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CHARITABLE GIVING WHEN ALTRUISM AND SIMILARITY ARE LINKED

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Charitable Giving When Altruism and Similarity are Linked Julio J. Rotemberg NBER Working Paper No. 17585 November 2011 JEL No. D03,D64,H31

ABSTRACT

This paper presents a model in which anonymous charitable donations are rationalized by two human tendencies drawn from the psychology literature. The first is people's disproportionate disposition to help those they agree with while the second is the dependence of peoples' self-esteem on the extent to which they perceive that others agree with them. Government spending crowds out the charity that ensues from these forces only modestly. Moreover, people's donations tend to rise when others donate. In some equilibria of the model, poor people give little because they expect donations to come mainly from richer individuals. In others, donations by poor individuals constitute a large fraction of donations and this raises the incentive for poor people to donate. The model predicts that, under some circumstances, charities with identical objectives can differ by obtaining funds from distinct donor groups. The model then provides an interpretation for situations in which the number of charities rises while total donations are stagnant.

Julio J. Rotemberg Graduate School of Business Harvard University, Morgan Hall Soldiers Field Boston, MA 02163 and NBER jrotemberg@hbs.edu This paper presents a model that is directed at rationalizing several aspects of charitable giving. First, individuals do not appear to reduce their contributions to a charity significantly when they learn that the government or other individuals have increased the funds that they devote to the charity's beneficiaries. Indeed, there are instances in which people increase their contributions when they hear that others have contributed more. Second, there are often several distinct charities that contribute to the same beneficiaries, and these charities frequently differ by the donor population to whom they target their appeal. Related to this, one sometimes observes increases in the number charitable organizations without a corresponding increase in the contributions relative to income. Lastly, the extent to which individuals contribute to charity differs greatly, even among countries that appear otherwise quite similar.

These observations can be rationalized by supposing that people have social preferences with the properties assumed in Rotemberg (2009). These preferences are based on two human tendencies detected in the empirical psychology literature. The first is that people are happier when they learn that there is more agreement with their point of view. The second is that they have warmer feelings towards, and are more willing to help, individuals whom they perceive as sharing their beliefs or, more generally, individuals who are more similar to themselves. Rotemberg (2009) captures these properties in a utility function and shows that, in combination, they can explain why people vote.

Charitable contributions are similar to voting in that they allow people to signal what they like. People who think a particular charitable cause is worthwhile can signal this attitude to others by contributing, just like voting for a candidate can signal the belief that a candidate is suitable for office. The parallel is in some ways even closer in the sense that both charitable contributions and voting involve the expression of beliefs about how resources ought to be distributed to others. These beliefs are often held quite passionately and it may be particularly important for people to find ways to make other people who share these beliefs feel good about themselves. In the current context, it should lead people who believe in a charitable cause to gain (vicarious) utility from contributing to this cause because they would expect the happiness of other believers to rise when they learn that there are more people like them.

Consistent with Andreoni (1990), whose model also rationalizes the observation that government contributions "crowd-out" private donations only modestly, my results hinge on the supposition that individual utility does not depend only on the public good that is provided by the charity. The extra utility of giving (or "warm glow" to use Andreoni's (1990) phrase) is modeled explicitly as depending on the utility received by others, however.¹ The size of this particular benefit from contributions depends on an individual's assessment of the number of people who agree with him. If an individual perceives this number to be larger, he expects more people to gain from learning that an additional person agrees with them, and his own vicarious benefits from donating rise. This fits broadly with the empirical evidence suggesting that, all else equal, people are more likely to contribute to a cause if they expect the cause to have many other supporters.

Democratic voting systems give one vote to each person regardless of income. Charitable contributions, on the other hand, do vary by income. If preferences do not vary by income, the standard public goods model of Bergstrom, Blume and Varian (1986) predicts this only too well. Indeed, it predicts that all contributors have the same marginal utility of (and level) of private consumption, with the rest of income being contributed to charity. On the other hand, List (2011) shows that, in the U.S, low income donors typically contribute at least as high a proportion of their income to charity as higher income donors.

In my model, higher income individuals have a related reason to contribute more, namely that their income makes them willing to pay a higher price to signal that there is an additional altruist around. One novel implication of the model, on the other hand, is that the contributions of poorer individuals tend to be subject to multiple equilibria. Equilibria where poor individuals do not contribute at all tend to coexist with equilibria in which their donations constitute the bulk of total contributions. The intuition for this multiplicity is

¹Andreoni (1990) refers to the warm glow as an "egoistic" force, in part to contrast this with the altruism implicit in charitable contributions. In my formalization, there is no particular reason to view one of the forces that leads to charity to be more oriented towards the ego than the other.

the following: When only rich people contribute, all individual donations are high so the cost of signaling that there is an additional altruist is high as well. This tends to deter contributions form poorer individuals. By contrast, if the bulk of contributions is made by poor individuals, the typical contribution is small. The cost of signaling that there is an additional altruist can thus be low enough that poor individuals wish to make contributions.

One attractive aspect of this multiplicity of equilibria is that it may help explain why the fraction of contributors to charity varies greatly across countries. According to a recent Gallup survey, 73% of individuals in the United Kingdom donated money to a charitable organization while only 31% of individuals in France did so.² This variability may well be due to sources other than multiple equilibria, though it is worth noting that it is unlikely to be due exclusively to France having a more extensive welfare state. Contributions are widespread in many countries with generous public welfare provisions. In the Netherlands, for example, 77% of individuals contributed to charity according to the same Gallup poll.

This paper is far from the first to suggest that gifts and charitable contributions are related to signaling. However, the important signaling papers of Glazer and Konrad (1996), Bénabou and Tirole (2006) and Ellingsen and Johannessson (2011) suppose that the individual is signaling in a way that makes his own contributions visible. Particularly in the case of large contributions, many contributions are indeed visible to others.³ My emphasis, by contrast, is on contributions whose total is visible to others but whose constituent individual contributions are not. Examples of such anonymous contributions include those made via SMS messages. After the Haiti earthquake of 2010, several organizations set up organization-specific phone numbers such that dialers to these numbers that texted "HAITI" would transfer a fixed sum (most commonly \$10) from their account to the organization in question. The funds raised in this manner were not insubstantial. The American Red Cross apparently raised \$29 million through this scheme.⁴

²See Charities Aid foundation (2010).

 $^{^{3}}$ According to these models this visibility is desired to the donors, who thereby gain the esteem from others. My model suggests that an alternative is possible, namely that it is the charities that desire this visibility so that they can use visible donations to obtain contributions from others.

⁴See Preston and Wallace, 2010.

Individuals may be able to remember their own contributions, so this still leaves the possibility that they are signaling to their future selves as in Bénabou and Tirole (2006). In their model, individuals value this because they would like to believe themselves to be generous. This still leaves open the question of what form of "genuine generosity" it is that people would like to believe themselves to be in possession of. The model in this paper is an attempt at answering this question.

Because it would be attractive to model genuine generosity in a manner that is consistent with people's behavior and attitudes in other domains, I focus on the two psychological forces mentioned at the start.⁵ The first is people's tendency to be more helpful to people that are more similar to them. There are two types of evidence for this. First, there is the cross-sectional positive correlation between similarity and the extent to which people are close in social networks, and thus tend to help each other. This correlation has been called *homophily* and an extensive literature on it is surveyed by McPherson *et al.* (2001). Second, a variety of experiments have sought to vary the extent to which subjects help by changing the extent to which subjects perceive the target of their helping as similar to themselves. Recent experiments showing that perceived similarity raises helping include Stürmer *et al.* (2006) and Valdesolo and DeSteno (2011).⁶

My analysis is also based on the idea that people's utility increases when they think that others agree with them or, in the terminology of Gaillot and Baumeister (2007), when they view others as validating their worldview. Gaillot and Baumeister (2007) provide crosssectional evidence consistent with this: people's self-esteem appears positively correlated with the extent to which they say that others agree with them.⁷ There is also some experimental evidence showing that attempts at changing people's perception of how much others

⁵Earlier evidence for these tendencies is discussed in Rotemberg (2009).

⁶While not involving helping *per se*, the experiments in Walton *et al.* (2011) are notable because a very minimal manipulation of similarity (being mentioned as belonging to a "group") leads to increased effort in a task that fits with the group's name.

⁷People do not give identical responses when they are asked how satisfied they are with themselves than when they are asked how satisfied they are with life as a whole, where the latter is more often used as a stand-in for happiness. Still the two responses are highly correlated. Indeed. Diener and Diener (1995) show that life satisfaction is more correlated with this measure of self- esteem than with the other measures of domain-specific satisfaction they consider.

agree with them affect their reported self-esteem. See, in particular, the studies in Pool et al. (1998) and Kenworthy and Miller (2001).

Pool et al. (1998) shows that the extent to which the opinions held by a group affects an individual's self-esteem depends on the nature of the group, with people caring more about groups that are more similar to themselves. By the same token, individuals's helpfulness appears to depend on similarity along a wide variety of dimensions.⁸ This suggests that, while donors to a charity care about other donors, the extent to which they care about a particular group of donors depends on the extent to which this group is similar to them in other ways. This leads me to analyze whether differentiated charities arise in equilibrium, where these charities provide funds to the same beneficiaries but specialize in collecting funds from distinct groups. As an example of this, many churches conduct their own fundraisers for popular causes. Also, disasters tend to generate fundraising activities by a variety of organizations, at least some of which cater to relatively narrow clienteles.⁹

The model predicts that charitable organizations that are differentiated by donor group can only arise if people do indeed care less about people outside the group than people inside the group. Otherwise, there is a force that tends to push towards the existence of indistinguishable charities. This force is that the typical level of a donation tends to be different in differentiated charities. For donors that do not distinguish among other donors, this difference tends to undermine differentiation by creating an incentive to donate to those charities whose contributions are lowest. The paper thus suggests that an increase in the extent to which people care differentially about donors of their own groups allows for an increase in the differentiation across charities. If this change tastes involves a reduction in the extent to which people care about out-groups, total contributions can fall even as differentiation rises.

This may help provide an interpretation for periods in which contributions stay stagnant relative to GDP while the number of charitable organizations grows. Data from the IRS

 $^{^8 \}mathrm{See}$ Byrne (1967) for a discussion.

⁹In the case of the Haiti earthquake, for example, an organization of Christian media companies called *National Religious Broadcasters* raised SMS funds though a phone number of their own.

shows that the number of tax exempt organizations grew on average by over 3.05 percent in the available sample 1991-2010. On the other hand, the Center on Philanthropy (2010) reports that total charitable giving was the same percent of GDP in 2009 as in 1969. It should be noted that this percentage grew from 1.7% to 2.2% from 1994 to 1999, when the number of tax exempt organizations grew relatively rapidly as well. Still, the number of charities grew by nearly 3% even in the period 1999-2009, when the ratio of giving to GDP declined slightly. An increase in the number of charities need not indicate an increase in differentiation (since the charities that spring up may simply be identical to existing ones). Nonetheless, a model that allows the number of differentiated charities to grow without leading to growth in contributions might be valuable in interpreting these trends.¹⁰

The paper proceeds as follows. The next section summarizes the public goods approach to charity, not only to recapitulate the weaknesses stressed by Sugden (1982) and Andreoni (1988) but also to lay the foundations for the behavioral assumptions added in Section 2. With these assumptions, government spending causes a smaller crowding out than in the public goods case. Moreover, people may respond to news of more contributions by increasing their own donations. Section 3 starts the analysis of the case where people also belong to one of two groups that differ in other ways. Section 4 presents equilibria in which the two groups contribute to distinct charities. The following section studies the inference problem faced by individuals when there is only one set of indistinguishable charities while section 6 presents the resulting equilibria. Section 7 compares outcomes with indistinguishable charities to outcomes where these cater to different types of donors. Section 8 concludes.

1 Background: The standard public goods case

There are N individuals, of which m of belong to a subset A and sympathize with the beneficiaries of a charity. The rest are selfish. All individuals have pre-tax income I, pay

¹⁰In tackling the question of what determines the equilibrium number of charities, this paper is related to Bilodeau and Slivinski (1997), Rose-Ackerman (1982) and Aldashev and Verdier (2010). None of these papers focuses on forces that can potentially increase the number of charities without raising charitable contributions, however.

taxes t and can spend their after-tax income on either privately consumed goods or on charity. Individual i's expenditures on the former are denoted by x_i while those on the latter are denoted by g_i . Individual i's budget constraint is thus

$$x_i + g_i = I - t. \tag{1}$$

The taxes t are used to support the charity's beneficiaries, so the total funds received by these beneficiaries equals

$$G = tN + \sum_{j} g_j \equiv G_{-i} + g_i, \tag{2}$$

where the second equality serves to define G_{-i} , the amount received by the beneficiaries from all sources other than *i*'s voluntary contributions.

The utility function of selfish individuals just depends on their private consumption so that they set $x_i = I - t$. Altruists, on the other hand, have payoffs that depend on the welfare of the beneficiaries so that, as in the standard public goods analysis of charitable contributions of Bergstrom, Blume and Varian (1986), their utility depends on G. For simplicity, I consider a particular functional form that relates the "material payoffs" P_i to x_i and G, namely

$$P_i = \log(x_i) + v \log(G). \tag{3}$$

Preferences with this functional form have been used before in the literature, particularly by Andreoni (1990). Using (1) and (2), these payoffs can be written as

$$P_{i} = \log(I - t - g_{i}) + v \log(G_{-i} + g_{i})$$
(4)

The first order condition for maximizing P_i with strictly positive g_i is

$$-\frac{1}{I-t-g_i} + \frac{v}{G_{-i}+g_i} = 0,$$
(5)

which gives

$$g_i = \frac{v(I-t) - G_{-i}}{1+v}$$
(6)

Consider a symmetric equilibrium in which people all know G_{-i} and set g_i optimally. At this equilibrium, all g_i must equal a common value g so that G equals (gm + tN). Using the first order condition (5), this symmetric equilibrium satisfies

$$g = \frac{vI - (v+N)t}{v+m}.$$
(7)

Total private giving to charity equals mg so that, using (7), the total received by the charity's recipients equals

$$G = \frac{mvI + (N-m)t}{v+m}.$$
(8)

When m = N so that everyone is an altruist, an increase in t has no effect on G. This is Warr's (1982) neutrality result and follows from the ability of altruistic individuals to reestablish the conditions equating the marginal utility of spending on private and public goods by fully offsetting the government's transfers to charity. When m < N, the taxation of people who do not contribute voluntarily increases the total funds available to the charity as in Bergstrom, Blume and Varian (1986). The total increase in G is smaller than the increase in the involuntary contributions of selfish individuals (N - m)t, however. The reason is that altruists respond by curtailing their own contributions by even more than the tax that is levied on them.

As shown in (7), altruists also reduce their own contribution g when the number of altruists m is higher. As far as an altruistic individual i is concerned, the only effect of adding additional altruists is to increase G_{-i} . Equation (6) then implies that g_i falls. As emphasized by Sugden (1982), this effect is likely to be substantial. If one supposes that the slope of individual giving with respect to after tax income is between .02 and .04 percent, which seems realistic for the U.S., v is also between .02 and .04. A one dollar increase in the charity's resources from other sources should lead individual i to reduce his own contribution by 1/(1+v), that is between 96 and 98 cents. This unappealing result comes about because a one dollar increase in G_{-i} is seen by someone who is altruistic towards the charity's recipients as equivalent to having received a dollar of income and having spent that dollar of income on the charity. The person's reaction, then, is to reduce his gifts to charity so that the total increase in the charity's resources are between .02 and .04.

2 Adding self-esteem and altruism for contributors to the standard model

The first modification introduced in this section is to let the utility function of altruists depend on their expectation of the number of people who share their altruism. For this to affect charitable contributions, it is important that people do not know m in advance, so that they use the observed level of G_{-i} to make inferences about m.

For an individual *i* belonging to A, let D_i represent his individualistic payoffs, *i.e.*, the payoffs that do not depend on the payoffs of others. Since the number of people who agree with this individual equals m - 1, we have

$$D_i = P_i + wE_i(m-1), \tag{9}$$

where E_i is the operator that takes expectations based on *i*'s information. The linearity of D_i in $E_i(m-1)$ turns out to be very convenient in the case of multiple types studied below.

In addition, the utility of each member of A depends on the payoffs of the other members. Letting the parameter a capture the intensity of this altruism for other altruists, we have

$$U_i = D_i + aE_i \left(\sum_{j \neq i, j \in A} D_j\right) \tag{10}$$

Since altruists expect other altruists to be identical, altruist *i* each expects all others to have the same private consumption x_j and the same expectation regarding (m-1), $E_j(m-1)$. Using (3), (9) in (10), the utility of altruist *i* is thus

$$U_{i} = \log(x_{i}) + E_{i}(m-1)\log(x_{j}) + v[1 + aE_{i}(m-1)]\log(G) + wE_{i}(m-1)[1 + aE_{i}(E_{j}(m-1))]$$
(11)

I focus on symmetric rational expectations equilibria at which each individual i sets g_i optimally while having correct beliefs about G, t, N, and g, the equilibrium contributions

of other altruists.¹¹ As a result, any altruist i's belief concerning m satisfies

$$E_i(m-1) = \frac{G_{-i} - tN}{g}.$$
 (12)

By the same token, i's expectation of $E_j(m-1)$ when j is any altruist different from i is

$$E_i(E_j(m-1)) = \frac{G_{-i} + g_i - g - tN}{g}.$$
(13)

This differs from $E_i(m-1)$ because *i* realizes that he can affect G_{-j} by changing g_i . Using (12) and (13) in (11), the utility of altruist *i* conditional on G_{-i} is

$$U_{i} = \log(x_{i}) + E_{i}(m-1)\log(I-g) + v\left(1 + a\frac{G_{-i} - tN}{g}\right)\log(G_{-i} + g_{i}) + w\left\{\frac{G_{-i} - tN}{g}\left[1 + a\left(1 + \frac{G_{-i} + g_{i} - g - tN}{g}\right)\right]\right\}$$
(14)

Using (1) to substitute for x_i in this equation, the first order condition for an optimal (interior) level of g_i is

$$-\frac{1}{I-t-g_i} + \frac{v}{G_{-i}+g_i} \left(1 + a\frac{G_{-i}-tN}{g}\right) + \frac{wa(G_{-i}-tN)}{g^2} = 0.$$
 (15)

As required by the second order condition, the derivative of this equation with respect to g_i is negative. Its derivative with respect to G_{-i} is

$$-\frac{v}{(G_{-i}+g_i)^2}\left(1+a\frac{G_{-i}-tN}{g}\right) + \left\{\frac{va}{g(G_{-i}+g_i)} + \frac{wa}{g^2}\right\}.$$
 (16)

In the standard case considered in the previous section, the parameters a and w are zero, so this expression is negative. It then follows that, as discussed above, g_i falls when G_{-i} rises. At the opposite extreme, when a and w are positive while v is negligible, so that the predominant source of donations is the desire to raise the self-esteem of people who share one's altruism, (16) is positive so that g_i rises with G_{-i} . An increase in G_{-i} signals that there are more members of A so that increases in g_i raise the self-esteem of more people.

¹¹While consistent with rational expectations, the assumption that people know g in equilibrium is a strong one. In a more realistic setting, people would have some information about this, but the information would be poorer. The essential feature of the model, namely that G_{-i} conveys information about m should be preserved even if in such a setting, however.

To understand in more detail the conditions under which an increase in G_{-i} raises g_i , it is worth computing the symmetric equilibrium. At such an equilibrium, each individual contribution g_i must equal the common belief about the contributions of others g. Therefore, $g_i = g = (G_{-i} - tN)/(m - 1)$. Using this in (15), this equilibrium satisfies

$$F \equiv \frac{-1}{I - t - g} + v \frac{1 + a(m - 1)}{gm + tN} + w \frac{a(m - 1)}{g} = 0.$$
 (17)

This equilibrium condition simplifies further when t = 0. Equation (17) implies that, in this case.

$$g = \frac{\psi}{1+\psi}I \qquad \text{where} \qquad \psi = v\left(a + \frac{1-a}{m}\right) + (m-1)aw \tag{18}$$

As in the standard analysis discussed earlier, increases in m, the number of contributors to public goods, lower individual contributions when w = 0. This is true even if a > 0 so that an increase in other's donations signals to all altruists that they should obtain a larger vicarious utility gain from an increase in G. Even with a > 0, the main effect of an increase in m is to raise G and lower the marginal utility of donating.

The result that g falls when m rises can be overturned if in addition to a being positive, w is large relative to v. Since g is strictly increasing in ψ and depends on m only through ψ , what is required for this is that $d\psi/dm$ be positive. Therefore, g rises with m if and only if

$$\frac{d\psi}{dm} = -\frac{v(1-a)}{m^2} + wa > 0 \qquad \text{or} \qquad w > \frac{1-a}{a}\frac{v}{m^2}$$
(19)

Notice that this condition turns out to be easier to meet as m and a grow. A reduction in a implies that altruists care less about the self-esteem of other altruists, so that it pushes in the same direction as a reduction in w. An increase in m, by contrast, raises the number of people whose self-esteem is affected by increasing g_i and thus acts in a way that is similar to an increase in w. The role of m in this model might seem problematic because (18) implies that, as m rises without bound, g becomes arbitrarily close to I so that people give almost all their income to charity. It is important to stress, however, that the analysis has been conducted for a fixed population N, and m cannot be larger than this. Moreover, the parameter w may well depend on N itself. If, for example, self-esteem depends on the

fraction of individuals that share one's views rather than on their absolute number, w would be inversely proportional to N. In that case, ψ would not rise with the total population N, though it would still be increasing in m for given N if (19) were satisfied.

Interestingly, condition (19) also ensures that g_i is increasing in G_{-i} . To see this, it suffices to notice that, when t = 0, the expression in (16) equals $1/g^2$ times the leftmost expression (19). Since a positive value of the expression in (16) leads g_i to be increasing in G_{-i} , the conclusion follows.

Three different field experiments suggest that increases in m and G_{-i} raise g_i . The most direct evidence is in Frey and Meier (2004) who selectively provided information to students in Zurich about past contributions. When the data they provided suggested that past contributions had been widespread, individual were more likely to contribute than when they provided no such data. The contribution rate fell further when they provided information suggesting that past participation was low. Similarly, List and Lucking-Reiley (2002) show that contributions rise when more "seed money" is available for the purchase of a university computer. Finally, Shang and Croson (2009) manipulate how public radio volunteers respond to incoming calls wishing to make a donation. They find that these donors make larger contributions if they are told that someone else has given more.

This observed complementarity between donations and expectations of other's donations contradicts the standard model described earlier (which implies that these variables are substitutes).¹² It also contradicts the version of Andreoni's (1990) "warm glow" model where the benefits of donations are "purely egoistic" in that individuals derive utility only from their own donations and not from G. The reason is that, in this case, G_{-i} should exert no influence on g_i . As demonstrated by Romano and Yildirim (2001), a "mixed" model where i's utility depends on both his own donation g_i and on total donations G need no be inconsistent with a positive response of g_i to G_{-i} . What is necessary for this to be the case, however, is that second partial derivatives satisfy certain properties. In the case where the

 $^{^{12}}$ It may be consistent, however, with a public goods model which includes asymmetric information, as in Vesterlund (2003).

utility function is separable in private goods, what is needed is that the derivative of utility with respect to g_i (the "warm glow effect") be larger when total donations are higher. It is not immediately apparent when utility functions should be expected to have this property, however, so that the current paper can be seen as an attempt to provide a psychological foundation for this feature.

I now proceed to study the extent to which an increase in taxes t that is matched by increased government expenditures on G leads to declines in individual contributions. Differentiating the equilibrium condition (17), we have

$$\frac{dg}{dt} = -\frac{dF/dt}{dF/dg} \qquad \text{where} \begin{bmatrix} -\frac{dF}{dt} &= \frac{1}{(I-t-g)^2} + \frac{v(1+a(m-1))N}{(mG+tN)^2} \\ -\frac{dF}{dg} &= \frac{1}{(I-t-g)^2} + \frac{v(1+a(m-1))n}{(mG+tN)^2} + \frac{wa(m-1)}{g^2}. \end{aligned}$$
(20)

Both -dF/dt and -dF/dg are positive. When w = 0, so that self-esteem considerations are absent, the former is strictly larger than the latter because N exceeds m. Thus a one dollar increase in taxes leads contributors to lower their contributions by more than one dollar. This result also obtained when both a and w were zero, so this shows that altruism among members of A is not sufficient to overturn this result. If, however, w and a are both positive, it becomes possible for dF/dg to exceed dF/dt so that dg/dt is smaller than one in absolute value.

For given w, a and n, the absolute value of dg/dt shrinks together with v. For illustrative purposes it is thus useful to study the limit where v is negligible. At that point, (17) simplifies so that the equilibrium value of g is given by

$$g = \frac{wa(m-1)}{1 + wa(m-1)}(I-t).$$
(21)

A one dollar increase in t thus has the same effect on the contributions of members of A as a one dollar reduction in I. If individuals contributions rise by 2 to 4 cents with a one dollar increase in income, this reduction in contributions is negligible. Total crowding out is smaller still since a one dollar increase in taxes raises total revenue by N dollars of which only m * dg/dI are crowded out. If the fraction of contributors m/N is 70 percent, total crowding out is between 1.5 and 3 cents per dollar. A rich empirical literature has sought to determine the extent to which government transfers to charities crowd out private donations. The estimates range widely, though relatively few studies find the nearly complete crowd out predicted by the model when w is set to zero. What we just established is that much lower levels of crowding out, even the negligible crowd-out found by Ribar and Wilhelm (2002), can be rationalized if one is willing to reduce v and increase w.

3 A model with two types

From now on, I let the population contain two types of individuals H and L, where these types can potentially differ in their income, in the fraction of altruists within each type, and in the tastes of the altruists of each type. As a result, the voluntary contributions of altruists of type H, g^H will generally differ in equilibrium from g^L , the voluntary contributions of altruists of type L.

Let the N_H individuals who belong to the set H have income I^H while the N^L individuals who belong to set L have income I^L with $I^H \ge I^L$. The tastes of altruists of type H can in principle differ from those of altruists of type L, though I mostly study special cases in which the tastes are the same.

Instead of being given by (3), the material payoffs of an altruist of type τ are now given by

$$P_i^{\tau} = \log(x_i) + v^{\tau} \log(G) \qquad r = H, L.$$

$$(22)$$

Similarly, equation (9) for total individualistic payoffs is replaced by

$$D_i^{\tau} = P_i^{\tau} + w^{\tau\tau} E_i^{\tau} (m^{\tau} - 1) + w^{\tau\omega} E^{\tau} (m^{\omega}) \qquad \tau, \omega = H, L; \ \omega \neq \tau$$
(23)

so that the self-esteem of an altruist of type τ can depend differentially on their expectations of the number of altruists of type H and the number of altruists of type L. Lastly, equation (10) for overall utility is replaced by

$$U_i^{\tau} = D_i^{\tau} + a^{\tau\tau} E_i^{\tau} \left(\sum_{j \neq i, j \in A} D_j^{\tau} \right) + a^{\tau\omega} E_i^{\tau} \left(\sum_{j \in A} D_j^{\omega} \right), \qquad \tau, \omega = H, L; \qquad \tau \neq \omega$$
(24)

so that an altruist of type τ can care differentially for altruists of types H and L.

The maximization of U_i^{τ} can be simplified somewhat by noting that individual *i* expects all the altruists of the same type to choose the same level of x, x_j^{τ} . Using (22), and (23) in (24), we obtain

$$U_{i}^{\tau} = \log(x_{i}^{\tau}) + \left[v^{\tau}(1 + a^{\tau\tau}E_{i}^{\tau}(m^{\tau} - 1)) + v^{\omega}a^{\tau\omega}E_{i}^{\tau}(m^{\omega})\right]\log(G) + \left\{ \left(a^{\tau\tau}\log(x_{j}^{\tau}) + w^{\tau\tau}\right)E_{i}^{\tau}(m^{\tau} - 1) + \left(a^{\tau\omega}\log(x_{j}^{\omega}) + w^{\tau\omega}\right)E_{i}^{\tau}(m^{\omega})\right\} + E_{i}^{\tau}\left((m^{\tau} - 1)a^{\tau\tau}[w^{\tau\tau}E_{j}^{\tau}(m^{\tau} - 1) + w^{\tau\omega}E_{j}^{\tau}(m^{\omega})] + m^{\omega}a^{\tau\omega}[w^{\omega\tau}E_{j}^{\omega}(m^{\tau}) + w^{\omega\omega}E_{j}^{\omega}(m^{\omega} - 1)]\right),$$

$$\tau, \omega = H, L; \tau \neq \omega, j \neq i$$
(25)

The terms inside curly brackets depend exclusively on factors that are outside *i*'s control. It is thus helpful to define \tilde{U}_i^{τ} as being equal to U_i^{τ} after subtracting the terms in curly brackets.

If H and L have the same tastes, both v^H and v^L should equal a common value v, $a^{\tau\tau}$ and $w^{\tau\tau}$ should be independent of τ and both $a^{\tau\omega}$ and $w^{\tau\omega}$ for $\tau \neq \omega$ should not depend on whether H equals τ or ω . In an even more special case, individuals do not pay attention to the question of whether another person is of type H or L so that $a^{\tau\omega}$ and $w^{\tau\omega}$ equal $a^{\tau\tau}$ and $w^{\tau\tau}$ respectively. Given the evidence discussed in the introduction, it seems reasonable to suppose that people of type τ care more about people of type τ than they care about people of the other type. The differential caring for one's own type then implies that, when $\tau \neq \omega$, $a^{\tau\tau} > a^{\tau\omega}$ and $w^{\tau\tau} > w^{\tau\omega}$.

Taking his budget constraint and G_{-i}^{τ} as given, individual *i* of type τ 's gain from a small increase in his contribution g_i^{τ} is

$$\frac{d\tilde{U}_{i}^{\tau}}{dg_{i}^{\tau}} = \frac{-1}{I^{\tau} - g_{i}^{\tau}} + \frac{v^{\tau}}{G} + a^{\tau\tau}E_{i}^{\tau}(m^{\tau} - 1)\left[\frac{v^{\tau}}{G} + w^{\tau\tau}\frac{dE_{j}^{\tau}(m^{\tau})}{dg_{i}^{\tau}} + w^{\tau\omega}\frac{dE_{j}^{\tau}(m^{\omega})}{dg_{i}^{\tau}}\right],
+ a^{\tau\omega}E_{i}^{\tau}(m^{\omega})\left[\frac{v^{\omega}}{G} + w^{\omega\tau}\frac{dE_{j}^{\omega}(m^{\tau})}{dg_{i}^{\tau}} + w^{\omega\omega}\frac{dE_{j}^{\omega}(m^{\omega})}{dg_{i}^{\tau}}\right] \qquad \tau, \omega = H, L, \ \tau \neq \omega, \quad j \neq i.$$
(26)

In the equilibria I consider, individuals pick g_i^{τ} optimally so that (26) equals zero if g_i^{τ} is positive while (26) is nonpositive if g_i^{τ} is zero. It turns out that two different kinds of equilibria are possible. I start with the simplest, namely ones where the two types of

altruists make contributions to observably distinct charities. After studying the conditions under which such separating equilibria are possible, I turn my attention to equilibria where all charities are indistinguishable.

4 Equilibria with contributions to distinct charities

If altruists of type H contribute to different charities than altruists of type L, charities are distinguished by type, and I let G^{τ} denote the total contribution to charities that cater to individuals of type τ . I consider rational expectations equilibria in which each agent ihas correct beliefs about the total amount contributed to both charities by people other than himself, where these amounts equal G^{τ} minus his own contributions, and I denote these amounts by G_{-i}^{τ} . Each agent also has correct beliefs about g^{τ} , the amount that other altruists of type τ contribute to charity τ in equilibrium. Given these beliefs' i's expectations concerning the number of other altruists must satisfy

$$E_i^{\tau}(m^{\tau}-1) = \frac{G_{-i}^{\tau}}{g^{\tau}} \qquad E_i^{\tau}(m^{\omega}) = \frac{G^{\omega}}{g^{\omega}} \qquad \tau, \omega = L, H \qquad \tau \neq \omega.$$
(27)

Each type of altruist can in principle contribute to either type of charity. At a separating equilibrium of the sort considered here, however, an altruist of type τ contributes only to charities of type τ so that dg_i^{τ} in (26) raises only G^{τ} . Using (27), equation (26) implies that the resulting benefits of increasing g_i^{τ} slightly are given by

$$-\frac{1}{I^{\tau}-g_{i}^{\tau}}+\frac{v^{\tau}}{G}+a^{\tau\tau}\frac{G_{-i}^{\tau}}{g^{\tau}}\left(\frac{v^{\tau}}{G}+\frac{w^{\tau\tau}}{g^{\tau}}\right)+a^{\tau\omega}\frac{G^{\omega}}{g^{\omega}}\left(\frac{v^{\omega}}{G}+\frac{w^{\omega\tau}}{g^{\tau}}\right), \qquad \tau,\omega=L,H \qquad \tau\neq\omega.$$

At a symmetric rational expectations equilibrium in which both g^H and g^L are positive, these expressions must equal zero while g_i^{τ} must equal to g^{τ} and G^{τ} must equals $g^{\tau}m^{\tau}$. Therefore,

$$-\frac{1}{I^{\tau}-g^{\tau}} + \left[\frac{v^{\tau}(1+a^{\tau\tau}(m^{\tau}-1))+v^{\omega}a^{\tau\omega}m^{\omega}}{m^{\tau}g^{\tau}+m^{\omega}g^{\omega}} + \frac{a^{\tau\tau}(m^{\tau}-1)w^{\tau\tau}+a^{\tau\omega}m^{\omega}w^{\omega\tau}}{g^{\tau}}\right] = 0. \quad (28)$$
$$\tau, \omega = H, L; \quad \tau \neq \omega.$$

Notice that, at a separating equilibrium with $g^{\tau} > 0$ the equations in (27) allow altruists to infer m^{τ} without error. The conditions in (28) are necessary for a such an equilibrium, and turn out to be easily met:

Proposition 1. There exists a pair of values g^L and g^H with $0 < g^{\tau} < I^{\tau}$ that solve (28).

Proof. For fixed $g^{\omega} > 0$, the limit of the left hand side of (28) when g^{τ} goes to zero from above is plus infinity while the limit when it goes to I^{τ} from below is minus infinity. There is thus a zero between 0 and I^{τ} for every positive g^{ω} .

This establishes that one can find a pair of values g^L and g^H that satisfy these necessary conditions. For this pair to be an actual equilibrium, altruists of type τ must not wish to deviate by contributing to the charity that receives funds from altruists of type ω where $\omega \neq \tau$. Since (28) ensures that altruists of type τ are indifferent to a small change in G^{τ} that is financed by an offsetting change in x_i^{τ} , this is equivalent to requiring that altruists of type τ not be willing to reduce G^{τ} by dg_i while raising G^{ω} by the same amount. According to (27), this deviation would raise all other individual's estimate of m^{ω} by dg_i/g^{ω} while lowering their estimate of m^{τ} by dg_i/g^{τ} . As a result, (25) implies that these deviations would raise the utility of altruists of type L and H respectively if and only if

$$a^{LL}(m^{L}-1)\left(\frac{w^{LH}}{g^{H}}-\frac{w^{LL}}{g^{L}}\right)+a^{LH}m^{H}\left(\frac{w^{HH}}{g^{H}}-\frac{w^{HL}}{g^{L}}\right)>0$$
(29)

$$a^{HH}(m^{H}-1)\left(\frac{w^{HL}}{g^{L}}-\frac{w^{HH}}{g^{H}}\right)+a^{HL}m^{L}\left(\frac{w^{LL}}{g^{L}}-\frac{w^{LH}}{g^{H}}\right)>0.$$
(30)

This leads to two conclusions:

Proposition 2. If $v^L = v^H a^{LL} = a^{LH} = a^{HL} = a^{HH}$ and $w^{LL} = w^{LH} = w^{HL} = w^{HH}$ while $I^H > I^L$, no separating equilibrium exists.

Proof. Setting $a \equiv a^{LL} = a^{LH} = a^{HL} = a^{HH}$ and $w \equiv w^{LL} = w^{LH} = w^{HL} = w^{HH}$, (30) implies that a separating equilibrium exists only if $g^L \ge g^H$. On the other hand, inspection of (28) under the conditions of the proposition implies that the numerators of the terms in square brackets are independent of τ so that, given that $I^H > I^L$, $g^H > g^L$

Proposition 3. As long as $m^{\tau} > 1$ while I^{τ} , a^{HH} , a^{LL} , w^{HH} and w^{LL} are strictly greater than zero, a separating equilibrium exists if a^{LH} , a^{HL} , w^{LH} and w^{HL} are low enough.

Proof. If $m^{\tau} > 1$ while I^{τ} , a^{HH} , a^{LL} , w^{HH} and w^{LL} are positive, the values of g^{L} and g^{H} that solve (28) are strictly positive even if a^{LH} , a^{HL} , w^{LH} and w^{HL} are all set arbitrarily close to zero. At the same time, the positive terms of (29) and (30) are arbitrarily small for arbitrarily low values of a^{LH} , a^{HL} , w^{LH} and w^{HL} so that, for these values, both inequalities are violated.

Together, these propositions establish that situations where all altruists care identically about each other are inconsistent with the existence of separate charities that cater to the two types. If, at the opposite extreme, altruists of type τ care almost exclusively about altruists of their own type and have have self-esteem that is depends almost exclusively on the attitudes of people of their own type, type-specific charities arise. For a tightly parameterized example, Proposition 9 below presents a more continuous version of this result, so that smooth reductions in the degree to which altruists care about people of the other type make it easier to sustain a separating equilibrium.

An extreme special case that is particularly revealing involves the limit when v^L and v^H go to zero while $a^{HL} = a^{LH} = w^{HL} = w^{LH} = 0$, so that altruists of type τ care only about other altruists of type τ . Proposition 3 implies that a separating equilibrium exists while (28) implies that it satisfies

$$g^{\tau} = \frac{a^{\tau\tau} w^{\tau\tau} (m^{\tau} - 1) I^{\tau}}{1 + a^{\tau\tau} w^{\tau\tau} (m^{\tau} - 1)}.$$

This shows that, as one might expect, contributions rise with altruism $a^{\tau\tau}$, the effect of agreement on self-esteem $w^{\tau\tau}$, and the number of altruists of type τ , m^{τ} . It also shows that, if all types have the same tastes (as defined by $a^{\tau\tau}$ and $w^{\tau\tau}$) and their altruists are equally numerous, the type whose I^{τ} is higher also has higher private consumption $I^{\tau} - g^{\tau}$. The reason for this is that increases in I^{τ} raise individual contributions g^{τ} and this raises the cost of signaling that there is one additional individual of type τ . This prompts individuals to shift resources from contributions towards private consumption. The model is thus consistent with the coexistence of positive charitable contributions by lower income individuals and a strictly positive correlation of individual income and consumption.

5 Expectations of m^{τ} when charities are indistinguishable

I now turn to the case where charities are indistinguishable. The first issue that arises in this case is how people make inferences about the two m's, now that they only observe the total level of contributions. As before, I assume that individuals have correct beliefs about g^H and g^L , the equilibrium contributions made by other people of the two types. While this helps altruists obtain estimates of the expected values of m^L and m^H , these estimates will now generally differ from the realized values of these variables.

In calculating these expectations, I neglect integer constraints and suppose that every individual's prior distribution for m^{τ} is uniformly distributed between 0 and N^{τ} . Conditional on being an altruist of type τ , an individual's subjective distribution of m^{τ} is thus uniform between 1 and N^{τ} so that it has a mean of $1 + (N^{\tau} - 1)/2$. As long as the origin of the y-axis is interpreted to start at 1, the box depicted in Figure 1 gives the *ex ante* range of all possible values of m^L and m^H for an individual of type L. All the combinations inside this box satisfy $1 \le m^L \le N^L$ and $0 \le m^H \le N^H$ and are *ex ante* equally likely.

The knowledge of total contributions by others, G_i^{τ} then limits the possible values of m^H , m^L , or both. To see this, focus first on an individual *i* of type *L*. This individual knows that at a symmetric equilibrium

$$g^{H}m^{H} + g^{L}(m^{L} - 1) = G^{L}_{-i},$$
(31)

If $G_{-i}^L < N^H g^H$, this individual perceives that the maximum possible value for m^H is smaller than N^H . If this inequality is reversed, this individual cannot rule out the possibility that m^H is equal to N^H . In this case, his perception regarding the minimum value of m^L is that it is strictly larger than one (because even if $m^H = N^H$ other individuals of type L must be making voluntary contributions). Similarly, if $G_{-i}^L < (N^L - 1)g^L$, *i* views the maximum possible value of m^L to be lower than N_L . If, instead, this latter inequality is reversed, m^L can equal N^L while the minimum value of m^H is above zero. Thus, depending on whether G_{-i}^L is above or below $N^H g^H$ and $(N^L - 1)g^L$, we obtain four qualitatively different kinds of outcomes. These are depicted in Figures 1-4.

First, suppose that, as in Figure 1, $(N^L - 1)g^L$ is smaller than G_{-i}^L , which is in turn smaller than $N^H g^H$. Aside from satisfying (31), the feasible *m*'s must remain inside the box that satisfies $1 \le m^L \le N^L$ and $0 \le m^H \le N^H$. The result is that the *m* combinations that an altruist of type *L* sees as possible after observing G_{-i}^L lie on the line between the points $\{(G_{-i}^L - (N^L - 1)g^L)/g^H, N_L\}$ and $\{G_{-i}^L/g^H, 0\}$. Since all these combinations are equally likely, the posterior distribution of m^H is uniformly distributed between $(G_{-i}^L - (N^L - 1)g^L)/g^H$ and G_{-i}^L/g^H while that of m^L remains uniformly distributed between 1 and N^L . As a result, small changes in G_{-i}^L have no effect on the posterior distribution of m^L . This result is obvious when g^L equals zero, and its extension to the case where g^L is "small" obtains here under special assumptions. Still, there is a simple intuition that is associated with this result and it suggests that it might be valid more generally. This intuition is that G_{-i}^L contains very little information about the range of the possible values of m^L when N^L and g^L are small enough that the level of contributions is consistent with both $m^L = 0$ and $m^L = N^L$.

Figure 2 shows that altruists reach analogous inferences when $N^H g^H$ is smaller than G_{-i}^L , which is smaller than $(N^L - 1)g^L$. In this case, their conclusion from G_{-i}^L is that m^H remains uniformly distributed between 0 and N^H while $(m^L - 1)$ is uniformly distributed between $(G_{-i}^L - n^H g^H)/g^L$ and G_{-i}^L/g^L .

Figure 3 turns to the case where G_{-i}^{L} is smaller than both $(N^{L} - 1)g^{L}$ and $N^{H}g^{H}$. Individual *i* then perceives that m^{L} can be between 1 and $1 + G_{-i}^{L}/g^{L}$, while m^{H} can be between 0 and G_{-i}^{L}/g^{H} . Given that all the values inside the box bordered by $m^{H} = N^{H}$ and $m^{L} = N^{L}$ were equally likely ex ante, and that the individuals knows that (31) must hold, all the outcomes on the line between $\{1, 1 + G_{-i}^{L}/g^{L} \text{ and } \{G_{-i}^{L}/g^{H}, 0\}$ are equally likely ex post. As a result, the posterior distribution of m^{H} is uniformly distributed between 0 and G_{-i}^{L}/g^{H} .

The leaves the last qualitative outcome, which arises when G_{-i}^L is larger than both $N^H g^H$

and $(N^L - 1)g^L$. The result is depicted in Figure 4. The *m*'s that are consistent with *i*'s information lie once again at the intersection of the line between $\{0, 1 + G_{-i}^L/g^L\}$ and $\{G_{-i}^L/g^H, 0\}$ and the subset of the plane given by $1 \le m^L \le N^L$ and $0 \le m^H \le N^H$. Since these combinations of *m* are all equally likely, the posterior distribution of m^H is uniform between $(G_{-i}^L - (N^L - 1)g^L)/g^H$ and N^H while that of m^L is uniform between $(G_{-i}^L - N^H g^H)/g^L$ and N^L .

Using (31), it is apparent that whether G_{-i}^{L} is greater than or smaller than $N^{H}g^{H}$ hinges on the relationship between g^{L}/g^{H} and $(N^{H} - m^{H})/(m^{L} - 1)$ while the question of whether G_{-i}^{L} is greater or smaller than $(N^{L} - 1)g^{L}$ hinges on the relationship between g^{L}/g^{H} and $m^{H}/(N^{L} - m^{L})$. If, in particular, g^{L}/g^{H} is smaller than both these critical values, Figure 1 applies, while Figure 3 is relevant when it is larger than both. If g^{L}/g^{H} is smaller than $(N^{H} - m^{H})/(m^{L} - 1)$ and larger than $m^{H}/(N^{L} - m^{L})$, the situation is described by Figure 3, while Figure 4 applies if g^{L}/g^{H} is smaller than the latter and larger than the former. The expectations held by altruist *i* of type *L* concerning m^{L} and m^{H} thus satisfy:

$$\frac{g^{L}}{g^{H}} \leq \min\left(\frac{N^{H}-m^{H}}{m^{L}-1}, \frac{m^{H}}{N^{L}-m^{L}}\right) : \quad E_{i}^{L}(m^{L}-1) = \frac{N^{L}-1}{2}, \qquad E_{i}^{L}(m^{H}) = \frac{2G_{-i}^{L}-(N^{L}-1)g^{L}}{2g^{H}} \\
\frac{m^{H}}{N^{L}-m^{L}} \leq \frac{g^{L}}{g^{H}} \leq \frac{N^{H}-m^{H}}{m^{L}-1} : \qquad E_{i}^{L}(m^{L}-1) = \frac{G_{-i}^{L}}{2g^{L}}, \qquad E_{i}^{L}(m^{H}) = \frac{G_{-i}^{L}}{2g^{H}} \\
\frac{N^{H}-m^{H}}{m^{L}-1} \leq \frac{g^{L}}{g^{H}} \leq \frac{m^{H}}{N^{L}-m^{L}} : \qquad E_{i}^{L}(m^{L}-1) = \frac{N^{L}-1}{2} + \frac{G_{-i}^{L}-N^{H}g^{H}}{2g^{L}}, \qquad E_{i}^{L}(m^{H}) = \frac{N^{H}}{2} + \frac{G_{-i}^{L}-(N^{L}-1)g^{L}}{2g^{H}} \\
\frac{g^{L}}{g^{H}} \geq \max\left(\frac{N^{H}-m^{H}}{m^{L}-1}, \frac{m^{H}}{N^{L}-m^{L}}\right) : \qquad E_{i}^{L}(m^{L}-1) = \frac{2G_{-i}^{L}-N^{H}g^{H}}{2g^{L}}, \qquad E_{i}^{L}(m^{H}) = \frac{N^{H}}{2}.$$
(32)

The analysis for an altruist of type H is quite similar, though not identical. One obvious difference is that, if the equilibrium value of g^H differs from that of g^L , the equilibrium value of G^H_{-i} differs from that G^L_{-i} . A related difference is that an altruist of type H realizes that m^H equals at least 1, whereas an altruist of type L does not know this. The result is that, for H, the formulas governing inference depend on whether G^H_{-i} is greater or less than $N^L g^L$ and $(N^H - 1)g^H$. Still, an analysis along the lines of the one above establishes that this altruist's expectations of m^L and m^H satisfy

$$\frac{g^{L}}{g^{H}} \leq \min\left(\frac{N^{H}-m^{H}}{m^{L}}, \frac{m^{H}-1}{N^{L}-m^{L}}\right) : \quad E_{i}^{H}(m^{L}) = \frac{N^{L}}{2}, \qquad \qquad E_{i}^{H}(m^{H}-1) = \frac{2G_{-i}^{H}-N^{L}g^{L}}{2g^{H}} \\
\frac{m^{H}-1}{N^{L}-m^{L}} \leq \frac{g^{L}}{g^{H}} \leq \frac{N^{H}-m^{H}}{m^{L}} : \qquad E_{i}^{H}(m^{L}) = \frac{G_{-i}^{H}}{2g^{L}}, \qquad \qquad E_{i}^{H}(m^{H}-1) = \frac{G_{-i}^{H}}{2g^{H}} \\
\frac{N^{H}-m^{H}}{m^{L}} \leq \frac{g^{L}}{g^{H}} \leq \frac{m^{H}-1}{N^{L}-m^{L}} : \qquad E_{i}^{H}(m^{L}) = \frac{N^{L}}{2} + \frac{G_{-i}^{H}-(N^{H}-1)g^{H}}{2g^{L}}, \qquad E_{i}^{H}(m^{H}-1) = \frac{N^{H}-1}{2} + \frac{G_{-i}^{H}-N^{L}g^{L}}{2g^{H}} \\
\frac{g^{L}}{g^{H}} \geq \max\left(\frac{N^{H}-m^{H}}{m^{L}}, \frac{m^{H}-1}{N^{L}-m^{L}}\right) : \qquad E_{i}^{H}(m^{L}) = \frac{2G_{-i}^{H}-N^{H}g^{H}}{2g^{L}}, \qquad \qquad E_{i}^{H}(m^{H}-1) = \frac{N^{H}-1}{2}. \\
\end{cases}$$

$$(33)$$

The equilibrium depends, once again, on the effect of changes in individual contributions on the perceived number of altruists. Regardless of whether an individual i is of type L or H, an increase in his own contribution g_i by one dollar raises the G_j^{τ} of all other agents by one dollar. At the boundary values of (32) and (33), the change in the perceived values of m^H and m^L is different for altruists of the two types. However, the effect is the same in the interior of these regions. To see this, differentiate (32) and (33), which yields

$$\frac{g^{L}}{g^{H}} < \min\left(\frac{N^{H}-m^{H}}{m^{L}}, \frac{m^{H}-1}{N^{L}-m^{L}}\right) : \frac{dE_{j}^{\tau}(m^{L})}{dg_{i}^{\omega}} = 0, \qquad \frac{dE_{j}^{\tau}(m^{H})}{dg_{i}^{\omega}} = \frac{1}{g^{H}}
\frac{m^{H}}{N^{L}-m^{L}} < \frac{g^{L}}{g^{H}} < \frac{N^{H}-m^{H}}{m^{L}} : \qquad \frac{dE_{j}^{\tau}(m^{L})}{dg_{i}^{\omega}} = \frac{1}{2g^{L}}, \qquad \frac{dE_{j}^{\tau}(m^{H})}{dg_{i}^{\omega}} = \frac{1}{2g^{H}}
\frac{N^{H}-m^{H}}{m^{L}-1} < \frac{g^{L}}{g^{H}} < \frac{m^{H}-1}{N^{L}-m^{L}} : \qquad \frac{dE_{j}^{\tau}(m^{L})}{dg_{i}^{\omega}} = \frac{1}{2g^{L}}, \qquad \frac{dE_{j}^{\tau}(m^{H})}{dg_{i}^{\omega}} = \frac{1}{2g^{H}}
\frac{g^{L}}{g^{H}} > \max\left(\frac{N^{H}-m^{H}}{m^{L}-1}, \frac{m^{H}}{N^{L}-m^{L}}\right) : \qquad \frac{dE_{j}^{\tau}(m^{L})}{dg_{i}^{\omega}} = \frac{1}{g^{L}}, \qquad \frac{dE_{j}^{\tau}(m^{H})}{dg_{i}^{\omega}} = 0,$$
(34)

for τ and ω equal to H or L, where j must differ from i when $\omega = \tau$.

One notable aspect of (34) is that the second and third lines are identical. Thus, the derivatives of beliefs about the m's with respect to total contributions when g^L/g^H takes on "intermediate" values does not depend on whether $m^H/(N^L - m^L)$ is smaller than or greater than $(N^H - m^H)/m^L$. The former is in fact larger than the latter if

$$m^{H}m^{L} < (N^{H} - m^{H})(N^{L} - m^{L})$$
 or $\frac{m^{H}}{N^{H}} + \frac{m^{L}}{N^{L}} < 1.$ (35)

With m^H/N^H and m^L/N^L having a standard uniform distribution and both N^L and N^H fixed, this inequality is satisfied for one half of all possible realizations of m^H and m^L . Because the case where this inequality holds is so similar to the case where it does not, I carry out the analysis only for one case, namely the case where it holds.

6 Equilibria with heterogeneous gifts to an indistinguishable set of charities

In this section, I construct equilibria in which the two altruistic types donate different amounts to charities that are indistinguishable from one another, so that they can be treated as being the same. One of the key conclusions of this section is that equilibria with different values of g^L can coexist for certain parameters and income levels. The reason is that, as demonstrated by (34), small changes in the volume of charitable contributions are interpreted differently for different values of g^L .

Rather than computing the equilibrium value(s) of g^L and g^H for given parameters and income levels, it turns out to be easier to start from a value of g^L/g^H and compute the value of I^L/I^H that leads this ratio g^L/g^H to be an equilibrium. As a byproduct, the analysis also yields the resulting equilibrium value of g^H/I^H . When proceeding in this manner, (34) implies that the formulas for I^L/I^H are different depending on the relationship between g^L/g^H and the two critical values. I start by considering the case where g^L/g^H is smaller than both, then move to the case where it is between the two and end with the case where it is larger than both.

When g^L/g^H is below both critical values, agent's expectations obey the first lines of (32), (33), and (34). I further assume, for simplicity:

Assumption A Individuals i believes that, regardless of the level of his donations, any change in his donations will lead others to change their beliefs about the m's according to (34).

This assumption about beliefs corresponds to the actual effect of individual donations under two conditions. The first is that individual's income is negligible relative to G, which requires that the N's be large. This implies that the region in which G_{-j}^{τ} finds itself within (34) is not affected by *i*'s contribution. The second is individual donations are necessarily treated as being given to the indistinguishable set of charities; the individual is unable to require that his donations be directed at a "different" one. Using the first line of (32), (33), and (34) in (26), an altruist's gains from increasing his contributions slightly are

$$\frac{d\tilde{U}_{i}^{\tau}}{dg_{i}^{\tau}} = -\frac{1}{I^{\tau} - g_{i}^{\tau}} + \frac{v^{\tau}}{G} + a^{\tau L}\tilde{m}_{\tau}^{L}\left[\frac{v^{L}}{G} + \frac{w^{LH}}{2g^{H}}\right] + a^{\tau H}\frac{G_{-i}^{\tau} - \tilde{m}_{\tau}^{L}}{g^{H}}\left[\frac{v^{H}}{G} + \frac{w^{HH}}{g^{H}}\right], \quad (36)$$

where \tilde{m}_{τ}^{L} represents an altruist of type τ 's ex ante expectation of how many other altruists of type L there are. It equals $N^{L}/2$ for altruists of type H and $(N^{L} - 1)/2$ for altruists of type L. Under the assumption that the individual believes that (34) describes the changes in other agent's beliefs regardless of the individual's own contribution, he will not deviate from a situation where (36) is non-positive. As a result, situations where these equations hold as equalities for τ equal to both H and L with $g_{i}^{\tau} = g^{\tau}$ constitute symmetric rational expectations equilibria. We thus have,

Proposition 4. Supposing Assumption A holds, a rational expectations equilibrium with $g^L/g^H = r < \min((N^H - m^H)/m^L, (m^H - 1)/(N^L - m^L))$ exists if I^L/I^H satisfies

$$\frac{I^{L}}{I^{H}} = \frac{\psi_{B}^{H}(r)}{1 + \psi_{B}^{H}(r)} \left[r + \frac{1}{\psi_{B}^{L}(r)} \right]$$
(37)

where

$$\begin{split} \psi^L_B(r) &= \frac{v^L}{m^H + m^L r} + a^{LH} \frac{2(m^H + m^L r) - (N^L + 1)r}{2} \left(\frac{v^H}{m^H + m^L r} + w^{HH} \right) \\ &\quad + a^{LL} \frac{N^L - 1}{2} \left(\frac{v^L}{m^H + m^L r} + w^{LH} \right) \\ \psi^H_B(r) &= \frac{v^H}{m^H + m^L r} + a^{HH} \frac{2(m^H + m^L r - 1) - N^L r}{2} \left(\frac{v^H}{m^H + m^L r} + w^{HH} \right) \\ &\quad + a^{HL} \frac{N^L}{2} \left(\frac{v^L}{m^H + m^L r} + w^{LH} \right). \end{split}$$

At this equilibrium,

$$g^{H} = \frac{\psi_{B}^{H}(r)}{1 + \psi_{B}^{H}(r)} I^{H}.$$
(38)

Proof. Because assumption A holds and the optimization problem of individuals satisfies the second order conditions, an equilibrium requires only that individuals not gain anything from changing their donations slightly. If g^L were exogenous, one could thus obtain the equilibrium level of g^H by taking (36) for $\tau = H$ and equating it to zero after substituting g^H for g_i^H and $g^H(m^H - 1) + g^L m^L$ for G_{-i}^H . The result is that g^H must satisfy (38).

For altruists of type L to find it optimal to set g_i^L equals to r times this value of g^H when other altruists of type L are giving rg^H , it must be the case that the expression in (36) for $\tau = L$ is zero at this point. This requires that

$$-\frac{-1}{I^L - rg^H} + \frac{\psi_B^L(r)}{g^H} = 0,$$

which is satisfied when I^L satisfies (37).

The income ratio I^L/I^H that solves (37) for r = 0 leads to an equilibrium in which altruists of type L are indifferent between keeping their contributions at zero and increasing them slightly. This income ration turns out to play an important role. In particular,

Proposition 5. Supposing Assumption A holds, if

$$\frac{I^L}{I^H} < \frac{\psi_B^H(0)}{\psi_B^L(0)(1+\psi_B^H(0))}$$
(39)

there exists an equilibrium with $g^L = 0$ and $g^H = \psi^H_B(0)/(1 + \psi^H_B(0))$.

Proof. At $g^L = 0$, and $g^H = \psi_B^H(0)/(1 + \psi_B^H(0))$, the benefits of increasing g_i^L slightly captured in (26) for $\tau = L$ are zero when (39) holds as an equality. Equation (26) implies that lowering I^L while keeping g^H and g^L constant reduces $d\tilde{U}_i^{\tau}/dg_i^{\tau}$. As a result, lower levels of I^L/I^H coupled with a constant g^H/I^H , lead $d\tilde{U}_i^{\tau}/dg_i^{\tau}$ to be negative when g^L equals zero.

In the standard public goods case the *a*'s or the *w*'s are zero, so that condition (39) is valid when I^L is below $(v^H/v^L)m^H I^H/(v^H + m^H)$. Since $(I^H - g^H)$ equals $m^H I^H/(v^H + m^H)$, this says that I^L must equal at least the private consumption of altruists of type *H* if v^H equals v^L . In practice, of course, many individuals with relatively low incomes give to charity even when their income is much smaller than the private consumption of donors whose income is higher. In the standard public goods analysis, this would be possible only if these lower

income individuals cared more for G than their richer counterparts, so that $v^L > v^H$. As already discussed above, this condition is not necessary for the more general preferences considered here. Still, there is still a minimum level of I^L such that, for lower levels of income, there exists an equilibrium with $g^L = 0$.

As the ratio g^L/g^H is raised above zero, it goes from being smaller than both $(N^H - m^H)/m^L$ and $m^H/(N^L - m^L)$ to being greater than these terms. When this ratio is larger than both, we find ourselves in the case described in the last line of (34). As discussed above, whether intermediate values of g^L/g^H lead to the second or third line of (34) depends on whether $(N^H - m^H)/m^L$ is larger than $m^H/(N^L - m^L)$ or not. I focus on the case where it is. It is then possible for g^L/g^H to be strictly between $m^H/(N^L - m^L)$ and $(N^H - m^H)/m^L$ so that G is smaller than both N^Lg^L and N^Hg^H and it is apparent to everyone that there exist non-contributors of both types.

Agent's expectations then obey the second lines of (32), (33), and (34). Using these expectations in (26) we obtain the private gains from increasing these contributions slightly. These are

$$\frac{d\tilde{U}_i^{\tau}}{dg_i^{\tau}} = -\frac{1}{I^{\tau} - g_i^{\tau}} + \frac{v^{\tau}}{G} + a^{\tau\tau} \frac{G_{-i}^{\tau}}{2g^{\tau}} \left[\frac{v^{\tau}}{G} + \frac{w^{\tau\tau}}{2g^{\tau}} + \frac{w^{\tau\omega}}{2g^{\omega}} \right] + a^{\tau\omega} \frac{G_{-i}^{\tau}}{2g^{\omega}} \left[\frac{v^{\omega}}{G} + \frac{w^{\omega\tau}}{2g^{\tau}} + \frac{w^{\omega\omega}}{2g^{\omega}} \right]$$
(40)

Using the same arguments used to prove Proposition 4, we then have:

Proposition 6. Let $r_0 = m^H/(N^L - m^L)$, $r_1 = (N^H - m^H)/m^L$ and suppose that $r_0 < r_1$ Let

$$\begin{split} \psi_{M}^{L}(r) &= \frac{v^{L}}{m^{H} + m^{L}r} + \frac{m^{H} + (m^{L} - 1)r}{2} \Big\{ \frac{a^{LL}}{r} \left(\frac{v^{L}}{m^{H} + m^{L}r} + \frac{w^{LH}}{2} + \frac{w^{LL}}{2r} \right) \\ &+ a^{LH} \left(\frac{v^{H}}{m^{H} + m^{L}r} + \frac{w^{HH}}{2} + \frac{w^{HL}}{2r} \right) \Big\} \\ \psi_{M}^{H}(r) &= \frac{v^{H}}{m^{H} + m^{L}r} + \frac{m^{H} + m^{L}r - 1}{2} \Big\{ \frac{a^{HL}}{r} \left(\frac{v^{L}}{m^{H} + m^{L}r} + \frac{w^{LH}}{2} + \frac{w^{LL}}{2r} \right) \\ &+ a^{HH} \left(\frac{v^{H}}{m^{H} + m^{L}r} + \frac{w^{HH}}{2} + \frac{w^{HL}}{2r} \right) \Big\}. \end{split}$$

Supposing Assumption A holds, an equilibrium with $g^L/g^H = r$ exists as long as $r_0 < r < r$

 r_1 and I^L/I^H satisfies

$$\frac{I^{L}}{I^{H}} = \frac{\psi_{M}^{H}(r)}{1 + \psi_{M}^{H}(r)} \left[r + \frac{1}{\psi_{M}^{L}(r)} \right]$$
(41)

At this equilibrium,

$$g^{H} = \frac{\psi_{M}^{H}(r)}{1 + \psi_{M}^{H}(r)} I^{H}.$$
(42)

I now demonstrate that a pooling equilibrium of the kind described in Proposition 6 can exist even when there also exists an equilibrium in which one of the two types does not contribute to charity. To do this, it is necessary to show that I^L/I^H can satisfy (41) for an r between r_0 and r_1 while also satisfying (39). These equations would be incompatible if $\psi_M^\tau(r)$ were equal to $\psi_B^\tau(r)$, both of whom are measures of the marginal benefit of giving an additional g^H dollars to charity. There are reasons, however, for $\psi_M^L(r)$ to be greater than $\psi_M^L(r)$ when $r > r_0$. The first of these is that, once r exceeds r_0 , additional donations raise people's estimates of m^L , and this is more valuable to altruists of type L if a^{LL} exceeds a^{LH} and w^{LL} exceeds w^{LH} . The second is that, if r is lower than one, the cost of signaling that there is an additional altruist in the population can be lower when r exceeds r_0 . This cost equals $(1/2g^H)(1 + 1/r)$ whereas it equals $1/g^H$ when r is smaller than r_0 (including when r = 0).

To illustrate the importance of these forces, I now focus on a special case in which every altruist cares about every other altruist equally. We then have:

Proposition 7. Suppose that $a = a^{HH} = a^{HL} = a^{LL} = a^{LH}$ and $w = w^{HH} = w^{HL} = w^{LL} = w^{LH}$ and that both v^L and v^H are negligible. For a fixed realization of m^H and m^L , and as long as $awm^H < 2$, one can find values of N^L and N^H large enough that I^L/I^H satisfies both (39) and (41) for an $r > r_0$.

Proof. Using the assumed properties of the a's, the w's and the v's, condition (39) becomes

$$\frac{I^L}{I^H} < \frac{m^H + N^L/2 - 1}{m^H + (N^L - 1)/2} \left(\frac{1}{1 + aw(m^H + N^L/2 - 1)} \right) \equiv R(N^L),$$

where note is taken that R depends on N^L . Using the properties of a, w and v in the

definitions of ψ_M^{τ} given in Proposition 6, we obtain

$$\psi_M^L(r) = \frac{aw(m^H + (m^L - 1)r)}{4} \left(1 - \frac{1}{r}\right)^2 \qquad \psi_M^H(r) = \frac{aw(m^H - 1 + m^L r)}{4} \left(1 - \frac{1}{r}\right)^2$$

Now consider the variable $\theta(r)$ given by

$$\theta(r) = \frac{\psi_M^H(r)}{1 + \psi_M^H(r)} \left[r + \frac{1}{\psi_M^L(r)} \right]$$

The limit of $\theta(r)$ as r goes to zero is zero while its limit as r becomes unboundedly large is infinite. Thus, r's can be found such that $\theta(r) < R$. At these r's, there is an equilibrium with an I^L/I^H satisfying (39) and (41). For given N^L , the resulting r might be below r_0 , however. Raising N^L lowers r_0 but also lowers R, thereby requiring yet another reduction in r. What can be shown, however, is that when N^L is large, the I^L/I^H that is consistent with r_0 is below R. To see this, let $r = r_0$, which yields

$$\psi_{M}^{L}(r_{0}) = \frac{aw}{4} \left(m^{H} + (m^{L} - 1) \frac{m^{H}}{N^{L} - m^{L}} \right) \left(1 - \frac{N^{L} - m^{L}}{m^{H}} \right)^{2}$$
$$\psi_{M}^{H}(r_{0}) = \frac{aw}{4} \left(m^{H} - 1 + m^{L} \frac{m^{H}}{N^{L} - m^{L}} \right) \left(1 - \frac{1}{r} \right)^{2}$$

The limit of

$$\frac{\psi_M^H(r_0)}{1 + \psi_M^H(r_0)} \frac{r_0}{R(N^L)}$$

for large N^L is then $awm^H/2$, while the limit of

$$\frac{\psi_M^H(r_0)}{1+\psi_M^H(r_0)}\frac{1}{\psi_M^L(r_0)R(N^L)}$$

is zero. The limit of $\theta(r_0)/R$ is thus smaller than one as long as $awm^H < 2$. For an r near this r_0 to be an equilibrium for an I^L/I^H below R, it must also be the case that this r_0 is below r_1 . For any r_0 , this can be achieved by raising N^H .

The reason high values of N^L help bring about these multiple equilibria is that they lead the observed value of G together with low values of g^L to be inconsistent with the possibility that all N^L individuals of type L have made contributions. Such a low g^L implies that the cost of signaling that there is an additional altruist is low, and this induces contributions from altruists of type L even if their income I^L is quite low. At the same time, this low level of income would lead altruists of type L not to contribute if everyone expected only people of type H to contribute. In that case, altruists of type L would set $g^L = 0$ because the cost of signaling that there is an additional altruist would equal g^H , and would be high.

To complete the analysis, I now briefly consider the case where g^L/g^H is greater than the maximum of $(N^H - m^H)/(m^L - 1)$ and $m^H/(N^L - m^L)$. This maximum can be expected to be small if N^L is large relative to N^H . This the case because, across realizations of the m's, the mean value of the numerators of both these expressions is $N^H/2$ while that of the denominators is near $N^L/2$. It follows that the fourth line of (34) is often relevant even for fairly small values of g^L/g^H when N^L is large relative to N^H .

Using these expectations in (26) the individual gains from increasing g_i^L and g_i^H slightly are

$$\begin{aligned} \frac{d\tilde{U}_{i}^{L}}{dg_{i}^{L}} &= -\frac{1}{I^{L} - g_{i}^{L}} + \frac{v^{L}}{G} + a^{LL} \frac{2G_{-i}^{L} - N^{H}g^{H}}{2g^{L}} \left(\frac{v^{L}}{G} + \frac{w^{LL}}{g^{L}}\right) + a^{LH} \frac{N^{H}}{2} \left(\frac{v^{H}}{G} + \frac{w^{HL}}{g^{L}}\right) \\ \frac{d\tilde{U}_{i}^{H}}{dg_{i}^{H}} &= -\frac{1}{I^{H} - g_{i}^{H}} + \frac{v^{H}}{G} + a^{hL} \frac{2G_{-i}^{H} - N^{H}g^{H}}{2g^{L}} \left(\frac{v^{L}}{G} + \frac{w^{LL}}{g^{L}}\right) + a^{HH} \frac{N^{H}}{2} \left(\frac{v^{H}}{G} + \frac{w^{HL}}{g^{L}}\right) \end{aligned}$$

The steps used to prove Proposition 4 then also imply that:

Proposition 8. Supposing Assumption A holds, an equilibrium with $g^L/g^H = r > \max((N^H - m^H)/(m^L - 1), m^H/(N^L - m^L))$ exists if I^L/I^H satisfies

$$\frac{I^{L}}{I^{H}} = \frac{\psi_{T}^{H}(r)}{1 + \psi_{T}^{H}(r)} \left[r + \frac{1}{\psi_{T}^{L}(r)} \right]$$
(43)

where

$$\begin{split} \psi_T^L(r) &= \frac{v^L}{m^H + m^L r} + a^{LL} \frac{2(m^H + (m^L - 1)r) - N^H}{2r} \left(\frac{v^L}{m^H + m^L r} + \frac{w^{LL}}{r} \right) \\ &+ a^{LH} \frac{N^H}{2} \left(\frac{v^H}{m^H + m^L r} + \frac{w^{HL}}{r} \right) \\ \psi_T^H(r) &= \frac{v^H}{m^H + m^L r} + a^{HL} \frac{2(m^H + m^L r) - N^H - 1}{2r} \left(\frac{v^L}{m^H + m^L r} + \frac{w^{LL}}{r} \right) \\ &+ a^{HH} \frac{N^H - 1}{2} \left(\frac{v^H}{m^H + m^L r} + \frac{w^{HL}}{r} \right). \end{split}$$

At this equilibrium,

$$g^{H} = \frac{\psi_{T}^{H}(r)}{1 + \psi_{T}^{H}(r)} I^{H}$$
(44)

Propositions 4, 6, and 8 allow one to compute the ratios I^L/I^H that lead particular values of g^L/g^H to be equilibria, except for those at the boundaries of the regions in (34). For a particular set of parameters, the results are displayed in Figure 5. This Figure is drawn for N^H , N^L , m^H and m^L equal to 500, 10,000, 100 and 7,000 respectively. In addition, the taste parameters v^{τ} , $a^{\tau\omega}$ and $w^{\tau\omega}$ for all τ and ω including $\tau = \omega$ equal .05, .0001, and .1 respectively. Altruists thus all have the same tastes and do not care whether another person belongs to H or to L.

Each panel of the figure has three distinct segments, corresponding to the boundaries of the regions in (34). Within each segment, I^L/I^H needs to be higher to rationalize a higher g^L/g^H . This is what one would expect since it says that relatively higher donations by altruists of type L arise when their relative income is higher as well. As g^L/g^H crosses from being below $m^H/(N^L - m^L)$ to being above, however, the income ratio I^L/I^H that rationalizes this increase in relative donations falls. As discussed earlier, this is because increases in G have a larger impact on the perceived number of altruists after g^L/g^H crosses this boundary. This, in turn, is due to two factors operating in combination. The first is that type L altruists now donate enough that it is no longer possible for all of them to be altruists. Therefore, increases in G suggest that there are more of them. At the same time, $g^L/g^H < 1$ so, in effect, the cost of signaling that there is an additional altruist is lower: it falls from g^H to an average of g^H and g^L .

Interestingly, there is a further drop in this cost as g^L/g^H rises from being smaller than $(N^H - m^H)/m^L$ to being above. The reason is that, given that (35) holds, higher values of g^L imply that increases in G no longer affects the posterior distribution of m^H . The cost of signaling that there is an additional altruists therefore becomes g^L rather than being an average of g^L and g^H . Since g^L remains below g^H , the incentive to donate increases. The result is that there are three equilibria for I^L/I^H between about .58 and .72. The first is the equilibrium with $g^L = 0$. The next has g^L/g^H between the two thresholds in (34), while the

last has g^L/g^H above both. Transitions between these equilibria might be interpretable as involving different marketing messages. To leave the equilibrium with $g^L = 0$ and reach the one between thresholds, it may be sufficient to convince altruists of type L that even small donations make a difference. By contrast, to transition to the one with the highest g^L/g^H , it might make sense to limit the minimum donation that charities accept.

As the second panel of the figure shows, total charity revenue rises as one goes from equilibria with lower values of g^L/g^H to ones with higher ones. This is not only because this increase is associated with an increase in the donations of altruists of type L. Rather, the last panel shows that the donations of altruists of type H rise as well. The reason is that, as already discussed, the equilibria with higher levels of g^L/g^H involve a lower cost of signaling that there is an additional altruist and this affects altruists of type H as well.

One unappealing aspect of the results in Figure 5 is that the equilibrium levels of g^L/g^H in the Figure are much smaller than the corresponding levels of I^L/I^H . Thus, rich people at these equilibria contribute a much larger fraction of their income than poorer people. This follows from the fact that people of the two types see each other as identical, so they must end up with the same level of private consumption. When people of different incomes are considered, this is mostly counterfactual.

In the context of this model, however, it seems more reasonable to suppose that altruists of type H have a particular affinity for altruists of type H, and analogously for altruists of type L. An example of this sort is considered in Figure 6. Most parameters, including $a^{\tau\tau}$ and $w^{\tau\tau}$ for τ equal to L or H are the same as those for Figure 5. The four values that are different are those for $a^{\tau\omega}$ and $w^{\tau\omega}$ in the cases where τ differs from ω . To make tastes identical in a certain sense, I set $a^{HL} = a^{LH}$ while $w^{HL} = w^{LH}$ and, these equal one twentieth of a^{HH} and w^{HH} respectively.

The Figure ignores the positive values of g^L/g^H below $m^H/(N^L - m^L)$ because these cannot be equilibria unless I^L/I^H exceeds .49. On the other hand, it shows that equilibria with higher values of g^L/g^H emerge when I^L/I^H is quite low. Most interestingly, many of the equilibrium values of g^L/g^H are comparable to those of I^L/I^H with there being an equilibrium in which they are identical when I^L/I^H equals about .056. This occurs for two reasons. First, the altruists of type H, who are relatively rich, are no longer so concerned about the welfare of the poorer altruists of type L, and this significantly reduces their contributions relative to those in Figure 5. Second, because the altruists of type L are so much more numerous, the incentive to signal altruism remains quite strong for members of L. The result is that there are equilibria where people with lower income devote a higher percentage of their income to charity. It follows immediately that the private consumption of contributors of type H exceeds that of contributors of type L.

7 Moving between pooling and separating equilibria

The first question studied in this section is whether, when both kinds of equilibria coexist, equilibria with indistinguishable charities raise more or less total revenue than equilibria with distinct charities. One case where the former clearly raise less is when only one type contributes to the indistinguishable charities. This leads me to consider how easy it is to "escape" from an equilibrium where only one type contributes. Lastly, I discuss reasons why the differentiation among charities might increase without an accompanying increase in donations

There is a simple, and extreme, case where equilibria of both types exist while the equilibrium with separate charities raises more revenue. This is the case studied in Proposition 3, where both types care only about the altruism of people of their own type. We then have:

Proposition 9. Suppose that $a^{\tau\omega} = w^{\tau\omega} = 0$ when τ differs from ω , that $v^H = v^L = 0$ and that the tastes of the two types are identical so that $a^{\tau\tau} = a$ and $w^{\tau\tau} = w$ for both values of τ . Then, at every equilibrium in which individuals have access only to indistinguishable charities, no type expects that their donation would be smaller if they had access to distinct charities and at least one type expects that they would be larger.

Proof. Equation (28) implies that contributions at separating equilibria satisfy

$$\frac{g^{\tau}}{I^{\tau} - g^{\tau}} = aw(m^{\tau} - 1) \qquad \tau = H, L.$$

$$\tag{45}$$

When charities are indistinguishable, (26) implies that the conditions for altruists of type τ not to wish to increase their contributions take the form

$$\frac{1}{I^{\tau} - g^{\tau}} \ge aw E_i^{\tau} (m^{\tau} - 1) \frac{dE_j^{\tau}(m^{\tau})}{dg_i^{\tau}}$$

$$\tag{46}$$

For interior equilibria, these have to hold as equalities, and otherwise $g^{\tau} = 0$. If g^L/g^H is either smaller or larger than the two threshold values, $dE_j^{\tau}(m^{\tau})/dg_i^{\tau}$ equals 0 for one type and $1/g^{\tau}$ for the other. The type for which it equals zero contributes nothing, and therefore expects that it would contribute more if distinct charities were available. The type for which it equals $1/g^{\tau}$ satisfies

$$\frac{g^{\tau}}{I^{\tau} - g^{\tau}} = awE_i^{\tau}(m^{\tau} - 1),$$

so that it expects its contributions to be the same as in (45).

If g^L/g^H is between the two threshold values, $dE_j^{\tau}(m^{\tau})/dg_i^{\tau}$ equals $1/2g^{\tau}$ so that contributions satisfy

$$\frac{g^{\tau}}{I^{\tau}-g^{\tau}} = \frac{aw}{2}E_i^{\tau}(m^{\tau}-1).$$

Since the left hand side is increasing in g^{τ} , both types expect that their g^{τ} would be larger is (45) held.

The intuition behind this proposition is simple: if people gain utility only from signaling to altruists of their own type, contributing to a joint charity is relatively unattractive because some of the signal is "wasted" by giving utility to altruists of the other type.

Even in the case where distinct charities collect more funds, it may not be easy to move from an equilibrium with a single type of charity to one with several. As already seen implicitly in the proof of Proposition 4, this is particularly difficult under assumption A, which guarantees that all contributions are treated as pertaining to a single set of indistinguishable charities. The problem extends, however, to situations where Assumption A is violated so that it is possible for an individual to contribute to a distinct charity. To see this, consider a situation where only altruists of type H make contributions to a set of indistinguishable charities, so that altruists of type L would clearly donate more if a distinct charity were available. The problem is that a single deviator who contributes to a distinct charity may be unable to change anyone's estimate of m^L .

This will occur, in particular, if people who observe a positive contributions to an alternative charity assume that these contributions come form a single individual while, at the same time, their prior distribution of m^L assigns zero weight to the possibility that $m^L = 0$. The posterior distribution of m^L is then equal to the prior one. What is interesting about this special case is that the individual who is deviating is conveying his type correctly, as in the suggestion by Cho and Kreps (1987), and yet the more relevant equilibrium inference, which concerns the total number of altruists of type L, does not change.¹³

What this suggests is that moving from an equilibrium with a single charity to one with several requires a certain degree of coordination. Charities may achieve this coordination through marketing messages, though how they accomplish this is left for further research. It is worth noting that, even when charities do manage to separate by appealing to different segments, revenues do not necessarily rise (as they did in the case considered in Proposition 9.

To demonstrate this, I consider a numerical example. Suppose that both N^H and N^L equal 900, while m^H and m^L equal 500 and 300 respectively. Altruists of type L care only about altruists of type L with a^{LL} and w^{LL} equal to .1 and .08 respectively while a^{LH} and w^{LH} equal zero. Similarly, the self-esteem of altruists of type H depends only on their belief regarding the number of other altruists of type H so that w^{HH} equals .05 and w^{HL} equals zero. On the other hand, altruists of type H care equally about altruists of type H and Lso that both a^{HH} and a^{HL} equal .001.

Equilibria with q^L/q^H above $m^H/(N^L - m^L)$ are displayed in Figure 7.¹⁴ This example differs from those in Figures 5 and 6 in that the highest levels of total contributions relative to I^H occur for income ratios I^L/I^H that lead g^L/g^H to be between the two thresholds. Focusing

¹³At the same time, this is a special case and it is equally possible to imagine cases where the demonstration by one individual that $m^L \ge 1$ affects the expectation of m^L . Indeed, when the prior distribution of m^{τ} is uniform between 0 and N^{τ} , evidence that $m^{\tau} \ge 1$ raises the expected value of m^{τ} from $N^{\tau}/2$ to $(N^{\tau}+1)/2$. ¹⁴Those with lower g^L/g^H require substantially larger levels of I^L/I^H .
only on this middle region, Figure 8 combines the first two panels of Figure 7 to plot total contributions as a function of I^L/I^H . It also plots the levels of total contributions that, for these income ratios, result from the solution to (28). These are equilibria if agents have access to charities that are distinguishable by type because, at these points, the inequalities (29) and (30) are violated.

The Figure shows that, for I^L/I^H between .039 and .0406, the equilibrium with indistinguishable charities collects more donations. Part of what lies behind this example is that people of type H like to make people of type L happy so they tend to contribute more to charities that L also contributes to. That is not all, however, because this force also tends to make equilibria with distinct charities infeasible, and these are viable in this example. One possible contributor to the finding that distinct charities collect less revenue is presented in the second panel in Figure 8. What this Figure shows is that people's expectation of m^L is high relative to the actual level of m^L at the points where the equilibrium with indistinguishable charities raises more donations. This high level of donations might thus be due to a mistake by people of type H, who would donate less if they had the information about m^L that is revealed by equilibria with distinct charities.

The coexistence of a relatively stagnant level of total donations with an increase in differentiation across charities can be rationalized in another way, and this is with a decline in the concern of altruists of any given type for altruists of the other type. This reduction in inter-group altruism tends to reduce donations for a constant set of charities while, at the same time, it makes increased differentiation possible. To see this in a simple case, focus on the limit where v^{τ} is zero. Equation (28) then implies that, if an equilibrium with distinct charities exists, equilibrium donations are given by

$$g^{\tau} = \frac{\hat{\psi}^{\tau} I^{\tau}}{1 + \hat{\psi}^{\tau}} \qquad \text{where} \qquad \hat{\psi}^{\tau} = a^{\tau\tau} (m^{\tau} - 1) w^{\tau\tau} + a^{\tau\omega} m^{\omega} w^{\omega\tau}. \tag{47}$$

It follows that these donations fall when either $a^{\tau\omega}$ or $w^{\tau\omega}$ decline. This is not surprising since a decline in either of these parameters signifies that people care less about the altruism of others and are less concerned about the welfare of others, and these are the forces that I have put at the center of my explanation for charitable contributions. At the same time, the combination of Propositions 2 and 3 suggest that declines $a^{\tau\omega}$ or $w^{\tau\omega}$ make it more likely that an equilibrium with distinct charities exists.

Because these propositions deal only with the extremes where $a^{\tau\omega}$ and $w^{\tau\omega}$ are either negligible or the same as $a^{\tau\tau}$ and $w^{\tau\tau}$ respectively, a more continuous result would seem desirable. For this purpose, suppose that $a^{\tau\tau}$ and $w^{\tau\tau}$ equal a and w respectively for both values of τ while $a^{\tau\omega}$ and $w^{\tau\omega}$ equal αa and αw respectively for both possible values of τ and ω . Thus, both groups have the same tastes and α is a simple measure of how much they care for one another, with $\alpha = 1$ signifying that they do not distinguish between types and $\alpha = 0$ signifying that they care only about their own type. We then have:

Proposition 10. Let $v^{\tau} = 0$, $a^{\tau\tau} = a$, $w^{\tau\tau} = w$, $a^{\tau\omega} = \alpha a$ and $w^{\tau\omega} = \alpha w$. For realizations with $m^H = m^L = m$, any α smaller than or equal to the smaller root of the quadratic equation

$$\alpha^2 - \frac{2m - 1}{mI^L/I^H} \alpha + \frac{m - 1}{m} = 0$$
(48)

allows an equilibrium with distinct charities to exist, while any larger α does not. This smallest root is close to 1 for I^L close to I^H and becomes smaller as I^L/I^H falls.

Proof. Under the conditions of the proposition, $\hat{\psi}^{\tau}$ in equation (47) is equal to $aw[m(1 + \alpha^2) - 1]$. Since this is the same for the two types, g^{τ} is proportional to I^{τ} . As a result (29) cannot hold if (30) is violated so that the violation of the latter is necessary and sufficient for an equilibrium with distinct charities to exist. This condition is now

$$\frac{(2m-1)\alpha}{m(1+\alpha^2)-1} < \frac{I^L}{I^H}$$

This requires that the quadratic expression on the left hand side of (48) be positive, which is true for α either smaller than the smallest root or larger than the largest root of the equation. The proposition focuses on the smaller root. This equals (m-1)/m, which is close to 1, for $I^L/I^H = 1$. Moreover, (48) implies that the sum of the roots is $(2m-1)/(mI^L/I^H)$ and this must exceed twice the smaller root. Differentiation of this equation thus implies that the smallest root declines smoothly as I^L/I^H declines. This proposition shows that smooth declines in α , the extent to which altruists care about people of the other type, eventually make it possible for an equilibrium with distinct charities to exist. Thus, reductions in inter-group altruism would lead to growth in the number of distinct charities if, for example, distinct charities were always created when they were sustainable in equilibrium.

8 Conclusions

This paper has shown that two assumptions grounded in evidence from psychology can help explain some aspects of charitable giving. Most particularly, the combination of letting altruism be larger towards like-minded people and having self-esteem depend on the number of people that agree with oneself is consistent with small reductions in one's own giving in response to larger giving by others. Indeed, there are parameters for which the model predicts that an individual will increase his own giving when others give more. The model is also able to explain why certain charities attract contributions from people with different income levels even if one does not assume that the underlying other regarding preferences differ by income class. In particular, the model does not require poor people to be extremely generous relative to rich people (or rich people to be extremely selfish relative to poor ones) in order to have both make contributions at the same time.

Having said this, it is important to stress that the paper has not set out to explain all known puzzles concerning charitable contributions. As it stands, for example, the model seems unlikely to provide a meaningful account of situations in which people split their charitable contributions among a number of charities. The reason is that, as in models where charitable giving is due exclusively to altruism towards recipients, the model predicts that the marginal utility of giving is independent of the size of the gift. This suggests that people should concentrate their gifts on charities that give the highest marginal utility of giving. If several charities provide this same maximal level, the allocation among them is a matter of indifference.

To provide a more determinate explanation of people who contribute to multiple char-

ities, the model would have to be modified. One possibility along these lines is to try to model people's desire to "hedge their bets" when making contributions. To capture this phenomenon, one would have to take into account people's uncertainty regarding charities and people's fear of regretting their contribution. This is consistent with one important aspect of charities, namely that measuring their effectiveness is difficult and, partly for this reason, they find themselves frequently embroiled in scandal. When a scandal erupts, contributors can be expected to regret their contributions. A contributor that spreads his gifts across charities increases the odds of regretting one of his gifts but reduces the size of each potential regret. Aversion to large regrets would thus incline individuals to spreading out their donations.

9 References

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Figure 1: Inferences about m^L and m^H when $(N^L - 1)g^L < G^L_{-i} < N^H g^H$



Figure 2: Inferences about m^L and m^H when $N^H g^H < G^L_{-i} < (N^L - 1)g^L$



Figure 3: Inferences about m^L and m^H when $G_{-i}^L < \min((N^L - 1)g^L, N^H g^H)$



Figure 4: Inferences about m^L and m^H when $G_{-i}^L > \max((N^L - 1)g^L, N^H g^H)$



Figure 5: Contributions to indistinguishable charities in an example where altruists do not distinguish between ${\cal H}$ and ${\cal L}$



Figure 6: Contributions to indistinguishable charities in an example where altruists distinguish between ${\cal H}$ and ${\cal L}$





Figure 7: Contributions to indistinguishable charities in an example with asymmetric tastes

Figure 8: Distinct versus indistinguishable charities in an example with asymmetric tastes

