Competition for status acquisition in public good games

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Abstract

This paper examines the role of status acquisition as a motive for giving in voluntary contributions to public goods. In particular, every donor's status is given by the difference between his contribution and that of the other donor. Specifically, I show that contributors give more than in standard models where status is not considered, their donation is increasing in the value they assign to status and, under certain conditions, in the value that their opponents assign to status (reflecting donors' competition to gain social status). Furthermore, I consider contributors' equilibrium strategies both in simultaneous and sequential contribution mechanisms. Then, I compare total contributions in both of these mechanisms. I find that the simultaneous contribution order generates higher total contributions than the sequential mechanism only when donors are sufficiently homogeneous in the value they assign to status. Otherwise, the sequential mechanism generates the highest contributions.

JEL CLASSIFICATION: C7, H41.

1 Introduction

The effect of status on individuals' consumption of private goods has been extensively analyzed from a theoretical perspective, and confirmed by multiple studies. Indeed, many authors, starting from Smith (1759) and Veblen (1899), have examined agents' incentives to consume certain positional goods (such as luxury cars) for the only purpose of acquiring social status among their neighbors, co-workers or friends; see Frank (1985), Congleton (1989), Fershtman and Weiss (1993), Ball *et al.* (2001) and Hopkins and Kornienko (2004).

Despite the extensive analysis of status in private good settings, there is yet a relatively limited theoretical literature analysing social status acquisition in public good contexts.[1] Nonetheless, the importance of status as a motive for individual donations to public goods cannot be overemphasized. For example, both BusinessWeek and Slate magazines recently created rankings of the most generous US philanthropists. More generally, publicizing the list of donors, as well as the size of their contributions to the charity, constitutes a common practice of many charitable organizations, what suggests that many donors are indeed concerned about how their contribution is ranked relative to others'. In the same spirit, recent experimental literature, such as Kumru and Vesterlund (2010) and Duffy and Kornienko (2010), have also confirmed the role of status as an individual incentive affecting donors' giving behavior in different experimental settings. Similarly, Frey and Meier (2004), Shang and Croson (2009) and Chen *et al.* (2010) demonstrate that informing a donor about other people's contribution has a significant effect on his donations, also suggesting the role of status as a giving incentive.[2]

This paper contributes to this literature by constructing a theoretical model that analyzes how individual (and total) contributions to a charity are affected by players' competition for social status. Intuitively, one may expect every donor's giving decision to be increasing in his value for social status, since this valuation might attenuate his incentives to free-ride on other donors' contributions. This intuitive prediction is indeed confirmed both in the simultaneous solicitation order (where both donors give simultaneously to the charity) and in its sequential version (in which one donor gives first and then the other gives second before the end of the game). Similarly, an individual's contribution should also be increasing in the value that other donors assign to status. Indeed, since an opponent with a higher value for status increases his contribution, individuals need to increase their donation to the charity in order to reduce as much as possible their loss of social status; this is confirmed in our model under certain parameter conditions.

A question of interest is which particular contribution order raises the highest total revenue to the charity. In particular, building on Romano and Yildirim (2001), I provide an answer to

[1] Harbaugh (1998) examines a model where contributions are announced among donors, and every donor gains 'prestige' from his donation, although such 'prestige' only depends on his own contribution. In this paper we assume, instead, that a donor gains status only if his contribution is higher than those of other donors (so an individual's status depends not only on his individual contribution, but also in those of other donors).

[2] In a linear public good game, Andreoni and Petrie (2004) experimentally test the effect of the identification of participants and the information they receive about other players' contributions on their donations to the public good. They show that individual contributions are significantly affected by subjects' information about the exact contribution of other participants (i.e., information about 'who gave what').

this question which can be directly applied by practitioners. Specifically, populations of relatively homogeneous donors —in terms of the value they assign to status— induce a higher competition (and contributions) in the simultaneous public good game than in its sequential version. In contrast, groups of contributors with heterogeneous values to status submit higher total donations in the sequential contribution game than in its simultaneous counterpart. Hence, this paper contributes to the literature on public good games by analysing which particular solicitation order raises the highest total revenue to the charity when players compete for social status. Similarly, it provides an explanation of why charities might prefer to organize sequential fund-raising events: their donors are relatively heterogeneous in their concerns for status acquisition. In particular, when some contributors can be regarded as 'net free-riders' (because their concerns for status acquisition are relatively low) whereas others can be denoted as 'net status-seekers' (because their concerns for status are relatively high), the charity would raise the highest revenue by organizing a sequential fund-raising event.[3] This result might explain why several charities and foundations —such as the New York Library or Johns Hopkins University— start their fundraising campaigns by announcing a relatively large contribution, which is then followed by other major donations.[4]

Finally, the model is extended to more than two symmetric players. In particular, we show that our revenue ranking result extends to N players, where total donations in the simultaneous game are higher than in its sequential version. We then examine the possibility that donors' social status might be acquired from their previous donations to the charity, or from any other sources. This is the case, for example, of famous philanthropists who start their competition for status with previously acquired levels of seniority. In particular, I show that if this previous status enters additively into donors' status concerns, seniority may work as an strategic substitute for the status donors can acquire through current donations, reducing their contributions. In contrast, if currently acquired status emphasizes previously acquired rankings, then status acquired during different periods work as strategic complements, and current donations are increased.

The article is organized as follows. In the next section, I present the model, and sections three and four describe the results in terms of the players' equilibrium contributions in the simultaneous and sequential games, respectively. In section five, given the previous results, I find the contribution mechanism that maximizes the charity's total revenue. Section six presents two extension of the previous results to more than two players and allowing for seniority in status. Section seven concludes and offers some extensions of the model.

2 Model

Let us consider a public good game (PGG) where two agents privately contribute to the provision of a public good. Let g_i denote subject i's voluntary contributions to the public good, and let $x_i \geq 0$ represent his consumption of private goods. Additionally, I assume that the marginal utility

[3] Note that this result differs from that in Varian (1994), where contributors without concerns for status acquisition give higher total contributions to the charity in the simultaneous than in the sequential public good game.

[4] For more details about this practice see Kumru and Vesterlund (2010).

individual i derives from his consumption of the private good is one. Specifically, the representative contributor's maximization problem is given by

$$\max_{x_i, G} \; x_i + \ln\left[mG + \alpha_i\left(g_i - g_j\right)\right] \tag{1}$$

$$\begin{aligned} \text{subject to } x_i + g_i &= w \\ g_i + g_j &= G \\ g_i, g_j &\geqslant 0 \end{aligned}$$

where $m \in [0, +\infty)$ denotes the return player i obtains from total contributions to the public good, $G = g_i + g_j$, and w represents players' endowment of monetary units that can be distributed between private and public goods consumption.[5] In addition, I assume that the status subject i acquires by contributing g_i is given by the difference between his contribution and that of the other player, $g_i - g_j$. That is, subject i enhances his relative status if his contribution is greater than individual j's; otherwise, subject i perceives himself as an individual with lower status than subject j. In addition, this difference is scaled by α_i, indicating the importance of relative status for subject i, where $\alpha_i \in [0, +\infty)$. As commented in the previous section, this is a game of complete information. Hence, in the equilibrium of the PGG, player i correctly conjectures donor j's contribution, g_j for all $j \neq i$, and as a consequence he knows whether he acquires status through his contribution, $g_i > g_j$, or if he does not, $g_i < g_j$. Furthermore, all the elements of the game, including the particular values of α_i, are assumed to be common knowledge among the players. Using $x_i = w - g_i \geq 0$, we can simplify the above program to

$$\max_{g_i \geq 0} \;\; w - g_i + \ln\left[m(g_i + g_j) + \alpha_i\left(g_i - g_j\right)\right] \tag{2}$$

In particular, the first term, $w - g_i$, represents the utility derived from the consumption of the remaining units of money that have not been contributed to the public good. The second term denotes, on the one hand, the utility that individual i gets from the consumption of the total contributions to the public good $g_i + g_j$, and on the other hand, the utility derived from relative status acquisition.

Intuitively, note that in our model an increase in player j's contribution, g_j, imposes both a positive and a negative externality on player i's utility level. The positive externality from g_j on player i's utility is just the usual one arising from the public good nature of player j's contributions. Player j's donations, however, impose also a negative externality on player i since this donation reduces the status perception of player i, i.e., higher g_j decreases $\alpha_i\left(g_i - g_j\right)$, for a given g_i. Finally, note that we do not make any additional assumption on the quasilinear part of player i's utility function in order to guarantee that it is positive for any parameter values. Indeed, as we show in

[5] Allowing for asymmetric monetary endowments, $w_i \neq w_j$, would not change our results, since players' utility function is quasilinear in w. Furthermore, we assume that w is sufficiently large.

the next sections, this term is never negative in equilibrium, since low contributions by player i correspond to those cases for which α_i is close to zero.

2.1 Best response function

In order to gain a clearer intuition of our results, let us analyse player i's best response function. Henceforth, all proofs are relegated to appendix 2.

Lemma 1. In the contribution game, player i's best response contribution level, $g_i(g_j)$, is

$$g_i(g_j) = \begin{cases} 1 + \frac{\alpha_i - m}{\alpha_i + m} g_j & \text{if } g_j \in \left[0, \frac{m+\alpha_i}{m-\alpha_i}\right], \text{ and} \\ 0 & \text{if } g_j > \frac{m+\alpha_i}{m-\alpha_i} \end{cases}$$

if $\alpha_i < m$. And in the case that $\alpha_i > m$, $g_i(g_j) = 1 + \frac{\alpha_i - m}{\alpha_i + m} g_j$ for all g_j.

Clearly, when $\alpha_i < m$, player i's best response function is decreasing in g_j, while $\alpha_i > m$ implies a positively sloped best response function, as the following figures indicate.

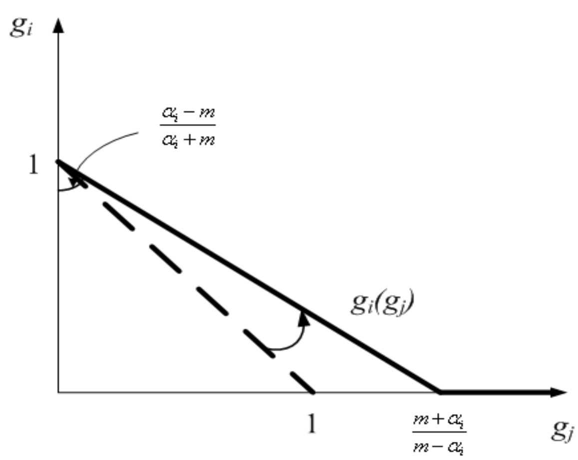

Fig. 1(a): $g_i(g_j)$ when $\alpha_i < m$ (net free-rider).

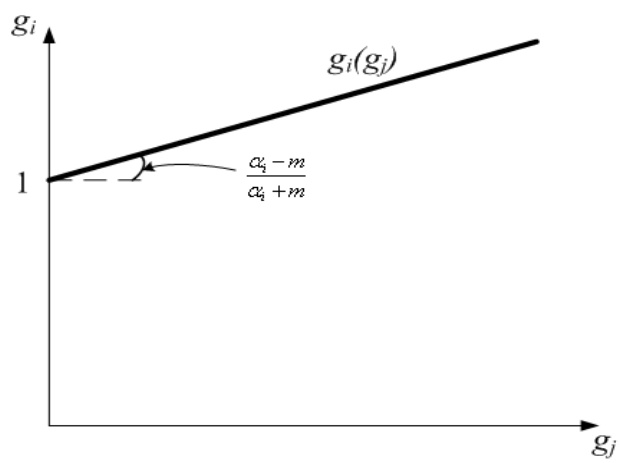

Fig. 1(b): $g_i(g_j)$ when $\alpha_i > m$ (net status-seeker).

In particular, when $\alpha_i < m$ the positive externality that player j's donations impose on player i's utility dominates the negative one, and player i considers player j's contributions as strategic substitutes of his own (i.e., he is a net free-rider), as in the usual PGG models without status. On the other hand, when $\alpha_i > m$ the negative externality resulting from player j's contributions is higher than the positive externality originated from the public good nature of his contributions. In this case, player i considers player j's donations as strategic complements to his own (i.e., he is a net status-seeker), which leads to the positively sloped best response function depicted in Fig. 1(b). In addition, from the above lemma and discussion, it is easy to infer that the slope of player

i's best response function increases in his value to status, α_i. Indeed, from the above figures, $g_i(g_j)$ pivots upward, with center at $g_i = 1$, as α_i increases: from a negative slope when $\alpha_i < m$ to a positive slope when $\alpha_i > m$.[6]

Let us next show that our results extend to more general quasilinear utility functions. Considering a utility function with a concave non-linear part $f(\cdot)$, $f' > 0$ and $f'' < 0$, every player i solves

$$\max_{g_i \geq 0} \quad w - g_i + f\left(m(g_i + g_j) + \alpha_i \left(g_i - g_j\right)\right) \tag{3}$$

An increase in g_i hence produces a marginal cost of -1 (since those resources are not used in private uses) and a marginal benefit stemming from two sources: the public good, as in standard models, and the acquisition of social status, i.e., $f'\left(m + \alpha_i\right)$. If, for simplicity, the benefit from status and the public good are increasing and linear in g_i, then the marginal benefit of g_i is increasing in the other donor's contribution, g_j, if $\frac{\partial f'}{\partial g_j} > 0$. Intuitively, this occurs when an increase in g_j produces a reduction in donor i's contribution (from his free-riding incentives) that is offset by an increase in his donations (because player i wants to maintain his social status after player j raised his contribution). Summarizing, when donors are net status-seekers (defined in this more general context as $\frac{\partial f'}{\partial g_j} > 0$), an increase in g_j produces an increase in donor i's marginal benefit from raising his contribution. In this case, player i's best response function is increasing in g_j. In contrast, when donors are net free-riders (defined as $\frac{\partial f'}{\partial g_j} < 0$), an increase in g_j leads to a decrease in donor i's marginal benefit from g_i, yielding a negatively sloped best response function.[7]

3 Simultaneous contributions

After analysing player i's best response function and its interpretation, we can now examine player i's optimal contribution in this simultaneous-move game.

Proposition 1. In the simultaneous contribution game, player $i = \{1, 2\}$ submits the following Nash equilibrium contribution level

$$g_i^{Sm} = \begin{cases} 1 \ \text{ if } \alpha_i > 0 \text{ and } \alpha_j = 0 \\ \frac{\alpha_i(\alpha_j + m)}{(\alpha_i + \alpha_j)m} \ \text{ if } \ \alpha_i > 0 \text{ and } \alpha_j > 0 \\ 0 \ \text{ if } \ \alpha_i = 0 \text{ and } \alpha_j > 0 \end{cases}$$

and $g_i^{Sm} + g_j^{Sm} = 1$ if $\alpha_i = \alpha_j = 0$.

Figure 2 illustrates the set of parameter values that support the above different contribution levels. In particular, $g_i^{Sm} = 1$ on the vertical axis of the figure where $\alpha_j = 0$; $g_i^{Sm} = 0$ on the

[6] For simplicity, we consider that the return from the public good, m, is symmetric across players. Allowing for different returns (for instance, because one donor benefits more from the public good than the other contributor) would not qualitatively affect our results.

[7] Needless to say, for the particular functional form considered above, $\frac{\partial f'}{\partial g_j}$ becomes positive for $\alpha > m$ and negative otherwise.

horizontal axis, where $\alpha_i = 0$; and $g_i^{Sm} = \frac{\alpha_i(\alpha_j+m)}{(\alpha_i+\alpha_j)m}$ when α_i,$\alpha_j > 0$. Intuitively, player i submits $g_i^{Sm} = 1$ when he assigns a value to status and player j does not; submits a zero contribution when he does not assign any value to status, $\alpha_i = 0$, and player j does, $\alpha_j > 0$;[8] and finally he submits $g_i^{Sm} = \frac{\alpha_i(\alpha_j+m)}{(\alpha_i+\alpha_j)m}$ when both players assign a value to status.

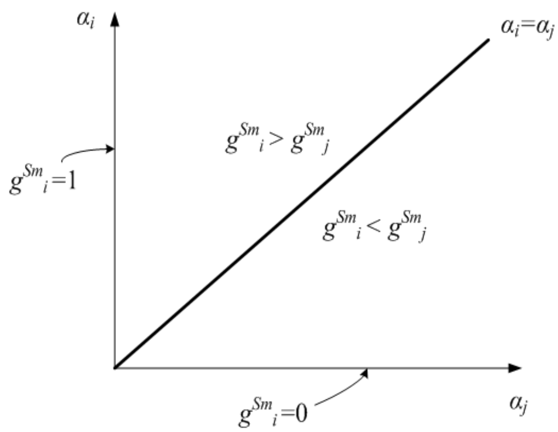

Fig. 2: g_i^{Sm} and g_j^{Sm}

In addition, Fig. 2 includes the 45^0- line, where $\alpha_i = \alpha_j$, which divides equilibrium contribution levels into two parts: an upper region where $\alpha_i > \alpha_j$ and as a consequence $g_i^{Sm} > g_j^{Sm}$, and a lower region where $\alpha_i < \alpha_j$ and $g_i^{Sm} < g_j^{Sm}$. This result originates in the fact that players' equilibrium strategies are symmetric up to their individual value to status. Hence, in this simultaneous game, the player who assigns the highest value to status submits the highest donation. Next, the following lemma presents the comparative statics of player i's equilibrium donation.

Lemma 2. In the simultaneous contribution game, player i's equilibrium contribution, g_i^{Sm}, is weakly increasing in his value to status acquisition, α_i, for all parameter values, and is weakly increasing in player j's value, α_j, if $\alpha_i \geq m$. Furthermore, g_i^{Sm} is weakly decreasing in the return, m, that every donor obtains from total contributions.

That is, a player who values status competes more ferociously when he becomes more concerned about the status he can acquire through his contributions. When his opponent becomes more concerned about status, however, he becomes more competitive only if he is a net status-seeker, i.e., $\alpha_i \geq m$. Indeed, since his opponent increases his donation, player i must increase his own as well if he pretends to maintain his level of social status unchanged.

Finally, note that individual donations are decreasing in the return that every donor obtains from total contributions to the public good. That is, for a given value of status among donors,

[8] Note that zero donations can be alternatively interpreted as players who decide not to participate in the contribution mechanism.

individual contributions decrease as his benefits from total contributions to the public good (free-riding effects) dominate his benefits from an increase in his individual contribution (status effects). These results might be specifically vivid in the case of donors helping charities with low returns from total contributions, such as those operating in distant countries. Indeed, according to our previous results, a donor would donate *more* to charities with goals he does not directly benefit from (low returns) than from those he does (high returns), for a given value of the status he acquires by donating to either charity. As a consequence of the above individual giving decision from players i and j, total contributions are the following.

Lemma 3. In the simultaneous contribution game total donations induced from Nash equilibrium play, G^{Sm}, are

$$G^{Sm} = \begin{cases} 1 \text{ if } \alpha_j = 0 \text{ and } \alpha_i > 0 \\ 1 + \frac{2\alpha_i \alpha_j}{(\alpha_i + \alpha_j)m} \quad \text{if } \alpha_i > 0 \text{ and } \alpha_j > 0 \\ 1 \text{ if } \alpha_i = 0 \text{ and } \alpha_j \geq 0 \end{cases}$$

where G^{Sm} is weakly increasing in both α_i and α_j, and maximized for (α_i, α_j) pairs such that $\alpha_i = \alpha_j = \alpha$.

Figure 3(a) represents total contributions in this simultaneous PGG for any α_i and α_j; and Fig. 3(b) illustrates the three areas in which total contributions can be divided. In particular, Fig. 3(b) shows that: (1) when player i assigns no importance to status but player j does, on the horizontal axis of Fig. 3(b), only player j contributes, submitting $g_j^{Sm} = 1$; (2) when the opposite happens, $\alpha_j = 0$ and $\alpha_i > 0$ on the vertical axis, it is player i who submits $g_i^{Sm} = 1$; and (3) when both players are positively concerned about status, α_i,$\alpha_j > 0$ in the interior points of the figure, both players give positive amounts and their total contributions are $1 + \frac{2\alpha_i \alpha_j}{(\alpha_i + \alpha_j)m}$.

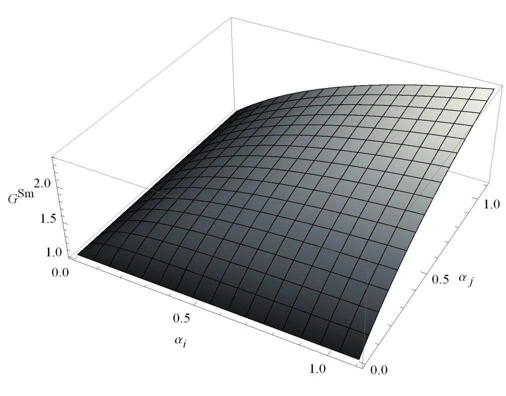

Fig. 3(a): G^{Sm}

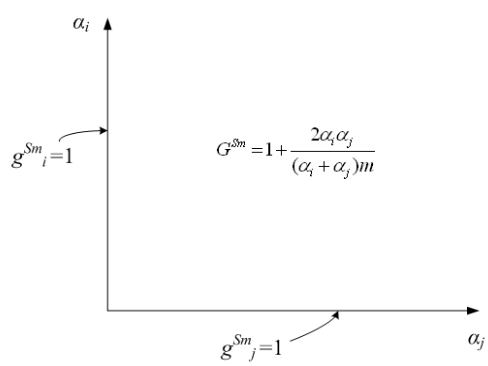

Fig. 3(b)

Finally, note that players' total contributions when either of them does not value status coincides with total contributions when *none* of them does, $G^{Sm} = 1$. Alternatively, an increase in the status concerns of the only individual who assigns a positive value to status does no raise total contributions. Furthermore, G^{Sm} is higher when players' value of status acquisition are relatively homogeneous ($\alpha_i = \alpha_j = \alpha$, in the main diagonal) than when they are heterogeneous ($\alpha_i \neq \alpha_j$, away from the main diagonal). Finally, note that total contributions are increasing in both α_i and α_j, in rays $\frac{\alpha_i}{\alpha_j}$ of Fig. 3(b) for which $\alpha_i \neq \alpha_j$.

4 Sequential contributions

Let us next examine donors' contributions in the sequential PGG, where player i is the first donor solicited to contribute (and he can only give once). Observing his contribution, player j (the follower) determines his donation.

Proposition 2. In the sequential contribution game in which player i moves first, equilibrium contributions are given by

$$g_i^{Seq} = \begin{cases} 0 \text{ if } \alpha_i \in [0, \bar{\alpha}_i]\text{, and} \\ \frac{\alpha_i\alpha_j + 3\alpha_i m + \alpha_j m - m^2}{2m(\alpha_i+\alpha_j)} \text{ if } \alpha_i \in (\bar{\alpha}_i, +\infty) \end{cases}$$

for player i, where $\bar{\alpha}_i \equiv \frac{m(m-\alpha_j)}{3m+\alpha_j}$. Similarly, for player j (second mover)

$$g_j^{Seq} = \begin{cases} 1 \quad \text{if} \quad \alpha_i \in [0, \bar{\alpha}_i)\text{,} \\ \frac{1}{2}\left(\frac{\alpha_i\alpha_j}{(\alpha_i+\alpha_j)m} + \frac{m}{\alpha_i+\alpha_j} + \frac{4\alpha_j}{\alpha_j+m} - 1\right) \text{ if } \alpha_j < m \text{ and } \alpha_i \in [\bar{\alpha}_i, \hat{\alpha}_i)\text{,} \\ \text{or if } \alpha_j > m \text{ and } \alpha_i \in [\bar{\alpha}_i, +\infty)\text{, and} \\ 0 \quad \text{if } \alpha_j < m \text{ and } \alpha_i \in [\hat{\alpha}_i, +\infty) \end{cases}$$

where $\hat{\alpha}_i \equiv \frac{m\left(3\alpha_j^2+m^2\right)}{-\alpha_j^2-4\alpha_j m+m^2}$.

Hence player i submits a strictly positive contribution if and only if $\alpha_i > \bar{\alpha}_i$. Figure 4(a) represents player i's equilibrium contribution for different values of α_i and α_j, and Fig. 4(b) illustrates cutoff level $\bar{\alpha}_i$ for different values of m.

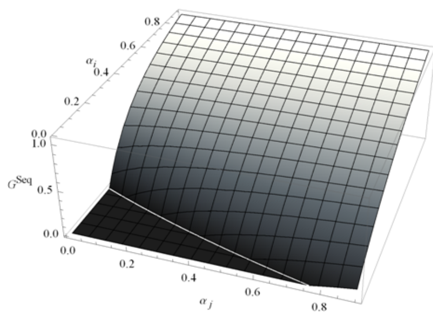

Fig. 4(a): g_i^{Seq}.

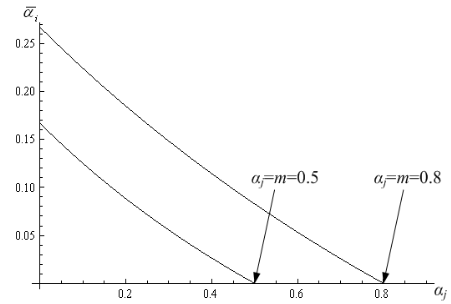

Fig. 4(b): $\bar{\alpha}_i$ for $m = 0.5$ and $m = 0.8$.

Corollary 1. In the sequential contribution game, $g_i^{Seq} > 0$ when $\alpha_i = 0$, if and only if $\alpha_j > m$. Furthermore, $g_i^{Seq} > 0$ when $\alpha_i > m$ for any α_j.

That is, when the first mover does not assign any value to status, $\alpha_i = 0$, he submits a positive contribution when the second donor is a net status-seeker ($\alpha_j > m$) since the second mover will be tempted to significantly increase his donation. Otherwise, when the second donor is a net free-rider ($\alpha_j < m$), a first mover with no value for status contributes zero, as in sequential PGGs without considerations about status. Figure 4(b) illustrates the above intuition, in particular at the α_j-axis (horizontal axis), where $\alpha_i = 0$. Note that for any value at the α_j-axis where $\alpha_j < m$, player i's optimal contribution is zero, while for any $\alpha_j > m$, player i submits positive donations.

On the other hand, the second result of corollary 1 specifies that when the first mover is a net status-seeker, $\alpha_i > m$, he submits positive contributions regardless of the value that the second mover may assign to status acquisition, α_j. Graphically, this result is depicted in Fig. 4(b). In particular, any (α_i, α_j)-pair satisfying $\alpha_i > m$, lies to the right-hand side of cutoff $\bar{\alpha}_i$, leading to strictly positive contributions from the first mover. Let us next examine comparative statics about g_i^{Seq} in this sequential game.

Lemma 4. In the sequential contribution game, g_i^{Seq} is weakly increasing both in his own value for status acquisition, α_i, and in the second mover's value, α_j, under all parameter conditions.

Let us finally analyse the charity's total revenues in this sequential solicitation mechanism.

Lemma 5. In the sequential PGG total contributions induced from the subgame perfect Nash equilibrium of the game, G^{Seq}, are

$$G^{Seq} = \begin{cases} 1 \quad \text{if} \quad \alpha_i \in [0, \bar{\alpha}_i) \\ \frac{2\alpha_j}{\alpha_j + m} + \frac{\alpha_i(\alpha_j + m)}{(\alpha_i + \alpha_j)m} \text{ if } \alpha_j < m \text{ and } \alpha_i \in [\bar{\alpha}_i, \hat{\alpha}_i), \text{ or if } \alpha_j > m \text{ and } \alpha_i \in [\bar{\alpha}_i, +\infty) \\ \frac{\alpha_i\alpha_j + 3\alpha_i m + \alpha_j m - m^2}{2m(\alpha_i + \alpha_j)} \text{ if } \alpha_j < m \text{ and } \alpha_i \in [\hat{\alpha}_i, +\infty) \end{cases}$$

Interestingly, when first mover assigns a sufficiently low value to status acquisition, $\alpha_i < \bar{\alpha}_i$, he does not contribute and the second mover responds by contributing one. In this case, $G^{Seq} = 1$, and the results resemble those in sequential PGG models without status considerations, $\alpha_i = \alpha_j = 0$. In contrast, when the first mover assigns a sufficiently high value to status, $\alpha_i \in [\bar{\alpha}_i, \hat{\alpha}_i)$, and $\alpha_j > m$, he contributes positive amounts which are then responded by the second mover with positive contributions (since the latter is a net status-seeker, i.e., $\alpha_j > m$). Finally, if $\alpha_i > \hat{\alpha}_i$ and the second mover is a net free-rider ($\alpha_j < m$), the first mover's contribution crowds-out all second mover's donations, and he is the only donor contributing to the charity.

5 Comparing contribution mechanisms

Different questions naturally arise from the above results. For example, given a particular pair of players' values for status, (α_i, α_j), under what contribution order does player i (or player j) contribute more? Or, what contribution order maximizes total donations received by the charity? Let us first compare individual contributions, and then extend our results to the total revenues received by the charity.

Lemma 6. Player i's equilibrium donations in the simultaneous and sequential contribution game satisfy $g_i^{Sm} > g_i^{Seq}$ if and only if both players are net status-seekers ($\alpha_i > m$ and $\alpha_j > m$), or both are net free-riders ($\alpha_i < m$ and $\alpha_j < m$). Player j's equilibrium donations satisfy $g_j^{Sm} > g_j^{Seq}$, if and only if player i is a net status-seeker ($\alpha_i > m$).

That is, when players' value of status is relatively homogenous (both players are net status-seekers or both are net free-riders), the first mover contributes more in the simultaneous PGG than in its sequential version. This result is indicated in Fig. 5(a) below for those quadrants in which $g_i^{Sm} > g_i^{Seq}$. If, on the contrary, players' value of status is relatively heterogeneous, i.e., if $\alpha_i > m$ and $\alpha_j < m$ for all $j \neq i$ (one player is a net status-seeker while the other is a net free-rider), then the above inequality is reversed, i.e., $g_i^{Sm} < g_i^{Seq}$.

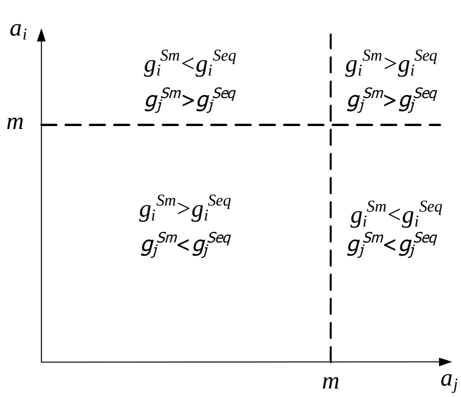

Fig. 5(a): Individual comparisons.

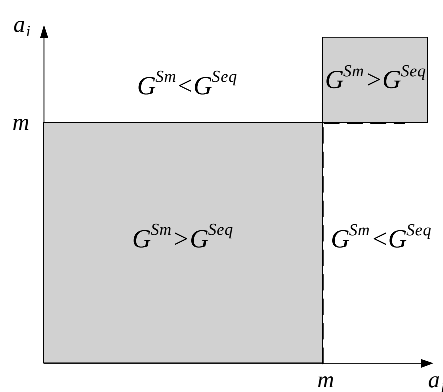

Fig. 5(b): Revenue comparisons.

In the case of player j, note that $g_j^{Sm} > g_j^{Seq}$ if player i is a net status-seeker. Intuitively, when $\alpha_i > m$ player i (the first mover in the sequential game) induces player j to 'give-up' from the competition for social status by submitting a sufficiently high donation. In contrast, when $\alpha_i < m$ player i 'tempts' player j to win the competition for social status by submitting a sufficiently low contribution which can be easily exceeded. After describing the ranking of individual contributions, let us now rank total contributions.

Proposition 3. Total donations under the simultaneous contribution game are weakly higher than under the sequential game, $G^{Sm} > G^{Seq}$, if and only if both players are net status-seekers ($\alpha_i > m$ and $\alpha_j > m$), or both are net free-riders ($\alpha_i < m$ and $\alpha_j < m$).

The results from this proposition are graphically illustrated in Fig. 5(b) above. Shaded areas indicate sets of parameters values for which the simultaneous contribution mechanism provides higher revenues to the charity than the sequential game, $G^{Sm} \geq G^{Seq}$, whereas unshaded areas support the contrary, i.e., $G^{Sm} < G^{Seq}$.

Let us first elaborate on those parameter values supporting $G^{Sm} \geq G^{Seq}$, where both donors are net status-seekers ($\alpha_i > m$ and $\alpha_j > m$) or both are net free-riders ($\alpha_i < m$ and $\alpha_j < m$). In the first case, competition for social status is so intense in the simultaneous version of the game that $G^{Sm} \geq G^{Seq}$. In the second case, when both players are net free-riders, we find equilibrium predictions resembling those in PGGs where players do not care about status. In particular, since both players consider each others' contributions as strategic substitutes, the first mover reduces his contribution anticipating that the second donor will increase his, what he then free-rides. Since, in addition, the second mover does not increase his donation enough to compensate for such a decrease, we observe $G^{Sm} \geq G^{Seq}$.

Let us now analyse those parameter values for which $G^{Sm} < G^{Seq}$, which occurs when only one donor is a net status-seeker while the other is a net free-rider, i.e., $\alpha_i > m$ and $\alpha_j < m$ for all $i = \{1, 2\}$ and $j \neq i$. As described in the previous section, when the first donor is the only status-seeker, he induces the second mover (a net free-rider) to 'give up' from the competition by submitting a sufficiently high contribution, which cannot be exceeded by the second donor.

On the other hand, when the second mover is the only net status-seeker, $\alpha_i < m$ and $\alpha_j > m$, the first donor (net free-rider) submits a low contribution, that 'tempts' the second mover with the chance to win the competition by contributing a higher donation to the charity. Finally, note that when both players assign the same value to status acquisition, $\alpha_i = \alpha_j$, as illustrated in the 45^0-line of Fig. 5(b), total contributions satisfy $G^{Sm} \geq G^{Seq}$, for any parameter values. This result extends that of Varian (1994), who determines that, for standard public good games where players do not assign any value to status acquisition, $G^{Sm} \geq G^{Seq}$.[9,10]

[9] Note that, for the particular functional form considered in the paper, both contribution mechanisms generate the same total revenue, $G^{Sm} = G^{Seq}$, if players do not sustain preferences for status, i.e., $\alpha_i = \alpha_j = 0$.

[10] Note that we assume that charities only allow donors to give once. This assumption is equivalent to considering that charities allow players to contribute many times, but donations are not revealed until the end of the game. This interpretation generates the same individual and total contributions.

Note that these results can be generalized to the quasilinear functional form considered in section two. Indeed, the outcome in proposition 3 relies on the fact that when both players are net free-riders (net status-seekers) their best response functions are negatively sloped (positively sloped, respectively) and every donor's utility increases (decreases) in the other donor's contribution. In this case, the simultaneous-move game provides a larger total revenue to the charity than its sequential version. If only one player is a status-seeker, however, the sequential contribution game generates larger revenue.

6 Extensions

6.1 Extension to N players

In this section we extend our results to simultaneous contribution games with N symmetric players. In particular, every player i chooses a donation g_i that maximizes his utility level, given that all other $N-1$ players contribute G_{-i}. Note that, for simplicity, we consider that player i obtains status if his contribution, g_i, exceeds the average contribution of all other $N-1$ players, $\frac{G_{-i}}{N-1}$.

$$\max_{g_i \geq 0} \; w - g_i + \ln\left[m(g_i + G_{-i}) + \alpha\left(g_i - \frac{G_{-i}}{N-1}\right)\right] \tag{4}$$

Taking first order conditions with respect to g_i and solving for g_i, every player i's best response function $g_i(G_{-i})$ becomes

$$g_i(G_{-i}) = \begin{cases} 1 + \frac{\alpha-(N-1)m}{(N-1)(m+\alpha)} G_{-i} & \text{if } G_{-i} < \frac{(N-1)(m+\alpha)}{(N-1)m-\alpha}, \text{ and} \\ 0 & \text{otherwise} \end{cases} \tag{5}$$

where the slope of the best response function becomes positive if status concerns are sufficiently high, i.e., $\alpha > m(N-1)$. Intuitively, an increase in other players' donations, G_{-i}, produces a benefit to player i from the return from the public good, m, but it also induces a loss in status relative to the average, $\frac{\alpha}{N-1}$. When the latter exceeds the former, the player behaves as a status seeker and must increase his donation as a response to larger contributions from other players, G_{-i}. (Note that, under $\alpha = 0$, the best response function collapses to $g_i(G_{-i}) = 1 - G_{-i}$ for all $G_{-i} < 1$, and zero otherwise, resembling standard specifications in public good games involving N players without concerns for social status.) In addition, the slope of this best response function is decreasing in N, becoming negative for all $N > \frac{m+\alpha}{m}$.[11] That is, for a given concern about status, an increase in the number of individuals who can benefit from the public good raises the free-riding incentives that every player faces when choosing his donation. Solving for every player i, and invoking symmetry we obtain equilibrium contribution $g_i^{Sm} = \frac{1}{N}\frac{m+\alpha}{m}$. This individual donation is decreasing in N, and converges to zero as $N \to \infty$. Nonetheless, individual contributions approach

[11] Furthermore, note that the slope of the best response function never reaches -1 (coinciding with that in the case where players do not sustain concerns for social status) since the limit of the slope when $N \to \infty$ is $-\frac{m}{m+\alpha}$, which lies in $(-1, 0)$ by definition.

zero faster when players are unconcerned about social status than when they are concerned. In other words, for a given population size N, individual contributions g_i^{Sm} are increasing in α. Finally, total contributions in the simultaneous-move game are hence $G^{Sm} = N \times g_i^{Sm} = \frac{m+\alpha}{m}$, being constant in N as in standard public good games. The previous result suggests that enlarging the population size does not affect the revenue ranking we identified in section five. The following corollary confirms this intuition.[12]

Corollary 2. Consider N symmetric players. Total contributions in the simultaneous-move game are weakly higher than in the sequential game.

This result extends our previous finding in proposition 3 —namely, that $G^{Sm} \geq G^{Seq}$ when both players are symmetric— to the context of N players. As suggested above, total contributions in the simultaneous-move game are $G^{Sm} = \frac{m+\alpha}{m}$ and remain constant in the number of players. In contrast, total donations in the sequential game, G^{Seq}, lie weakly below $\frac{m+\alpha}{m}$ for any population size N (see appendix). As a consequence, the simultaneous-move game generates a larger total revenue for the charity than the sequential version for N symmetric players.

6.2 Seniority in status

Previous sections considered that individuals can only acquire status through their donations while playing the PGG. Donors, however, usually start the voluntary contribution game with some previous status arising, for example, from their prior donations to the charity or from any other source (which we generally refer to as 'seniority' in status). In this section, I analyse how our results would change when allowing for such seniority in status. In particular, assuming that players i and j start the PGG with previous seniority levels of S_i and S_j respectively, their utility function becomes

$$U_i = w - g_i + \ln\left[m\left(g_i + g_j\right) + \alpha_i\left(g_i - g_j\right)S_i\right] \tag{6}$$

Intuitively, player i assigns a larger value to the status he gains through his current contribution, $g_i - g_j$, as his seniority in status S_i increases. Status acquired during previous periods works as a complement of that acquired today, and therefore an increase in S_i produces the same effect on player i's donations as an increase in α_i. Similarly, an increase in his opponent's seniority in status, S_j, is equivalent to an increase in α_j. We refer to the previous sections for a comparative statics analysis examining the effect of α_i and α_j on individual and total donations. For completeness, we finally consider seniority as a substitute of current status, where player i's utility function becomes

$$U_i = w - g_i + \ln\left[m\left(g_i + g_j\right) + \alpha_i\left(S_i + g_i - g_j\right)\right] \tag{7}$$

The following proposition examines contributions in both the simultaneous and the sequential-move game for this case.

[12] For compactness, we extend the sequential-move game to N players in Appendix 1.

Proposition 4. When seniority in status is a substitute for current status, player i's equilibrium contribution is weakly decreasing in his own seniority in status, S_i, for any parameter values; but weakly increasing in the other player's seniority in status, S_j, if and only if $\alpha_i < m$, both in the simultaneous and sequential contribution game. The ranking of total contributions satisfies the conditions of Proposition 3.

In this case donors' incentives to acquire status in the current period are reduced by seniority, since the contributor regards both forms of status as equivalent. More empirical research is needed, however, in order to determine whether seniority in status enters into donors' preferences as a substitute or a complement of current status.

7 Conclusions

Recent experimental evidence (as well as casual observation) supports status acquisition as an individual incentive for charitable giving. Despite its interest, relatively few studies have analyzed this topic from a theoretical approach. We find that, under certain parameter conditions, every contributor's giving decision is increasing both in his own concern for status, α_i, and that of the other donor, α_j. This pattern clearly reflects donors' competition in their contributions with the objective of acquiring higher social status, which is confirmed both in the simultaneous and sequential solicitation mechanisms. In addition, I identify what parameter values induce the charity to choose a simultaneous over a sequential contribution order. In particular, I show that the charity prefers simultaneous PGGs when players are sufficiently homogeneous in the relative value they assign to status acquisition.[13] Otherwise, the charity prefers the sequential mechanism.

In the extensions, I first investigate the effect of enlarging the number of players competing for status. Our results indicate that, under symmetry, total contributions still maintain the same ranking as in the two-player setting, i.e., a simultaneous contribution order provides a larger revenue to the charity than its sequential version. Second, I analyse how the above results would be modified if we allow donors to start their competition for status acquisition with previously acquired 'stocks' of status, i.e., seniority in status. In particular, the results in terms of what contribution mechanism is more profitable for the charity are not changed. However, several insights about the role of seniority in status are obtained. Specifically, I demonstrate that when previous status enters additively into donors' concerns, seniority may work as an strategic substitute for the status that donors can acquire through current donations, reducing their contributions. In contrast, if currently acquired status emphasizes previously acquired rankings, then status acquired during different periods works as strategic complements, and current donations increase in seniority.

Different extensions of this paper would enhance our understanding of the role of status acquisition in PGG. First, it would be interesting to analyse how a charity can influence donors' concerns about status, by inducing on them higher or lower preferences for status acquisition. Second, in order to focus on the role of status seeking behavior, this paper considers a specific quasilinear

[13] This result is similar to that of Dixit (1987) for contests where players expend effort to win a certain prize.

functional form, where the return from the public good is symmetric among players, whereas utility from status is asymmetric. In a more general setting, however, donors' return from the public good could be asymmetric if, for instance, one donor benefits more from the public good than the other contributor. Similarly, we assume that the utility from status is concave, but an interesting extension would allow for both players whose utility is concave and convex in status. Finally, we could extend this model by considering status acquisition in PGGs with incomplete information. In such settings contributors do not know each other's preferences for status, which is closer to many real-life situations, where donors may have a common understanding of the return from the public good, but may not know each others' preferences for status acquisition. Further research in this area can certainly provide additional insights about donors' incentives to contribute to charities, how status acquisition affects their giving decisions and, finally, how does it lead them to compete in their contributions.

Supplementary material

Appendix 2, including the proofs to all results, is available online at the OUP website.

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Appendix 1 - Sequential game with N players

Consider N symmetric players. Assume that $N/2$ players independently and simultaneously choose their contribution g_i during the first stage of the game. We refer to these individuals as first movers. Observing first movers' total contribution, G_i, the remaining $N/2$ individuals (second movers) independently and simultaneously select their donation to the public good. Every second mover j chooses a contribution g_j that solves

$$\max_{g_j \geq 0} \; w - g_j + \ln\left[m(g_j + G_i + G_{-j}) + \alpha\left(g_j - \frac{G_i + G_{-j}}{N-1}\right)\right] \tag{8}$$

where G_{-j} represents total contributions from the $\frac{N}{2} - 1$ second movers different to player j. (Note that if there is only one second mover, then $G_{-j} = 0$). Taking first order conditions and solving for g_j, we first find player j's best response function $g_j(G_i, G_{-j})$,

$$g_j(G_i, G_{-j}) = \begin{cases} 1 + \frac{\alpha-(N-1)m}{(N-1)(m+\alpha)}\left(G_i + G_{-j}\right) & \text{if } G_i + G_{-j} < \frac{(N-1)(m+\alpha)}{(N-1)m-\alpha}, \text{ and} \\ 0 & \text{otherwise} \end{cases} \tag{9}$$

where, similarly to the simultaneous-move game with N players described in section 6, every second mover's best response function is positively sloped if $\alpha > (N-1)m$. Since all second movers are symmetric, then $G_j = \frac{N}{2} \times g_j$, and hence $G_{-j} = \left(\frac{N}{2} - 1\right) g_j$. Using this property, we obtain every second mover's contribution as a function of first movers' total donations, $g_j(G_i)$,

$$g_j(G_i) = \begin{cases} \frac{2(N-1)(m+\alpha)}{N[\alpha+(N-1)m]} + \frac{2[\alpha-(N-1)m]}{N[\alpha+(N-1)m]}G_i & \text{if } G_i < \frac{(N-1)(m+\alpha)}{(N-1)m-\alpha}, \text{ and} \\ 0 & \text{otherwise} \end{cases} \tag{10}$$

(Note that in the case of two players, $N = 2$, this best response function coincides with the best response function identified in Fig. 1, under symmetry. In addition, note that when players do not sustain preferences for social status, $\alpha = 0$, then $g_j(G_i)$ collapses to $g_j(G_i) = \frac{2}{N} - \frac{2}{N}G_i$ for all $G_i < 1$ and zero otherwise.). Total contributions from the $N/2$ second movers $G_j(G_i)$ are therefore $G_j(G_i) = \frac{N}{2} \times g_j(G_i)$, or

$$G_j(G_i) = \begin{cases} \frac{(N-1)(m+\alpha)}{[\alpha+(N-1)m]} + \frac{[\alpha-(N-1)m]}{[\alpha+(N-1)m]}G_i & \text{if } G_i < \frac{(N-1)(m+\alpha)}{(N-1)m-\alpha}, \text{ and} \\ 0 & \text{otherwise} \end{cases} \tag{11}$$

Using the best response function from the group of second movers found above, $G_j(G_i)$, every first mover selects the donation g_i that solves

$$\max_{g_i \geq 0} \; w - g_i + \ln\left[m(g_i + G_i + G_j(G_i)) + \alpha\left(g_i - \frac{G_i + G_j(G_i)}{N-1}\right)\right] \tag{12}$$

where first movers' total donations satisfy $G_i = g_i + G_{-i}$. For $N = 2$ players $G_{-i} = 0$, and taking first order conditions in the above maximization problem we obtain the first mover's equilibrium contribution level in proposition 2, under symmetry, i.e., $g_i = \frac{\alpha^2+4m\alpha-m^2}{4m\alpha}$. For $N > 2$ players, $G_{-i} = \left(\frac{N}{2} - 1\right) g_i > 0$, we can take first order conditions with respect to g_i in order to obtain every first mover's equilibrium contribution level, g_i,

$$g_i = \begin{cases} \frac{m^2(N-1)^2-4m(N-1)\alpha+(3-2N)\alpha^2}{(N-2)\alpha(m-mN+\alpha)} & \text{if } \alpha > \widetilde{\alpha} \\ 0 & \text{otherwise} \end{cases} \tag{13}$$

where $\widetilde{\alpha} \equiv \frac{[m^2(N-1)^2(2N+1)]^{1/2}-(N-1)2m}{2N-3}$. Total contributions by all first movers are hence $G_i = \frac{N}{2} \times g_i$, or

$$G_i = \begin{cases} \frac{N\left[m^2(N-1)^2-4m(N-1)\alpha+(3-2N)\alpha^2\right]}{2(N-2)\alpha(m-mN+\alpha)} & \text{if } \alpha > \widetilde{\alpha} \\ 0 & \text{otherwise} \end{cases} \tag{14}$$

Note that when $\alpha > \widetilde{\alpha}$, G_i is lower than $\frac{(N-1)(m+\alpha)}{(N-1)m-\alpha}$, and therefore both first and second movers submit positive contribution levels in the interior equilibrium. In this case, total contributions from first and second movers in the sequential-move game with $N > 2$ players are hence

$$G^{Seq} = \frac{m(N-1)(4+N^2)\alpha + (N^2-2)\alpha^2 - 2m^2(N-1)^2}{(N-2)[m^2(N-1)^2 - \alpha^2]}, \tag{15}$$

which approach $\frac{\alpha}{m}$ as $N \to \infty$. Otherwise, when $\alpha \leq \widetilde{\alpha}$, first movers do not contribute to the public good while second movers submit positive contributions, i.e., $G_i = 0$ and $G_j = \frac{(N-1)(m+\alpha)}{[\alpha+(N-1)m]}$. Total contributions in this corner solution are therefore $G^{Seq} = \frac{(N-1)(m+\alpha)}{[\alpha+(N-1)m]}$, which approach $\frac{m+\alpha}{m}$ as $N \to \infty$. Since this corner solution occurs when $\alpha < \widetilde{\alpha}$, we must use $G^{Seq} = \frac{(N-1)(m+\alpha)}{[\alpha+(N-1)m]}$ to evaluate total contributions when players are unconcerned about social status, $\alpha = 0$. In this case, total contributions become $G^{Seq} = \frac{(N-1)(m+0)}{[0+(N-1)m]} = 1$ for any population size N. Since total contributions in the simultaneous game are also $G^{Sm} = 1$ when players do not sustain preferences for status acquisition ($G^{Sm} = \frac{m+0}{m} = 1$), we can thus conclude that total contributions in the simultaneous and sequential game coincide and are constant in N when $\alpha = 0$. (Note also that the interior solution cannot be evaluated at $\alpha = 0$ since, by definition, $\alpha > \widetilde{\alpha}$).