Behavioral Economics

Topic 2: Intertemporal Choice
Lectures 11–14: Present Bias, Model and Applications

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Taking Stock

Last class:

- The standard exponential model and evidence that contradicts it

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- An alternative model: present bias
- Time inconsistency; sophistication vs. naivete
- Procrastination, and present bias and saving
- Applications: procrastination, health clubs, job search, cigarette taxes

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Logistics:

- Problem Set 3 is due before class on Thursday, October 22
- Problem Set 4: posted October 15; due before class November 3

Alternative Models of Discounting

Motivation

Exponential discounting implies constant discounting:

$$\frac{D(0)}{D(1)} = \frac{D(1)}{D(2)} = \frac{D(2)}{D(3)} = ... = \frac{1}{\delta}.$$

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But the evidence suggests more discounting in the short run than in the long run:

$$\frac{D(0)}{D(1)} > \frac{D(1)}{D(2)} > \frac{D(2)}{D(3)} > ....$$

A Simplified Model

A simplified model: "β, δ preferences" or "present bias"

Period-t intertemporal utility is

$$U^t = u_t + \beta * \sum_{x=1}^{T-t} \delta^x \, u_{t+x}.$$

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In other words, the discount function is:

$$D(x) = \begin{cases} 1 & \text{if } x = 0 \\ \beta * \delta^x & \text{if } x > 0. \end{cases}$$

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$$\Rightarrow \quad \frac{D(1)}{D(0)} = \beta\delta < \delta = \frac{D(2)}{D(1)} = \frac{D(3)}{D(2)} = ...$$

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People who assume β, δ preferences use many different names:

- present bias (present-biased preferences)
- hyperbolic discounting
- quasi-hyperbolic discounting
- preference for immediate gratification
- self-control problems

A First Implication of the Model

Hence, under β, δ preferences:

$$\frac{D(0)}{D(1)} = \frac{1}{\beta\delta} > \frac{1}{\delta} = \frac{D(1)}{D(2)} = \frac{D(2)}{D(3)} = ...$$

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In words: This implies more discounting in the immediate near-term (now vs. near-now), and an even-handedness of dealing with time for all future periods.

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Suppose there is no reward, that you value costs linearly, and that $\beta = 1/2$ and $\delta = 1$.

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Recall:

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Your preferences from a period-1 perspective are:

- If complete the task in period 1, your utility is
- If complete the task in period 2, your utility is
- If complete the task in period 3, your utility is

Hence...?

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Conditional on not doing it in period 1, your preferences from a period-2 perspective are:

- If complete the task in period 2, your utility is
- If complete the task in period 3, your utility is

Hence...?

Example to Illustrate Time Inconsistency

To summarize, your period-1 preferences are

$$(\text{period } 2) \succ (\text{period } 1) \succ (\text{period } 3)$$

while your period-2 preferences are

$$(\text{period } 3) \succ (\text{period } 2).$$

Note the time inconsistency:

- As time passes, your preference between period 2 vs. period 3 flips.

The Importance of Awareness

An important issue: Are you aware of your future self-control problems (i.e., of your future present bias)?

Reminder: Your period-1 preferences are

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If you were asked to commit yourself in period 1, you'd commit yourself to do the task in period 2.

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If you were asked to commit yourself in period 1, you'd commit yourself to do the task in period 2.

Suppose instead that in period 1 you only choose whether or not to do the task then. Then your choice will depend on what you expect to do in period 2 (if you were to wait).

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Suppose you are **fully aware** of future self-control problems — that is, you correctly predict your period-2 preferences.

- If so, you correctly predict that if you wait now, then in period 2 you'll prefer to wait again.

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- Hence, you compare completing the task now to completing the task in period 3, and you prefer the former.

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$\Rightarrow$ Complete task in period 1.

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Suppose you are **fully unaware** of future self-control problems — that is, you incorrectly think that you'll feel the same way in period 2 as you do now.

- If so, then since you currently prefer period 2 to period 3, you think that if you wait now, you'll just complete the task in period 2.

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- Of course, when period 2 arrives, you'll change your mind and decide to wait.

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- Of course, when period 2 arrives, you'll change your mind and decide to wait.

$\Rightarrow$ End up completing task in period 3.

Sophistication vs. Naivete

More generally:

Two extreme assumptions about people's awareness of their own future self-control problems:

- *Sophisticates* are **fully aware** of their future self-control problems and thus correctly predict future behavior.

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Two extreme assumptions about people's awareness of their own future self-control problems:

- *Sophisticates* are **fully aware** of their future self-control problems and thus correctly predict future behavior.
- *Naifs* are **fully unaware** of their future self-control problems and thus expect to behave in future exactly as they currently would like themselves to behave in future.

Sophistication vs. Naivete

To solve for naifs:

- Each period, derive the optimal lifetime path, and follow this period's component. But when next period arrives, reassess this plan.
- **Note:** Naifs may not stick to their plans.

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To solve for sophisticates:

- Treat each period-self as a separate agent, and solve for the subgame-perfect Nash equilibrium to the game played between these agents (use backward induction — start at the end, and work backward).
- Note: Sophisticates always stick to their plans.
- . . . they just never plan to do something they won't later carry out.

Example 1

Suppose there is a task that you must complete on one of the next four days. To complete this task, you incur costs as follows:

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Suppose there is no reward, that you value costs linearly, and that $\beta = 1/2$ and $\delta = 1$.

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- From a prior perspective, the best time is
- Naifs complete the task in
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Example 1

Some features of Example 1:

- Procrastination: For an onerous task that involves immediate costs, a preference for immediate gratification implies a tendency to procrastinate — to delay beyond the best time.

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- Sophistication mitigates procrastination — if expect future delay, then do it now to prevent this future delay.
- Naifs suffer a bad outcome (under essentially any measure of bad).

Example 2

Suppose there is an enjoyable activity that you get to do on one of the next four days. The reward generated by this activity is as follows:

- If you do the activity in period 1, the reward is 3.
- If you do the activity in period 2, the reward is 5.
- If you do the activity in period 3, the reward is 8.
- If you do the activity in period 4, the reward is 13.

Suppose there is no cost, that you value rewards linearly, and that $\beta = 1/2$ and $\delta = 1$.

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Example 2

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- For enjoyable activities with immediate rewards, a preference for immediate gratification implies a tendency to preproperate — to do it before the best time.
- Sophistication exacerbates preproperation — if expect future preproperation, more incentive to preproperate now.
- Sophisticates suffer a bad outcome.

Doing It Now or Later: Extended Example

Fibonacci's Fine Arts Cinema

- Week 1: mediocre movie, 3 utils
- Week 2: good movie, 5 utils.
- Week 3: great movie, 8 utils.
- Week 4: amazing movie, 13 utils.

Assume $\delta = 1$, $\beta = \frac{1}{2}$.

- Suppose you must *miss* one movie, and thus get 0 utils that day.

Doing It Now or Later: Extended Example

Your (cinematic) life choices are $(u_1, u_2, u_3, u_4) =$

- $(0, 5, 8, 13)$ or $(3, 0, 8, 13)$ or $(3, 5, 0, 13)$ or $(3, 5, 8, 0)$.

You cannot commit to which movie to miss—you must decide incrementally each week whether to see that movie or skip it.

(This assumption **matters**.)

- What movie should you miss?
- What movie *will* you miss?

Doing It Now or Later: Extended Example

Have to consider two cases: naif vs sophisticate decision-maker.

Case 1: What will a sophisticate do?

- Because $8 + \frac{1}{2}0 > 0 + \frac{1}{2}13$, the sophisticate won't skip Week 3.

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- Because $8 + \frac{1}{2}0 > 0 + \frac{1}{2}13$, the sophisticate won't skip Week 3.
- Because $0 + \frac{1}{2}(8 + 13) > 5 + \frac{1}{2}(8 + 0)$, the sophisticate *will* skip Week 2 (if she has not already skipped Week 1).

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- Because $3 + \frac{1}{2}(0 + 8 + 13) > 0 + \frac{1}{2}(5 + 8 + 13)$, the sophisticate *won't* skip Week 1.

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Hence: The sophisticate will miss the 2nd movie.

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Case 2: What will a naif do?

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- Because $5 + \frac{1}{2}(0 + 13) > 0 + \frac{1}{2}(8 + 13)$, *won't* skip Week 2.
- Because $3 + \frac{1}{2}(0 + 8 + 13) > 0 + \frac{1}{2}(5 + 8 + 13)$, won't skip Week 1.

Hence: The naif will miss the amazing movie.

- As before: **awareness** of self-control can matter a lot.

Doing It Now or Later: Extended Example

Note that even given $\beta = \frac{1}{2}$, all four selves agree that missing the amazing movie is a bad thing to happen. Yet the naif does so.

- Despite substantial “disagreement” among “different selves", they all agree missing either the 1st movie or the 2nd movie is better than missing the 4th.
- Yet she misses the 4th.
- In many applications, this sort of “dominated outcome” is common

Aside: Naive vs Sophisticated Economists

Aside: Let us see what we would infer from the observed behavior if we were an anachronistic economist who believed in $\beta = 1$.

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An exponential discounter would have to have a *weekly* discount factor $\widetilde{\delta} \leq Min[\sqrt[3]{\frac{3}{13}}, \sqrt[2]{\frac{5}{13}}, \frac{8}{13}] \approx .61$ to be willing to miss the amazing movie

	Letting $\beta < 1$ $(= \widehat{\beta})$	Insisting $\beta = 1$
Week 1 weight on u_2 vs. u_1	.61	.61
Week 1 weight on u_4 vs. u_1	.61	.23

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Lesson: Some behavior looks more (absurdly) impatient if (mis)interpreted through the lens of exponential discounting.

- But less so through the lens of present-biased discounting.

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- And all we changed was that the good outcomes are no longer a “one off”

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- But not here!
- And all we changed was that the good outcomes are no longer a “one off”
- That previous “Example 2” was misleading in that sophistication usually helps
- But the details of the setting matter!

Recall Example 1 from Earlier

Suppose there is a task that you must complete on one of the next four days. To complete this task, you incur costs as follows:

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Suppose there is no reward, that you value costs linearly, and that $\beta = 1/2$ and $\delta = 1$.

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- From a prior perspective, the best time is period 1.
- Naifs complete the task in period 4.
- Sophisticates complete the task in 2.

Welfare Implications

Our welfare criterion: A person's "long-run utility" — which reflects how she feels from a prior perspective — is given by

$$U^0 = \sum_{\tau=1}^{T} \delta^\tau u_\tau.$$

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Long-run utility from best option (do it in period 1) is -3.

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Long-run utility for sophisticates (who do it in period 2) is -5.

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Long-run utility for naifs (who do it in period 4) is -13.

Welfare loss for sophisticates is 2.
Welfare loss for naifs is 10.

In this simple "do-it-once" environment, for onerous tasks, naifs can suffer large harm, sophisticates cannot.

Welfare Implications

In Example 2:
Long-run utility from best option (do it in period 4) is 13.
Long-run utility for naifs (who do it in period 3) is 8.
Long-run utility for sophisticates (who do it in period 1) is 3.

Welfare Implications

In Example 2:
Long-run utility from best option (do it in period 4) is 13.
Long-run utility for naifs (who do it in period 3) is 8.
Long-run utility for sophisticates (who do it in period 1) is 3.

- Welfare loss for naifs is 5.
- Welfare loss for sophisticates is 10.

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Long-run utility for naifs (who do it in period 3) is 8.
Long-run utility for sophisticates (who do it in period 1) is 3.

- Welfare loss for naifs is 5.
- Welfare loss for sophisticates is 10.

In this simple “do-it-once” environment, for pleasurable tasks, sophisticates can suffer large harm, naifs cannot.

Welfare Implications

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Long-run utility from best option (do it in period 4) is 13.
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Long-run utility for sophisticates (who do it in period 1) is 3.

- Welfare loss for naifs is 5.
- Welfare loss for sophisticates is 10.

In this simple “do-it-once” environment, for pleasurable tasks, sophisticates can suffer large harm, naifs cannot.

In more realistic environments, sophistication is likely better than naivete, because sophisticates will use commitment devices to overcome their self-control problems.

Procrastination

Procrastination: Doing It . . . Tomorrow

- Procrastination involves the “immediate gratification” of not doing something onerous
- Often the main “cost” of doing some beneficial task is primarily the opportunity cost of doing something gratifying

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But what *is* it?

- Not just delaying unpleasant tasks, which is often right thing to do.
- It is delaying beyond when you yourself want to complete them.

Procrastination

Important example of unpleasant task we procrastinate on: learning.

- Learning how to do something better is pervasive example of something with long-term benefits.
- Many people recognize the enormous benefits of financial planning and literacy. And so want to do so. And plan to do so.

  ... tomorrow.

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$$= -120 + \beta\frac{\delta}{1-\delta}10,$$

relative to the utility you would get from doing nothing (which we can assume is zero).

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- E.g., $\beta = 1$, $\delta = .999$. Then:

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$$U^t(\textit{fix today}) = -120 + \frac{.999}{1-.999}10 = 9,870.$$

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So: Person will do it right away.

Procrastination

For any example like this, Time Consistent (that is, non-present-biased) ranking is **either**:

- $U^t(today) \succ$
- $U^t(tomorrow) \succ$
- $U^t(day\ after\ tomorrow) \succ$
- $... \succ$
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or

- $U^t(never) \succ$
- $... \succ$
- $U^t(day\ after\ tomorrow) \succ$
- $U^t(tomorrow) \succ$
- $U^t(today)$.

Procrastination

The combination we are interested in:

- $U^t(\textit{fix today}) \succ U^t(\textit{never})$, but $U^t(\textit{fix tomorrow}) \succ U^t(\textit{fix today})$.

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- If a task is worth doing, it is worth doing right away.

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- If a task is worth doing, it is worth doing right away.
- Note: Day-to-day variation in opportunity cost, etc., then there may be particular reason to do tomorrow than today or vice versa
- But no **systematic** tendency to put off tasks.

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Suppose some taste for immediate gratification (present bias)

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Even with a taste for immediate gratification:

- Feels to you like you are saving about 150 hours in the future with the two hours today.

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Even with a taste for immediate gratification:

- Feels to you like you are saving about 150 hours in the future with the two hours today.
- Indeed, you would prefer doing the task today to never doing it even if it would take you 24 hours, not just 2 hours.

Procrastination

So ...

- Do you do the task?

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You'd prefer to learn tomorrow rather than today.

Procrastination

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So, let's repeat the question: Do you do the task?

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  - What will you believe?

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- But when tomorrow comes:
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- And when the next day comes:
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- You will (in this extreme example) procrastinate forever—always planning to do the task the next day.

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So: Sophistication helps overcome procrastination.

- The absurd (yet realistic) procrastination doesn't come just from self-control problem itself, but from naivety/overoptimism about future conduct.

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General principle: *Severe* procrastination for "one-shot" tasks requires some naivety.

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So she'll perpetually *plan* to do the full fix tomorrow—and meanwhile *never do either of them*.

- Unfortunate motto of naifs: "If you're going to do something, do it right...tomorrow."
- This is nice example of famous saying: "The best is the enemy of the good" (Voltaire, referencing Italian proverb)

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- Maybe not **despite** its importance that we never do something, but **because** of its importance.

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Cumulative Procrastination

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- Day 1: April Mae will $Max_{\ h_1}\ U^1 \equiv -h_1 + \frac{1}{2}\left[-29\left(\frac{30-\sqrt{h_1}}{29}\right)^2\right]$. If she reads h_1 hours on Day 1, she'll need to read $\frac{30-\sqrt{h_1}}{29}$ pages each remaining day, spending $\left(\frac{30-\sqrt{h_1}}{29}\right)^2$ hours each day.

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- Day 1: April Mae reads for $15\frac{1}{2}$ minutes (planning to read 62 minutes each of the remaining 29 days). She is planning to increase future h by 58 minutes to decrease h today by 45 minutes.

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- Day 2: $Max_{\ h_2}\ U^2 \equiv -h_2 + \frac{1}{2}\left[-28\left(\frac{29.5-\sqrt{h_2}}{28}\right)^2\right]$ Day 2: April Mae reads for 16 minutes (and plans to read 64 minutes each day from now on).

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- Day 30: April Mae reads for $23\frac{3}{4}$ hours. (an “all-nighter”).

Procrastination

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- Sally Mae will read 39 hours total.
- Note that the stark contrast between sophisticates and naifs, and the strong limits on harm done to sophisticates, that we observed in one-shot situation has gone away.

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- But must schedule in advance to do so.
- The enjoyment of studying together would serve as a serendipitous commitment for naifs.
- Suppose $u_t = -1.01h_t$ from studying together and again must be planned in advance (where backing out of agreeing to study with somebody is more costly than refraining from planned studying)
- A principle: Providing "incremental incentives" may help combat "cumulative procrastination".
- Another principle: Providing deadlines may help combat "simple" procrastination.

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- This is challenging, but worth exploring for "fun". Impress your friends and neighbors!

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- Do you do the task? If so, when?

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  - Take-away: more likely to procrastinate on important thins because: (i) these are

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  - As above, the amount they do each day also increases over time: $e_1^S < e_2^S < e_3^S < ...$

Applications of Present Bias

Application 1: Present Bias & Saving

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[Based on work by David Laibson and his collaborators.]

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To keep things simple, let's use specific numerical values. In particular, let's use $r = 10\%$ and $W = \$1000$, and so the budget constraint is

$$c_1 + \frac{c_2}{1.1} + \frac{c_3}{(1.1)^2} \leq \$1000$$

Preferences

You have β, δ intertemporal preferences:

$$U^t(c_t, c_{t+1}, ..., c_T) = 2(c_t)^{1/2} + \beta \sum_{x=1}^{T-t} \delta^x \ 2(c_{t+x})^{1/2}.$$

Note: per-period utility is $u(c) = 2(c)^{1/2}$.

Preferences

You have β, δ intertemporal preferences:

$$U^t(c_t, c_{t+1}, ..., c_T) = 2(c_t)^{1/2} + \beta \sum_{x=1}^{T-t} \delta^x \ 2(c_{t+x})^{1/2}.$$

Note: per-period utility is $u(c) = 2(c)^{1/2}$.

Again, to keep things simple, let's use specific numerical values. In particular, let's use $\beta = .8$ and $\delta = .9$.

Long-Run Desired Behavior

Long-run desired behavior $(c_1^{**}, c_2^{**}, c_3^{**})$ maximizes

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subject to

$$c_1 + \frac{c_2}{1.1} + \frac{c_3}{(1.1)^2} \leq \$1000.$$

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Note: This represents the person's ideal behavior when asked from a removed perspective — what she would follow if she were to commit prior to period 1.

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Solution from previous page:

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Of course: Whether this is what the person will do depends on whether $\beta = 1$ or $\beta < 1$.

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Propensity to Over-Consume

Recall: Long-run desired behavior is

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Recall: Period-1 desired behavior is

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$c_1^* > c_1^{**}$ reflects that the present bias creates a propensity to over-consume (or under-save).

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Suppose you are naive.

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- Hence, in period 2, you re-optimize given this wealth...

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Conditional on having period-2 wealth $W_2^N = \$570.72$, you choose (c_2, c_3) to maximize

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Actual Behavior for Sophisticates

Solution for period-2 behavior as a function of c_1:

$$c_2(c_1) = 0.70053 * (\$1000 - c_1)$$

$$c_3(c_1) = 0.43942 * (\$1000 - c_1)$$

^^

Knowing this, in period 1 you choose c_1 to maximize

$$2(c_1)^{1/2} + \beta\delta\ 2\,(c_2(c_1))^{1/2} + \beta\delta^2\ 2\,(c_3(c_1))^{1/2}$$

$$= 2(c_1)^{1/2} + (.8)(.9)2\,[0.70053(\$1000 - c_1)]^{1/2} + (.8)(.9)^2 2\,[0.43942(\$1000 - c_1)]^{1/2}$$

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After choosing c_1^S, in period 2 you actually choose:

$$c_2^S = c_2(c_1^S) = 0.70053(\$1000 - c_1^S) = \$361.35$$

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Hence, to summarize, actual behavior for sophisticates is:

$$c_1^S = \$484.17 \qquad c_2^S = \$361.35 \qquad c_3^S = \$226.67$$

Summary of the Basic Example

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Conclusions from the Basic Example

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1. $c_1^* > c_1^{**}$ reflects that the present bias creates a propensity to over-consume (or under-save).

2. $c_2^N > c_2^*$ and $c_2^S > c_2^*$ reflects that the time inconsistency exacerbates the problem.

3. $c_1^S > c_1^N$ reflects that sophistication exacerbates over-consumption in period 1.

- Important note: unlike the previous two results, this result is not general and is specific to this example
- Sophistication can exacerbate or mitigate period-1 over-consumption depending on the specific instantaneous utility function.

Extended Example with an Illiquid Asset

Let's introduce an illiquid asset into our example:

- "Examples": a CD account, a house, a retirement account.
- If in period 1 you invest z in this asset, then in period 3 you receive $z(1+\hat{r})^2$
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Let's initially suppose $\hat{r} = r$, and suppose further that $Y_1 = \$1000$ and $Y_2 = Y_3 = \$0$, and that you cannot borrow.

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Sophisticates strictly prefer to use the illiquid asset in this way — indeed, they choose to do so even for $\hat{r}$ smaller than r.

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- And naifs would not use the illiquid asset at all if $\hat{r} < r$.

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- Now suppose that she can't borrow. However, in each period she can save money in the bank at 0% interest (which she can access at any point) and in period 1 she can invest in an illiquid asset at 0% interest that she can access only in period 3.

Illiquid Asset: Another Example (continued)

- For each of the following income streams, describe if the person can achieve her desired period-1 plan, how she will save her money in each period, and what her resulting consumption will look like.

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  4. $Y_1 = \$450,\ Y_2 = \$400,\ Y_3 = \$150$
  5. $Y_1 = \$530,\ Y_2 = \$320,\ Y_3 = \$150$

Illiquid Asset: Another Example (Answers)

1. Yes, you can achieve your period-1 desired plan. Save 100 in the illiquid asset in period one, and consume $c_1 = 400$, $c_2 = 300$, $c_3 = 300$
2. Yes, you can achieve your period-1 desired plan. Save 100 in the bank in period one, and consume $c_1 = 400$, $c_2 = 300$, $c_3 = 300$
3. Yes, you can achieve your period-1 desired plan. Save 300 in the bank and 300 in the illiquid asset in period one, and consume $c_1 = 400$, $c_2 = 300$, $c_3 = 300$
4. No, you can't achieve your period-1 desired plan, since there is no way to control period-2 spending. The best you can do is to save 50 in the illiquid asset in period 1 and save 50 in the bank in period 2, resulting in $c_1 = 400$, $c_2 = 350$, $c_3 = 250$.
5. No, you can't achieve your period-1 desired plan. You won't save anything in the bank in period 1 and will spend $c_2 = 320$ in period 2. You then have 530+150=680 to divide between periods 1 and 3 using the illiquid asset. This is 20 less than you'd optimally have to divvy up and we can't say exactly how this \$20 loss is divided between periods 1 and 3. So we can conclude

Illiquid Assets: Conclusions

- For people with self-control problems, tying up wealth in illiquid assets can be a useful commitment device to help counteract future over-consumption.

- Sophisticates are always on the lookout for such commitment opportunities, whereas naifs do not recognize the commitment value in illiquid assets.

Illiquid Assets: A Few Comments

- The illiquid asset is not a perfect commitment technology, because you cannot prevent yourself from consuming current income. For instance, if $Y_1 = \$500$ and $Y_2 = \$550$, the illiquid asset would not help at all.

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- An illiquid asset will not work as a commitment device if you can borrow against its future payoff. Hence, liquidity-enhancing instruments such as credit cards may in fact undermine the commitment value of illiquid assets.
- In the real world, illiquid assets usually have a **larger** return than liquid assets ($\hat{r} > r$).
- Standard explanation: There can be costs associated with having your wealth tied up in illiquid assets, and so people need an extra incentive to do so.

A Related Aside: Retirement Plans

Two features of retirement plans (IRA plans, 401(k) plans, etc):

- They are tax-exempt.
- They are illiquid (big penalty for early withdrawal).

Why have retirement plans?

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To the extent that retirement plans are aimed at counteracting self-control problems:

- If people are sophisticated, the illiquidity feature of retirement plans is all that's needed to induce more retirement saving.

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Why have retirement plans?

- Goal: induce people to save for retirement.

To the extent that retirement plans are aimed at counteracting self-control problems:

- If people are sophisticated, the illiquidity feature of retirement plans is all that's needed to induce more retirement saving.
- If people are naive, then both features are crucial: the tax-exempt feature induces people to use retirement plans rather than some other form of saving, and then the illiquidity feature generates unexpected commitment benefits that "multiply" the effect.

Applying These Ideas to Real Data

Angeletos *et al* (*JEP* 2001)

- They conduct a quantitative test of present bias (in the consumption-saving environment).

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Basic idea:

- We observe people take on large credit-card debts at high interest rates, but also accumulate significant pre-retirement wealth.
- Under exponential discounting, it is very difficult to accommodate both.
- Under present bias, this combination can be (roughly) understood as credit-card debt being driven by short-term impatience (β) and accumulation of pre-retirement wealth being driven by long-term patience (δ).

Angeletos et al: The Model

They consider a rich, calibrated model:

- A “period” is one year.
- Households begin life at 20, retire at 63, and die at 90 (if not sooner).
- Demographics calibrated to the “U.S. population”.
- Labor income calibrated to the “U.S. population”.
- There is a liquid asset with real interest rate 3.75%.
- There is credit-card borrowing with real interest rate 11.75% (with a credit limit).
- There is an illiquid asset that generates annual consumption flow equal to 5% of its value (can be sold only with a transaction cost).
- Preferences: CRRA instantaneous utility with $\rho = 2$, and β, δ intertemporal preferences.

Angeletos et al: Simulations

Exponential simulation:

- Assume that the entire economy is populated by exponential discounters with discount factor δ_{exp}.
- Choose δ_{exp} so that the simulations generate a median wealth-to-income ratio for households aged 50-59 of 3.2.

Present bias simulation (sophisticates):

- Assume that the entire economy is populated by people with present bias with $\beta = .7$ and $\delta = \delta_{PB}$.
- Choose δ_{PB} so that the simulations generate a median wealth-to-income ratio for households aged 50-59 of 3.2.

Chosen discount factors: $\delta_{\text{exp}} = .944$ and $\delta_{PB} = .957$

Angeletos et al: Performance of Simulated Models

Finally, they compare their simulated data to real-world data:

- households with liquid assets $>$ one-month's income:

Exponential simulation:	73%
Present Bias simulation:	40%
Data:	43%

- households with positive credit-card borrowing:

Exponential simulation:	19%
Present Bias simulation:	51%
Data:	70%

Angeletos et al: Performance of Simulated Models

- mean credit-card borrowing (all households):

Exponential simulation:	\$900
Present Bias simulation:	\$3400
Data:	$>$ \$5000

- consumption-income comovement:

Exponential simulation:	0.032
Present Bias simulation:	0.166
Data:	≈ 0.2

Application 2: Present Bias & Procrastination

Ariely & Wertenbroch (*Psychological Science* 2002)

- Subjects were 99 professionals in an MIT executive-education course.

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  - *No Choice*: Evenly spaced deadlines imposed.
  - *Free Choice*: Each student chose own deadlines.
- Note: A deadline had the same implications for both groups.

Application 2: Present Bias & Procrastination

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In the free-choice group, people imposed deadlines on themselves. On average:

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Results

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- Deadline for paper 1 about 42 days before end of term.
- Deadline for paper 2 about 26 days before end of term.
- Deadline for paper 3 about 10 days before end of term.

$\Longrightarrow$ People chose to make costly commitments, which is consistent with present bias and sophistication (or at least some degree of sophistication).

Application 2: Present Bias & Procrastination

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- The free-choice group had lower grades than the no-choice group, in both their overall grades and especially their grades on a final project that was due on the last day of class.

Application 2: Present Bias & Procrastination

But was it optimal commitment?

To answer, compare outcomes (grades) across treatments:

- The free-choice group had lower grades than the no-choice group, in both their overall grades and especially their grades on a final project that was due on the last day of class.

$\Longrightarrow$ This evidence is perhaps more consistent with present bias and partial naivete / partial sophistication.

Application 3: Present Bias & Health Clubs

DellaVigna & Malmendier (*AER* 2006)

They analyze evidence from health clubs — in particular, a panel data set that tracks members' usage over time.

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$\Longrightarrow$ They interpret as present bias with partial naivete.

Application 3: Present Bias & Health Clubs

Further evidence of naivete:

- The monthly contract has automatic renewals, and they see what looks like procrastination in cancelling (a duration between last usage and cancellation).

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Further evidence of naivete:

- The monthly contract has automatic renewals, and they see what looks like procrastination in cancelling (a duration between last usage and cancellation).
- Moreover, this duration is positively correlated with overpayment in the initial months.

Application 4: Present Bias & Job Search

DellaVigna & Paserman (*J. of Labor Econ*, 2005)

Setting:

- Each period, an unemployed person chooses how much effort to put into searching for a job.
- Search effort requires an immediate cost, but also determines the probability of receiving job offer that period.
- If the person receives a job offer, a proposed wage is "randomly" chosen by the firm, and the person must decide whether to accept that offer — in which case the job search ends — or to decline that offer and search again next period.

Application 4: Present Bias & Job Search

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Job searcher chooses search effort e:

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- The person must decide whether to accept the job offer.

In this environment, a "strategy" for the job searcher is an effort level e^* and a cutoff wage $\bar{w}^*$ such that put in effort e^* each period and accept the first wage offer $w \geq \bar{w}^*$.

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They study the exit rate from unemployment:

- Exit Rate from Unemployment $= p(e^*) \cdot \Pr(w \geq \bar{w})$.

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Note:

- $\uparrow e^* \Longrightarrow \uparrow p(e^*) \Longrightarrow \uparrow$ Exit Rate from Unemployment
- $\uparrow \bar{w}^* \Longrightarrow \downarrow F(\bar{w}^*) \Longrightarrow \downarrow$ Exit Rate from Unemployment

Application 4: Present Bias & Job Search

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Theoretical conclusion:

According to standard exponential discounting:

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Theoretical conclusion:

According to standard exponential discounting:

$$\uparrow \text{impatience } (\downarrow \delta) \implies \uparrow \text{exit rate}$$

According to β, δ discounting:

$$\uparrow \text{long-run impatience } (\downarrow \delta) \implies \uparrow \text{exit rate}$$

$$\uparrow \text{short-run impatience } (\downarrow \beta) \implies \downarrow \text{exit rate}$$

Application 4: Present Bias & Job Search

Empirical test:

- They use data from the National Longitudinal Survey of Youth (NLSY) and from the Panel Study of Income Dynamics (PSID) on unemployment spells among male heads of households.

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- They use a variety of proxies for impatience, and for most proxies, increased impatience is correlated with lower exit rates from unemployment — which is consistent with changes in short-run impatience (β)!
- Some specific proxies: Doesn't have bank account, did not have life insurance, smoked, more hangovers in past 30 days.

Application 5: Present Bias & Cigarette Taxes

Gruber & Mullainathan (*BE Policy*, 2005)

Starting point: models of present bias predict that people might smoke despite preferring not to smoke, and hence might be made better off by cigarette taxes.

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Hypothesis to Test:

$$\uparrow \text{Cigarette Taxes} \Longrightarrow \uparrow \text{Happiness for Potential Smokers}$$

Application 5: Present Bias & Cigarette Taxes

Data

From the US General Social Survey (GSS), they have data on:

- Happiness: "Taken all together, how would you say things are these days — would you say that you are very happy, pretty happy, or not too happy?"
- Smoker vs. Non-Smoker
- Demographic variables: age, gender, income, education, parents' education, race, marital status, employment status, and more.

They match this data to state cigarette taxes.

Application 5: Present Bias & Cigarette Taxes

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- Step 1: Investigate how actual smoking behavior depends on demographic variables.

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BUT we want to study impact of cigarette taxes on "potential smokers" — how to define a potential smoker:

- Step 1: Investigate how actual smoking behavior depends on demographic variables.
- Step 2: Use results from Step 1 to assign to each person a propensity to smoke — e.g., because increased education is associated with being less likely to actually be a smoker, someone with more education will be assigned a lower propensity to smoke.

Application 5: Present Bias & Cigarette Taxes

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- Among the low propensity group, increased cigarette taxes have no impact on happiness.
- Among the high propensity group, increased cigarette taxes are associated with increased happiness — as predicted.

Next Class

After present bias: Utility from anticipation

Remember:

- Problem Set 3 is due before class on Thursday, October 22
- Problem Set 4 is due before class on Tuesday, November 3