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Inequality and giving

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ABSTRACT

In a laboratory experiment, we incentivize participants to make donations to a real-world charity. By randomizing the income distribution, we identify a causal effect of inequality on giving behavior. On both the intensive and extensive margins, donations fall when inequality is higher. Our results conflict with theories that predict greater inequality increases charitable giving, but are consistent with other empirical evidence that charitable giving is lower when inequality increases. We present a model where the income distribution directly affects the marginal utility of charitable giving, making a negative inequality-giving relationship possible.

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1. Introduction

In much of the world, the inequality of income and wealth have risen rapidly.[1] Economic inequality could inspire political disaffection, reduce social cohesion, and lessen equality of opportunity. To what extent does income inequality affect charitable giving?

The traditional economic theory of philanthropy treats charitable giving as a voluntary contribution to a public good. Early models found that total contributions of self-interested parties are insensitive to the distribution of income (Warr, 1983), or emphasized inequality's mitigation of the free-riding problem (e.g. Bergstrom et al., 1986). Because the free-riding problem is solved in the limiting case of a single household controlling all resources, this literature generally finds that, conditional on a fixed amount of total resources, public good provision is closer to the planner's optimum as the distribution of endowments becomes more unequal.

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[1] In the thoroughly studied case of the United States, Piketty et al., 2018 document an increase in the share of pretax national income flowing to the top 1% of households rising from about 10% to about 20% over 1975–2014. Saez and Zucman, 2016 compute that the wealth share of the top 0.1% has risen from 7% to 22% over 1974–2012. Other papers have used different methodologies to compute less rapid increases in inequality over the recent decades (Kopczuk and Saez, 2004; Auten and Splinter, 2016). Increasing inequality has been documented in other developed countries as well, particularly Anglophone countries (Canada, UK, Ireland, India), though in other countries this trend is weaker or not apparent. See Piketty (2014), Veall (2012), Alvaredo et al. (2013), and World Inequality Database (2019).

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Over time these models grew more sophisticated and realistic by adding terms for "warm glow" or "joy-of-giving" that capture utility from one's own contributions to a good (Andreoni, 1990; Fehr and Schmidt, 1999; Ribar and Wilhelm, 2002). Nonetheless, adding joy-of-giving terms to the model typically only mitigates (rather than eliminates) the free-rider problem (Andreoni, 1990). Thus, warm-glow models also predict that inequality will increase giving, albeit less sharply than in the pure altruism case. Derin-Güre and Uler (2009, 2010) embed an inequality aversion term in a warm glow model, and demonstrate in cross-sectional data that high-income people who are more concerned about inequality give more to charity, while low-income people's giving is negatively associated with inequality aversion, consistent with theoretical predictions of the role of inequality-averse preferences conditional on placement within the income distribution. By assumption, however, inequality-aversion preferences cannot predict that increasing inequality leads to lower giving by higher-income agents, who will prefer to do additional giving beyond any pure income effect in order to voluntarily redistribute their own endowments.

On the other hand, a substantial empirical literature has found that inequality and giving are negatively associated. Lab experiments with voluntary within-experiment redistribution find that greater inequality of incomes generally *decreases* contributions (Chan et al., 1996; Buckley and Croson, 2006; Côté et al., 2015). Uler (2011) introduces a tax to the public goods game and finds that while greater pre-tax equality decreases contributions, greater after-tax equality increases total contributions, and concludes that observed giving behavior is inconsistent with all prevailing models (Uler, 2011, Result 8). Sheremeta and Uler, 2020 show experimentally that higher government waste—which leaves less for redistribution and so increases *ex post* inequality—reduces charitable giving in a lab experiment. In observational studies, the correlation between charitable giving and inequality is ambiguous (Payne and Smith, 2015; Duquette, 2018). It is difficult to reconcile these results without inequality playing a significant role in prosocial behavior in general and charitable giving in particular. These findings highlight the need for a new theoretical framework to think about inequality and prosocial behavior.

Rather than relying on inequality aversion or a free-riding mechanism, we conjecture that inequality may affect the marginal utility of giving. Theories that permit any giving-reducing role for inequality are difficult to find; we know only of Mayo and Tinsley (2009), who propose a model where perceptions of relative returns to luck and skill affect perceptions of merit and reduce generosity. In this paper we provide a new model of charitable giving where the concentration of resources directly affects giving decisions. The sign of this effect is ambiguous as the behavioral influence of the income distribution on marginal utility is not constrained *a priori*. There are different ways that behavioral influences might manifest in our model. For example, inequality could increase giving by eliciting empathy of those with disproportionate resources, and therefore increase the giving of the rich: we note that campaigns that help prospective donors to empathize with recipients are more successful (Einolf et al., 2013; Fong and Oberholzer-Gee, 2011; Fong and Luttmer, 2011; Andreoni and Rao, 2011). Alternatively, greater inequality could depress giving by provoking disgust or weakening social cohesion: we note that reductions in prosocial behavior caused *inter alia* by increases in social distance have been observed in the lab and in observational data (Charness et al., 2007; Charness and Gneezy, 2008; Alesina and La Ferrara, 2000; Luttmer, 2001; Hungerman, 2008; Dahlberg et al., 2012; Andreoni et al., 2016). We are agnostic on this effect, and consider the sign of this behavioral parameter to be an empirical question.

Drawing on these insights, we investigate the effect of inequality on giving in a lab experiment. We presented subjects with an opportunity to donate to a partner charity under exogenously varied inequality conditions. By randomizing inequality, we differentiate our research from related studies of social pressures and giving behavior (DellaVigna et al., 2012; Andreoni et al., 2017b; List, 2011). By partnering with an outside charity, we abstract away from within-lab redistributive concerns (Côté et al., 2015; Sheremeta and Uler, 2020). Our findings on the effect of inequality are clear: increasing inequality significantly decreases total donations. A 1% increase in inequality decreases donations by about 0.2%. The negative coefficient of inequality is robust to functional form assumptions, the inclusion of additional controls for relative income, and whether incomes were wholly luck-based or partly linked to effort. The giving-reducing effect of inequality on giving is observed on both extensive and intensive margins of the giving decision: subjects are less likely to give, and conditional on giving give less, when inequality is higher. Relative income controls mitigate inequality's effect on giving, and appear to be one mechanism to explain how the result manifests: in a companion paper (Hargaden and Duquette, 2020) we show that giving as a fraction of income follows a U-shape pattern, with overall giving level-shifted down in high inequality treatments.

This paper proceeds as follows. We present the main points of our theoretical model in Section 2, while reserving derivations and proofs for the online appendix, available in the Supplementary Materials section of the journal. We then explain the design of our experiment in Section 3. The experimental data are summarized and described (Section 4) before we present our main results (Section 5). Additional results and checks are presented in the appendix. Section 6 concludes.

2. A distribution-dependent theory of philanthropy

In this section, we propose a variant of the warm-glow utility model. This variant generalizes the warm-glow model to the case where the distribution of endowments may have a behavioral effect on joy-of-giving. To motivate our experiment, we focus here on conveying the intuition behind our model and its implications. The model is formally derived and explained in detail in Appendix A1.

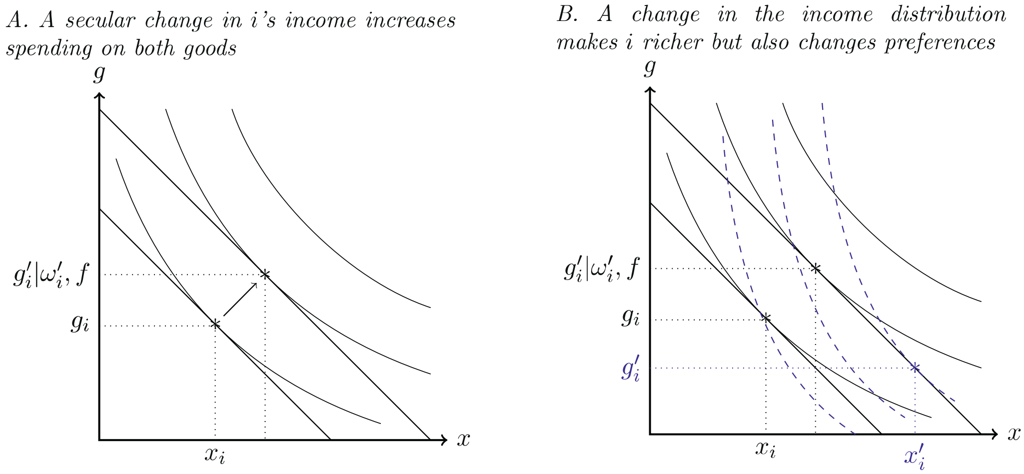

Fig. 1. A donor's response to two different income shocks.

Consider a consumer i with an endowment of income ω_i. She maximizes her utility over consumption x_i and the warm-glow from charitable giving g_i:

$$U_i = u(x_i) + v(g_i; \omega_i, f(\omega))$$

$$\text{s.t. } \omega_i \geq x + pg_i$$

where p represents the price of giving relative to numeraire consumption.[2] For simplicity, we model charitable giving as solely providing warm glow to the donor, with no role for "pure altruism" in total provision G; this is equivalent to the problem where G does contribute to utility, but does not affect behavior at the margin as the number of potential donors becomes large (Ribar and Wilhelm, 2002). Thus, this setup collapses to a standard large-N warm-glow model when the utility from the public good contribution $v(\cdot)$ does not directly depend on ω_i or its distribution $f(\omega)$.

From the standard assumptions[3] we can immediately generate two null hypotheses:

Hypothesis 1: An increase in i's income ω_i will weakly increase i's charitable giving g_i, i.e. that $\frac{\partial g_i}{\partial \omega_i} \geq 0$; and

Hypothesis 2: An increase in the relative price p of the charitable good will decrease provision, so that $\frac{\partial g_i}{\partial p} < 0$.

These results are standard, and known in the literature (e.g. Andreoni 1990). Our innovation arises from our third, more subtle, hypothesis. This hypothesis relates individual giving g_i to changes in the range of endowments. Let ϕ_i be a measure of the dispersion of the set of incomes $\phi(\omega_i, \{\omega_j\}_j)$.[4] The existing literature predicts that when the same resources are distributed more unequally—i.e. a greater ϕ_i holding $\int_i \omega_i di$ fixed—total giving $\left(\int_i g_i di\right)$ will weakly increase because of a mitigated free-rider problem.

Instead of a pure-altruism model with free riding, we model warm glow as a function of both absolute resources and direct behavioral influences of inequality on the joy of giving. One could imagine various ways inequality might change agents' interest in prosocial behavior. Increasing inequality could plausibly elicit either greedy fatalism or empathetic selflessness. To see how this might work, consider the indifference curves in Fig. 1.

In Fig. 1A, an outward shift of the budget constraint leads to an increase in both g_i and x_i, conditional on an unchanging marginal rate of substitution as represented by the parallel indifference curves. Fig. 1B presents the same outward shift in the budget constraint, but where a simultaneous increase in the variance of the distribution has rotated the indifference curves clockwise.

The key innovation here is that the rotation of the marginal rate of substitution is caused by the distribution of resources. In other models such as Bergstrom et al. (1986) a concentration of resources can change g_i by expanding or contracting the set of donors making a strictly positive contribution, but not changes in preferences for the public goods itself. The

[2] While $p = 1$ is a natural starting point, this formulation permits subsidization through the tax code, or through a fundraising match as in our experimental design.

[3] The standard warm-glow model assumptions include public good G equalling the sum (or integral) of all contributions g_i, concave utility with appropriate Inada conditions, etc. As these are standard, we do not dwell on them in this section. A more detailed depiction of the theory is included in Appendix A1.

[4] In our theory appendix, we will use the difference between the maximum and minimum endowment, $\phi_i = \Delta\omega = \omega_{\max} - \omega_{\min}$, for simplicity and for congruence to our experimental setup. However, the existing theory of giving finds that inequality weakly increases total provision under more general situations, e.g. a transfer from any non-donor to any donor (Bergstrom et al., 1986), and one could easily imagine using other measures of inequality, such as the variance of endowments, or a Gini-type index.

Table 1
Summary of hypotheses.

	Theoretical hypothesis	Experimental treatment
1.	Giving increases in income ω_i	Change subject's endowment
2.	Giving decreases in price p	Change match rate
3.	Giving increases/decreases in variance σ	Change range of endowments $\Delta\omega$

new optimal point is (x_i', g_i'), where the new giving level is lower than the original level. Of course the clockwise rotation represents just one specification of the MRS, and an equally plausible counter-clockwise rotation would result in an entirely different comparative static.

Given these plausible effects we thus propose these derivatives may be nonzero, and test a null of zero effect as our third hypothesis:

Hypothesis 3: A secular increase in the variance of the income distribution will not affect individual-level giving, after accounting for changes in *i*'s income individually.

We specify this model in more detail in Appendix A1. We show in Appendix A1.5 that the result is most clearly shown for *compensated* changes in giving. That is, if the equality of the income distribution changes while holding total resources constant, it is quite plausible that the net giving of some households will increase and some will decrease simply because the distributional change has made some richer and others poorer. The theory appendix also derives predictions specific to the measure of dispersion actually observed by experimental participants—the difference between minimum and maximum endowments observed within rounds of the game—which we denote $\Delta\omega$.

We summarize the three hypotheses in Table 1. The primary purpose of our experiment is to test hypothesis 3: holding price and own income constant, is giving affected by the dispersion of endowments? And if we reject hypothesis 3, does a more unequal income distribution increase giving all else equal (as implied by existing models), or does it decrease giving (as suggested by some experiments)? The next section discusses the experimental implementation.

3. Experimental design

Given the stylized facts about giving, the primary objective of the laboratory experiment was to identify how people's willingness to donate depends on a within-experiment income distribution. An important feature of this setup is its focus on a real, external charity: unlike related literature that looks at how the within-experiment distribution affects within-experiment redistribution, we collaborated with a brand-name charity as the recipient of donations. Partnering with an external charity brings the benefit of isolating the behavioral effect of inequality on giving from concerns about group identity and other unobservables. That is, by giving subjects the opportunity to donate to an actual cause rather than to a within-lab game, the real-charity design separates the decision to contribute from within-group social pressures other than the effect of changes across rounds in decision parameters.

The second objective was to test how price sensitive donations are, captured by varying the rate at which we match donations. This was of interest to our collaborating charity, and of increased policy relevance given the increase in the standard deduction in the US tax code.[5]

A final objective was to test if the above two objectives differed between luck-based and reward-based distributions, as suggested by Luccasen and Grossman (2017). We tested this by implementing an additional effort task at the start of half the sessions. The effort task based on Gill and Prowse (2012) rewarded participants with increased tokens based on the number of sliders they could precisely position under time pressure. Our results are robust: we find no differential effects of inequality between the effort-based groups and luck-based groups. We outline the details of this treatment and our findings in Appendix A5.

An application to conduct an experiment involving human subjects was approved by the University of Tennessee's Institutional Review Board (application reference IRB-17-03776-XP) in May 2017. Subsequently the experiment was conducted at the University of Tennessee's Experimental Economics Lab, and was implemented using z-Tree (Fischbacher, 2007).

One-hundred and twenty participants took part in the experiment, held over six sessions in September 2017. Participants were drawn from the UT Experimental Economics mailing-list, the vast majority of which were full-time undergraduates at the university. The mean number of participants per session was 20, and the median was 22.

Participants were told the purpose of the study was to "examine how inequality and subsidies affect charitable-giving", but not the specific research question. They were informed the experiment was in conjunction with United Way of Greater Knoxville, and provided a short summary of their objectives ("many programs, ranging from delivering hot meals to elderly

[5] Public Law 115–97, colloquially known as the Tax Cut and Jobs Act (a short title removed from the final bill), increased the standard deduction of the individual federal income tax significantly while eliminating or substantially reducing many itemized deductions. As a result, the share of itemizers was expected to fall from 26% of all tax units to 11% (Tax Policy Center, 2018). Filers who do not itemize do not receive a federal tax deduction for charitable contributions, substantially increasing the "price" of making a gift. While a large literature has traditionally found that the average household response elasticity is about −1, or "treasury neutral," (Andreoni, 2006) more recent work has found that charities' donation receipts are significantly more price-elastic (Duquette, 2016), possibly because the major donors exhibit greater tax-sensitivity than the typical household (Fack and Landais, 2010).

Table 2
Allocation distributions and match rates for unearned income treatments.

Round number	Income distribution	Match rates
1 and 2	U[50, 300]	1, 5
3 and 4	U[0, 1000]	2, 0
5 and 6	U[200, 500]	2, 8
7 and 8	U[200, 800]	1, 6
9 and 10	U[100, 400]	10, 5
11 and 12	U[0, 200]	0, 6
13 and 14	U[0, 300]	2, 3
15 and 16	U[100, 200]	0, 3
17 and 18	U[100, 500]	1, 2
19 and 20	U[200, 300]	4, 2
21 and 22	U[50, 500]	0, 1
23 and 24	U[0, 200]	4, 1

citizens, to providing job training to people with intellectual disabilities.") United Way were invited to collaborate in the experiment because they are a large and relatively uncontroversial organization in the community, providing assistance to 20% of the population in Knox County every year (more than 100,000 people). Despite this, knowledge of the organization was quite low: in a post-experiment survey, 58% of participants reported being "Not Familiar at all" or "Not particularly familiar" with the charity. Copies of the charity's annual report and promotional materials were available to participants (see Appendix A2), but take-up was very low.

Participants were provided with an informed consent sheet, and given instructions. Real money was allocated to participants via tokens worth either 3 or 5 cents each, and donations solicited. Participants were told in advance that donations would be incentivized with a varying match rate. They were also informed that they would be told how many tokens they have been allocated, and some information about how many tokens other people were allocated. The consent sheet and full instructions are presented in the appendix (Sections A3 and A4), but the key provisions were:

> "In this experiment, the computer will allocate a number of tokens to each of you. In each round you will be told how many tokens you received, and some information on how many tokens other people in the experiment received. Tokens are worth money, and will be converted into cash at the end of the experiment. Each token is worth 5 (3) cents, and so you can think of 100 tokens being worth 5 (3) dollars.
>
> You will be asked how many of these tokens you are willing to donate to United Way.
>
> To incentivize donations, you will see on-screen that we will match any donations with a varying amount. For example, you might see 'For every token you donate, we will match this with two more.' This means United Way would receive three tokens in total for every one you donate. The amounts donated will remain confidential.
>
> We will analyze how participants' donations depend on this information. We will run several rounds of this experiment. From these, the computer will select two to count for real, and payments will be based on those two rounds. At the end of the last session, you will be asked to fill out a questionnaire and paid for the tokens from the two selected rounds, in addition to the $5 show-up fee. Everybody will be paid in private after showing the record sheet. You are under no obligation to tell others how much you earned."

All sessions began with clearly-specified practice rounds. In sessions where participants conducted the slider task to allocate tokens, an additional paragraph of instructions were read aloud, and a practice round of the slider task was included.

The first treatment is the allocation of tokens. This is the experimental analogue of Hypothesis 1, that income affects giving. By way of a simple income effect, we expect a positive relationship between tokens and contributions.[6]

The second treatment is a donation match. This affects the price of giving, as per Hypothesis 2. The experimental sessions were held amidst public debates on the Tax Cuts and Job Act, and our partner charity was concerned about the effect the Act would have on charitable giving. To vary the price of charitable giving, we matched contributions with external funds.[7] Immediately above the input box for the number of tokens to be donated, participants are informed of the match rate. Participants had been told they would face a varying match rate. In this particular example, the match rate is 5. The full list of match rates is outlined in Table 2. The specific instructions read "Your allocation of tokens in this round is **195.** Given this information, and the fact we are willing to match every token you donate to United Way with **5** more, how many tokens would you be willing to donate?"

The third treatment, income inequality, is more subtle. Participants are told the highest and lowest token allocation each round. This revelation is truthful, and reflects the fact that the number of tokens were drawn from uniform distributions of

[6] Subjects' "income" here is an endowment of tokens. We call changes in these allocations "income effects" and their distribution "income inequality" to avoid confusion with the "endowment effect" discussed in other behavioral experiments.

[7] Karlan and List (2007) have previously found that match rates of 2:1 and 3:1 had little additional impact above a 1:1 match. While our matching treatments are primarily of that magnitude (the mean rate is 2.7), we extend the analysis by varying the rates from as low as zero to as high as 10:1. These high match rates simulate the effect of low tax prices of giving during the middle-20th Century, when marginal tax rates over 90% on top earners, and when giving as a share of income was very high and income inequality low (Duquette, 2018).

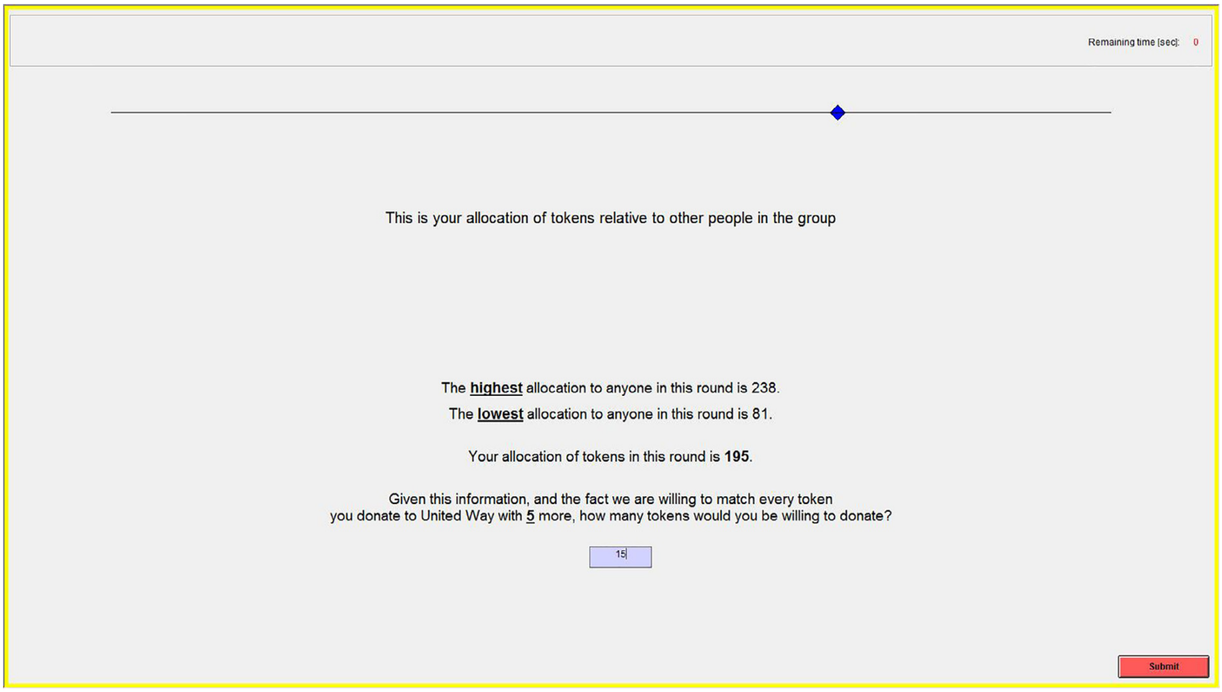

Fig. 2. Primary experimental screen.

Table 3
Distribution of donations.

Variable	Min	Percentile					Max
		20th	*40th*	*50th*	*60th*	*80th*	
Contribution (tokens)	0	4	11	20	25	70	850
Contribution (% of income)	0	2.04	6.9	9.85	13.04	31.25	100

varying width. This serves to make dispersion of token incomes, as well as the subject's own allocation of tokens, salient. The distribution of tokens is clear through the figure towards the top of the screen, demonstrated in Fig. 2. The subject's own income relative to the min and max is plotted to help visualize the distance to the minimum and maximum points.

In the example, the user indicates they will donate 15 tokens. After submitting the number of tokens, a confirmation screen repeats the donation level, and makes explicit that the matches increase the donations. This is shown in Fig. A6 in Appendix A6.

Table 2 provides details of the distributions for the experiment. Consider the fifth and sixth round. Participants were separated into two groups randomly by z-Tree. For example, in rounds 5 and 6, Group 1 participants drew an income worth between 200 ($10) and 500 ($25) tokens, and were prompted to donate based on match rates of $2x$ or $8x$. Group 2's incomes came from the same distribution, but the match rates were reversed ($8x$ or $2x$). Thus within the two rounds, incomes are drawn and remain constant, but match rates vary, and the order of the match rates vary. This has the effect of identifying the effect of the match rate from within person-round variation, i.e. only the match rate changes. While the within person-round variation has advantages, it is plausible that the repeated nature of the experiment influences behavior as time progresses. Table A8 flexibly tests for patterns as subjects proceed through the experiment, i.e. for experimental-round effects, and finds essentially no evidence to support this. Furthermore we switched the ordering of the rounds, and included some additional variation (different upper- and lower-limits) across sessions, keeping the mean income approximately constant. (The z-Tree code and experimental data, are available from the openICPSR website, https://doi.org/10.3886/E137682V1.)

4. Data description

Summary statistics of the experiment are presented in Tables 3 and 4. The experiment lasted 24 rounds, generating 2880 observations on contributions.[8] The average income was 260 tokens per round, and 49 (19%) of those are contributed

[8] Session-by-session point estimates are included in Table A14 in the appendix.

Table 4
Summary statistics of philanthropy experiment.

	Mean	Std. dev	N	Min	Max
Endowment (tokens)	260.12	183.17	2880	2	998
Match rate	2.72	2.42	2880	0	10
Contribution (tokens)	48.62	82.36	2880	0	850
Contribution, % of tokens	19.07	24.29	2880	0	100
Log of contributions	3.40	1.77	2880	0	7
Extent of inequality	343.67	214.18	2880	73	987
Distance to highest endowment	187.71	178.94	2880	0	987
Distance to lowest endowment	155.96	160.88	2880	0	987
Age	20.72	1.99	2880	18	32
Male	0.57	0.50	2880	0	1
Married	0.02	0.13	2880	0	1
First experiment	0.38	0.48	2880	0	1
Social class (1–5 scale)	2.93	1.01	2880	1	5
Well compensated (1–5 scale)	4.23	0.92	2880	1	5
Understand experiment (1–5 scale)	4.35	0.90	2880	1	5
Exchange rate (USD/tokens)	0.04	0.01	2880	0.03	0.05
Economics courses taken	1.77	2.05	2880	0	12

on average.[9] To account for zero-contributions, we use the inverse hyperbolic sine transformation to generate log-like values.[10]

Two rounds were randomly selected to count for payment, meaning the average earnings (including $5 the show-up fee) was about $22. The highest donation was 850 tokens, which translates to $42.50 of money that would otherwise be theirs.

Reflecting the student population, the average age of participants was 21 and largely identified as from middle-class households. In a post-experiment questionnaire, participants reported that they understood the experiment and were adequately compensated for their time.

5. Results

In this section, we present selected experimental results. For brevity, we focus on discussion of the relationship between inequality and giving. We will also summarize our full set of findings while reserving a more complete discussion of all results for the online appendix.

5.1. Inequality reduces giving

We begin with a visual examination of the relationship between inequality and giving in our experimental data. Fig. 3 presents a graphical depiction of a regression,[11] plotting the line of best-fit between charitable giving and the width of the distribution after controlling for both own income and the match rate.[12] The figure includes a “binned scatter plot” of same. For ease of visibility, we use twenty bins so that rounds of similar inequality are averaged together into a single scatterpoint. With a sample size 2880, each scatterpoint represents the average of 144 separate observations ($2880/20 = 144$). There is an obvious negative relationship between income inequality and participants' generosity. This negative relationship, which we reiterate controls for one's own income, is striking and is perhaps the main result of the entire paper. The variables here are reported in levels; a similar analysis conducive to an elasticity interpretation finds that a 1% increase in the width of the distribution decreases donations by 0.25%.

Next, we test for these and other treatments' effects on contributions simultaneously, in a multivariate setting. Table 5 reports estimates of a multivariate regression of giving on experimental treatments and sets of control variables. Our focus is on the effect of inequality, though we include results for the price and income treatments as well. We include five specifications of the primary question: how does inequality affect (the log of) contributions to charity? Column 1 reports the regression of contributions on the participant's token income, match rate, and the within-round dispersion of the distribu-

[9] Note that donations were encouraged with generous match rates.

[10] The inverse hyperbolic sine function, $arcsinhx = \ln\left(x + \sqrt{x^2+1}\right)$, converges quickly to $\ln x + \ln 2$ for positive values of x. Since $\ln 2$ is absorbed into a constant term in a regression specification, a regression using inverse hyperbolic sine transformation will give very similar results to a log-transform, and we thus informally refer to “log” values for this function throughout this manuscript. The primary advantage of the inverse hyperbolic sine over the natural logarithm is that it is defined, continuous and differentiable at $x = 0$. In the appendix, we present results of untransformed (level-level) and Poisson regressions with very similar results to our main specification, demonstrating that this transformation's handling of zero values does not drive our results.

[11] Rather than a comparison of means, we use linear regression to control for the effect of own income and the match rate.

[12] For example, Table 2 reports Rounds 11–12 drew from a $U[0, 200]$ distribution, while Rounds 3–4 drew from a $U[0, 1000]$ distribution. Residualizing donations with respect to income allows us to plot the correlation between inequality and giving without allowing the fivefold increase in expected income across these two rounds to confound the relationship.

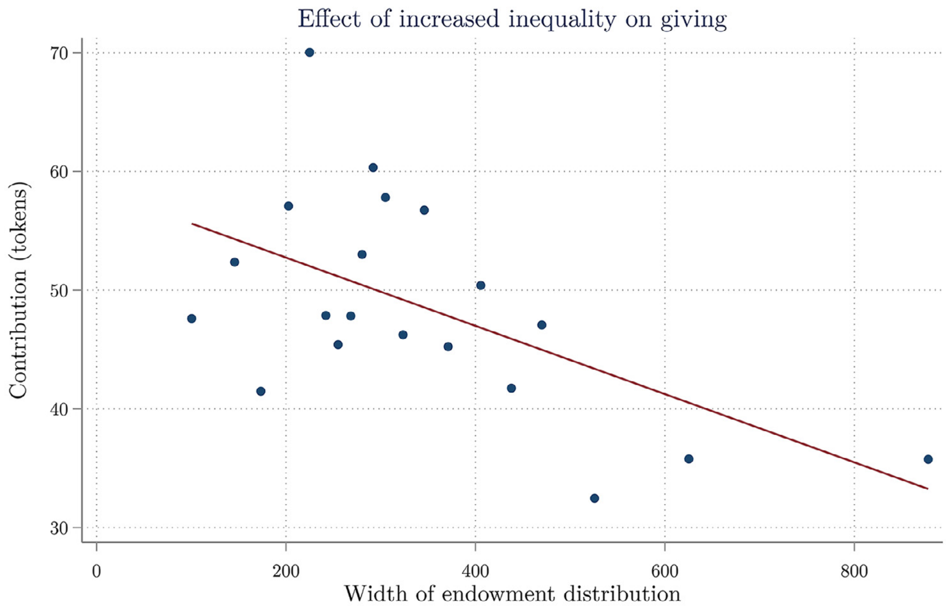

Fig. 3. Average tokens donated relative to dispersion of the distribution, holding income constant. Giving is declining in inequality. As with all bin-scatter figures, each dot represents the average of many datapoints.

Table 5
Effects of various treatments on log of contributions donated.

	(1)	(2)	(3)	(4)	(5)
Endowment ('00s)	0.40***	0.43***	0.42***	0.36***	0.36***
	(0.036)	(0.028)	(0.029)	(0.020)	(0.013)
Match rate	0.081***	0.088***	0.086***	0.092***	0.092***
	(0.016)	(0.016)	(0.016)	(0.015)	(0.0076)
Extent of inequality ('00s)	−0.072***	−0.096***	−0.095***	−0.060***	−0.061***
	(0.023)	(0.019)	(0.019)	(0.014)	(0.011)
Control variables		✓	✓		✓
Experimental session FE			✓		
Participant FE				✓	
Random effects					✓
Adjusted R^2	0.153	0.284	0.297	0.287	0.287
Observations	2880	2880	2880	2880	2880

SEs in Models 1–4 clustered at the individual level. $^{*}p < 0.1$, $^{**}p < 0.05$, $^{***}p < 0.01$.

tion of tokens with no other controls.[13] Columns 2, 3 and 5 add standard control variables on the participant's sociodemographics and economics course experience;[14] Columns 3 and 4 add fixed effects for the experimental session and for the subject, respectively (testing for any common within-round or within-subject confounding unobservables), while Column 5 is a random effects specification.

The variable denoted "Extent of inequality" is defined as the difference in hundreds of tokens between the min and max of the empirical distribution, and is presented to the subjects as a simple proxy for the dispersion of the income distribution.[15] The interpretation of these coefficients is thus the causal effect of increasing the dispersion of the distribution, holding both one's own income and the match rate fixed.

In all specifications, the coefficient on inequality is large, negative, and statistically different from zero at the 99% confidence level. Expanding inequality lowers giving consistently across specifications. As the outcome variable is the log of

[13] Table A6 in the appendix adds the visual midpoint of the distribution to the set of treatments; the findings with respect to price, own income, and inequality are unchanged, and visual midpoint is not strongly associated with giving behavior.

[14] The full list of control variables are age, sex, marital status, self-reported social class, a dummy variable for previous experience with experiments, Likert scales for satisfaction with compensation and level of understanding of the experiment, and the number of economics courses taken. Results are shown in the appendix.

[15] The theory derived in the appendix considers the case where the min-max range of endowments is the inequality parameter of interest. Also, Table A10 in the appendix shows the results when the treatment is the standard deviation of within-round incomes.

Table 6
Effect of visual endowment position on giving.

	Fixed effects		Random effects	
	(1)	(2)	(3)	(4)
Endowment ('00s)	0.30***	0.30***	0.30***	0.30***
	(0.022)	(0.022)	(0.018)	(0.018)
Match rate	0.095***	0.095***	0.095***	0.095***
	(0.015)	(0.015)	(0.0076)	(0.0075)
Extent of inequality ('00s)	−0.027*	−0.029*	−0.027**	−0.029**
	(0.016)	(0.016)	(0.012)	(0.012)
Endowment (Positional)	0.46***	1.66***	0.48***	1.66***
	(0.11)	(0.33)	(0.090)	(0.23)
(Endowment (Positional))^2		−1.21***		−1.20***
		(0.29)		(0.21)
Control variables			✓	✓
Adjusted R^2	0.294	0.302	0.294	0.302
Observations	2880	2880	2880	2880

contributions, we can interpret the coefficients in percentage terms.[16] The coefficient on increasing inequality from Column 2 implies that expanding the extremes of the distribution by 50 tokens on both sides causes giving to fall by about 9.6%. In the latter specifications the effect size, at around 6.1%, is still quite large. The use of random versus fixed effects does not change the estimates meaningfully, as expected given the experimental nature of the setup.

We consider this quite a remarkable result: increasing inequality reduces giving. As this result cannot be attributed to within-group redistributive motives because of our real-charity experimental design, this is clear evidence of a real behavioral effect of inequality influencing choices. The results are consistent with a giving-reducing-inequality mechanism in the utility function. Returning to our theoretical framing, this rejects the null of no effects in Hypothesis 3: when the dispersion of incomes is increased, then in the raw data and conditional on other controls, giving decreases.

5.2. Income position and inequality interactions

To test the robustness of the effect of inequality on giving, we extend the analysis by exploring the importance of within-round relative economic position for the donation decision. A growing experimental literature has suggested that income position is an important behavioral factor in economic decision-making, and that the psychological mechanisms underpinning charitable giving decisions are complex (Erkal et al., 2011; DellaVigna et al., 2012; Andreoni et al., 2017a; 2017b). Erkal et al. (2011) shows a non-monotonic relationship between earnings and charitable giving (specifically, people who rank first in an effort-experiment are less likely to donate than people who come second).

To investigate whether relative position or ranking affects giving, we extend the regressions of Table 5 to include variables measuring relative income. Specifically we define a new regressor, Endowment (Positional), to measure income normalized to the within-round distribution. It is a variable between 0 and 1 expressing the participant's within-round income as a share of the distance from the within-round min to the within-round max incomes. To investigate potential nonlinearities in this relationship, we also include the square of this variable in some specifications.

These regressions are presented in Table 6. Columns 1 and 2 include individual fixed effects and so are comparable to Column 4 in Table 5. Columns 3 and 4 replace individual fixed effects with random effects, resembling the final column in Table 5. The fixed effects specifications are clustered at the individual level.

We find that within-distribution heterogeneity is an important pathway for much of the inequality effect. Adding an effect for positional income reduces the coefficient on inequality from 6% to 7% to less than 3%, i.e. by a bit more than half. The point estimates are consistent across all specifications, varying only slightly. The random effects specifications, the most efficient estimator, indicates the inequality effects are significant at the 95% level. We interpret these findings as showing that in addition to a level effect of inequality on giving, there is an important interaction effect between absolute and relative income, which is equivalent to inequality dampening the income effect (since higher inequality means that it takes more tokens to get the same change in relative income). Appendix Section A1.7 generalizes our model to the case where positional income affects giving, and shows that this effect is closely related to the extent of inequality via a dampened or exaggerated income effect.

Including the square of position as well as the level suggests significant nonlinearities in the effects of position on giving, although inclusion of the squared term does not substantially affect the point estimate on inequality. The positive sign on the quadratic term is consistent with a long literature finding a U-shaped relationship between relative income position and charitable giving (Clotfelter and Steuerle, 1981; Clotfelter, 1985; Auten et al., 2000; List, 2011). In the Appendix to this paper

[16] While the specification is intuitively appealing, we present results from alternative specifications (e.g. log–log or levels–levels functional forms, with linear and nonlinear round fixed effects, with controls for relative endowments, etc.), in Appendix A7. The paper's principal finding that inequality reduces giving is robust to these specifications.

Table 7
Hurdle model results.

	Binary hurdle		*Overall effect*		*Comparison*
	Coef. score	Marg. effect	Coef. score	ATE	OLS
Endowment ('00s)	0.14***	0.020***	0.40***	16.23***	22.3***
	(0.031)	(0.004)	(0.027)	(2.07)	(3.15)
Match rate	0.18***	0.025***	0.008	1.37***	1.71**
	(0.027)	(0.004)	(0.011)	(0.48)	(0.66)
Extent of inequality ('00s)	−0.032**	−0.004**	−0.089***	−3.67***	−3.43***
	(0.017)	(0.002)	(0.019)	(0.89)	(1.01)
Control variables	✓	✓	✓	✓	✓
Non-zero observations	2560	2560	2560	2560	2560
Total observations	2880	2880	2880	2880	2880

Results of Cragg exponential hurdle model on extensive margin (zero/positive) contributions, and total effect (controlling for the hurdle) tokens are donated. Marginal effects are evaluated at means of independent variables.

(Section A5.2), and in a separate manuscript (Hargaden and Duquette, 2020), we investigate in detail how relative placement (as opposed to inequality) affects giving. Intriguingly, we find that there is a robust U-shape in the share of tokens given. However, even after adjusting for this nonlinear functional form, we find that contributions are level-shifted down in high-inequality rounds, indeed by about the 3% suggested by Table 6.[17] That is, relative position is one behavioral influence on giving, but inequality still independently causes differences in giving within our experiment.

With the evidence that inequality reduces giving after controlling for relative position, we now turn our attention to the extensive and intensive margins.

5.3. Extensive and intensive margin effects

Given that over a fifth of observations consisted of zero contributions, we researched differences between the intensive and extensive margin decisions of participants. We employ the exponential hurdle model proposed by Cragg (1971). This approach combines a selection model for clearing the hurdle of zero contributions and the intensive margin of how much thereafter to donate. The set of independent variables in this model are identical to those in Table 5, Column 2. Results are shown in Table 7.

The first two columns display results from a probit of zero or non-zero contributions. Columns 3 and 4 display results from an exponential model on how many tokens to donate, conditional on "clearing the hurdle" and donating something at all. The right-hand side column shows the full-sample OLS results as a baseline comparison. We see the sign, magnitudes, and statistical significance of OLS and the hurdle model paint very similar pictures. The OLS estimate is an average of two negative inequality effects: greater inequality both reduces the conditional probability of making a contribution at all, and reduces the number of tokens given conditional on giving.

5.4. Additional results

For brevity, we reserve a full discussion of our price-match and effort-task effects for the appendix. These are presented in section A5. Consistent with work in field experimental settings (e.g. Karlan and List 2007), we find that higher price match ratios increase giving, but that the "bang for buck" of increasing the match is low. Subjects presented with an incentivized effort task do not make choices that are statistically different than subjects whose endowment of tokens is purely random; from this we conclude that our findings are not due to a windfall effect, and are more likely to be externally valid to real-world settings where people make charitable giving decisions out of earned income.

6. Discussion

Rising inequality has been studied extensively by economists, largely to describe and document its evolution over time (Auten and Splinter, 2016; Piketty et al., 2018; Saez and Zucman, 2016). No doubt because it is challenging to find exogenous changes in inequality in naturally occurring data, less work has been done on inequality's causal effects.

This paper has demonstrated that economic inequality has a negative, causal effect on charitable giving. Our experiment used exogenous variation in the dispersion of the incomes participants received to identify the effect of inequality on gifts to a real charitable organization. We observe lower overall giving as the distribution of incomes becomes more unequal. We further identify income and matching effects consistent with charitable giving as a normal good, with small match-effect magnitudes in line with the field experiment literature (e.g. Karlan et al., 2011; Huck et al., 2015). Results are consistent across specifications, and independent of whether incomes are earned or unearned. Relative position also appears to matter, acting as a mechanism to dampen (though not remove) the detrimental effect of inequality on giving.

[17] This result is depicted graphically in Fig. A.5 in Appendix A5.2.

Though these findings were produced in a laboratory setting, we believe the case for their external validity is strong on at least three grounds. First, variation in the distributions of a few dollars' worth of tokens are almost certainly less important and less salient than the actual distribution of income and wealth. Second, by offering subjects the opportunity to give to a United Way, we remove one of the barriers to external validity present for more traditional public goods games—subjects were giving real money to a real charity, at real cost to themselves. In this sense, our experiment was a hybrid between lab and field methodologies, as the laboratory acted solely as a tool to randomize inequality for an otherwise real decision process. Third, in their research comparing giving elasticities across settings, Eckel and Grossman (2008) found magnitudes from a field experiment "are very similar to (and insignificantly different from) [those from] lab experiments."

Moreover, the power of our relatively large sample (thousands of observations over hundreds of subjects) suggest that these findings are unlikely to be spurious. We demonstrate in Appendix A8 that our results should shift the prior beliefs of the vast majority of readers. Using the framework of Maniadis et al. (2014, 2017) and applying reasonable parameter values, an unbiased reader's post-study belief that inequality negatively affects giving should be at least 15 percentage points higher than her prior after our study. Further analysis presented in Appendix A9 demonstrates that our findings are robust to using Bonferroni-style p-values for the testing of multiple hypotheses.

Our empirical findings are inconsistent with the prevailing theory of voluntary public good provision. Rather, our results crystalize the importance of inequality to the giving decision. The theoretical framework in this paper allows for behavioral changes in the joy-of-giving in response to shifts in the income distribution, and we note that the empirical results are consistent with this framework. However, our experiment provides little in the way of distinguishing between the multiple plausible mechanisms (e.g. social distance effects) that may cause changes in the joy-of-giving. We believe this work is a first step toward a new empirical and theoretical literature that focuses on inequality and other behavioral influences in addition to the classic questions of crowd-out and tax price of giving. We hope future work can pin down the specific mechanisms our general framework facilitates.

These findings are important both for understanding the economics of charitable giving and for public policy regarding inequality and social cohesion. If charitable giving is an expression of civic feeling lessened by disparate economic situations of potential donors, then voluntary contributions will not work against rising inequality; rather, inequality will undermine charitable contributions. It is possible that civil societies have multiple equilibria, one of high social cohesion and high giving supporting each other, others of low giving and low social cohesion. Policies that support one of these while discouraging the other will have ambiguous results. While this paper has focused on charitable giving, we believe it possible that the negative, causal effect of inequality extends to other forms of prosocial behavior, and our method could be applied to the study of social influences on, for example, voting behavior (as in Messer et al. 2010) or conservation (Ito et al., 2018). If so, inequality imposes a direct, first-order social cost on the public that is currently not widely discussed or well-understood. We hope that future research will speak to these broader questions.

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Supplementary material

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References

Alesina, A., La Ferrara, E., 2000. Participation in heterogeneous communities. Q. J. Econ. 115 (3), 847–904.
Alvaredo, F., Atkinson, A.B., Piketty, T., Saez, E., 2013. The top 1 percent in international and historical perspective. J. Econ. Perspect. 27 (3), 3–20.
Andreoni, J., 1990. Impure altruism and donations to public goods: a theory of warm-glow giving. Econ. J. 100 (401), 464–477.
Andreoni, J., 2006. Philanthropy. In: Kolm, S.-C., Ythier, J.M. (Eds.), Handbook of the Economics of Giving, Altruism and Reciprocity, 2. North-Holland, pp. 1201–1269.
Andreoni, J., Nikiforakis, N., Stoop, J., 2017a. Are the Rich More Selfish than the Poor, or Do They Just Have More Money? A Natural Field Experiment. Working Paper. National Bureau of Economic Research.
Andreoni, J., Payne, A., Smith, J.D., Karp, D., 2016. Diversity and donations: the effect of religious and ethnic diversity on charitable giving. J. Econ. Behav. Organ. 128.
Andreoni, J., Rao, J.M., 2011. The power of asking: how communication affects selfishness, empathy, and altruism. J. Publ. Econ. 95 (7–8), 513–520.
Andreoni, J., Rao, J.M., Trachtman, H., 2017b. Avoiding the ask: a field experiment on altruism, empathy, and charitable giving. J. Polit. Econ. 125 (3), 625–653.
Auten, G.E., Clotfelter, C.T., Schmalbeck, R.L., 2000. Taxes and philanthropy among the wealthy. In: Slemrod, J. (Ed.), Does Atlas Shrug: The Economic Consequences of Taxing the Rich. Harvard University Press, Cambridge, Massachusetts, pp. 392–424.
Auten, G.E., Splinter, D., 2016. Using Tax Data to Measure Long-Term Trends in U.S. Income Inequality. Mimeo.
Bergstrom, T., Blume, L., Varian, H., 1986. On the private provision of public goods. J. Publ. Econ. 29 (1), 25–49.

Buckley, E., Croson, R., 2006. Income and wealth heterogeneity in the voluntary provision of linear public goods. J. Publ. Econ. 90 (4), 935–955.
Chan, K.S., Mestelman, S., Moir, R., Muller, R.A., 1996. The voluntary provision of public goods under varying income distributions. Can. J. Econ. 29 (1), 54–69.
Charness, G., Gneezy, U., 2008. What's in a name? Anonymity and social distance in dictator and ultimatum games. J. Econ. Behav. Organ. 68 (1), 29–35.
Charness, G., Haruvy, E., Sonsino, D., 2007. Social distance and reciprocity: an internet experiment. J. Econ. Behav. Organ. 63 (1), 88–103.
Clotfelter, C.T., 1985. Federal Tax Policy and Charitable Giving. The University of Chicago Press, Chicago.
Clotfelter, C.T., Steuerle, C.E., 1981. Charitable contributions. In: How Taxes Affect Economic Behavior. Brookings Institute, Washington, DC, pp. 403–446.
Côté, S., House, J., Willer, R., 2015. High economic inequality leads higher-income individuals to be less generous. Proc. Natl. Acad. Sci. 112 (52), 15838–15843.
Cragg, J.G., 1971. Some statistical models for limited dependent variables with application to the demand for durable goods. Econometrica 39 (5), 829–844.
Dahlberg, M., Edmark, K., Lundqvist, H., 2012. Ethnic diversity and preferences for redistribution. J. Polit. Econ. 120 (1), 41–76.
DellaVigna, S., List, J.A., Malmendier, U., 2012. Testing for altruism and social pressure in charitable giving. Q. J. Econ. 127 (1), 1–56.
Derin-Güre, P., Uler, N., 2009. The Relationship Between Charitable Giving and Inequality Aversion. Mimeo.
Derin-Güre, P., Uler, N., 2010. Charitable giving under inequality aversion. Econ. Lett. 107 (2), 208–210.
Duquette, N.J., 2016. Do tax incentives affect charitable contributions? Evidence from public charities' reported revenues. J. Publ. Econ. 137, 51–69.
Duquette, N.J., 2018. Inequality and philanthropy: high-income giving in the United States 1917–2012. Explor. Econ. Hist. 70, 25–41.
Eckel, C.C., Grossman, P.J., 2008. Subsidizing charitable contributions: a natural field experiment comparing matching and rebate subsidies. Exp. Econ. 11 (3), 234–252.
Einolf, C.J., Philbrick, D.M., Slay, K., 2013. National giving campaigns in the United States: entertainment, empathy, and the national peer group. Nonprofit Volunt. Sect. Q. 42 (2), 241–261.
Erkal, N., Gangadharan, L., Nikiforakis, N., 2011. Relative earnings and giving in a real-effort experiment. Am. Econ. Rev. 101 (7), 3330–3348.
Fack, G., Landais, C., 2010. Are tax incentives for charitable giving efficient? Evidence from France. Am. Econ. J.: Econ. Policy 2 (2), 117–141.
Fehr, E., Schmidt, K.M., 1999. A theory of fairness, competition, and cooperation. Q. J. Econ. 114 (3), 817–868.
Fischbacher, U., 2007. z-Tree: Zurich toolbox for ready-made economic experiments. Exp. Econ. 10 (2), 171–178.
Fong, C.M., Luttmer, E.F.P., 2011. Do fairness and race matter in generosity? Evidence from a nationally representative charity experiment. J. Publ. Econ. 95 (5–6), 372–394.
Fong, C.M., Oberholzer-Gee, F., 2011. Truth in giving: experimental evidence on the welfare effects of informed giving to the poor. J. Publ. Econ. 95 (5–6), 436–444.
Gill, D., Prowse, V., 2012. A structural analysis of disappointment aversion in a real effort competition. Am. Econ. Rev. 102 (1), 469–503.
Hargaden, E.P., Duquette, N.J., 2020. The U-Shaped Charitable-Giving Curve. Mimeo.
Huck, S., Rasul, I., Shephard, A., 2015. Comparing charitable fundraising schemes: evidence from a field experiment and a structural model. Am. Econ. J.: Econ. Policy 7 (2), 326–369.
Hungerman, D.M., 2008. Race and charitable church activity. Econ. Inq. 46 (3), 380–400.
Ito, K., Ida, T., Tanaka, M., 2018. Moral suasion and economic incentives: field experimental evidence from energy demand. Am. Econ. J.: Econ. Policy 10 (1), 240–267.
Karlan, D., List, J.A., 2007. Does price matter in charitable giving? Evidence from a large-scale natural field experiment. Am. Econ. Rev. 97 (5), 1774–1793.
Karlan, D., List, J.A., Shafir, E., 2011. Small matches and charitable giving: evidence from a natural field experiment. J. Publ. Econ. 95, 344–350.
Kopczuk, W., Saez, E., 2004. Top wealth shares in the United States, 1916–2000: evidence from estate tax returns. Natl. Tax J. 57 (2), 445–488.
List, J.A., 2011. The market for charitable giving. J. Econ. Perspect. 25 (2), 157–180.
Luccasen, A., Grossman, P.J., 2017. Warm-glow giving: earned money and the option to take. Econ. Inq. 55 (2), 996–1006.
Luttmer, E.F.P., 2001. Group loyalty and the taste for redistribution. J. Polit. Econ. 109 (3), 500–528.
Maniadis, Z., Tufano, F., List, J.A., 2014. One swallow doesn't make a summer: new evidence on anchoring effects. Am. Econ. Rev. 104 (1), 277–290.
Maniadis, Z., Tufano, F., List, J.A., 2017. To replicate or not to replicate? Exploring reproducibility in economics through the lens of a model and a pilot study. Econ. J. 127 (605), F209–F235.
Mayo, J.W., Tinsley, C.H., 2009. Warm glow and charitable giving: why the wealthy do not give more to charity? J. Econ. Psychol. 30 (3), 490–499.
Messer, K.D., Poe, G.L., Rondeau, D., Schulze, W.D., Vossler, C.A., 2010. Social preferences and voting: an exploration using a novel preference revealing mechanism. J. Publ. Econ. 94 (3), 308–317.
Payne, A.A., Smith, J., 2015. Does income inequality increase charitable giving? Can. J. Econ. 48 (2), 793–818.
Piketty, T., 2014. Capital in the Twenty-First Century. Belknap Press of Harvard University Press, Cambridge, Mass..
Piketty, T., Saez, E., Zucman, G., 2018. Distributional national accounts: methods and estimates for the United States. Q. J. Econ. 133 (2), 553–609.
Ribar, D.C., Wilhelm, M.O., 2002. Altruistic and joy of giving motivations in charitable behavior. J. Polit. Econ. 110 (2), 425–457.
Tax Policy Center, 2018. Impact on the Number of Itemizers of H.R.1, the Tax Cuts and Jobs Act (TCJA), by Expanded Cash Income Level, 2018. Simulation.
Saez, E., Zucman, G., 2016. Wealth inequality in the United States since 1913: evidence from capitalized income tax data. Q. J. Econ. 131 (2), 519–578.
Sheremeta, R.M., Uler, N., 2020. The impact of taxes and wasteful government spending on giving. Exp. Econ doi:10.1007/s10683-020-09673-9.
Uler, N., 2011. Public goods provision, inequality and taxes. Exp. Econ. 14 (3), 287–306.
Veall, M.R., 2012. Top income shares in Canada: recent trends and policy implications. Can. J. Econ. 45 (4), 1247–1272.
Warr, P.G., 1983. The private provision of a public good is independent of the distribution of income. Econ. Lett. 13 (2), 207–211.
World Inequality Database, 2019. World Inequality Database. https://wid.world/.