Two-sided Altruism and Signaling

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Abstract

This paper shows that when donors and recipients care about each other – two-sided altruism – the presence of asymmetry of information about the donor's income leads very naturally to a signaling game. A donor who cares about the recipient's welfare has incentives to appear richer than he is when the recipient cares about him. Similarly, asymmetry of information regarding the donor's income generates a signaling game in the presence of two-sided altruism. These signaling games put upward pressure on transfers and this pressure increases with the altruism of the recipient.

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"Jack's unhappy that Jill's unhappy
Jill's unhappy that Jack's unhappy
that Jill's unhappy that Jack's unhappy
that Jill's unhappy"

— Laing (1970), *Knots, p.26*

1 Introduction

The concept of altruism has a long history in philosophical and social sciences. The term was originally coined in the 19th century by the founding sociologist and philosopher of science, Auguste Comte (Auguste (1874)), and has become a major topic in many fields. In simple terms, altruism is caring about the welfare of other people and acting to help them (see Hammond (1987)). Evidence of altruism abound, especially among friends and family members, (see James Andreoni and Vesterlund (2008) and Curry, Roberts, and Dunbar (2013)) and has an evolutionary rationale (see Hamilton (1964) and Bergstrom (1995)). Altruism has been credited to be an important motive behind remittances and other private transfers between households (see among others Cox and Fafchamps (2008), Foster and Rosenzweig (2001), Kazianga (2006), Ligon and Schechter (2012), Mitrut and Nordblom (2010) and Rapoport and Docquier (2006)).[1]

For the purpose of this paper, we shall consider two individuals who care about each other's welfare, one of which (the donor) is richer than the other (the recipient) and may want to financially help the latter. To fix ideas, think of a migrant son who can send remittances to his mother. The purpose of this paper is to show that two-sided altruism in the presence of asymmetry of information leads very naturally to a signaling game.

Under full information, it is a generally understood fact that if the mother also cares for her son – two-sided versus one-sided altruism – then the son's utility increases but it doesn't affect the level of remittances chosen. This is because, in valuing his entire welfare, the altruistic component of the mother's utility puts the same relative weights as her son on his utility of consumption and on her utility. Hence, the son's utility or objective is just multiplied by a constant (see for instance Bourles and Bramoullé (2013)).

[1] There is also a large literature in public economics on the role of altruism and two-sided altruism on whether Ricardian equivalence holds (see Kotlikoff, Razin, and Rosenthal (1990) among others) and how to deal with it in the context of welfare analysis (see Cremer and Pestieau (2006) for instance).

However, this result generally does not hold in the presence of asymmetry of information. Assume that the mother does not know her son's income. As the mother cares about her son's welfare, she would be like to know that he makes a good living. As the son cares about his mother's welfare, he would like her to believe that he makes a good living, irrespective of his real standards of living. As a result, she cannot take his word for it and she will try to infer information about her son's achievement from the remittances that he sends her. This gives incentives to poorer donors to transfer more to imitate richer donors, as transfers affect beliefs. Believing the donor to be richer gives a utility boost to the recipient if she is altruistic, and this is valuable to the donor if he is altruistic. This implies that, to be informative, the transfers have to satisfy an incentive constraint. This is a standard signaling game (see Spence (1973) and Mailath (1987)).

Uncovering this effect is the first contribution of the paper. The second is to show how this puts a pressure upward on the amounts remitted. Indeed, in a separating equilibrium all transfers, but the transfer of the poorest donor, are higher in order to satisfy the incentive constraint. This is because transfers have two distinct impacts: a direct one on the payoff of the recipient and an indirect via the inference that the recipient makes about the wealth of the donor.

This work is related to the literature on signaling as a motive for charity contributions (Glazer and Konrad (1996)) but, crucially, the present paper does not assume that individuals want to signal their wealth but shows that this concern arises naturally when donors and recipients care for each other.

Finally, asymmetry of information regarding the donor's level of altruism has similar results. The paper shows that our migrant son has an incentive to appear more altruistic than he is to his mother, the more so the more his mother cares about him. This provides a micro-foundation for the preferences assumed by Ellingsen and Johannesson (2008) where individuals gain esteem from appearing altruistic to others and this gain increase in the level of altruism of others.

The remainder of the paper proceeds as follows. Section 2 provides the benchmark case with full information. Section 2 introduces asymmetry of information regarding the sender's income,characterizes the separating equilibrium in the resulting signaling game and derive a number of its properties. Next, Section 2 shows that similar results apply when there is asymmetry information regarding the altruism of the donor. Finally, Section 5 concludes.

2 Full Information

Consider two individuals, a recipient R and a donor D who are altruistic towards each other. They both care about their own utility of consumption but also the other's welfare. The donor's income y is drawn from a continuous distribution function $F(y)$ ($f(y)$ denotes the associated probability density function) with full support on $Y \equiv [\underline{y}, \bar{y}]$ ($\bar{y} > \underline{y} > 0$). As a benchmark, assume for now that the realization of the donor's income is known to the recipient.

Let u_i be individual i's direct utility of consumption, $i \in \{R, D\}$, and assume that $u_i'(c) > 0$, $u_i''(c) < 0$ and $\lim_{c \downarrow 0} u_i'(c) = \infty$. We denote as $\alpha_i \in (0, 1)$ the weight that individual $i \in \{R, D\}$ puts on the other's welfare. That is, for a given allocation of consumption $\mathbf{c} = \{c_D, c_R\}$, i's utility $v_i(\mathbf{c})$ is given by

$$v_i(\mathbf{c}) = u_i(c_i) + \alpha_i v_j(\mathbf{c}) \tag{1}$$

for $i, j \in \{R, D\}$.

It follows that

$$v_i(\mathbf{c}) = A[u_i(c_i) + \alpha_i u_j(c_j)] \;\; for \;\; i, j \in \{R, D\}$$

where $A = \frac{1}{1-\alpha_R \alpha_D}$.

A donor with income y chooses to transfer the amount $t \in I\!R_+$ that maximizes his objective

$$A[u_D(y - t) + \alpha_D u_R(t)].$$

He transfers $t^*(y)$, the transfers that satisfies

$$u_D'(y - t^*) = \alpha_D u_R'(t^*) \tag{2}$$

if it is non-negative and zero otherwise. It is worth making a couple of observations.

Observation 1 *Under full information, transfers are independent of the altruism of the recipient.*

This observation follows directly from the first order conditions (2) that are clearly independent of α_R.

Observation 2 *Under full information, transfers increase less than proportionally with the income of the donor.*

Proof. It is easy to check that $\frac{dt^*}{dy} = \frac{-u''_D}{-u''_D - \alpha_D u''_R} < 1$. ■

Example 1: Assume that both the migrant son and his mother have logarithmic utility, $u_i(c) = ln(c)$ for $i \in \{R, D\}$. It is easy to see that, under full information, the son remits a constant fraction of his income:

$$t^*(y) = \beta y, \;\; where \;\; \beta = \frac{\alpha_D}{1 + \alpha_D},$$

and this whether his mother cares about him or not.

3 Signaling Income

Now assume that the income of the donor y is private information. The distribution from which the income is drawn is common knowledge but the actual realization is private information.

A *Perfect Bayesian Equilibrium* consists of a strategy profile $\mu : Y \to I\!R_+$, designating a strategy for each type of donor, and an inference function ϕ, characterizing the beliefs of the recipient at each information set, such that μ is sequentially rational for each player given ϕ and ϕ is derived from μ using Bayes's rule whenever possible.

The *inference function* $\phi(z, t)$ is the probability that the donor is of type z if he transfers t. $\Phi(t) \equiv \{z | \phi(z, t) > 0\}$ is the support of types for transfer t.

A donor of income z who gives t has utility

$$v_D(z, t) = u_D(z - t) + \alpha_D v_R(t), \tag{3}$$

where $v_R(t)$ is the recipient's utility from receiving a transfer t:

$$v_R(t) = u_R(t) + \alpha_R \int \phi(z, t) v_D(z, t).$$

Using (3) in the recipient's utility, we get

$$v_R(t) = u_R(t) + \alpha_R \int \phi(z,t) u_D(z-t) dt + \alpha_R \alpha_D v_R(t),$$

or

$$v_R(t) = A \left[u_R(t) + \alpha_R \int \phi(z,t) u_D(z-t) dt \right], \tag{4}$$

where $A = \frac{1}{1-\alpha_R \alpha_D}$ as earlier.

Plugging it back in equation (3), we see that, given beliefs ϕ, the utility of a donor with income y who transfers t is

$$v_D(y,t) = u_D(y-t) + \alpha_D A u_R(t) + \alpha_D \alpha_R A \int \phi(z,t) u_D(z-t) dt. \tag{5}$$

Strong single crossing ($v_{D\,12} > 0$) implies that in any perfect Bayesian equilibrium, the choice of transfer is weakly increasing in income. As shown in Appendix (Section A1), if a donor with income y prefers to a transfer $t' > 0$ to a smaller transfer t ($t < t'$), any donor with an income $y' > y$ strictly prefers t' to t.

3.1 Separating Equilibrium.

In a separating equilibrium, different types of donor make different transfers. The utility of a donor with income y who gives t and is believed to be of type z is given by

$$w(y,z,t) = u_D(y-t) + \alpha_D A u_R(t) + \alpha_D \alpha_R A u_D(z-t). \tag{6}$$

Donors irrespective of their income would like to be perceived as richer, $w_2 > 0$ as long as $\alpha_R > 0$ and $\alpha_D > 0$. For any given donor's income, we can draw the donor's indifferent curves between t and z. These are U-shaped as the amount transferred initially increases the donor's utility then decreases it. It is easy to check that the indifference curves satisfy the single crossing condition: their slope is decreasing in y.[2] Figure 1 illustrates how lower income donors have incentive to mimic higher income donors in our logarithmic example.

[2] $\frac{-w_3(y,z,t)}{w_2(y,z,t)}$ is strictly decreasing in y for all z and t.

Example 2: Let's assume logarithmic utilities and $\alpha_D = \alpha_R = 0.5$. Consider two potential levels of income for the migrant son: 1 and 1.5. Figure 1 illustrates the indifference curves between z and t. Under full information, the son gives a third of his income to his mother ($\beta = 1/3$). These levels of transfer $t^*(1)$ and $t^*(1.5)$ are indicated by crosses on the graph. We see clearly that the son with an income level of 1 would prefer making a transfer of $t^*(1.5)$ and be believed to earn 1.5 by his mother than to give her $t^*(1)$ and for her to know that he earns 1.

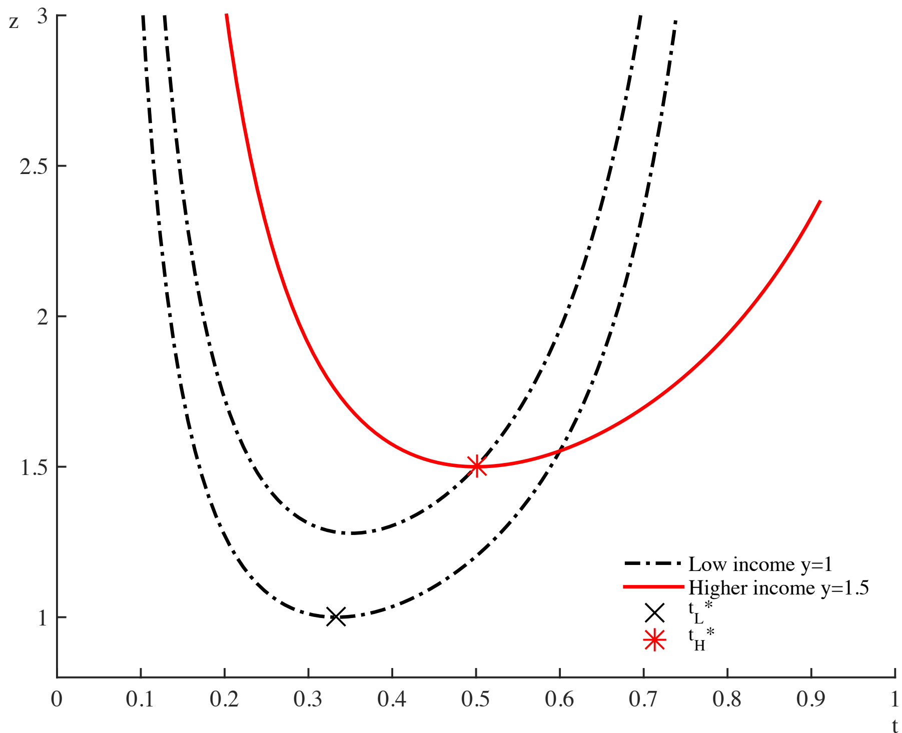

Figure 1: Indifference Curves.

Next, we characterize the separating equilibrium. If $\widetilde{t} : Y \rightarrow T$ is a one-to-one strategy for the donor then, when he chooses $t = \widetilde{t}(y)$, the recipient infers that he is of type $\widetilde{t}^{-1}(t)$: $\phi(y,t) = 1$ if $t = \widetilde{t}(y)$ and 0 otherwise.

For $\widetilde{t}$ to be an equilibrium separating strategy, it must be that

$$\widetilde{t}(y) \in \; argmax_t \; w(y, \widetilde{t}^{-1}(t), t) \; \forall \; y \in Y.$$

Hence, the first order condition for $\widetilde{t}(y)$ to locally maximize $w(y, \widetilde{t}^{-1}(t), t)$ tells us that

$$w_3(y, y, t) + w_2(y, y, t)\frac{1}{\widetilde{t}'(y)} = 0 \tag{7}$$

or

$$\widetilde{t}'(y) = \frac{\alpha_D \alpha_R u_D'(y - \widetilde{t})}{u_D'(y - \widetilde{t}) - \alpha_D u_R'(\widetilde{t})} \quad \forall\, \underline{y} < y \leq \bar{y}. \tag{8}$$

Appendix A2 shows that w satisfies Mailath (1987)'s regularity conditions and the single crossing condition, so that $\widetilde{t}(y)$ is continuous and strictly increasing. In addition, Lemma 2 in Appendix A2 proves that the transfer of the poorest donor must be the same as the full information transfer: $\widetilde{t}(\underline{y}) = t^*(\underline{y})$. Indeed, in a separating equilibrium, a donor transferring $\widetilde{t}(\underline{y})$ is believed to earn the lowest income $\underline{y}$. If $\widetilde{t}(\underline{y})$ differed from $t^*(\underline{y})$, then a transfer of $t^*(\underline{y})$ would increase the donor's utility at these beliefs, and even more so if it affected the recipient's beliefs.

Hence, the differential equation (8), along with the initial condition $\widetilde{t}(\underline{y}) = t^*(\underline{y})$, characterizes the unique separating equilibrium (see Mailath (1987)).

3.2 Pooling Equilibrium and D1 Criterion.

Often, pooling equilibria are also possible where donors of all income levels transfer t^p and are believed to be of average income $y^{av} = \int y f(y) dy$. These are sustained by assigning the worst beliefs on off-equilibrium-path transfers. These beliefs are in many case implausible beliefs off the equilibrium path especially when the range of incomes is large.

For given level of altruism, we can take $\bar{y}$ to be large enough that $u(\underline{y} - t^*(\bar{y})) \to -\infty$. In this case, upon receiving a transfer $t^*(\bar{y})$ it would make little sense for the recipient to believe that the sender has the lowest income $\underline{y}$.

Various equilibrium refinement techniques reduces the set of equilibria in signaling games by restricting the set of disequilibrium beliefs. One such refinement is the D1 Criterion. When observing an off-equilibrium-path transfer t, the receiver must place zero posterior weight on a type y whenever there is another type y' that has a stronger incentive to deviate from the equilibrium, in the sense that type y' would strictly prefer to deviate for any response z that would give type y a weak incentive to deviate. Ramey (1996) showed that under strong single crossing for a continuum of types drawn from a compact interval $D1$ refinement selects the dominant separating equilibrium described in the previous section. This justifies our focus on the separating equilibrium.

3.3 Properties of the transfers under asymmetric information.

This Section highlights the distinctive features of the transfers that arise under asymmetry of information.

Observation 3 *If both agents are altruistic, the transfers for all but the lowest income are higher than when information is complete.*

Proof. Since $\widetilde{t}$ is increasing, it follows directly from (7) that $w_3(y, y, t) < 0$ and therefore $\widetilde{t}(y) > t^*(y)$ for all $y > \underline{y}$. ■

This Observation shows that the signaling game in the presence of asymmetry of information puts upward pressure on transfers.

Observation 4 *Transfers are increasing in the altruism of the recipient for all $y > \underline{y}$, and strictly so when positive transfers are made.*

Proof. Assume not. Then there exist two levels of altruism $\alpha_1 > \alpha_2$ for the recipient and a level of income z at which the transfers are lower when the recipient's altruism is higher $\widetilde{t}_1(z) < \widetilde{t}_2(z)$. Since $\widetilde{t}_1(\underline{y}) = \widetilde{t}_2(\underline{y}) = t^*(\underline{y})$ and the slope of the transfers (8) is increasing in the altruism of the recipient, $\widetilde{t}_1(y) > \widetilde{t}_2(y)$ for y sufficiently close to $\underline{y}$ when the solution is interior. The last two inequalities and continuity imply that there is an intermediary level of income x such that $\underline{y} < x < z$ such that $\widetilde{t}_1(x) = \widetilde{t}_2(x)$ and $\widetilde{t}_1'(x) < \widetilde{t}_2'(x)$. This contradicts (8) that shows that the slope of the transfers is increasing in the altruism of the recipient. ■

This testable implication is in direct contrast with Observation 1 that shows that transfers under full information $t^*(y)$ are independent of α_R.

Observation 5 *There exists a threshold income $\tilde{y} > \underline{y}$ such that transfers increase more than proportionally with income.*

Proof. Since $\widetilde{t}(\underline{y}) = t^*(\underline{y})$ and $w_3(\underline{y}, \underline{y}, t^*(\underline{y})) = 0$, it is clear that $\widetilde{t}'(y) = -w_2/w_3$ in equation (8) becomes arbitrarily large for values of y close to $\underline{y}$. Hence, there is a range of incomes so that $\widetilde{t}'(y) > 1$. ■

This is also in contrast with transfers under full information that, as seen in Observation 2, increase less than proportionally with the donor's income.

Observation 6 *For low incomes, transfers are concave so that redistribution of income increases total remittances.*

Proof. We can rewrite the differential equation (8) as

$$\widetilde{t}'(y) = \frac{\alpha_D \alpha_R}{1 - \alpha_D M(y)} \text{ where } M(y) \equiv \frac{u_R'(\widetilde{t}(y))}{u_D'(y - \widetilde{t}(y))} \tag{9}$$

One can easily check that $\widetilde{t}'(y) \geq 1$ is a sufficient condition for $M(y)$, and therefore $\widetilde{t}'(y)$, to be decreasing in income. Hence, it follows from Observation 5 that $\widetilde{t}(y)$ is concave at least up to $\tilde{y}$. ■

Observation 7 *An influx of population that widens the support of the income distribution raises the transfers of the original population.*

Proof. Consider an influx of population whose income distribution has positive support on $[y_0, \underline{y}]$.Clearly the transfers of individuals with income at or slightly above $\underline{y}$ must strictly increase while the transfers for larger incomes can never be lower since the slope in (8) is unchanged. ■

Although these properties are clear and simple, testing them empirically is not straightforward. Observation 3 tells us that when altruism is the dominating motive behind the transfers, the amount remitted should increase in the presence of asymmetry of information regarding the donor's income. In a couple of experiments, Jakiela and Ozier (2012) and Ambler (2015) found the opposite: lower transfers when recipients do not observe the result of a lottery for the donors. Naturally altruism may not be the only motive for transfers. De Weerdt, Genicot, and Mesnard (2015) found that pressure from recipients is likely to be one of the main motives for transfers among extended family networks in Tanzania. This would explain more information resulting in larger transfers and suggests that testing the implications of our model would require carefully controlling for pressure and other motives of transfers.

3.4 Logarithmic Example.

This Section illustrates these properties in the case of logarithmic utilities. Equation (8) becomes

$$\widetilde{t}'(y) = \frac{\alpha_D \alpha_R}{1 - \alpha_D(y/\widetilde{t} - 1)} \quad \forall\, \underline{y} < y \leq \bar{y}. \tag{10}$$

As seen in Observation 5, transfers initially increase more than proportionally in the income. As long as the marginal transfer $\widetilde{t}'(y)$ is higher than average transfer $\widetilde{t}/y$, the average increases and therefore, from (10), the marginal transfer $\widetilde{t}'(y)$ decreases. Hence, the marginal transfer converges to the average transfers and in the limit transfers represent a constant fraction $\widetilde{\beta}$ of the income:[3]

$$\widetilde{\beta} = \frac{\alpha_D(1 + \alpha_R)}{(1 + \alpha_D)}.$$

Clearly $\widetilde{\beta}$ is strictly larger than the full information share β and the more so the larger the recipient's altruism is.

Figure 2 illustrates the transfer under full information and under private information assuming that $\alpha_D = \alpha_R = 0.5$ and that the donor's income takes value from $\underline{y} = 1$ to $\bar{y} = 3$. As seen earlier, under full information, the donor gives a third of his income to the recipient so that transfers range from 0.33 to 1. Under asymmetry of information, in the separating equilibrium, the transfers starts at the same level (0.33) but increase faster with income converging towards a share of $\widetilde{\beta} = 0.5$ of their income.

4 Signaling Altruism

This Section shows that in the presence of two-sided altruism, asymmetry of information regarding the donor's level of altruism generate a similar signaling game. To see that, assume now that the income of the donor is known but that his level of altruism α_D is not. Assume that the particular realization of α_D is private information but the distribution defined over $A \equiv [\underline{\alpha}, \bar{\alpha}]$ from which it is drawn is common knowledge. Let α_R be the expected level of altruism of the recipient according to the donor. Whether this belief is correct or not plays no role in the analysis since the recipient

[3]Although the specific fraction differs, the same is true for all CRRA utility functions.

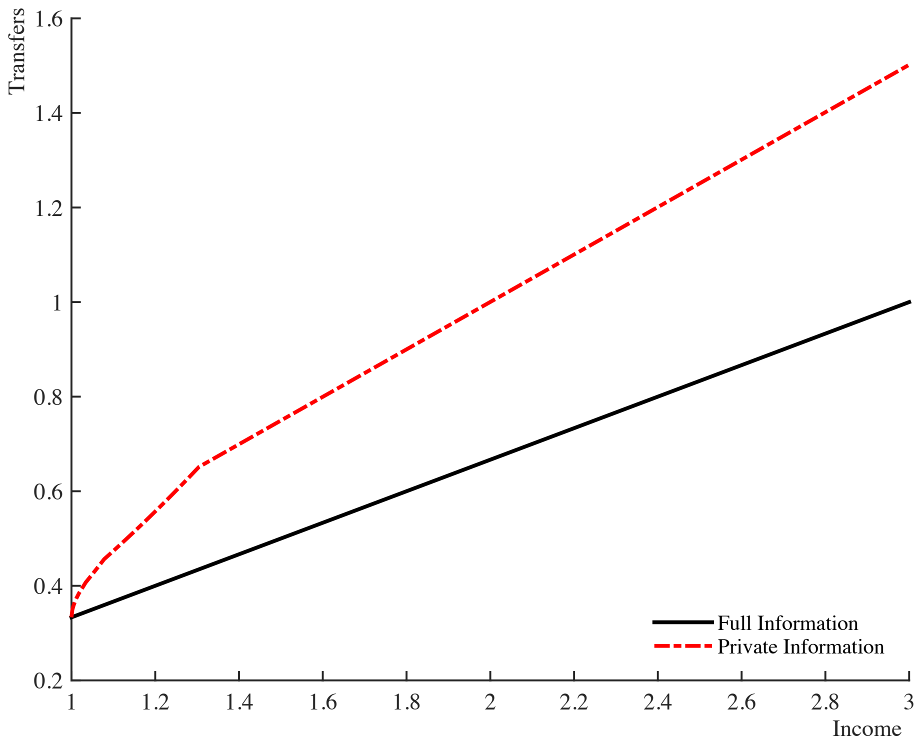

Figure 2: TRANSFERS UNDER FULL AND PRIVATE INFORMATION.

is passive here. As before, the equilibrium concept is Perfect Bayesian Equilibria and we focus on separating equilibria, where different types of donor make different transfers.

As shown in Appendix (Section A3), the utility of a donor with altruism α_D who gives t and is believed to be of type $\widehat{\alpha}$ is given by

$$\omega(\alpha_D, \widehat{\alpha}, t) = \frac{1}{1 - \alpha_R \widehat{\alpha}} \left[(1 + \alpha_R \alpha_D - \alpha_R \widehat{\alpha}) u_D(y - t) + \alpha_D u_R(t) \right]. \tag{11}$$

If utility levels are positive, then donors would like to be perceived as more altruistic ($\omega_2 > 0$) when altruism is two-sided ($\alpha_R > 0$). A mechanism very similar to before is at play. Let's return to the migrant son and his mother from the introduction. When utility levels are positive, the utility of a mother, who cares about her son, increases if she thinks that her son is more altruistic. Hence, a son who cares about his mother's welfare would like her to believe that he is more altruistic than he is. Since remittances convey information on altruism, his mother will try to infer her son's altruism from the remittances that he sends her. Hence, less altruistic sons have incentive to transfer more to imitate more altruistic sons. This is what gives rise to a signaling game among donors.

Since this benefit is larger for more altruistic donors, the single-crossing condition holds, $\frac{-\omega_3(\alpha_D,\widehat{\alpha},t)}{\omega_2(\alpha_D,\widehat{\alpha},t)}$ is strictly decreasing in α_D for all $\widehat{\alpha}$ and t, so that it is possible for more altruistic donors to distinguish themselves. In a separating equilibrium $\widehat{t} : A \to T$ is a one-to-one strategy for the donor: when he chooses $t = \widehat{t}(\alpha)$, the recipient infers that he is of type $\widehat{t}^{-1}(t)$, that is $\psi(\alpha, t) = 1$ if $t = \widehat{t}(\alpha)$ and 0 otherwise.

If $\widehat{t}$ is an equilibrium separating strategy then $\widehat{t}(y) \in \ argmax_t \ \omega(\alpha_D, \widehat{t}^{-1}(t), t) \ \forall \ \alpha_D \in A$. It follows from the first order condition that

$$\omega_3(\alpha_D, \alpha_D, t) + \omega_2(\alpha_D, \alpha_D, t)\frac{1}{\widehat{t}'(\alpha_D)} = 0,$$

so that

$$\widehat{t}'(\alpha_D) = \left(\frac{\alpha_R\alpha_D}{1-\alpha_R\alpha_D}\right)\left(\frac{u_R(\widehat{t}) + \alpha_R u_D(y-\widehat{t})}{u'_D(y-\widehat{t}) - \alpha_D u'_R(\widehat{t})}\right) \quad \forall \ \underline{\alpha} < \alpha_D \leq \bar{\alpha}. \tag{12}$$

The single crossing condition implies that $\widehat{t}(\alpha)$ is continuous and strictly increasing. And, following Mailath (1987), the unique separating equilibrium is characterized by the differential equation (12) along with the initial condition $\widehat{t}(\underline{\alpha})$ is equal to $t^*(y)$ evaluated at $\alpha_D = \underline{\alpha}$. It is easy to check that transfers are increasing in the altruism of the recipient.

Observation 8 *Transfers are increasing in the altruism of the recipient, and strictly so when positive transfers are made.*

The proof is very similar to the proof of Observation 4 and is therefore omitted, but the result is intuitive. The more altruistic the recipient is, the more she gains from believing that the donor is more altruistic. Hence, the incentive to signal higher altruism is higher when the recipient's altruism is higher. Ellingsen and Johannesson (2008) assumes that individuals gain esteem from appearing altruistic to others and that this gain increases in the level of altruism of others, and show that such preferences provides a simple explanation for a number of puzzling experimental results.[4] This model shows that two-sided altruism in the presence of asymmetry of information provides foundation for their preferences that they assumed.

5 Conclusion

This paper shows that, under asymmetry of information regarding the donor's income, transfers behave very differently depending on whether the altruism is reciprocated. When both the donor and the recipient care for each other, the asymmetry of information gives rise to a signaling game among donors of different income levels. Donors have incentive to give more to appear better off than they are. This puts upward pressure to the transfers and more is remitted. This also generate concavity in the transfer schedule at least for low levels of income. Hence, redistribution increases amounts remitted.

Finally, asymmetry of information regarding altruism levels generate very similar results. Altruistic donors transfer more not just because they care but also to signal their altruism, all the more so that the recipient is altruistic.

[4]For instance, why in a trust game the agent is more likely to return money to the principal when the principal chose to trust the agent (voluntary trust game) than when he had no choice in the matter (involuntary trust game).

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A1. Appendix

Proof of Monotonicity

Lemma 1 *If $y > y'$ then $\widetilde{t}(y) \geq \widetilde{t}(y')$*

Proof. Assume not $t = \widetilde{t}(y) < t' = \widetilde{t}(y')$ for some $y > y'$. Let

$$h(t) = \alpha_D A \left(u(t) + \alpha_R \int \phi(z,t) u(z-t) dt \right).$$

If $h(t) \geq h(t')$, then clearly y' would prefer reducing its expenses to t and get more esteem. Hence, it must be that $h(t) < h(t')$. Incentive compatibility for y and y' implies that

$$u(y-t) - u(y-t') \geq h(t') - h(t) \geq u(y'-t) - u(y'-t')$$

which is a contradiction since $u(y-t) - u(y-t') < u(y'-t) - u(y'-t')$. ■

A2. Properties of $w(y,z,t)$ in (11)

Recall (11). The utility of a donor with income y who gives t and is believed to be of type z is given by

$$w(y,z,t) = u_D(y-t) + \alpha_D A u_R(t) + \alpha_D \alpha_R A u_D(z-t).$$

$w(y,z,t)$ satisfies the following regularity conditions :

Smoothness: $w(y,z,t)$ is C^2 on $Y^2 \times \mathbb{R}$.

Belief monotonicity: $w_2(y,z,t) > 0$.

Type monotonicity: $w_{13}(y,z,t) = -u''_D(y-t) > 0$.

Strict quasiconcavity: $w_3(y,y,t) = 0$ has a unique solution $t^*(y)$ that maximizes $w(y,y,t)$ and $w_{33}(y,y,t) < 0$.

In addition, $w(y,z,t)$ satisfies the single-crossing condition:

$\frac{-w_3(y,z,t)}{w_2(y,z,t)} = \frac{-u'_D(y-t)+\alpha_D A u'_R(t)-\alpha_D\alpha_R A u'_D(z-t)}{\alpha_D\alpha_R A u'_D(z-t)}$ is strictly decreasing in y for all z and t.

Finally, the equilibrium transfers must satisfy the following initial condition.

Lemma 2 $\widetilde{t}(\underline{y}) = t^*(\underline{y})$

Proof. Assume that this is not the case and that $\widetilde{t}(\underline{y}) \neq t^*(\underline{y})$. In a separating equilibrium an individual that transfers $\widetilde{t}(\underline{y})$ is believed to earn $\underline{y}$ and therefore has utility $w(\underline{y}, \underline{y}, \widetilde{t}(\underline{y}))$. Since $t^*(\underline{y})$ uniquely maximizes $w(\underline{y}, \underline{y}, t)$, $w(\underline{y}, \underline{y}, t^*(\underline{y})) > w(\underline{y}, \underline{y}, \widetilde{t}(\underline{y}))$. In addition, $u_D(y-t) + \alpha_D A u_R(t) + \alpha_D\alpha_R A \int \phi(z,t) u_D(z-t)dt \geq w(\underline{y}, \underline{y}, t^*(\underline{y}))$ where $\phi(z,t)$ is the equilibrium inference function. Hence,

$$u_D(y-t) + \alpha_D A u_R(t) + \alpha_D\alpha_R A \int \phi(z,t) u_D(z-t)dt > w(\underline{y}, \underline{y}, \widetilde{t}(\underline{y}))$$

and the lowest earner would want to deviate to $t^*(\underline{y})$, a contradiction. ■

A3. Altruism as Private Information

Assume that the donor's level of α_D is drawn from $A \equiv [\underline{\alpha}, \bar{\alpha}]$ according to a distribution that is common knowledge. However, the donor has private information over the particular realization. Let α_R be the expected level of altruism of the recipient according to the donor. Whether this belief is correct or not plays no role in the analysis since the recipient is passive here. As before, we focus on Perfect Bayesian Equilibria. The *inference function* $\psi(\alpha, t)$ is the probability that the donor is of type α if he transfers t. $\Psi(t) \equiv \{\alpha | \psi(\alpha, t) > 0\}$ is the support of types for transfer t.

A donor with altruism α_D who gives t has utility

$$V_D(\alpha_D, t) = u_D(y-t) + \alpha_D E_D V_R(t), \tag{13}$$

where $E_D V_R(t)$ is the donor's expectation regarding the recipient's utility from receiving a transfer t:

$$E_D V_R(t) = u_R(t) + \alpha_R \int \phi(\alpha, t) E_D(\alpha, t).$$

Using (13) in the recipient's utility, we get

$$E_D V_R(t) = u_R(t) + \alpha_R u_D(y-t) + \alpha_R \widetilde{\alpha} E_D V_R(t),$$

where $\widetilde{\alpha} = \int \phi(al, t)\alpha d\alpha$, or

$$E_D V_R(t) = \frac{1}{1-\alpha_R \widetilde{\alpha}} \left(u_R(t) + \alpha_R u_D(y-t) \right). \tag{14}$$

Plugging it back in equation (13), we see that

$$V_D(\alpha, t) = \frac{1}{1-\alpha_R \widetilde{\alpha}} \left[(1 + \alpha_R \alpha_D - \alpha_R \widetilde{\alpha}) u_D(y-t) + \alpha_D u_R(t) \right]. \tag{15}$$

$V_{D\,12} > 0$ implies that in any perfect Bayesian equilibrium, the choice of transfer is weakly increasing in altruism.