Online Appendix “Only You: A Field Experiment of Text Message to Prevent Free-riding in Japan Marrow Donor Program”

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1 Economic Models for Predictions

We present a simple inter-temporal economic model to make predictions of message effects. Consider three periods ($t = 1, 2, 3$). A potential donor responds in either the first ($t = 1$) or second period ($t = 2$). Alternatively, the potential donor can choose not to respond. If the donor responds at $t = 1$, then the donor pays the response cost, c_1, at $t = 1$ and receives the donation utility, b_1, at $t = 2$. If the donor responds at $t = 2$, then the donor pays the response cost, c_2, at $t = 2$ and receives the donation utility, b_2, at $t = 3$. Assume that $c_1 = c_2 = c$.

We assume that the donor has the present bias. According to Laibson (1997), the utility of present-biased donor is $U_t = u_t + \beta \sum_{\tau=t+1}^{3} \delta^{\tau-t} u_\tau$ where $\beta \in (0, 1]$ is the degree of present bias and $\delta \in (0, 1]$ is standard time discount factor. Moreover, at period t, the donor expect that s/he makes decisions after $t + 1$ based on $\hat{\beta} \in [\beta, 1]$. If $\beta < \hat{\beta}$, the donor falsely believes that the present bias of their future self is not as strong. We will solve an interpersonal game (O’Donoghue & Rabin 2001) to obtain optimal response timing.

We employ a backward induction to solve the interpersonal game. Consider $t = 2$. The donor receives $U_2 = -c + \beta\delta b_2$ if s/he responses. Thus, the donor responses at $t = 2$ if and only if $b_2 \geq c/\beta\delta$. Consider $t = 1$. First, we analyze how the donor expect their behavior at $t = 2$. The donor believes that future selve’s present bias is $\hat{\beta}$. Thus, at $t = 1$, the donor expect that s/he will respond at $t = 2$ if and only if $b_2 \geq c/\hat{\beta}\delta$. Due to $\beta \leq \hat{\beta}$, $c/\hat{\beta}\delta \leq c/\beta\delta$.

Consider $b_2 < c/\hat{\beta}\delta$. Then, at $t = 1$, the donor expects that to give up responding, and actually does so. Thus, the donor at $t = 1$ responds if and only if $U_1 = -c + \beta\delta b_1 \geq 0$ or $b_1 \geq c/\beta\delta$. Otherwise, the donor gives up responding.

Consider $c/\hat{\beta}\delta \leq b_2 < c/\beta\delta$. Then, at $t = 1$, the donor expects to respond at $t = 2$, but will not actually take that action. Due to this false prediction, the donor at $t = 1$ responds if and only if $U_1 \geq \beta(-\delta c + \delta^2 b_2)$ or

$$b_1 \geq \delta b_2 + c\frac{1-\beta\delta}{\beta\delta}. \tag{1}$$

Otherwise, the donor eventually stops responding.

Consider $c/\beta\delta \leq b_2$. Then, at $t = 1$, the donor expects to respond at $t = 2$, and actually does so. Thus, the donor responds at $t = 1$ if and only if equation (1) holds.

As a basic result, we show optimal timing assuming correct belief in β ($\hat{\beta} = \beta$) and constant utility of donation ($b_1 = b_2$). The second assumption implies that the donor believes that he can help the recipients at any time by transplantion. In addition to the assumption of $c_1 = c_2 = c$, we obtain the following optimal respond timing.

$$\begin{cases} t = 1 & \text{if} \quad c\frac{1-\beta\delta}{(1-\delta)\beta\delta} \leq b_1 \\ t = 2 & \text{if} \quad c\frac{1}{\beta\delta} \leq b_1 < c\frac{1-\beta\delta}{(1-\delta)\beta\delta} \\ \text{give up} & \text{if} \quad b_1 < c\frac{1}{\beta\delta} \end{cases} \tag{2}$$

Suppose that a policy intervention (Early Coordination message) reduces the utility of donation at $t = 3$, b_2, by $d > 0$. That is, $b_2 = b_1 - d$. If $b_1 < c/\beta\delta$, then $b_2 < c/\beta\delta$ due to $b_2 < b_1$. Thus, the optimal timing is unchaneged, that is, the donor stops responding. If $c/\beta\delta \leq b_1 < c/\beta\delta + d$, then $b_2 < c/\beta\delta$ still holds. Thus, the optimal timing is $t = 1$ because of $c/\beta\delta \leq b_1$.

Consider the case of $c/\beta\delta + d \leq b_1$. Then, $c/\beta\delta \leq b_2$ holds. We can reformulate the equation (1) as follows:

$$b_1 \geq c\frac{1-\beta\delta}{(1-\delta)\beta\delta} - d\frac{\delta}{1-\delta}. \tag{3}$$

Thus, the optimal timing is $t = 2$ holds only if

$$\begin{aligned} c\frac{1}{\beta\delta} + d &\leq c\frac{1-\beta\delta}{(1-\delta)\beta\delta} - d\frac{\delta}{1-\delta} \\ d\frac{1}{1-\delta} &\leq c\left[\frac{1-\beta\delta}{(1-\delta)\beta\delta} - \frac{1}{\beta\delta}\right] \\ d\frac{1}{1-\delta} &\leq c\frac{1-\beta}{(1-\delta)\beta} \\ d &\leq c\frac{1-\beta}{\beta}. \end{aligned} \tag{4}$$

If $d > c(1-\beta)/\beta$, then the optimal timing is $t = 1$.

In summary, we can theoretically predict the message effect as follows:

Prediction. (i) Suppose that $d \leq c(1-\beta)/\beta$. Then, the optimal timing changes from $t = 2$ to $t = 1$ if $c/\beta\delta \leq b_1 < c/\beta\delta + d$ or $c(1-\beta\delta)/(1-\delta)\beta\delta - d\delta/(1-\delta) \leq b_1 < c(1-\beta\delta)/(1-\delta)\beta\delta$. (ii) Suppose that $c(1-\beta)/\beta < d$. Then, the optimal timing changes from $t = 2$ to $t = 1$ if $c/\beta\delta \leq b_1 < c(1-\beta\delta)/(1-\delta)\beta\delta$. For any case, those whose have other preferences are not affected by the message.

References

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O'Donoghue, T. & Rabin, M. (2001), 'Choice and Procrastination', *The Quarterly Journal of Economics* **116**(1), 121–160.