>Unequal</i>	<i>Pooled</i>
Dependent variable, <i>giving</i>	(1)	(2)	(3)	(4)	(5)	(6)
t	-0.46	-0.07	-0.27	0.34	1.46	0.94
[tax rate]	(1.11)	(1.23)	(0.85)	(1.09)	(1.20)	(0.83)
w	-4.26***	-3.92***	-4.13***	-4.06***	-3.56***	-3.83***
[degree of waste]	(1.05)	(1.12)	(0.79)	(0.95)	(0.97)	(0.70)
<i>Income</i>		0.02	0.03		0.02	0.03
[income = \$15, \$30, \$45]		(0.08)	(0.08)		(0.08)	(0.08)
<i>Unequal</i>			1.66			1.52
[1 if the <i>Unequal</i> treatment]			(1.33)			(1.31)
<i>Constant</i>	1.47	0.95	-0.30	0.91	-0.31	-1.24
[constant term]	(1.22)	(2.49)	(2.79)	(1.11)	(2.46)	(2.77)
Observations	810	1026	1836	900	1140	2040
Clusters	90	114	204	90	114	204

Note: * indicates statistical significance at 0.05, ** at 0.01, and *** at 0.001 level. Standard errors in parentheses are clustered at the participant level.

Table 5: Giving and the curvature of the utility function

Treatment	<i>More than 7 safe choices</i>			<i>Less than 7 safe choices</i>		
	<i>Equal</i>	<i>Unequal</i>	<i>Pooled</i>	<i>Equal</i>	<i>Unequal</i>	<i>Pooled</i>
Dependent variable, <i>giving</i>	(1)	(2)	(3)	(4)	(5)	(6)
t	0	-1.33	-0.78	-0.29	4.00	1.85
[tax rate]	(1.43)	(1.16)	(0.90)	(1.90)	(2.76)	(1.77)
w	-4.25**	-5.39**	-4.92***	-2.46*	-1.56	-2.09
[degree of waste]	(1.42)	(1.99)	(1.33)	(1.16)	(1.91)	(1.15)
<i>Income</i>		-0.08	-0.07		-0.10	-0.07
[income = \$15, \$30, \$45]		(0.11)	(0.11)		(0.13)	(0.12)
<i>Unequal</i>			0.04			3.06
[1 if the <i>Unequal</i> treatment]			(1.98)			(2.16)
<i>Constant</i>	2	5.3	4.75	-0.20	0.92	-0.87
[constant term]	(1.84)	(2.78)	(3.83)	(2.03)	(4.46)	(4.41)
Observations	333	450	783	351	351	702
Clusters	37	50	87	39	39	78

Note: * indicates statistical significance at 0.05, ** at 0.01, and *** at 0.001 level. Standard errors in parentheses are clustered at the participant level.

Table 6: The determinants of giving

Dependent variable, <i>giving</i>	(1)	(2)	(3)	(4)
<i>t</i>	-0.27	-0.33	-0.25	-0.27
[tax rate]	(0.85)	(0.85)	(0.84)	(0.86)
<i>w</i>	-4.13***	-4.14***	-4.08***	-4.16***
[degree of waste]	(0.79)	(0.79)	(0.76)	(0.78)
<i>Income</i>	0.03	-0.02	-0.01	-0.02
[income = \$15, \$30, \$45]	(0.08)	(0.07)	(0.07)	(0.09)
<i>Unequal</i>	1.66	1.60	1.83	1.43
[1 if the <i>Unequal</i> treatment]	(1.33)	(1.27)	(1.17)	(1.16)
<i>Egalitarian</i>		2.76	1.81	1.83
[1 if (\$2.00; \$2.00)]		(1.82)	(1.68)	(1.70)
<i>Generous</i>		7.71**	7.92**	7.86**
[1 if (\$1.75; \$3.00)]		(2.78)	(2.41)	(2.45)
<i>Hardwork</i>			-0.53	-0.52
[how hard you worked in part 1]			(0.28)	(0.27)
<i>Female</i>			3.89**	3.89**
[1 if female]			(1.41)	(1.40)
<i>Family income</i>			0.13	0.22
[family income]			(0.32)	(0.32)
<i>Right-wing</i>			0.78	0.71
[right-wing political view]			(0.54)	(0.56)
<i>Unnecessary</i>			-3.63	-3.04
[1 if taxes are annoying and unnecessary]			(2.27)	(2.30)
<i>Necessary</i>			0.13	1.53
[1 if taxes are necessary and do not bother]			(2.60)	(2.68)
<i>Reputation</i>			0.01	-0.11
[importance of own reputation]			(0.39)	(0.40)
<i>Church</i>			0.72	0.61
[giving to church]			(0.39)	(0.39)
<i>Charity</i>			0.44	0.5
[giving to charities]			(0.50)	(0.51)
<i>Familiar</i>			0.30	0.28
[knowledge of charity]			(0.24)	(0.24)
<i>American</i>			-0.41	-0.34
[1 if a United States citizen]			(1.56)	(1.58)
<i>Part 1</i>				0.13
[part 1 score]				(0.35)
<i>Constant</i>	-0.30	-1.84	-7.43	-7.45
[constant term]	(2.79)	(3.06)	(5.46)	(5.40)
Observations	1836	1827	1827	1764
Clusters	204	203	203	196

Note: * indicates statistical significance at 0.05, ** at 0.01, and *** at 0.001 level. Standard errors in parentheses are clustered at the participant level.

Table 7: Giving – Robustness Check

Tax rate, t	<i>All 15 rounds</i>		<i>First three</i>		<i>Last three</i>	
	Average giving	Fraction of \$0	Average giving	Fraction of \$0	Average giving	Fraction of \$0
25%	\$3.18 (0.22)	0.63	\$4.12 (0.53)	0.70	\$2.50 (0.47)	0.56
50%	\$2.95 (0.19)	0.63	\$3.73 (0.47)	0.68	\$2.55 (0.44)	0.56
75%	\$2.93 (0.22)	0.56	\$3.62 (0.55)	0.61	\$2.50 (0.44)	0.49
N	450	450	90	90	90	90

Standard error of the mean is in parentheses.

Table 8: Wilcoxon Signed Rank Tests

	<i>All 15 rounds</i>	<i>First three</i>	<i>Last three</i>
25% vs 50%	0.24	0.30	0.82
50% vs 75%	0.92	0.09	0.87
25% vs 75%	0.80	0.23	0.87

Note: For each test, sample size is 30 (*i.e.*, there are 30 independent pairs).

Table 9: Regression Analysis

Dependent variable, <i>giving</i>	Tobit		OLS	
	(1)	(2)	(3)	(4)
t	-1.34	-1.29	-0.51	-0.52
[tax rate]	(1.05)	(1.04)	(0.71)	(0.73)
<i>Income</i>	0.05	0.05	0.04	0.04
[income = \$15, \$30, \$45]	(0.05)	(0.05)	(0.03)	(0.04)
<i>Round</i>	-0.16***	-0.17***	-0.10***	-0.10***
[round = 1,...,15]	(0.04)	(0.04)	(0.02)	(0.02)
<i>Constant</i>	1.59	0.72	2.72**	2.45
[constant term]	(1.42)	(4.37)	(0.84)	(2.47)
Controls Added	No	Yes	No	Yes
Observations	1350	1335	1350	1335
Clusters	30	30	30	30

Note: * indicates statistical significance at 0.05, ** at 0.01, and *** at 0.001 level. Standard errors in parentheses are clustered at the group level. Data for one subject is automatically dropped from the analysis when controls are included in regressions (2) and (4), since this subject did not fill in the questionnaire.

Figure 1: Average giving in response to changes in t

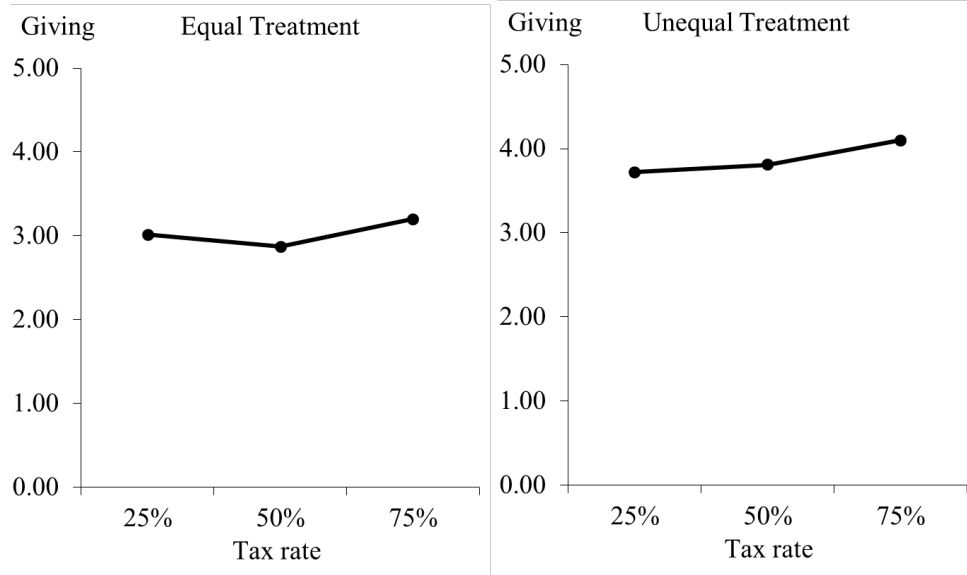


Figure 2: Average giving in response to changes in w

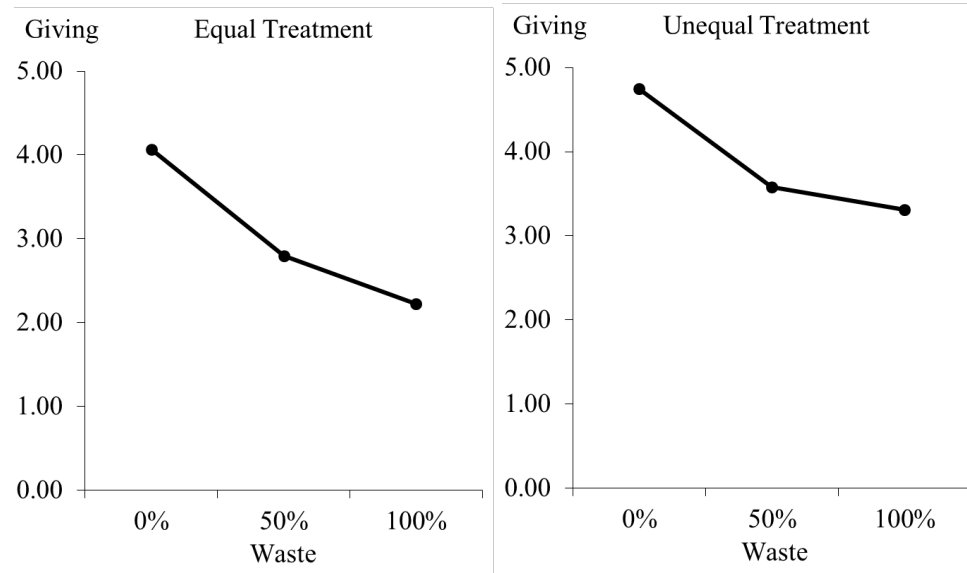
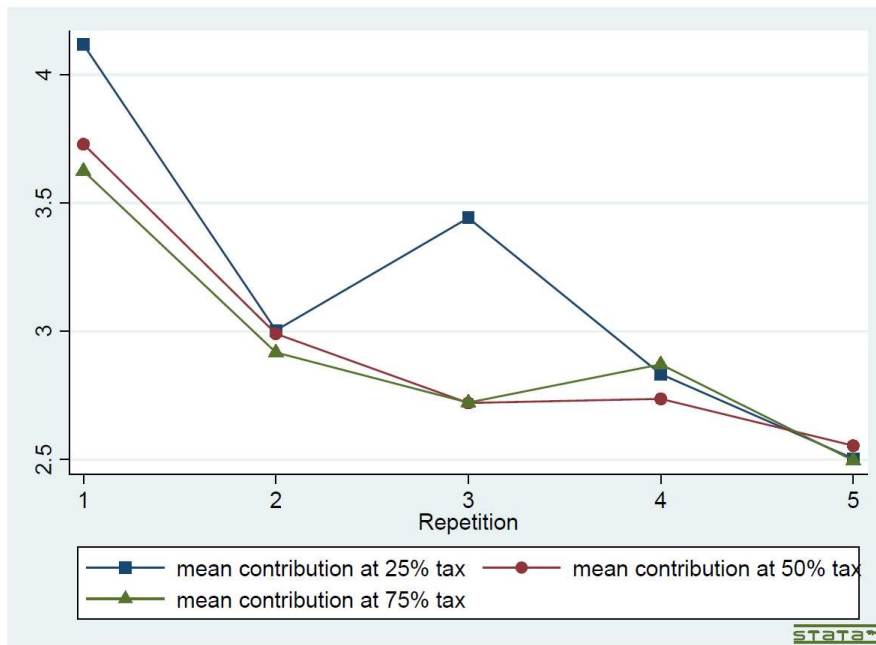


Figure 3: Average giving over repetitions



Appendix (For Online Publication)

Appendix A: Proofs for Section 3

We start by writing the maximization problem of an agent i :

$$\begin{aligned} & \max_{c_i, g_i} u(c_i) + v(G) \\ \text{s.t. } & c_i = (1-t)(y_i - g_i) + (1-w) \frac{t \sum_{j=1}^n (y_j - g_j)}{n} \text{ and } g_i \geq 0. \end{aligned}$$

Assuming an interior solution, the first order condition is

$$u' \left((1-t)(y_i - g_i) + (1-w) \frac{t \sum_{j=1}^n (y_j - g_j)}{n} \right) \left(1 - \left(1 - \frac{1-w}{n} \right) t \right) = v'(G).$$

Since this equation holds for all agents, in equilibrium, the following should hold:

$$y_i - g_i = y_k - g_k = \frac{Y-G}{n}.$$

Therefore, the FOC simplifies to:

$$u' \left((1-wt) \left(\frac{Y-G}{n} \right) \right) \left(1 - \left(1 - \frac{1-w}{n} \right) t \right) = v'(G).$$

Proof for Theorem 1: Totally differentiating the FOC with respect to the tax rate t , and then solving for $\frac{\partial G}{\partial t}$, we get

$$\frac{\partial G}{\partial t} = - \frac{u''(b)w \left(\frac{Y-G}{n} \right) (1-at) + u'(b)a}{v''(G) + u''(b) \left(\frac{1-wt}{n} \right) (1-at)},$$

where $a = 1 - \frac{1-w}{n}$ and $b = (1-wt) \left(\frac{Y-G}{n} \right)$. Since the denominator is always negative, the sign of the numerator determines the sign of the partial derivative of G with respect to t .

If $w = 0$, the numerator simplifies to $u'(b)a$ and it is easy to see that it is always positive and, therefore, we do not need any additional assumptions about the consumption utility.

Now assume $0 < w < 1$. Note that $a = 1 - \frac{1-w}{n} = \frac{n-1+w}{n} > w$. Hence,

$$\begin{aligned} & u''(b)w \left(\frac{Y-G}{n} \right) (1-at) + u'(b)a > \\ & > u''(b)w \left(\frac{Y-G}{n} \right) (1-at) + u'(b)w = \\ & = w \left(u''(b) \left(\frac{Y-G}{n} \right) (1-at) + u'(b) \right). \end{aligned}$$

Since $(1-at) < (1-wt)$, we can show that

$$u''(b)w \left(\frac{Y-G}{n} \right) (1-at) + u'(b)a > w(u''(b)b + u'(b)).$$

This implies that if $u''(b)b + u'(b)$ is nonnegative, $u''(b)w \left(\frac{Y-G}{n} \right) (1-at) + u'(b)a$ has to be positive. In other words, for the numerator to be positive, it is sufficient to have $-\frac{u''(x)x}{u'(x)} \leq 1$.

Finally, if $w = 1$, total public goods provision is still a strictly increasing function of the tax rate if $-\frac{u''(x)x}{u'(x)} < 1$. For the extreme case of $w = 1$ and $-\frac{u''(x)x}{u'(x)} = 1$, public goods provision does not change with the tax rate.

Proof for Theorem 2: Totally differentiating the FOC with respect to the rate of waste, and then solving for $\frac{\partial G}{\partial w}$, we get

$$\frac{\partial G}{\partial w} = -\frac{u''(b)t\left(\frac{Y-G}{n}\right)(1-at)+u'(b)\frac{t}{n}}{v''(G)+u''(b)\left(\frac{1-wt}{n}\right)(1-at)},$$

where $a = 1 - \frac{1-w}{n}$ and $b = (1 - wt)\left(\frac{Y-G}{n}\right)$.

We provide a proof by contradiction. Suppose $\frac{\partial G}{\partial w} > \frac{\partial G}{\partial t}$. We see that in order for $\frac{\partial G}{\partial w}$ to be larger than $\frac{\partial G}{\partial t}$, the following needs to hold:

$$u''(b)w\left(\frac{Y-G}{n}\right)(1-at) + u'(b)a < u''(b)t\left(\frac{Y-G}{n}\right)(1-at) + u'(b)\frac{t}{n}.$$

Rearranging,

$$u'(b)\left(a - \frac{t}{n}\right) < u''(b)\left(\frac{Y-G}{n}\right)(1-at)(t-w).$$

We can immediately see that if $t \geq w$, then the previous inequality cannot hold. Instead, let's assume $t < w$. Rearranging one more time, we get

$$\frac{a-\frac{t}{n}}{w-t} < -\frac{u''(b)\left(\frac{Y-G}{n}\right)(1-at)}{u'(b)}.$$

Note that $\frac{a-\frac{t}{n}}{w-t} = \frac{(n-1)+(w-t)}{n(w-t)} > 1$, for any $t > 0$. In addition, the following inequality holds:
 $-\frac{u''(b)\left(\frac{Y-G}{n}\right)(1-at)}{u'(b)} < -\frac{u''(b)b}{u'(b)}$. Together these imply $1 < -\frac{u''(b)b}{u'(b)}$, which contradicts our initial assumption. Therefore, if $-\frac{u''(b)b}{u'(b)} \leq 1$, then $\frac{\partial G}{\partial t} > \frac{\partial G}{\partial w}$.

Proof for Theorem 3: Recall that

$$\frac{\partial G}{\partial w} = -\frac{u''(b)t\left(\frac{Y-G}{n}\right)(1-at)+u'(b)\frac{t}{n}}{v''(G)+u''(b)\left(\frac{1-wt}{n}\right)(1-at)},$$

where $a = 1 - \frac{1-w}{n}$ and $b = (1 - wt)\left(\frac{Y-G}{n}\right)$. Since the denominator is always negative, the sign of the numerator determines the sign of the partial derivative of G with respect to w .

When $t = 0$, waste does not matter, so we consider $0 < t \leq 1$. Since $(1 - at) < (1 - wt)$ and $u''(b) < 0$, we get

$$\begin{aligned} & u''(b)t\left(\frac{Y-G}{n}\right)(1-at) + u'(b)\frac{t}{n} > \\ & > u''(b)t\left(\frac{Y-G}{n}\right)(1-wt) + u'(b)\frac{t}{n} = \\ & = t\left(u''(b)b + u'(b)\frac{1}{n}\right). \end{aligned}$$

This implies that if $u''(b)b + u'(b)\frac{1}{n}$ is nonnegative, then $u''(b)t\left(\frac{Y-G}{n}\right)(1-at) + u'(b)\frac{t}{n} > 0$. Therefore, the condition needed is $-\frac{u''(x)x}{u'(x)} \leq \frac{1}{n}$.

Proof for Theorem 4: Assume the agents' consumption preferences are defined by the CRRA utility function $u = \frac{x^{(1-\theta)}}{(1-\theta)}$ for $\theta \neq 1$ and $u = \ln(x)$ for $\theta = 1$. Then the elasticity of marginal utility is given by θ .

We are looking for when donations strictly decrease as the degree of waste increases. In other words, we study when $u''(b)t\left(\frac{Y-G}{n}\right)(1-at) + u'(b)\frac{t}{n} < 0$. Substituting $u = \frac{x^{(1-\theta)}}{(1-\theta)}$ in this previous equation, we get

$$-\theta b^{-\theta-1}t\left(\frac{Y-G}{n}\right)(1-at) + b^{-\theta}\frac{t}{n} < 0.$$

Rearranging, this equation simplifies to

$$\theta > \frac{(1-wt)}{(1-at)n}.$$

It is important to note that $\frac{(1-wt)}{(1-at)n} > \frac{1}{n}$ when $w < 1$, since $(1-at) < (1-wt)$. When $w = 1$, $\frac{(1-wt)}{(1-at)n} = \frac{1}{n}$.

Appendix B: Instructions to the Experiment

Instructions for the *Unequal Treatment*

Thank you for agreeing to participate in this experiment. Your participation is voluntary. In this experiment we want to see the choices that people make. You will be making choices on your own and in private. So it is very important that you remain silent and do not look at other people's choices. If you have any questions, please raise your hand.

The experiment will proceed in four parts. At the beginning of each part you will receive detailed instructions for that part. The earnings that you make will depend on your decisions in each part.

In Part 1, you will take a 20-minute cognitive test containing 10 questions. Upon completion of Part 1 you will earn a certain amount of money. This amount may be the same for everyone in this room or each participant's earnings may depend on their relative performance in the test.

In Part 2, you will be asked to make a series of choices in decision problems. Depending on your choices and chance, you may lose part of the money you earn in Part 1. Your decisions in Part 2 will not affect your earnings from Part 3 and Part 4.

In Part 3, you will be asked to make another series of choices in decision problems. How much money you receive in Part 3 will depend partly on chance and partly on the choices you make.

In Part 4, you will be asked to make one last choice in a decision problem. Again, your decisions from preceding Part 2 and Part 3 will not affect your earnings in Part 4.

In addition, upon completion of the experiment, you will receive a show-up reward of \$5. This is yours to keep regardless of the decisions you make in the experiment. After you complete the experiment, you will be asked to fill out a questionnaire while you wait to be paid.

Your computer has been assigned an ID number that you will be informed of. Your decisions and payoffs from the experiment will be recorded with that ID number. At no time your name will be linked to that ID number. At the end of the experiment, you will be paid in private. Your decisions and payoff will not be revealed to anyone during or after the experiment.

Please turn off your cell phones now to avoid any interruption during the experiment.

Part 1 – Cognitive Test

You will now take a 20-minute cognitive test containing 10 questions. You may use the margins of this booklet to work out your answer if needed. You may **ONLY** use pencil and paper provided. No other aids are permitted. All questions have the following format:

Who is the current President of the United States?

- A. Mitt Romney
- B. Bill Clinton
- C. Barack Obama
- D. George W. Bush
- E. David Cameron

To correctly answer this example question, you would select C. You will **gain** one point for each **correct** answer and zero for an **incorrect** answer. Try to get as many points as you can. Upon completion of Part 1 you will earn a certain amount of money. This amount may be the same for everyone in this room or each participant's earnings may depend on their relative performance in the test.

You will have 20 minutes to work on the test. You may not be able to finish all the questions in this time.

Part 2 – Donation to a Charity

In Part 2 of the experiment you will be **randomly and anonymously matched** into a group which consists of **3 participants**. Based on the performance on the cognitive test in Part 1, all participants in your group will be ranked, and the **highest ranked participant will earn \$45**, the **middle ranked participant will earn \$30**, and the **lowest ranked participant will earn \$15**. Then, each participant in your group (including you) will have an opportunity to donate **to the same charity**. However, **each group will be randomly assigned to a different charity**.

When Part 2 starts, the name of the charity that your group is assigned to will be given to you on the computer screen. You can donate any amount to this charity from **\$0** to the **amount earned** with increments of 5 cents. **The amount you donate will be deducted from the amount you earned**. We will write a check in the total amount that you as well as the other participants in your group chose to donate and send it to the charity (If you want to get a

confirmation about your donation, please include your e-mail address in the sign out sheet and we will have the charity automatically email you the total amount of donation by your group).

Here are several examples:

- The numbers in this example are only for demonstration purposes.
- Suppose you have earned \$30 upon completion of Part 1.
- If you donate \$0 and 0 cents to the charity then your remaining income is \$30.
- If you donate \$15 and 45 cents to the charity then your remaining income is \$14 and 55 cents.
- If you donate \$30 to the charity then your remaining income is \$0.

You and the other members of your group will make donations simultaneously. You will learn your group's total donation to the charity only at the very end of the experiment.

After all three participants in your group make their donations, we will apply a **tax rate of x%** (which can be either 0%, 25%, 50%, or 75%) on each participant's **remaining income** and collect the corresponding amount of money. Then we will **evenly redistribute y%** (which can be either 0%, 50%, or 100%) of the collected money among the participants of your group (including you).

Here is an example:

- The numbers in this example are only for demonstration purposes.
- Assume that the tax rate is 25% and the redistribution rate is 50%.
- Next, assume that based on the performance on the cognitive test in Part 1, participant 1 was ranked 3rd earning \$15, participant 2 was ranked 2nd earning \$30, and participant 3 was ranked 1st earning \$45 (see column 2 in the table below).
- Also, assume that participant 1 donated \$10 to the charity, participant 2 donated \$0, and participant 3 donated \$20 (see column 3 in the table below).
- Therefore, we will send a check for \$30 (\$10 + \$0 + \$20) to the charity.
- Then, on each participant's remaining pre-tax income (see column 4), we will apply a tax rate of 25% (see column 5), collecting \$1.25 from participant 1, \$7.5 from participant 2, and \$6.25 from participant 3 (\$1.25 + \$7.5 + \$6.25, for a total \$15). So, after tax participant 1 will have \$3.75 remaining (since participant 1 donated \$10 and there was a tax of 25% on the remaining \$5, leaving participant 1 with \$3.75). Similarly, participant 2's and 3's remaining after-tax income will be \$22.5 and \$18.75, respectively (see column 6).
- Then, 50% of the total amount of \$15, collected as taxes from all three participants, will be evenly redistributed among the three participants. Therefore, each participant will receive a redistribution amount of \$2.5 ($0.5 \times \15 divided by 3).
- So, the **final income** of each participant (see column 8) will be the sum of the **after-tax income** (see column 6) and the **redistribution amount** (see column 7). In this example only 50% of the collected taxes were redistributed back. **The amount that has not been redistributed goes back to the experimenter, and not to the charity.**

Table 1

(tax rate = 25% and redistribution rate = 50%)

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Participant	Initial income	Charity donation	Pre-tax income, (2) - (3)	Tax, (4)×25%	After-tax income, (4) - (5)	Redistribution amount, $0.5 \times \text{Total}(5)/3$	Final income, (6) + (7)
1	\$15	\$10	\$5	\$1.25	\$3.75	\$2.5	\$6.25
2	\$30	\$0	\$30	\$7.5	\$22.5	\$2.5	\$25
3	\$45	\$20	\$25	\$6.25	\$18.75	\$2.5	\$21.25
Total	\$90	\$30	\$60	\$15	\$45	\$7.5	\$52.5

We will ask you to make 10 decisions of how much you would like to donate to the assigned charity under different combinations of the **tax rate** and the **redistribution rate**. Specifically, on your computer screen you will see a table with 10 lines (also as shown below). In each line you will state how much you would like to donate to the charity. You should think of each line as a separate decision you need to make. However, **only one line will be the 'line that counts' and will be implemented.**

When tax rate is 0%, no tax will be collected. Therefore, your final income is simply equal to your pre-tax income (initial income – donations to charity). When tax rate is not 0%, your final income may be **lower** or **higher** than your pre-tax income depending on the tax rate, redistribution rate and the donation decisions of group members.

Table 2

Decision Line	Tax rate	Redistribution rate	How much would you like to donate to the charity?
1	0%	N/A	
2	25%	100%	
3	50%	100%	
4	75%	100%	
5	25%	50%	
6	50%	50%	
7	75%	50%	
8	25%	0%	
9	50%	0%	
10	75%	0%	

To facilitate your decisions, we will provide a "calculator". You may use the calculator to see your final income for any potential donation plans you have in mind before actually making the donation decision. To use the calculator, first enter the **tax rate**, **redistribution rate** and the **possible donation decisions** by you and the other participants in your group. The calculator will then fill in the numbers in Table 1 for you. You can use the calculator as many times as you like.

At the end of the experiment, the computer will randomly draw one line for payment. We will implement the choices of each participant made in that line and will send the contributed amount to the charity. Also, we will apply the appropriate tax rate and the redistribution rate to compute final income for each participant. You will learn which line was drawn, your earnings corresponding to that line and your group's total donation to the charity at the very end of the experiment.

Your decisions in Part 2 do not have any effect on your earnings in Part 3 or Part 4.

An Understanding Check: (All participants need to pass this before the decision making part of the experiment)

1. Suppose you contribute \$15 to your group's assigned charity, and the other group members contributed \$5 and \$10. How much money will the experimenter send to this charity on behalf of your group? Answer: \$30
2. Suppose you have earned \$30 upon completion of Part 1. Suppose you contribute \$10 to your group's assigned charity, what is your pre-tax income? Answer: \$20
3. Suppose you have earned \$30 upon completion of Part 1. Suppose you contribute \$10 to your group's assigned charity, and the tax rate is 50%, what is your after-tax income? Answer: \$10
4. Suppose the total amount of taxes collected from your group is \$30 and the redistribution rate is 50%, then how much money will you get back? Answer: \$5
5. If your after-tax income is \$10 and if you also receive \$5 back from the redistribution of tax revenue, what is your final income? Answer: \$15

Part 3 – 15 Decision Problems

In Part 3 of the experiment, you will be asked to make choices in 15 decision problems. How much money you receive will depend partly on chance and partly on the choices you make.

On your computer screen you will see a table with 15 lines (as shown below). In each line you will state whether you prefer **Option A** or **Option B**. Option A always offers a 50% chance to get \$9 and a 50% chance to get \$1, while Option B always offers a certain amount for sure (between \$0.50 and \$7.50, depending on the line). You should think of each line as a separate decision you need to make. **However, only one line will be the 'line that counts' and will be paid out.**

At the end of the experiment, for each participant, the computer will randomly draw one line for payment. Your earnings for the selected line depend on which option you chose: If you chose A in that line, then the computer will randomly choose either \$9 or \$1 with equal chances as your payment. If you chose B in that line, then you will receive for sure the exact amount that is specified by Option B in that line.

Your decisions in Part 3 do not have any effect on your earnings in Part 4. The actual earnings for this part will be determined at the end of Part 4.

Table 1

Decision Line	Option A		Option B	Choose A or B
1	\$9.00 with 50% chance	\$1.00 with 50% chance	\$0.50 for sure	
2	\$9.00 with 50% chance	\$1.00 with 50% chance	\$1.00 for sure	
3	\$9.00 with 50% chance	\$1.00 with 50% chance	\$1.50 for sure	
4	\$9.00 with 50% chance	\$1.00 with 50% chance	\$2.00 for sure	
5	\$9.00 with 50% chance	\$1.00 with 50% chance	\$2.50 for sure	
6	\$9.00 with 50% chance	\$1.00 with 50% chance	\$3.00 for sure	
7	\$9.00 with 50% chance	\$1.00 with 50% chance	\$3.50 for sure	
8	\$9.00 with 50% chance	\$1.00 with 50% chance	\$4.00 for sure	
9	\$9.00 with 50% chance	\$1.00 with 50% chance	\$4.50 for sure	
10	\$9.00 with 50% chance	\$1.00 with 50% chance	\$5.00 for sure	
11	\$9.00 with 50% chance	\$1.00 with 50% chance	\$5.50 for sure	
12	\$9.00 with 50% chance	\$1.00 with 50% chance	\$6.00 for sure	
13	\$9.00 with 50% chance	\$1.00 with 50% chance	\$6.50 for sure	
14	\$9.00 with 50% chance	\$1.00 with 50% chance	\$7.00 for sure	
15	\$9.00 with 50% chance	\$1.00 with 50% chance	\$7.50 for sure	

Part 4 – One Decision Problem

In Part 4 of the experiment, you will be randomly matched with another participant in this room. Nobody will ever learn whom they were matched with. You will be asked to choose between the following four options:

- Option 1: You will receive \$2.00 and your paired participant will receive \$2.00.
- Option 2: You will receive \$1.75 and your paired participant will receive \$3.00.
- Option 3: You will receive \$2.25 and your paired participant will receive \$1.00.
- Option 4: You will receive \$2.00 and your paired participant will receive \$1.75.

Similarly your paired participant will decide between these four options.

After you and the other participant make your decisions, the computer will also randomly determine whose decision to implement. If the computer chooses your decision to implement, then the earnings to you and the other participant will be determined according to your choice. If the computer chooses the other participant decision to implement, then the earnings will determined according to the other participant choice.

The actual earnings for this part will be determined after everyone makes their decisions.

Part 5 – Questionnaire

1. How hard did you work in the first part of the experiment in a scale from 1 to 10 where 1 indicates little work and 10 indicates extremely hard work.
2. What is your gender?
 - a) male
 - b) female
3. What is your age in years?
4. What is your major?
5. Family income:
 - a) less than 50,000
 - b) between 50,000 and 75,000
 - c) between 75,000 and 100,000
 - d) between 100,000 and 150,000
 - e) between 150,000 and 200,000
 - f) more than 200,000

6. What proportion of your own income comes from your own work?
- less than 20%
 - between 20% and 50%
 - between 50% and 70%
 - more than 70%
7. What is the importance of religion in your life?
- extremely important
 - very important
 - important
 - somewhat important
 - not very important
 - not important at all
8. In political matters, people talk of "the left" and "the right." How would you place your views on this scale, generally speaking?
- extreme left
 - left
 - left-center
 - center
 - right-center
 - right
 - extreme right
9. How would you place your views on this: "Hard work doesn't bring success - it's more a matter of luck and connections"
- I completely agree
 - I agree most of the times
 - I agree
 - I am indifferent
 - I disagree
 - I disagree most of the times
 - I completely disagree
10. Which of the following statements do you agree with the most?
- Income taxes are annoying and mostly unnecessary
 - Income taxes are annoying but necessary
 - Income taxes are necessary and do not bother me
11. How would you place your views on this: "It is very annoying if the tax revenues are used for things I do not care for."
- I completely agree
 - I agree most of the times
 - I agree
 - I am indifferent
 - I disagree
 - I disagree most of the times
 - I completely disagree
12. How would you place your views on this: "It is the government's job to ensure that everyone is provided for."
- I completely agree
 - I agree most of the times
 - I agree
 - I am indifferent
 - I disagree
 - I disagree most of the times

g) I completely disagree

13. If the government had a choice between reducing taxes or spending more on social programs like health care, social security, and unemployment benefits, which do you think it should do?

- a) Reduce taxes
- b) Spend more on social programs

14. How would you place your views on this: "I often consider what others will think of me before I make a decision in my life."

- a) I completely agree
- b) I agree most of the times
- c) I agree
- d) I am indifferent
- e) I disagree
- f) I disagree most of the times
- g) I completely disagree

15. Do you agree with the following statement: "I regularly give to religious organizations."

- a) I completely agree
- b) I agree most of the times
- c) I agree
- d) I am indifferent
- e) I disagree
- f) I disagree most of the times
- g) I completely disagree

16. Do you agree with the following statement: "I regularly give to charities (excluding religious organizations)."

- a) I completely agree
- b) I agree most of the times
- c) I agree
- d) I am indifferent
- e) I disagree
- f) I disagree most of the times
- g) I completely disagree

17. How well do you know the charity assigned for your group in Part 2? Please rate it in a 1 to 10 scale where 1 indicates little information and 10 indicates a perfect knowledge about this organization.

18. Are you a United States citizen?

- a) Yes
- b) No

Instructions for the *Robustness Treatment*

(Only the first two parts have some differences and therefore only these are given below.)

Part 1 – Cognitive Test

You will now take a 20-minute cognitive test containing 10 questions. You may use the margins of the booklet to work out your answer if needed. You may **ONLY** use pencil and paper provided. No other aids are permitted.

All questions have the following format:

Who was the President of the United States during 2009-2017?

- A. Mitt Romney

- B. Bill Clinton
- C. Barack Obama
- D. George W. Bush
- E. David Cameron

To correctly answer this example question, you would select C. You will **gain** one point for each **correct** answer and zero for an **incorrect** answer. Try to get as many points as you can. Upon completion of Part 1 you will earn a certain amount of money. This amount may be the same for everyone in this room or each participant's earnings may depend on their relative performance in the test.

You will have 20 minutes to work on the test. You may not be able to finish all the questions in this time.

PLEASE WAIT FOR THE FACILITATOR TO TELL YOU WHEN TO BEGIN

Part 2 – Donation to a Charity

In Part 2 of the experiment you will be **randomly and anonymously matched** into a group which consists of **3 participants**. Each group will consist of one participant with **high relative performance** on the cognitive test in Part 1, who will **receive \$45**, one participant with **middle relative performance**, who will **receive \$30**, and one participant with **low relative performance**, who will **receive \$15**. Note that if there are any ties during this process, they will be randomly broken by the computer. At the beginning of Part 2 you will learn how much you earned based on your performance in Part 1. Then, each participant in your group (including you) will have an opportunity to donate **to the same charity**. However, **each group will be randomly assigned to a different charity**.

When Part 2 starts, the name of the charity that your group is assigned to will be given to you on the computer screen. You can donate any amount to this charity from **\$0** to the **amount earned** in increments of 5 cents (\$0.05). **The amount you donate will be deducted from the amount you earned in Part 1**. We will write a check in the total amount that you (as well as the other participants in your group) chose to donate and send it to the charity. If you want to get a confirmation about your donation, please include your e-mail address and subject ID number in the sign out sheet and we will have the charity automatically email you the total amount of donation by your group.

Here are several examples:

- The donation amounts in this example are only for demonstration purposes.
- Suppose you have earned \$30 upon completion of Part 1.
- If you donate \$0 and 0 cents to the charity then your remaining income is \$30.
- If you donate \$15 and 45 cents to the charity then your remaining income is \$14 and 55 cents.
- If you donate \$30 to the charity then your remaining income is \$0.

You and the other members of your group will make donations simultaneously.

After all three participants in your group make their donations, we will apply a **tax rate of x%** (which can be either 25%, 50%, or 75%) to each participant's **remaining income**, and collect the corresponding amount of money. Then we will **evenly redistribute 50%** of the collected money among the participants of your group (including you).

Here is an example:

- The numbers in this example are only for demonstration purposes.
- Assume that the tax rate is 25% and recall that the redistribution rate is 50%.
- Next, assume that based on the performance on the cognitive test in Part 1, participant 1 earned \$15, participant 2 earned \$30, and participant 3 earned \$45 (see column 2 in the table below).
- Also, assume that participant 1 donated \$10 to the charity, participant 2 donated \$0, and participant 3 donated \$20 (see column 3 in the table below).
- Therefore, we will send a check for \$30 (\$10 + \$0 + \$20) to your group's assigned charity.

- Then, to each participant’s remaining pre-tax income (see column 4), we will apply a tax rate of 25% (see column 5), collecting \$1.25 from participant 1, \$7.50 from participant 2, and \$6.25 from participant 3 (\$1.25 + \$7.5 + \$6.25, for a total \$15). So, after taxes, participant 1 will have \$3.75 remaining (since participant 1 donated \$10 and there was a tax of 25% on the remaining \$5, leaving participant 1 with \$3.75). Similarly, participant 2’s and 3’s remaining after-tax income will be \$22.5 and \$18.75, respectively (see column 6).
- Then, 50% of the total amount of \$15, collected as taxes from all three participants, will be evenly redistributed among the three participants. Therefore, each participant will receive a redistribution amount of \$2.5 ($0.5 \times \15 divided by 3).
- So, the **final income** of each participant (see column 8) will be the sum of the **after-tax income** (see column 6) and the **redistribution amount** (see column 7). Note that only 50% of the collected taxes were redistributed back. **The amount that has not been redistributed goes back to the experimenter, and not to the charity.**

Table 1
(tax rate = 25% and redistribution rate = 50%)

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Participant	Initial income	Charity donation	Pre-tax income, (2) - (3)	Tax, (4)×25%	After-tax income, (4) - (5)	Redistribution amount, $0.5 \times \text{Total}(5)/3$	Final income, (6) + (7)
1	\$15	\$10	\$5	\$1.25	\$3.75	\$2.5	\$6.25
2	\$30	\$0	\$30	\$7.5	\$22.5	\$2.5	\$25
3	\$45	\$20	\$25	\$6.25	\$18.75	\$2.5	\$21.25
Total	\$90	\$30	\$60	\$15	\$45	\$7.5	\$52.5

There are 15 rounds in Part 2. In each round, we will ask you to make a decision regarding how much you would like to donate to the assigned charity under a given **tax rate**. You should think of each round as a separate decision you need to make. **Only one round, however, will be the ‘round that counts,’ and will be implemented.**

Note that your final income may be **lower** or **higher** than your pre-tax income depending on the tax rate and the donation decisions of group members.

To facilitate your decisions, we will provide a “**calculator**”. You may use the calculator to see your final income for any potential donation plans you have in mind before actually making the donation decision. To use the calculator, first enter the **tax rate given in that round** and the **possible donation decisions** by you and the other participants in your group. The calculator will then fill in the numbers in Table 1 for you. You can use the calculator as many times as you like.

At the end of each round, you will learn your group’s total donation to the charity. In addition, you will be provided with information on your pre-tax income, tax payment, after-tax income, redistribution amount and your final income for that round. The computer will apply the appropriate tax rate and the redistribution rate to compute the final income for each participant in your group, including you.

At the end of the experiment, the computer will randomly select one round for payment. We will implement the choices of each participant made in that round and will send the contributed amount to the charity. Also, each participant will receive earnings corresponding to that round.

Your decisions in Part 2 do not have any effect on your earnings in Part 3 or Part 4.

PLEASE WAIT FOR THE FACILITATOR TO TELL YOU WHEN TO BEGIN

Appendix C: Supplement to Theoretical Predictions

Here, we provide theoretical predictions for our experiment under the following utility functional form: $\frac{c_i^{1-\theta}}{1-\theta} + a \frac{G^{1-\theta}}{1-\theta}$. The predictions rely on the assumption that everyone is a contributor. If this assumption does not hold, quantitative results change, but the qualitative results on the effect of the tax rate and the degree of waste do not change. Table C1 shows the predictions when the public goods utility is weighted at $a = 1/2$, while Table C2 shows the predictions when $a = 1/4$.

Table C1: Theoretical predictions under specific utility functions with $a = 1/2$

Tax rate, t	Waste, w	$\theta = 1$ (Cobb-Douglas)	$\theta = 3/4$	$\theta = 1/2$	$\theta = 1/4$
0%	-	4.29	3.50	2.31	0.61
25%	0%	5.00	4.33	3.21	1.24
50%	0%	6.00	5.55	4.74	2.86
75%	0%	7.50	7.50	7.50	7.50
25%	50%	4.67	4.09	3.13	1.33
50%	50%	5.29	5.07	4.66	3.57
75%	50%	6.52	7.02	8.11	11.91
25%	100%	4.29	3.81	3.00	1.41
50%	100%	4.29	4.29	4.29	4.29
75%	100%	4.29	5.21	7.50	17.14
Maximum possible donation level for a given preference structure for $0 \leq t \leq 1$ and $0 \leq w \leq 1$		10.00	30.00	30.00	30.00

Table C2: Theoretical predictions under specific utility functions with $a = 1/4$

Tax rate, t	Waste, w	$\theta = 1$ (Cobb-Douglas)	$\theta = 3/4$	$\theta = 1/2$	$\theta = 1/4$
0%	-	2.31	1.50	0.61	0.04
25%	0%	2.73	1.88	0.87	0.08
50%	0%	3.33	2.48	1.34	0.20
75%	0%	4.29	3.50	2.31	0.61
25%	50%	2.53	1.77	0.85	0.09
50%	50%	2.90	2.24	1.32	0.25
75%	50%	3.66	3.25	2.54	1.19
25%	100%	2.31	1.64	0.81	0.09
50%	100%	2.31	1.86	1.20	0.31
75%	100%	2.31	2.31	2.31	2.31
Maximum possible donation level for a given preference structure for $0 \leq t \leq 1$ and $0 \leq w \leq 1$		6.00	30.00	30.00	30.00

Appendix D: Supplementary Analysis and Discussions

Table D1 provides robustness checks related to the discussion in Section 5 and Table 4. For convenience, regression (1) in Table D1 replicates the estimation results of regression (3) in Table 4. Regression (2) adds an additional interaction term $t \times w$. Regression (3) further adds interaction terms $w \times Unequal$, $t \times Unequal$ and $t \times w \times Unequal$. Note that upon adding these controls, the qualitative results originally reported in regression (1) do not change. Giving significantly decreases in the degree of waste w , but it does not change in the tax rate t .

Table D1: Tobit regression of giving

Treatment	<i>Pooled</i>	<i>Pooled</i>	<i>Pooled</i>
Dependent variable, <i>giving</i>	(1)	(1)	(2)
t	-0.27	-0.76	0.06
[tax rate]	(0.85)	(0.79)	(1.37)
w	-4.13***	-4.64***	-3.95**
[degree of waste]	(0.79)	(0.94)	(1.33)
<i>Income</i>	0.03	0.03	0.03
[income = \$15, \$30, \$45]	(0.08)	(0.08)	(0.08)
<i>Unequal</i>	1.66	1.66	1.88
[1 if the <i>Unequal</i> treatment]	(1.33)	(1.33)	(1.56)
$t \times w$		1.03	-1.57
[interaction term]		(1.84)	(2.88)
$t \times Unequal$			-1.43
[interaction term]			(1.66)
$w \times Unequal$			-1.19
[interaction term]			(1.77)
$t \times w \times Unequal$			4.51
[interaction term]			(3.78)
<i>Constant</i>	-0.30	-0.05	-0.17
[constant term]	(2.79)	(2.76)	(2.76)
Observations	1836	1836	1836
Clusters	204	204	204

Note: * indicates statistical significance at 0.05, ** at 0.01, and *** at 0.001 level.

Standard errors in parentheses are clustered at the participant level.

Table D2 provides further robustness checks related to the discussion in Section 5 and Table 4. Here, we focus separately on each income group (*i.e.*, participants who received \$15, \$30, or \$45) in the *Unequal* treatment. Consistent with our previous results, regressions (2) and (3) show that giving of middle income individuals (who received \$30) and high income individuals (who received \$45) significantly decreases in the degree of waste w , but it does not change in the tax rate t . Regression (1) also shows that giving of low income individuals (who received \$15) decreases (although not significantly) when w increases.

Table D2: Tobit regression of giving

Treatment	<i>Unequal</i>	<i>Unequal</i>	<i>Unequal</i>
<i>Income</i>	\$15	\$30	\$45
Dependent variable, <i>giving</i>	(1)	(1)	(2)
<i>t</i>	0.11	-2.07	-3.94
[tax rate]	(1.01)	(1.27)	(3.21)
<i>w</i>	-0.77	-7.22***	-10.56*
[degree of waste]	(0.81)	(1.99)	(4.30)
<i>t</i> × <i>w</i>	-3.17	5.26	11.07
[interaction term]	(1.83)	(3.16)	(7.53)
<i>Constant</i>	2.29*	4.52***	-1.68
[constant term]	(1.06)	(1.33)	(3.72)
Observations	342	342	342
Clusters	38	38	38

Note: * indicates statistical significance at 0.05, ** at 0.01, and *** at 0.001 level. Standard errors in parentheses are clustered at the participant level.

Table D3 examines if there is any non-monotonic relationship between giving and income in the *Unequal* treatment (also see Tables D5-D6). Recall that in Table 4 and Table D1 the *Income* coefficient is not significant. It is possible, however, that there is a non-monotonic relationship between giving and income. To examine this, we provide pairwise comparisons of different income individuals. For example, regression (1) uses the data from individuals with low income (who received \$15) and middle income (who received \$30). As we can see, the *Income* coefficient is not significant. The same is true for regressions (2) and (3).

Table D3: Tobit regression of giving

Treatment	<i>Unequal</i>	<i>Unequal</i>	<i>Unequal</i>
<i>Income</i>	\$15 and \$30	\$15 and \$45	\$30 and \$45
Dependent variable, <i>giving</i>	(1)	(1)	(2)
<i>t</i>	-0.71	-0.80	-3.05*
[tax rate]	(0.81)	(1.41)	(1.46)
<i>w</i>	-3.51***	-3.91*	-9.08***
[degree of waste]	(1.00)	(1.70)	(2.20)
<i>Income</i>	0.10	0.01	-0.10
[income = \$15, or \$30, or \$45]	(0.10)	(0.08)	(0.19)
<i>t</i> × <i>w</i>	0.27	1.00	8.22*
[interaction term]	(1.79)	(3.47)	(3.77)
<i>Constant</i>	0.91	0.42	6.17
[constant term]	(2.33)	(2.70)	(7.05)
Observations	684	684	684
Clusters	76	76	76

Note: * indicates statistical significance at 0.05, ** at 0.01, and *** at 0.001 level. Standard errors in parentheses are clustered at the participant level.

Table D4 provides robustness checks for our regressions presented in Table 4. We repeat the same analysis as in Table 4 by running OLS regressions (instead of Tobit regressions). Tables D5 and D6 repeat same regressions as in Table 4 and Table D4, respectively, but instead of using a continuous income variable, they use dummies for high and low income.

Table D4: OLS regressions of giving

Treatment	For $t > 0\%$			For all t		
	<i>Equal</i>	<i>Unequal</i>	<i>Pooled</i>	<i>Equal</i>	<i>Unequal</i>	<i>Pooled</i>
Dependent variable, <i>giving</i>	(1)	(2)	(3)	(4)	(5)	(6)
t	0.38	0.76	0.59	0.43	1.02	0.76
[tax rate]	(0.58)	(0.75)	(0.49)	(0.59)	(0.70)	(0.47)
w	-1.84**	-1.43*	-1.61***	-1.83***	-1.37*	-1.57***
[degree of waste]	(0.55)	(0.63)	(0.42)	(0.49)	(0.53)	(0.37)
<i>Income</i>		0.08	0.08		0.08	0.08
[income = \$15, \$30, \$45]		(0.05)	(0.05)		(0.05)	(0.05)
<i>Unequal</i>			0.84			0.77
[1 if the <i>Unequal</i> treatment]			(0.65)			(0.65)
<i>Constant</i>	3.76***	1.9	1.23	3.73***	1.67	1.1
[constant term]	(0.60)	(1.26)	(1.51)	(0.53)	(1.16)	(1.46)
Observations	810	1026	1836	900	1140	2040
Clusters	90	114	204	90	114	204

Note: * indicates statistical significance at 0.05, ** at 0.01, and *** at 0.001 level. Standard errors in parentheses are clustered at the participant level.

Table D5: Tobit regression of giving

Treatment	For $t > 0\%$			For all t		
	<i>Equal</i>	<i>Unequal</i>	<i>Pooled</i>	<i>Equal</i>	<i>Unequal</i>	<i>Pooled</i>
Dependent variable, <i>giving</i>	(1)	(2)	(3)	(4)	(5)	(6)
t	-0.46	-0.07	-0.27	0.34	1.47	0.95
[tax rate]	(1.11)	(1.23)	(0.85)	(1.09)	(1.20)	(0.83)
w	-4.26***	-3.91***	-4.12***	-4.06***	-3.54***	-3.83***
[degree of waste]	(1.05)	(1.13)	(0.79)	(0.95)	(0.97)	(0.70)
<i>High</i>		-0.91	-0.7		-1.04	-0.82
[1 if income = \$45]		(2.61)	(2.53)		(2.55)	(2.49)
<i>Low</i>		-1.41	-1.43		-1.73	-1.73
[1 if income = \$15]		(1.88)	(1.78)		(1.85)	(1.76)
<i>Unequal</i>			2.37			2.35
[1 if the <i>Unequal</i> treatment]			(1.66)			(1.63)
<i>Constant</i>	1.47	2.24	0.46	0.91	1.32	-0.3
[constant term]	(1.22)	(1.67)	(1.20)	(1.11)	(1.56)	(1.14)
Observations	810	1026	1836	900	1140	2040
Clusters	90	114	204	90	114	204

Note: * indicates statistical significance at 0.05, ** at 0.01, and *** at 0.001 level. Standard errors in parentheses are clustered at the participant level.

Table D6: OLS regression of giving

Treatment	For $t > 0\%$			For all t		
	<i>Equal</i>	<i>Unequal</i>	<i>Pooled</i>	<i>Equal</i>	<i>Unequal</i>	<i>Pooled</i>
Dependent variable, <i>giving</i>	(1)	(2)	(3)	(4)	(5)	(6)
t	0.38	0.76	0.59	0.43	1.02	0.76
[tax rate]	(0.58)	(0.75)	(0.49)	(0.59)	(0.70)	(0.47)
w	-1.84**	-1.43*	-1.61***	-1.83***	-1.37*	-1.57***
[degree of waste]	(0.55)	(0.63)	(0.42)	(0.49)	(0.53)	(0.37)
<i>High</i>		0.84	0.84		0.78	0.78
[1 if income = \$45]		(1.52)	(1.51)		(1.50)	(1.50)
<i>Low</i>		-1.48	-1.48		-1.58	-1.58
[1 if income = \$15]		(0.90)	(0.89)		(0.89)	(0.89)
<i>Unequal</i>			1.06			1.04
[1 if the <i>Unequal</i> treatment]			(0.86)			(0.85)
<i>Constant</i>	3.76***	4.43***	3.54***	3.73***	4.29***	3.46***
[constant term]	(0.60)	(0.91)	(0.54)	(0.53)	(0.81)	(0.47)
Observations	810	1026	1836	900	1140	2040
Clusters	90	114	204	90	114	204

Note: * indicates statistical significance at 0.05, ** at 0.01, and *** at 0.001 level. Standard errors in parentheses are clustered at the participant level.

Table D7 provides robustness checks for our regressions presented in Table 5. We repeat the same analysis as in Table 5 by running OLS regressions (instead of Tobit regressions).

Table D7: Giving and the curvature of the utility function (OLS)

Treatment	<i>More than 7 safe choices</i>			<i>Less than 7 safe choices</i>		
	<i>Equal</i>	<i>Unequal</i>	<i>Pooled</i>	<i>Equal</i>	<i>Unequal</i>	<i>Pooled</i>
Dependent variable, <i>giving</i>	(1)	(2)	(3)	(4)	(5)	(6)
t	0.55	-0.48	-0.04	0.14	3.47	1.81
[tax rate]	(0.84)	(0.71)	(0.54)	(0.84)	(1.76)	(0.99)
w	-1.87*	-2.82**	-2.42***	-1	0.04	-0.48
[degree of waste]	(0.77)	(0.99)	(0.66)	(0.57)	(1.11)	(0.62)
<i>Income</i>		0.03	0.03		0.05	0.05
[income = \$15, \$30, \$45]		(0.08)	(0.08)		(0.06)	(0.06)
<i>Unequal</i>			-0.07			1.38
[1 if the <i>Unequal</i> treatment]			(1.05)			(0.94)
<i>Constant</i>	4.19***	4.26*	3.92	2.82**	0.53	0.24
[constant term]	(1.00)	(1.63)	(2.25)	(0.84)	(2.32)	(2.20)
Observations	333	450	783	351	351	702
Clusters	37	50	87	39	39	78

Note: * indicates statistical significance at 0.05, ** at 0.01, and *** at 0.001 level. Standard errors in parentheses are clustered at the participant level.

Table D8 provides robustness checks for our regressions presented in Table 6. We repeat the same analysis as in Table 6 by running OLS regressions (instead of Tobit regressions).

Table D8: The determinants of giving (OLS)

Dependent variable, <i>giving</i>	(1)	(2)	(3)	(4)
<i>t</i>	0.59	0.53	0.53	0.53
[tax rate]	(0.49)	(0.49)	(0.49)	(0.49)
<i>w</i>	-1.61***	-1.67***	-1.67***	-1.67***
[degree of waste]	(0.42)	(0.42)	(0.42)	(0.42)
<i>Income</i>	0.08	0.05	0.06	0.05
[income = \$15, \$30, \$45]	(0.05)	(0.04)	(0.04)	(0.04)
<i>Unequal</i>	0.84	0.84	0.91	0.91
[1 if the <i>Unequal</i> treatment]	(0.65)	(0.63)	(0.59)	(0.59)
<i>Egalitarian</i>		0.83	0.33	0.31
[1 if (\$2.00; \$2.00)]		(0.70)	(0.71)	(0.71)
<i>Generous</i>		4.40**	4.35***	4.32**
[1 if (\$1.75; \$3.00)]		(1.56)	(1.30)	(1.30)
<i>Hardwork</i>			-0.33*	-0.33*
[how hard you worked in part 1]			(0.15)	(0.15)
<i>Female</i>			2.08**	2.09**
[1 if female]			(0.73)	(0.73)
<i>Family income</i>			0.06	0.06
[family income]			(0.16)	(0.16)
<i>Right-wing</i>			0.46	0.45
[right-wing political view]			(0.31)	(0.32)
<i>Unnecessary</i>			-0.71	-0.67
[1 if taxes are annoying and unnecessary]			(1.02)	(1.03)
<i>Necessary</i>			1.06	1.11
[1 if taxes are necessary and do not bother]			(1.56)	(1.59)
<i>Reputation</i>			-0.04	-0.03
[importance of own reputation]			(0.22)	(0.22)
<i>Church</i>			0.25	0.26
[giving to church]			(0.24)	(0.24)
<i>Charity</i>			0.33	0.33
[giving to charities]			(0.29)	(0.30)
<i>Familiar</i>			0.23	0.23
[knowledge of charity]			(0.13)	(0.13)
<i>American</i>			0.06	0.12
[1 if a United States citizen]			(0.85)	(0.88)
<i>Part 1</i>				0.06
[part 1 score]				(0.14)
<i>Constant</i>	1.23	0.91	-2.37	-2.51
[constant term]	(1.51)	(1.43)	(3.05)	(3.09)
Observations	1836	1827	1827	1764
Clusters	204	203	203	196

Note: * indicates statistical significance at 0.05, ** at 0.01, and *** at 0.001 level. Standard errors in parentheses are clustered at the participant level.

Next, we study heterogeneity in individual giving behavior. Although we find that, on average, giving decreases in the degree of waste and it does not change in the tax rate, there is substantial heterogeneity when examining individual behavior. Table D9 shows how different participants change their giving in response to changes in t and w . We categorize each individual by two dimensions: (i) how they respond to changes in t and (ii) how they respond to changes in w . In Table D9, we combine the data from the *Equal* and *Unequal* treatments.

Table D9: Individual giving in response to changes in t and w

Giving response to changes in the tax rate t	Giving response to changes in the degree of waste w					Total
	Zero giving	Constant	Decreasing	Increasing	Other	
Zero giving	56	0	0	0	0	56
Constant	0	18	13	2	0	33
Decreasing	0	1	38	2	8	49
Increasing	0	0	11	13	6	30
Other	0	0	13	0	23	36
Total	56	19	75	17	37	204

Each number in the table indicates the number of participants that fall into one of the categories. For example, there are 38 participants whose giving decreases in t and in w .

Table D9 shows that there are three main types of individuals that account for more than half of all observations (112/204). First, there are 56 participants who always give \$0, independent of t and w . Second, there are 38 participants who weakly decrease their giving in response to an increase in t and w . Third, there are 18 participants who always give the same amount independent of t and w . Summing over each category, we see that the most common types of individuals are those who decrease their giving when w increases (75 participants), those who always give \$0 (56 participants), and those who decrease their giving when t increases (49 participants).

We also make an interesting observation. Not including the participants with inconsistent choices, we see that out of 41 participants who consistently decrease their giving when the tax rate increases, 38 of them also decrease their giving when the degree of waste increases. In contrast, among 24 participants who increase their giving when the tax rate increases, only 13 participants consistently increase their giving when the degree of waste increases, while 11 of these consistently decrease their giving when the degree of waste increases. This observation is consistent with our Hypothesis 2.

Table D10 and Table D11 provide robustness checks related to the previous discussion in Table D9. As in Table D9, we categorize each individual by two dimensions: (1) how they respond to changes in t and (2) how they respond to changes in w . Unlike in Table D9, we split the data by the *Equal* and *Unequal* treatments. Table D10 and Table D11 show that in both treatments there are three main types of individuals that account for more than half of all observations: (1) participants who always give \$0, disregarding t and w , (2) participants who weakly decrease their

giving in response to increases of t and w , and (3) participants who do not change their giving in response to changes in t and w .

Table D10: Individual giving response in the *Equal* treatment

Giving response to changes in the tax rate t	Giving response to changes in the degree of waste w					Total
	Zero giving	Constant	Decreasing	Increasing	Other	
Zero giving	26	0	0	0	0	26
Constant	0	7	4	1	0	12
Decreasing	0	0	17	1	3	21
Increasing	0	0	4	6	4	14
Other	0	0	7	0	10	17
Total	26	7	32	8	17	90

Each number in the table indicates the number of participants that fall into one of the categories. For example, there are 17 participants whose giving decreases in t and in w .

Table D11: Individual giving response in the *Unequal* treatment

Giving response to changes in the tax rate t	Giving response to changes in the degree of waste w					Total
	Zero giving	Constant	Decreasing	Increasing	Other	
Zero giving	30	0	0	0	0	30
Constant	0	11	9	1	0	21
Decreasing	0	1	21	1	5	28
Increasing	0	0	7	7	2	16
Other	0	0	6	0	13	19
Total	30	12	43	9	20	114

Each number in the table indicates the number of participants that fall into one of the categories. For example, there are 21 participants whose giving decreases in t and in w .