Appendix to: The Completion Effect in Charitable Crowdfunding

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This document presents a simple descriptive model of how uncertainty about the likelihood of fundraising success, and a donor benefit from personally achieving completion, can both lead in equilibrium to completion donations being larger than preceding donations. The purpose of this model is simply to illustrate theoretically that these mechanisms can lead to a completion effect.

A1. Basic Setup

The model is a modification of Admati and Perry (1991). N donors, indexed by $i \in \{1, \ldots, N\}$, decide sequentially and one at a time how much to contribute toward a charitable project. In period $t \in \{1, \ldots, N\}$, donor $i = t$ chooses her level of contribution g_i. Contributions are fully observable. Denote the aggregate contribution up to and including period t by $G(t) = \sum_{i=1}^{t} g_i$, and define $G_{-i}(t) = G(t) - g_i$.[1]

The charitable project is carried out only if it raises the target amount $\bar{G}$, which is exogenous and commonly known. Donors derive utility from the project only if it gets carried out. Donor i's utility is

[1] Vesterlund (2003) and Romano and Yildirim (2005) note that this move structure incorrectly assumes that donors are unable to contribute more than once to any given campaign. However, this assumption is not too unreasonable in our case, as only 7 percent of donations in Benevolent and 9 percent of donations in JustGiving are repeated donations by the same donor to the same campaign.

$$U_i = \begin{cases} -g_i & \text{if } G(N) < \bar{G} \\ V_i - g_i & \text{if } G(N) \geq \bar{G} \end{cases}$$

where V_i is the value donor i gets if the project is carried out.[2] For simplicity, we assume values are common knowledge.[3]

A2. Completion Uncertainty

We explore the role of uncertainty about the recipient's ability to reach the fundraising goal in a simple, parametric case as follows. Let there be a commonly-known probability $p \in (0,1)$ that $N = 2$, and probability $1 - p$ that $N = 3$. Thus, donors 1 and 2 are certain to participate in the fundraising campaign (although they may decide to give zero). With probability p, donor 2 will be the last to participate, while with probability $1 - p$ donor 3 will be the last to participate.

Finally, assume that $0 < V_i < \bar{G} < V_i + V_j$ for any $i \neq j$. This implies that no donor wants to single-handedly fund the project, but it is efficient that the project is carried out even when only two donors participate in the fundraising campaign.

In solving this game, it is helpful to consider first the degenerate cases $p = 1$ and $p = 0$. In the former, two donors participate in the fundraising with certainty, and donor 2's best-response function is

$$g_2^*(g_1) = \begin{cases} 0 & \text{if } \bar{G} - g_1 > V_2 \\ \bar{G} - g_1 & \text{if } \bar{G} - g_1 \leq V_2 \end{cases}$$

That is, given donor 1's contribution, donor 2 is willing to donate enough to raise cumulative funds to 100 percent of the goal if she can do so with a donation smaller than or equal

[2] This is the binary benefit function in Marx and Matthews' (2000) comparison of dynamic versus static contributions to public goods.
[3] Alternatively, we can allow for private values, but this complicates the model without providing much additional insight.

to her value from the project's completion. The Subgame-Perfect Nash Equilibrium (SPNE) achieves completion at $t = 2$, with donations $(g_1 = \bar{G} - V_2, g_2 = V_2)$. In this case, donor 1 uses her first-mover advantage to partially free ride on donor 2, who contributes her entire value.

In the case where $p = 0$, three donors participate in the fundraising with certainty, and the SPNE also achieves completion, at $t = 3$. Donor 1 fully free rides on donors 2 and 3, and the game at $t = 2$ is identical to the 2-donor case. The SPNE outcome is $(g_1 = 0, g_2 = \bar{G} - V_3, g_3 = V_3)$.

Moving away from the degenerate cases, when $p \in (0,1)$, we get the interesting question of whether donor 2 completes in the SPNE. To answer this, not that, if called to participate, donor 3 follows the best-response function

$$g_3^*(G_{-3}(3)) = \begin{cases} 0 & \text{if } \bar{G} - G_{-3}(3) > V_3 \\ \bar{G} - G_{-3}(3) & \text{if } \bar{G} - G_{-3}(3) \leq V_3 \end{cases}$$

Taking this reaction function as given, donor 2 may give either $g_2 = 0$ or $g_2 = \bar{G} - g_1 - V_3$, in either case not reaching the goal and leaving the project open for potential completion by donor 3. Alternatively, she may decide to complete the project by giving $g_2 = \bar{G} - g_1$. For donor 2 to decide to give the latter amount, it must be that $\bar{G} - g_1 > V_2$. Moreover, it must be that $V_2 > V_3$ for donor 2 not to prefer to partially free ride on the potential contribution from donor 3.[4] If these two conditions hold, donor 2 prefers to complete the project at $t = 2$ rather than to make a smaller donation and wait for potential completion by donor 3, only if the expected utility from

[4] Donor 2's best-response function is

$$g_2^*(g_1) = \begin{cases} 0 & \text{if } \bar{G} - g_1 > V_2 \text{ and } p > \dfrac{V_3}{V_2} \\ \bar{G} - g_1 & \text{if } \bar{G} - g_1 \leq V_2 \text{ and } p > \dfrac{V_3}{V_2} \\ \bar{G} - V_3 - g_1 & \text{if } p < \dfrac{V_3}{V_2} \end{cases}$$

completing at $t = 2$ exceeds the expected utility from leaving the project incomplete at $t = 2$. That is, only if

$$V_2 - \bar{G} + g_1 > p \cdot (V_3 - \bar{G} + g_1) + (1 - p) \cdot (V_3 + V_2 - \bar{G} + g_1)$$

which reduces to $p > \frac{V_3}{V_2}$.

As this result indicates, large enough uncertainty about the arrival of a donation after $t = 2$ leads to a completion effect: a larger contribution and completion of the project at $t = 2$. When $p > \frac{V_3}{V_2}$, the SPNE outcome is $(g_1 = \bar{G} - V_2, g_2 = V_2, g_3 = 0)$, whereas when $p < \frac{V_3}{V_2}$, the SPNE outcome is $(g_1 = 0, g_2 = \bar{G} - V_3, g_3 = V_3)$.

A3. Private benefit from personally making a difference

As proposed by Duncan's (2004) theory of impact philanthropy, donors may care about personally making a difference on the recipient with their contributions. If donors derive a sense of making a difference by making the completion donation, the addition of this private benefit term could give rise to a completion effect in equilibrium. To illustrate this, we continue to use the setup above, but now add to the donor's utility function a term that reflects an extra benefit from personally reaching the fundraising goal. In particular, let donor i's utility now be

$$U_i = \begin{cases} -g_i & \text{if } G(n) < \bar{G} \\ V_i - g_i & \text{if } G(n) < \bar{G} \text{ and } i \neq T \\ V_i - g_i + b_i & \text{if } G(n) < \bar{G} \text{ and } i = T \end{cases}$$

where b_i is the private benefit from personally completing the project, and T is the period at which completion is achieved.

Following the previous derivation, it can be verified that, when $p \in (0,1)$, the condition for observing a completion effect at $t = 2$ becomes $p > \frac{V_3 - b_2}{V_2}$. Thus, a large enough private benefit for donor 2 from personally reaching the fundraising goal can obtain a completion effect at $t = 2$, independently of how small p gets.

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