Modeling self-control problems I: Multi-self vs. temptation

Lectures in Behavioral economics
Fall 2014, Part 2

People have demand for commitment
Ariely & Wertenbroch (2002)

Experiment where the students in a course had to hand in three compulsory assignments before the final exam, they could choose deadlines, and were punished if the deadlines were not observed.

Result: Many choose deadlines before the end of the semester, & among these, students with evenly spread deadlines did better.

- Hyperbolic discounting leads to time-inconsistent preferences (Strotz, 1956), procrastination of tasks with immediate cost, and makes commitment desirable, given awareness of the self-contr. problems.
- Other ways to model the demand for commitment?

Present-biased preferences: \((\beta, \delta)\)-pref.

\[ U'(c_1, \ldots, c_T) = u(c_t) + \beta \sum_{t=T+1}^{\infty} \delta^{t-t} u(c_t) \]

- Yields time-inconsistent preferences.

Behavior with time-inconsistent preferences

- **Naive behavior**: Choosing the best plan under the presumption that it will be followed.
- **Sophisticated behavior**: Choosing the best plan among those that will actually be followed.
- **Multi-self model of sophisticated behavior**: Let every decision node corresponds to a different “self”.

Outline

- ”Do it now or later”-article
  Interesting application of the multi-self approach showing that sophisticates need not realize better outcomes than naifs.

- Problems with the multi-self approach

- Alternative to the multi-self approach
  Direct modeling of temptation.

- Soft paternalism (”Nudge”)
“Do it now or later”  O’Donoghue & Rabin (1999)

- Model:
  - Must perform an activity exactly once.
  - \( T < \infty \) periods in which to perform it.
  - Each period, choose to “do it” or “wait”.
  - If wait until period \( T \), must do it then.

- If activity is done in period \( t \), incur cost \( c_t \geq 0 \) and receive reward \( v_t \geq 0 \).
  - Reward schedule: \( v \equiv (v_1, \ldots, v_T) \)
  - Cost schedule: \( c \equiv (c_1, \ldots, c_T) \)

“Do it now or later” (2)

- Two cases:
  - Immediate costs: incur cost when you do it, receive reward after some delay.
  - Immediate rewards: receive reward when you do it, incur cost after some delay.

- Assume \((\beta, \delta)\)-preferences with \( \delta = 1 \) (for simplicity):
  - Period-\( t \) utility for “do it” in period \( \tau \geq t \):
    - For immediate costs: \( U^t = \begin{cases} \beta v_\tau - c_\tau & \text{if } \tau = t \\ \beta v_\tau - \beta c_\tau & \text{if } \tau > t \end{cases} \)
    - For immediate rewards: \( U^t = \begin{cases} v_\tau - \beta c_\tau & \text{if } \tau = t \\ \beta v_\tau - \beta c_\tau & \text{if } \tau > t \end{cases} \)

“Do it now or later”: Ex. with immediate costs

- \( T = 4 \)
- Reward schedule: \( v \equiv (0, 0, 0, 0) \)
- Cost schedule: \( c \equiv (3, 5, 8, 13) \)

- Period-\( t \) utility for “do it” in period \( \tau \geq t \):
  - Naïfs do it in period 4.
  - Sophisticates do it in period 2.

- Welfare comparisons of naïve & sophisticated behavior:
  - \( \tau = 2 \) is better than \( \tau = 4 \) at both \( t = 0 \), \( t = 1 \) and \( t = 2 \).
  - \( \tau = 2 \) cannot be compared with \( \tau = 4 \) at \( t = 3 \).
“Do it now or later”: Ex. with immediate rewards

\[ T = 4 \quad \text{Reward schedule: } v = (3, 5, 8, 13) \]

\[ \beta = \frac{1}{2} \quad \text{Cost schedule: } c = (0, 0, 0, 0) \]

<table>
<thead>
<tr>
<th>Period-t utility for “do it” in period ( \tau \geq t ):</th>
<th>( \tau = 1 )</th>
<th>( \tau = 2 )</th>
<th>( \tau = 3 )</th>
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<tr>
<td>( t = 0 )</td>
<td>( \frac{3}{2} ) ( (4) )</td>
<td>( \frac{5}{2} ) ( (3) )</td>
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- Naifs do it in period 3.
- Sophisticates do it in period 1.

General lesson: Sophistication about future self-control problems can mitigate or exacerbate misbehavior

- **Proposition 2.** For both immediate costs and immediate rewards, \( \tau_s \leq \tau_n \).
  - **Why?** The future is always more promising from the point of view of a naif, since a sophisticate removes some future possibilities as unattainable without commitment. Hence, for a sophisticate the present is relatively more attractive, leading to the task being performed earlier.
  - **With im. costs: Naifs may procrastinate repeatedly even if \( \beta \) is close to 1.** Sophisticates with immediate rewards may procrastinate repeatedly even if \( \beta \) is close to 1.

General lesson: Even “small” self-control problems can cause severe welfare losses.
Procrastination example revisited

- A task to be performed at time 0, 1, 2, ..., or not at all.
  Immediate cost: 25. Benefits at the next stage: 125.
- \((\beta, \delta)\)-preferences with \(\beta = 1/2\) and \(\delta = 4/5\).

\[
\begin{align*}
\beta &= \frac{1}{2} \\
\delta &= \frac{4}{5} \\
\text{Immediate cost} &= 25 \\
\text{Benefits at the next stage} &= 125
\end{align*}
\]

Even better to do it at the next stage.

Sophisticated behavior with 3 periods

- Let every decision node correspond to a different “self” or “agent” of the decision-maker.
- Backward induction
  - A sophisticate does the task now, since else postponed for 2 periods.

Sophisticated behavior with 4 periods

- Backward induction
- A sophisticate does the task with a delay of 1 period.

Sophisticated behavior with odd # periods

- A sophisticate does the task now, since else postponed for 2 periods.

Sophisticated behavior with even # periods

- A sophisticate does the task with a delay of 1 period.

Conclusion: Multi-self model with sophisticated behavior may not be descriptively accurate

- Introduce naivete (or partial naivete) (O’Donoghue & Rabin, 1999, 2001)
- Is it “right” to apply the multi-self model?
Sophisticated behavior with $\infty$ periods

- Backw. induct. cannot be used since no last period
- It is an equilibrium (planning) to do the task in periods 0, 2, 4, ..., but not in periods 1, 3, 5, ...
- It is another equilibrium (planning) to do the task in periods 1, 3, 5, ..., but not in periods 0, 2, 4, ...
- If we impose that behavior is the same in all periods, conditional on the task not having been done, there is a unique equilibrium, where the task is done in each period with prob. $\frac{1}{2}$.

Demand for commitment

- Suppose the decision maker can purchase a commitment device costing $c$, ensuring that the task be done in the next period? What is the largest $c$?
- With an odd # periods, she does the task now with present payoff 25. Commitment to next period yields payoff $30 - c$. Hence, $c$ cannot exceed 5.
- With an even # periods, she does the task in the next period anyway. Not interested in committing.
- With $\infty$ periods, she receives a payoff of 25. Commitment to next period yields payoff $30 - c$. Hence, $c$ cannot exceed 5.

Temptation (Gul & Pesendorfer 2001)

- $a_1$: Doing the task
- $a_0$: Not doing the task

In standard consumer theory, if $a_1$ is preferred to $a_0$, then she has the following preference over menus:

$$\{a_1\} \succ \{a_0, a_1\} \succ \{a_0\}$$

In G & P’s analysis, if tempted by $a_0$ and gives in:

$$\{a_1\} \succ \{a_0, a_1\} \succ \{a_0\}$$

If tempted by $a_0$, but does not give in:

$$\{a_1\} \succ \{a_0, a_1\} \succ \{a_0\}$$

Temptation in a dynamic setting

(Gul & Pesendorfer 2004)

- No time-inconsistency; the future is discounted by $\delta$
- Still, temptation yields a demand for commitment

Payoff when choosing $a_1$: $-25 + \frac{4}{5}125 - t$

Payoff when choosing $a_0$: $0 + \frac{4}{5}W_0$

Maximal payoff when task has not been done:

$$W_0 = \max\{75 - t, \frac{4}{5}W_0\}$$

$$\delta = \frac{4}{5}$$

$t$: Cost of temptation
Temptation in a dynamic setting (2)

Optimal not to give in at a low cost of temptation \((t < 75)\)
\[
W_0 = 75 - t > 0 \quad W_0 > 0 + \frac{4}{5}W_0
\]

Optimal to give in at a high cost of temptation \((t \geq 75)\)
\[
W_0 = 0 \quad W_0 \geq 75 - t
\]

Temptation and the demand for commitment

Assume that she can commit by paying \(c\) to doing the task in the next period (without being tempted).
\[
W_c = 0 - c + \frac{4}{5}(-25 + \frac{4}{5}125) = 60 - c
\]

Optimal to commit at a low cost of temptation \((t < 75)\) if
\[
W_c = 60 - c > 75 - t = W_0 \quad c < t - 15
\]

Optimal to commit at a high cost of temptation \((t \geq 75)\) if
\[
W_c = 60 - c > 0 = W_0 \quad c < 60
\]

Soft paternalism

- With procrastination, the status quo matters
- E.g. organ donation, savings decisions

Organ donation:
- Opt out. Austria: 99.98 % consent
- Opt in. Germany: 12 % consent
- Active choice. US driver’s licence