Altruism and Warm Glow in Dictators' Giving

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Abstract: We design an experiment to test whether the behavior of dictators can be rationalized by the utility function that includes both altruistic and warm glow effects (impure altruism). By giving the recipients an endowment of varying levels, we create an environment that allows for observable differences in behavior depending upon whether warm glow or altruism is the primary motivation. We find that the behavior of 89% of the dictators can be rationalized by the utility function that includes both altruistic and warm glow effects while only 16% of the dictators made choices that are consistent with the utility function that excludes the warm glow effects.

PRELIMNARY VERSION

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1. Introduction

Andreoni and Miller (2002) studied the altruistic behavior of individuals in the context of the dictator game, in which a subject –the dictator—has the opportunity to share her endowment with another subject –the recipient. Andreoni and Miller argued that, indeed, altruism is rational: In a series of experiments, they showed that subjects' choices can be rationalized by a well-behaved utility function of the form: $U(\pi_D, \pi_R)$, where π_D is the final payoff of the dictator and π_R is the final payoff of the recipient. Thus, the dictator's problem can be modeled as choosing the optimal amount to pass so to maximize a utility function: $U(\pi_D, \pi_R)$. To establish this result Andreoni and Miller showed that the subjects' choices satisfied the Generalized Axiom of Reveal Preferences (GARP), and this, by Afriat's theorem, is equivalent to establish the existence of a well-behaved utility function.

To be able to test GARP, subjects must make choices from different intersecting budget sets/. To accomplish this, Andreoni and Miller modified the original dictator game by introducing prices on final payoffs, so that: $\pi_D + p\pi_r = m.$, where m is the amount of money to be divided. Multiplying the recipients final payoff by a price introduces the possibility to tax ($p<1$) or subsidize ($p>1$) the altruistic donation of the dictator.

When considering possible government subsidies to dictator's giving, the 1998 contribution by Bolton and Katok comes to mind. In their 1998 paper, they showed that transferring one dollar from the dictator's endowment to the recipient's endowment (i.e., introducing a tax on the dictator and a subsidy to the recipient) decreases dictator's giving by less than one dollar. That is, such a transfer incompletely crowds out giving by the dictator.

The incomplete crowding out observed should not occur in a world in which utility is defined as $U(\pi_D, \pi_R)$ --the so-called pure altruism model– and such function fully describes dictators' choices. According to the Andreoni and Miller's model, a $1 transfer should completely crowd-out the dictator's private donation, that is, should decrease it exactly by $1. If final payoffs are the only arguments in the dictator's utility function, then the dictator's optimal choice should not be altered by the experimenter, or by a government transfer. The dictator should still choose the same pair of final payoffs. For example, in a game in which the dictator's endowment is $10 and the recipient's endowment is $0, suppose that passing $5 maximizes the dictator's utility. That is, equalizing final payoffs is the optimal choice for the dictator. Then, a $1 transfer from the dictator's endowment to the recipient's endowment (that is, $9 dictator's endowment and $1 recipient's endowment), should not alter the dictator's optimal choice of equal payoffs, and the dictator should pass $4. So a $1 transfer crowds out dictator's giving by $1, leading to a complete crowding out.

Bolton and Katok (1998), instead, show that transfers in the lab do crowd-out dictators' giving, but only in an incomplete way: in our example, dictators would send less than $4 but more than $3 to the recipient. Bolton and Katok, conclude that "this is direct evidence that donor preferences are incompletely specified by the standard (pure altruistic) model" (page 316). In particular they consider a different utility function by adding the pass rate as an additional argument in the dictator's utility: $U(\pi_D, \pi_R, P)$. The introduction of P, amount passed, into the utility function implies that the dictator derives utility not only from the final payoffs to himself and to the recipient, but also from the very act of passing. This is the so-called impure altruism model. Such utility function can rationalize the incomplete crowding out observed.

While the impure altruism model is used in the literature to rationalize incomplete crowding out (the paper by Bolton and Katok is just one example), to our knowledge, no existence result has been established for the impure altruism model, in an equivalent fashion to the Andreoni and Miller (2002) result for the pure altruism model. In this paper, we test whether dictator's choices can be rationalized by using the impure altruism utility function $U(\pi_D, \pi_R, P)$. To this end, we report results from experiments conducted in the VCU Experimental Laboratory for Economic and Business Research and we check if the observed data satisfy the three revealed preferences axioms, and GARP in particular.

2. Experimental Design

Consider the variation of the dictator game that has been used in Korenok *et al.* (2009), in which the dictator chooses the amount to pass, P, so to maximize utility

$$U(\pi_D, \pi_R, P) \tag{1}$$

subject to two constraints

$$\begin{aligned} \pi_D &= (E_D - P)\,p_h \\ \pi_R &= E_R + P p_p, \end{aligned} \tag{2}$$

In (2), E_D is the dictator's endowment, E_R is the recipient's endowment, the hold price p_H multiplies the amount that dictator holds for herself and the pass price p_P multiplies the amount the recipient receives from the dictator. The case in which $E_R = 0$, $p_h = p_p = 1$ corresponds to the traditional dictator game.

In the spirit of Andreoni and Miller's analysis, we have modified the Korenok *et al.* (2009) design by introducing prices. As in Andreoni and Miller (2002), we need to vary prices to ensure intersection of budget sets. In addition to varying prices, as we will illustrate below, we also need to vary endowments, as in Korenok *et al.* (2009). Consider the following example: E_D = 17, E_R =11, p_h =3 and p_p =1, reported in the second raw in Table 1. In this case, both the dictator and the recipient have a positive endowment. Also, given the prices, passing one dollar reduces by three dollars the dictator's payoff, while increases by 1 dollar the recipient's payoff, so that the relative price of giving is 3.

Budget	Dictator's Token Endowment	Recipient's Points Endowment	Hold Value	Pass Value	Relative Price of Giving	Average Tokens Passed	
						Sessions 1-4	Sessions 5-6
1	40	0	1	3	0.33	7.37	11.47
2	17	11	3	1	3.00	3.32	2.44
3	21	2	2	2	1.00	4.39	5.48
4	60	0	1	3	0.33	10.93	16.65
5	24	12	3	1	3.00	4.42	4.16
6	31	2	2	2	1.00	6.46	7.69
7	40	0	1	4	0.25	6.25	10.60
8	13	12	4	1	4.00	2.60	1.76
9	21	2	2	3	0.67	3.56	5.52
10	60	0	1	4	0.25	10.72	17.50
11	18	12	4	1	4.00	3.26	2.76

12	21	3	3	2	1.50	4.61	4.24
13	80	0	1	4	0.25	13.14	23.23
14	23	12	4	1	4.00	4.54	2.95
15	43	6	2	3	0.67	6.79	10.55
16	80	0	1	3	0.33	14.77	18.11
17	32	16	3	1	3.00	5.47	3.52
18	42	4	2	2	1.00	8.46	10.29

Table 1: Budgets and Average Dictators' Choices

In the experiments, the subjects are given a menu of choices characterized by different endowments of tokens and different prices, as specified in first five columns of Table 1.

In what follows, we check if the subjects choices under the conditions listed in Table 1 violate GARP, and if they don't, then, according to Afriat's theorem, we can conclude that there exists a well-behaved utility function $U(\pi_D, \pi_R, P)$ that rationalizes these choices.

2.1 Revealed Preference Axioms and their Violations

Let *x*, *y*, *z*,…. be distinct choices or bundles belonging to the sets specified in (2). Using Varian (1993) terminology, *x* is directly revealed preferred to *y* if *y* was available in the budget set when *x* was chosen; and *x* is indirectly revealed preferred to *z* if *x* is directly revealed preferred to *y* and *y* is directly revealed preferred to *z*. The three axioms respectively require:

Weak Axiom of Revealed Preferences (WARP). *If x is directly revealed preferred to y, then y is not directly revealed preferred to x.*

Strong Axiom of Revealed Preferences (SARP). *If x is indirectly revealed preferred to y, then y is not directly revealed preferred to x.*

Generalized Axiom of Revealed Preferences (GARP). *If x is indirectly revealed preferred to y, then y is not strictly directly revealed preferred to x.*

If the observed choices satisfy SARP, this is both necessary and sufficient for the existence of a *strictly* convex utility function, while satisfaction of WARP is only necessary but not sufficient. If the choices satisfy GARP, this is necessary and sufficient for the existence of a convex utility function.

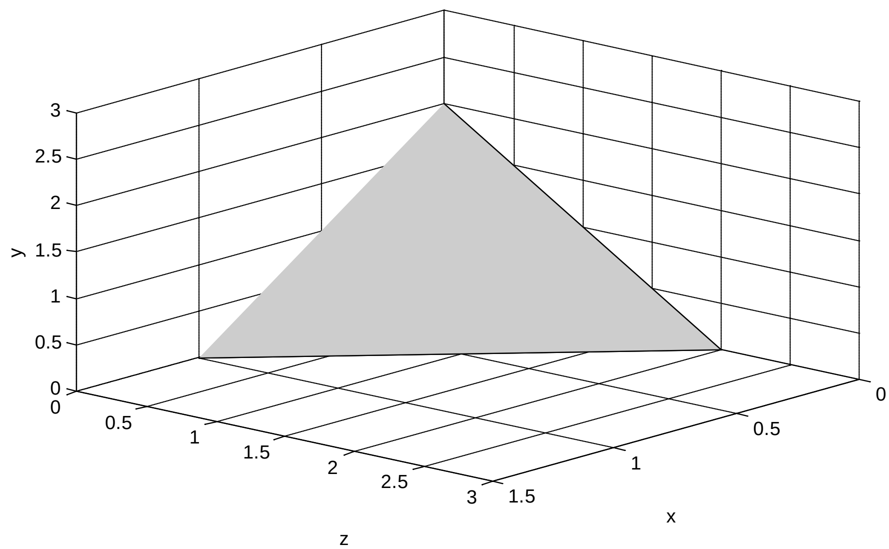

Figure 1: Standard Budget Set

In a general utility maximizing framework over three goods, the budget set identifies a three-dimensional polyhedron, and in this set the utility maximizing choice of any two goods completely identifies the choice of the third (see Figure 1). In the context of our model, however, there is only one degree of freedom in the subjects' choices. In fact, once P is chosen, then, given endowments and prices, the final payoffs, π_D and π_R, are completely determined by the system in (2). That is, the budget set corresponds to a line in a three-dimensional space, and for given values of P, π_D and π_R are completely determined (as shown in Figure 2).

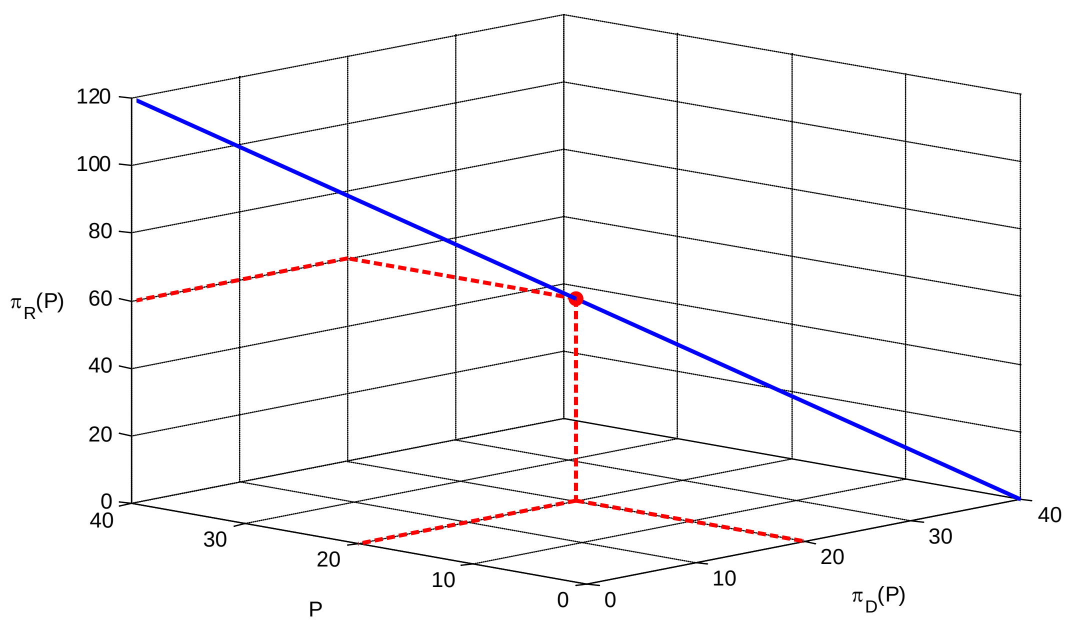

Figure 2: Budget Set in a Modified Dictator Game

In the Andreoni and Miller's set up, violations of the Weak Axiom of Revealed Preferences (WARP) happen in situations such as those depicted in Figure 3, with subjects choosing the two bundles *x* and *y*. If the *y*-bundle is affordable when the *x* bundle is chosen, then when the *y*-bundle is chosen, the *x*-bundle must not be affordable. The proof to establish a violation of WARP in the Andreoni and Miller's context is slightly more complicated than the standard proof, because the budget constraints in the Andreoni and Miller's model are restricted to the budget lines, and allocations below the budget line are not available to the subjects. In particular bundle *x* is not available when *y* is chosen and vice versa.

When only bundles on the budget lines are available, the proof can be established as follows: Let the subject choose bundle *y* when facing budget line A in Figure 3. Since *y* was chosen, it must be that *y* is weakly preferred to bundle x', which is available and costs the same as bundle *y*, so it is affordable. By strict monotonicity, bundle x' is strictly preferred to bundle *x* because it has more of one good and the same of the other. Therefore, by transitivity we conclude that *y* is strictly preferred to *x*. Consider now budget line B and let the subject chooses bundle *x*. Since *x* is chosen when y' was affordable, it must be that *x* is weakly preferred to y'. By strict monotonicity, bundle y' is strictly preferred to bundle *y* because it has a larger quantity of one good and the same of the other. Therefore, by transitivity we have that *x* is strictly preferred to *y*, which contradicts the previous conclusion.

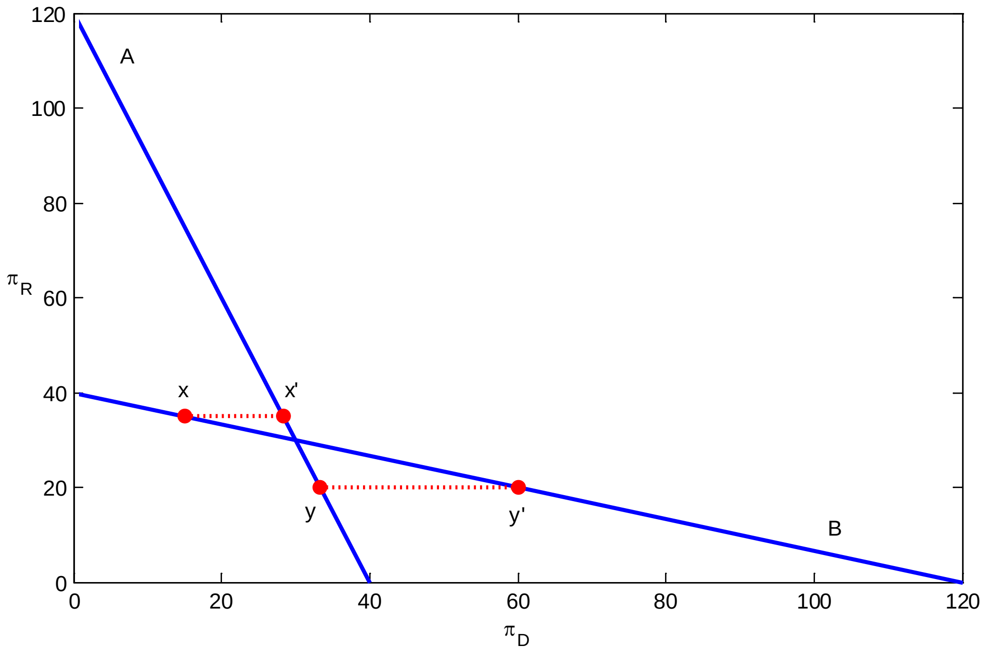

Figure 3: Violation of WARP in Two Dimensions

A similar argument can be used to illustrate a violation of WARP in our three-dimensional set up in Figure 4. Consider budget constraints A and B, identified by the following prices and endowments: A: $E_D = 40$, $E_R = 0$, $p_h = 1$, $p_p = 3$ (this is first budget in Table 1); and B: $E_D = 17$, $E_R = 11$, $p_h = 3$, $p_p = 1$ (second budget in Table 1). Let bundle *x* = (27, 19, 8) be the subject's choice under constraint A and bundle *y* = (37, 9, 3) be the subject's choice under constraint B. We can show2 that these two choices violate WARP. To argue this, consider bundle *x* on budget A and bundle x' = (32, 24, 8) on budget set B. By strict monotonicity, x' is strictly preferred to *x*. Since x' is on budget set B and *y* is the chosen bundle, it must be that *y* is weakly preferred to x'. By transitivity, we conclude that *y* is strictly preferred to *x*. Similarly, consider now bundle *y* on budget line B and bundle y' = (42, 14, 3) on budget line A. By strict monotonicity y'

is strictly preferred to *y*. Since *x* is the chosen bundle when y' is affordable, it must be that *x* is weakly preferred to y'. By transitivity, *x* is strictly preferred to *y*, and this contradicts the previous conclusion.

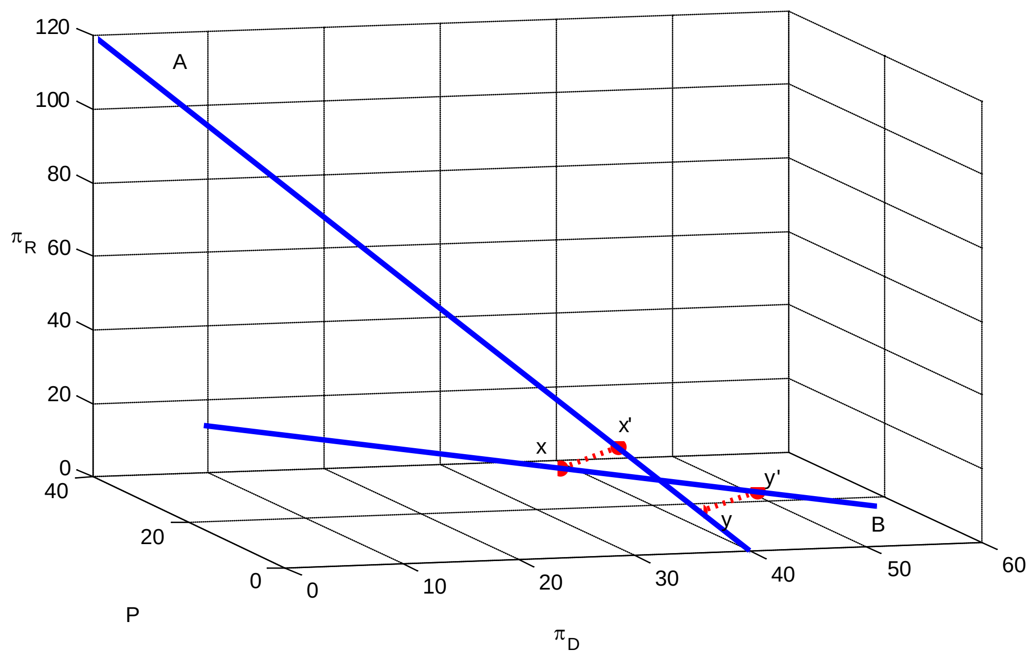

Figure 4: Violation of WARP in Three Dimensions

As Andreoni and Miller observe (page 739), if choices violate WARP, they must also violate SARP; and if they violate GARP then they must also violate SARP, but the opposite is not true. To check for violation of GARP, the General Axiom of Revealed Preferences, we need to consider three budget sets, and remember that having established that three bundles chosen on the three sets do not violate WARP is not enough to establish that they will not violate GARP as well. Indeed, one can find three chosen bundles which satisfy WARP but do violate GARP. To check for GARP, we must consider three mutual intersecting budget lines. Table 1 is constructed so that every set of three budget lines has three mutual intersections. For example, budget lines 1, 2 and 3 intersect with each other at points: lines 1 and 2 at (34.5, 16.5, 5.5), lines 2 and 3 at (24, 20, 9), lines 1 and 3 at (38, 6, 2). Each three intersections of budget lines uniquely define a plane and each of the three budget lines lie in this plane. To check for violation of GARP, we consider choices that belong to the three budgets sets with mutual intersections on a same plane. At this point, checking for GARP in our set up turns out to be identical to the Andreoni and Miller's procedure. Since the three mutual intersecting budget lines must all lie on the same plane, the analysis reduces a two-dimensional study, in the spirit of Andreoni and Miller.

3. The Experimental Procedure

The experiment consisted of 6 sessions conducted in the Experimental Laboratory for Economics and Business Research at Virginia Commonwealth University in the Spring 2009, using the program z-Tree (Fischbacher, 2007). A total of 178 subjects recruited from introductory economics and business classes participated in the experiment. In session 1-4, subjects were randomly assigned by the computer the role of dictator (Blue player) or recipient (Green player). In these sessions, we had 57 dictators and 57 recipients. Subjects earned an average of $8.98. We added sessions 5 and 6, in which, as in the Andreoni and Miller's design, subjects were both dictator and recipients at the same time. In these two sessions, we had 62 subjects who earned an average of $13.06.

Upon arrival, subjects were randomly seated at computer terminals and given a set of instructions (included in the Appendix), which were later read aloud by the experimenter. The instructions concluded with a quiz designed to help the participants become familiar with the type of choices involved in the dictator game. The monitor checked the answers to the quiz to be sure that all subjects clearly understood the nature of the choices. After the quiz, the computer randomly determined the role of each subject, weather dictator (Blue player) or recipient (Green player).

Throughout the session, no communication between subjects was permitted and all information and choices were transmitted through computer terminals. Each Blue player made simultaneously all 18 decisions specified in Table 1.[1] Next, the dictator's decisions were transmitted by the computer anonymously to the recipient randomly paired with that dictator. After the recipients recorded the 18 decisions on their own personal record sheets, the computer randomly determined which of the 18 decisions will

[1] In sessions 5 and 6, all subjects completed the 18 decisions at the same time, while in sessions 1-4, recipients waited until all dictators were finished.

be implemented and paid out. The subjects recorded their payoffs in a personal log sheet and proceeded to be paid privately by an assistant not involved with the experiment. At this time, the subjects also received a $3 participation fee.

4. Dictators' Rationality

The last two columns of Table 1 summarize the average choices for the 18 budgets used, respectively, in the sessions 1-4 and sessions 5-6. Sessions 5-6 and two budget sets – budget 1 and 7 --- are comparable to those reported in Andreoni and Miller, respectively budget 2 and 11. In these two cases dictators pass on average 11.47 under budget 1 and 10.60 under budget 7. For the same budgets, Andreoni and Miller report an average amount passed of 12.80 (budget 2) and 14.80 (budget 11) respectively.

Three budget sets, budgets 3, 6, and 18, are relatively close to representing choices as in the standard dictator game. Under these budgets, the relative price of giving equals 1, and the recipient's endowment is quite small, less than 10 percent of the dictator's endowment. Dictators on average give away 23 percent of their endowment, which is quite close to the pass rates reported in the literature for the standard game. In sessions 1-4, dictators on average pass 4.39 tokens (21 percent of their endowment), 6.46 tokens (21 percent), and 8.46 tokens (20 percent) under budgets 3, 6, and 18, respectively. In sessions 5-6, dictators on average give away 5.48 tokens (26 percent of endowment), 7.69 tokens (25 percent), and 10.29 tokens (25 percent) under budgets 3, 6, and 18, respectively. Combining all six treatments, dictators pass 23 percent of their endowment.

Dictators' giving in sessions 1-4 does not differ from dictators' giving in sessions 1-5. We compared the median amount passed under every budget situation using the Mann-Whitney test. We prefer to compare medians rather than means, because heterogeneity of dictators' giving results in highly non-symmetric and multimodal distributions of the amount passed. For 8 budgets, the medians in sessions 1-4 are identical to the medians in sessions 5-6. For all 18 budgets, the median amounts passed in sessions 1-4 are not significantly different from the median amounts passes in sessions 5-6 at the 5% significance level. We, then, compared the distribution of the amounts passed using the Kolmogorov-Smirnov test. Again, for all 18 budgets, the distributions in sessions 1-4 do not significantly differ from the distributions in sessions 5-6 at the 5% significance level.

	Subject	Number of Violations			Critical Cost Efficiency Index
		WARP	SARP	GARP	
Sessions 1-4:	1	1	1	1	0.98
	10	11	14	14	0.72
	16	4	4	4	0.98
	19	4	4	4	0.98
Sessions 5-6:	60	12	18	17	0.40
	66	3	3	3	0.95
	77	5	5	5	0.90
	87	6	6	6	0.89
	94	6	6	6	0.89
	99	1	1	1	0.98
	104	12	18	18	0.40
	105	2	2	2	0.95
	107	5	5	5	0.90
	109	4	4	4	0.91

Table 2: Violations of Revealed Preference Axioms

Dictators' giving can be rationalized by well-behaved impure altruism utility function $U(\pi_D, \pi_R, P)$. Table 2 reports the analysis of the subjects' behavior and the observed violations of the axioms of revealed preferences. Few dictators violated the axioms. The first four columns of Table 2 list the subjects that violated the axioms and enumerate the number of violations. Out of 119 dictators, 14 (12 percent) violated one or more axioms of revealed preferences.

Even fewer dictators severely violated the axioms. The last column in Table 2 reports Afriat's (1972) Critical Cost Efficiency Index (CCEI) , which can be used to measures the severity of violations. The index shows the highest value by which each budgets have to be relaxed to eliminate all violations of the axioms. The CCEI can be interpreted as the highest amount of wealth that the dictator 'wastes' by making inconsistent choices. Of 14 dictators with violations, 6 have the CCEI above 0.95 (the threshold adopted by Varian (1991)) and 8 have severe violations with a CCEI below 0.95. These 8 subjects appear as ‘wasting’ more than 5% of their wealth.

The observed frequency of violations is quite comparable to that of Andreoni and Miller (2002). Of 176 dictators, they reported 18 violations (10 percent); and 3 violations with a CCEI below 0.95.

The above analysis, in sharp contrast to Andreoni and Miller’ s results, leads us to conclude that a utility function of the form $U(\pi_D, \pi_R)$, according to which subject make choices only over final payoffs, fails to rationalize the dictators’ behavior. Almost all dictators violate the axioms of revealed preferences if we limit our analysis to the final payoff space (π_D, π_R). Of 119 dictators, 100 (84 percent) violate one or more axioms of revealed preferences, and 73 (61 percent) have severe violations with a CCEI below 0.95.

The fact that in our design, the recipients’ endowments may take positive values explains these drastic differences in results. Only when we vary the recipient’s endowment, the possibility of incomplete crowding out leads to violation of the revealed preference axioms. Andreoni and Miller do not detect any violations of the axioms due to incomplete crowding because they never gave recipients a positive endowment.

Our revealed preference tests are quite powerful according to Bronars’ (1987) test. Ex-ante, the test offers many opportunities to violate the axioms. To show this, we generated artificial choices for 50,000 subjects by randomly drawing points from a uniform distribution over each budget set. Most of these random subjects violate the axioms at least once, 81.3 percent violate all three axioms, with an average of 1.72 violations of WARP, 2.17 of SARP, and 2.14 of GARP. Ex-post, dictators make choices that could lead also to many violations. To demonstrate this, we generated artificial choices for 50,000 subjects by randomly drawing from the set of actual choices made by the subjects in the experiment. Again, even more of these bootstrapped subjects violated the axioms, 92.2 percent violated all three axioms, with an average of 2.75 violations of WARP, 3.39 of SARP, and 3.35 of GARP.

4. Estimating Individual Preferences

Having established that the impure altruism utility function $U(\pi_D, \pi_R, P)$ rationalizes the choices for most of the dictators, we will next determine its form and try to estimate its parameters.

Following Andreoni and Miller, we begin by estimating, for every dictator, the parameters of a Constant Elasticity of Substitution utility function

$$U(\pi_D, \pi_R, P) = \left(\alpha\pi_D^\rho + \beta\pi_R^\rho + (1-\alpha-\beta)P^\rho\right)^{\frac{1}{\rho}} .$$

Parameters α and β are the relative weights on the payoff to the dictator and the recipient, respectively. The CES function incorporates a number of other utility functions as special cases as the parameter ρ, which determines the curvature of the indifference curves, varies. As ρ converges to -1, the utility converges to perfect substitutes preferences: $U(\pi_D, \pi_R, P) = \alpha\pi_D + \beta\pi_R + (1-\alpha-\beta)P$; as ρ converges to $-\infty$, the utility converges to The Leontief preferences: $U(\pi_D, \pi_R, P) = \min\{\alpha\pi_D, \beta\pi_R, (1-\alpha-\beta)P\}$; as ρ converges to 0, the utility converges to the Cobb-Douglas preferences $U(\pi_D, \pi_R, P) = \pi_D^\alpha \pi_R^\beta P^{(1-\alpha-\beta)}$.

Maximizing the CES function subject to the budget constraints in (2) yields the following first order condition

$$\alpha\left(\left(E_D - P\right)p_h\right)^{\rho-1} - \beta\left(E_R + Pp_p\right)^{\rho-1} - \left(1-\alpha-\beta\right)P^{\rho-1} = 0,$$

which we solve numerically for the optimal pass $P(E_D, E_R, p_h, p_p; \alpha, \beta, \rho)$.

As in Andreoni and Miller, we specify the econometric model in terms of budget shares:

$$\frac{\pi_{D,i}^n}{m^n} = \frac{\left(E_D^n - P_i\left(E_D^n, E_R^n, p_h^n, p_p^n; \alpha_i, \beta_i, \rho_i\right)\right)p_h^n}{m^n} + \epsilon_i^n, \quad n = 1, \ldots, 18$$

where $P_i(E_D^n, E_R^n, p_h^n, p_p^n; \alpha_i, \beta_i, \rho_i)$ is the optimal pass for subject i under budget n, ϵ_i are i.i.d. normally distributed errors with mean zero and variance σ_i^2, and $m^n = \pi_D^n + \frac{p_h^n}{p_p^n}\pi_R^n$.

Since $0 \le \frac{\pi_{D,i}^n}{m^n} \le 1$, ϵ_i have truncated distributions. We estimate α_i, β_i, ρ_i and σ_i^2 via non-linear two-limit Tobit maximum likelihood. Prior to estimation we omit 30 subjects with uniformly selfish choices, 1 subject that uniformly chose to equalize final payoffs (Leontief), and 2 subjects that uniformly choose to maximize the sum of final payoffs (perfect substitutes).

For the remaining 86 subjects (72 percent), we estimate the parameters using CES specification. For 53 subjects, the sum $\hat{\alpha}_i + \hat{\beta}_i \square 1$; for 52 of these 53 subjects $\hat{\rho}_i < -0.5$. Our small Monte-Carlo study have confirmed that parameters α_i and β_i are poorly identified when the true $\rho < -0.5$. To address this problem we re-estimated the parameters for all subjects with $\hat{\rho}_i < -0.5$ restricting the CES to Leontief preferences. We also re-estimated the parameters for 32 subjects for whom $\hat{\rho}_i$ was within three standard deviations from 0, restricting the CES to Cobb-Douglas preferences. For those subjects for whom we estimated both a Leontief and a Cobb-Douglas function, we report estimates for the specification with the smallest root-mean squared error.

Of 86 subjects, for 21 subjects with $\hat{\rho}_i > -0.5$ --three standard deviations away from zero-- we report the CES estimates. For all of these subjects $\hat{\rho}_i$ is positive, indicating preference toward increasing total payoffs and the amount passed. None of the subjects are selfish attaching the most weight on their own payoff: the maximum value for $\hat{\alpha}_i$ is 0.84 and the average is 0.55. Of the 21 other-regarding subjects, 5 put little weight on pass, with $\hat{\alpha}_i + \hat{\beta}_i > 0.9$. Of the 16 dictators who are concerned about the amount passed, 9 attach little weight on the recipient's final payoff (IN THIS CASE CAN WE STILL CALL THEM OTHER-REGARDING?) with $\hat{\beta}_i < 0.1$.

For 20 subjects we report estimates restricted to the Cobb-Douglas specification. Of these 20 subjects, 5 are mostly concerned about their own payoff, with $\hat{\alpha}_i > 0.9$. Of the 15 remaining other-regarding subjects, 7 attach little weight on pass, with $\hat{\alpha}_i + \hat{\beta}_i > 0.9$. Of the 8 dictators concerned about the amount passed, 7 put little weight on the recipient's final payoff (IN THIS CASE CAN WE STILL CALL THEM OTHER-REGARDING?) with $\hat{\beta}_i < 0.1$.

For 45 subjects we report estimates[2] restricted to the Leontief preference specification. Of these 45 subjects, 7 are mostly concerned about their own payoff, with $\hat{\alpha}_i > 0.9$. Of the remaining 38 other-regarding subjects, 27 put little weight on pass with $\hat{\alpha}_i + \hat{\beta}_i > 0.9$. Of the 11 dictators who are concerned about the amount passed, none attach little weight on the recipient's final payoff, with $\hat{\beta}_i < 0.1$.

We estimated preferences for a total of 86 subjects. Combining our classification for all three specification, , we observe that 12 subjects (10 percent of the total population, 119) are selfish mostly concerned with their own final payoff; 39 subjects (33 percent of the total population) are purely altruistic, mostly concerned with their own and the recipient's final payoff; 35 subjects (29 percent) are impurely altruistic, as they show a significant concern for the amount passed; of these 35 subjects, 16 care little about the final payoff of the recipient.

5. Out-of-Sample Prediction

Our estimates of the subjects' preferences from the previous section allow us to predict the Bolton and Katok (1998) results with an impressive accuracy. Bolton and Katok (1998) conducted two treatments 18-2, in which $E_D = \$18$, $E_R = \$2$, $p_h = \$1$, $p_p = \$1$, and 15-5, in which $E_D = \$15$, $E_R = \$5$, $p_h = \$1$, $p_p = \$1$. Compared to the treatment 18-2, in the treatment 15-5 the experimenter transfers \$3 from the dictator to the recipient. If public giving completely crowds out private giving (which occurs if preferences are defined only over final payoffs) the average amount passed should fall by \$3. Our estimates, however, suggest that many dictators care not only about final payoffs, but also about the amount passed and, thus, crowding out will be incomplete. In particular, we predict that the average amount passed will fall from \$3.70 in the 18-2 treatment to \$2.53 in the 15-5 treatment. Thus, we predict crowding out to be incomplete, about one-third (\$1.17) of the \$3 transfer. Bolton and Katok (1998) also reported incomplete crowding out, as they found that the average amount passed fell by \$1 from

[2] Under the Leontief specification, we do not estimate α_i and β_i directly, but we infer their values from the estimated parameters.

$3.48 in the 18-2 treatment to $2.62 in the 15-5 treatment. The amount of incomplete crowding out that we predict in this paper is close to what Bolton and Katok reported in their 1998 paper. Our prediction is also close to the upper bound reported in the field studies by Bolton and Katok (1998), Kingma (1989), and Payne (1998).

6. Conclusions

Despite overwhelming evidence of unselfish behavior[3], few economic models incorporate altruism. Economists often consider altruism as irrational and are reluctant to formally consider it because 'irrationality' can fit any empirical evidence and, thus, is non-testable. Our research contributes to establishing that unselfish behavior meets economists' definition of rationality and that a standard, testable utility maximization model fits well the evidence from the lab and from the field.

In the spirit of Andreoni and Miller's seminal paper, we have indeed shown that dictator's choices can be rationalized by the impure altruism utility function $U(\pi_D, \pi_R, P)$. Such utility function can rationalize the incomplete crowding out so often observed in the field and in the laboratory

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[3] Even animals often behave altruistically. Vampire bats share blood with one another; dolphins and monkeys exchange favors.

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