REVIEW

EE416 Sem 2/2019

What is behavioral economics?

- Behavioral Economics suggests that individuals (might) deviate from the standard model in three (related) respects (DellaVigna, JEL, 2009).
  - Nonstandard preferences: Present bias, Reference dependence, Social preferences
  - Nonstandard beliefs/Incorrect beliefs: Overconfidence, Projection bias
  - Nonstandard decision making: Framing effect, Heuristics, Emotion
- Two-system thinking

The Original Three Heuristics

- **Representativeness:** People draw inferences based on **the degree of similarity** between features of a sample and features of a population from which it might have been drawn.

- **Availability:** People judge the probability of an event by **the ease with which instances can be brought to mind**.

- **Anchoring-and-adjustment:** People make estimates by **starting from an initial value** (perhaps suggested by the problem, or a partial computation) **and then adjusting,** often insufficiently in the direction of the correct answer.

Risk Preference

Suppose you have initial wealth w,
Consider lotteries $X = (x, p; 0, 1-p)$, i.e. $X = (x, p)$
How will you evaluate lottery X ?

- Expected Value Theory

$$EV = px$$

>> St.Peterberg paradox >> Bernoulli’s Solution: Diminishing MU

- Expected Utility Theory

$$EU = pU(w + x) + (1 - p)U(w)$$

>>Rabin’s Calibration, Bernoulli’s error that didn’t allow change in wealth

- Prospect theory

$$V(X, p) = \pi(p)v(x),$$

$v(.)$ at the reference point is usually normalized to 0.

Prospect theory

- Kahneman & Tversky (1979) develop a new theory, Prospect Theory, to incorporate these observed behaviors.
- Some key features they emphasize in their model:
- Evaluation of choices are made relative to a reference point.
- Diminishing sensitivity (risk-averse in gains, risk-loving in losses)
- Loss Aversion
- Probability weighting

Prospect theory

A person evaluates a prospect $(x, p; y, q)$ according to the functional

$$V(x, p; y, q) \quad = \quad \pi(p)\, v(x) \quad + \quad \pi(q)\, v(y).$$

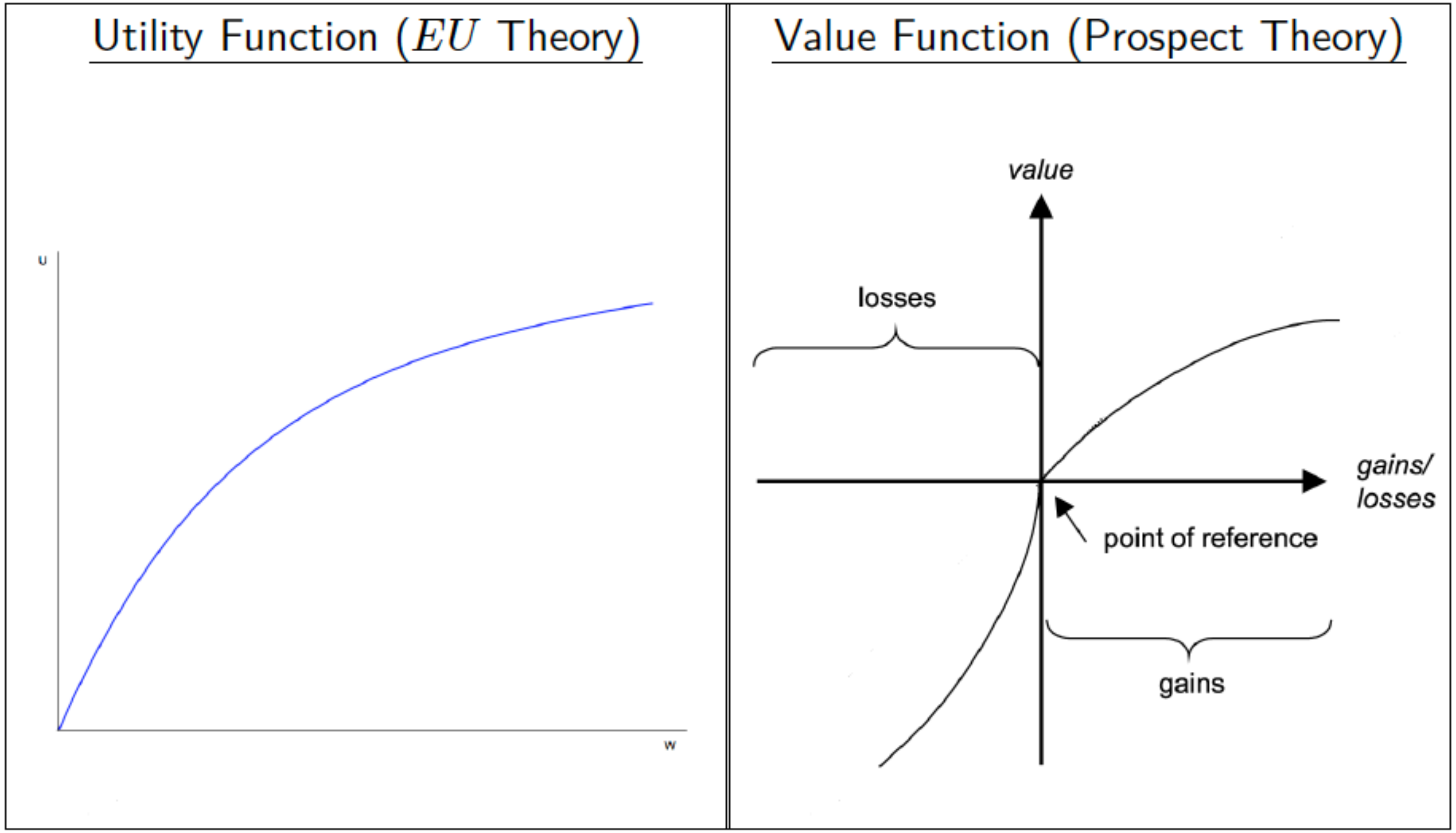
Reminder: EU theory says use

$$U(x, p; y, q) = pu(w + x) + qu(w + y) + (1 - p - q)\, u(w)$$

What's new?

- $\pi(\cdot)$ is the probability-weighting function.
- $v(\cdot)$ is the value function.

Utility function vs. Value function



Prospect Theory: Value Function

- Two common functional forms for the value function:
- Tversky & Kahneman (1992)

$$v(x) = \begin{cases} x^{\alpha} & if\ x > 0 \\ -\lambda(-x)^{\beta} & if\ x < 0 \end{cases}$$,where $\alpha, \beta \in (0,1]$ and $\lambda \geq 1$

- Two-part linear

$$v(x) = \begin{cases} x & if\ x > 0 \\ \lambda x. & if\ x < 0 \end{cases}$$,where $\lambda \geq 1$

λ is the coefficient of loss aversion.

Coefficient of Loss Aversion

- Earlier, we measured the coefficient of loss aversion from answers to whether you would accept a bet with a 50% chance to win X , and a 50% chance to lose Y , where:

- Coefficient of Loss Aversion = $\frac{X}{Y}$ for the smallest X given a fixed Y, OR for the largest Y given a fixed X

- We can also measure the coefficient of loss aversion using the endowment effect experiment:

- Coefficient of Loss Aversion = $\frac{WTA}{WTP}$

Using data from the experiments above =5.75/2.25 = 2.6

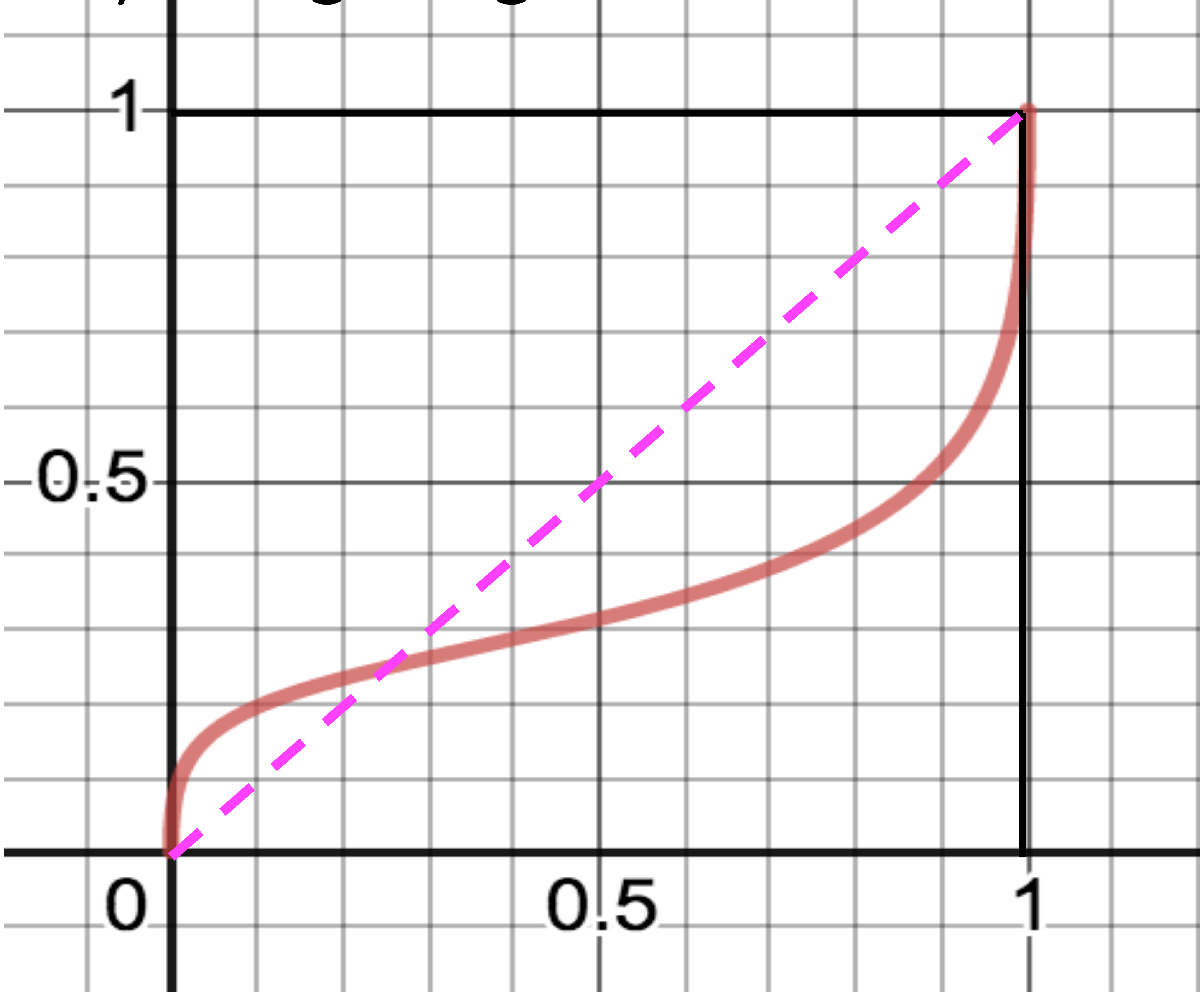
Loss aversion as an explanation for:

- The endowment effect.
  - "People tend to value an object more highly when they own it than when they do not."
  - the disutility from giving up an item is larger than the utility from receiving that same item.
  - The mug experiment
- Status Quo bias
- The sunk cost fallacy

Probability Weighting in Kahneman & Tversky (1979)

- They suggest that the probability-weighting function $\pi(p)$ will have several features such as:
  - Overweighting of small probabilities $\pi(p) > p$,
    - The possibility effect
  - Underweighting of large probabilities $\pi(p) < p$,
    - The uncertainty effect
  - Subcertainty $\pi(p) + \pi(1-p) < 1$,
  - A discontinuity at the endpoints.

Probability Weighting Functions



The Fourfold pattern of risk preferences: The core achievement of prospect theory

	GAINS	LOSSES
HIGH PROBABILITY	95% chance to win \$10,000 Risk averse + Underweighting **RISK AVERSE** Accept unfavorable settlement Ex: refusing low-risk high return business opportunity	95% chance to lose \$10,000 Risk seeking + Underweighting **RISK SEEKING** Reject favorable settlement Ex: taking desperate gambles for a small hope of avoiding large loss
LOW PROBABILITY	5% chance to win \$10,000 Risk averse + Overweighting **RISK SEEKING** Reject favorable settlement Ex: buying lottery tickets	5% chance to lose \$10,000 Risk seeking + Overweighting **RISK AVERSE** Accept unfavorable settlement Ex: buying insurance policies

Choices are:
risk averse if sure thing(corresponding to the expected value) is preferred,
risk seeking if the gamble is preferred.

A new reference-dependent utility function: Lottery L and stochastic referent R

Finally, if you face a lottery L over consumption bundles, and your referent is a lottery R, then your utility is

$$U(L|R) = \int_{\mathbf{x}} \int_{\mathbf{r}} [u(\mathbf{x}) + v(\mathbf{x}|\mathbf{r})] \, dL(\mathbf{x}) dR(\mathbf{r}).$$

<u>Example</u>: If $L = (200, \frac{1}{4}; 0, \frac{3}{4})$ and $R = (150, \frac{1}{3}; 50, \frac{2}{3})$, then

$$\begin{aligned} U(L|R) &= \frac{1}{4}\left[\frac{1}{3}[u(200) + v(200|150)] + \frac{2}{3}[u(200) + v(200|50)]\right] \\ &\quad + \frac{3}{4}\left[\frac{1}{3}[u(0) + v(0|150)] + \frac{2}{3}[u(0) + v(0|50)]\right] \end{aligned}$$

Time Preference

The Exponential Discounting Model vs. Present-Biased preferences (β, δ preferences)

$$\mathrm{U}(c_t, \dots, c_T) = \sum_{\tau=t}^{T} \delta^{\tau-t} u(c_\tau)$$

$$U^t = u(c_t) + \delta u(c_{t+1}) + \delta^2 u(c_{t+2}) + \delta^3 u(c_{t+3}) + \cdots + \delta^{T-t} u(c_T)$$

$$\mathrm{U}(c_t, \dots, c_T) = u(c_t) + \beta \sum_{\tau=t+1}^{T} \delta^{\tau-t} u(c_\tau)$$

$$U^t = u(c_t) + \beta\delta u(c_{t+1}) + \beta\delta^2 u(c_{t+2}) + \beta\delta^3 u(c_{t+3}) + \cdots + \beta\delta^{T-t} u(c_T)$$

>> extra impatient about now vs. future trade-offs

>> time inconsistency

>>preference for commitment

O'Donoghue&Rabin(AER 1999): Model

- Assume (β, δ)- intertemporal preferences
- $\mathrm{U}(x_t, \ldots, x_T) = u(x_t) + \beta \sum_{\tau=t+1}^{T} \delta^{\tau-t} u(x_\tau)$
- Assume $\delta = 1$ for simplicity
- Period-t intertemporal utility if do it in period $\tau \geq t$:
- For immediate costs:

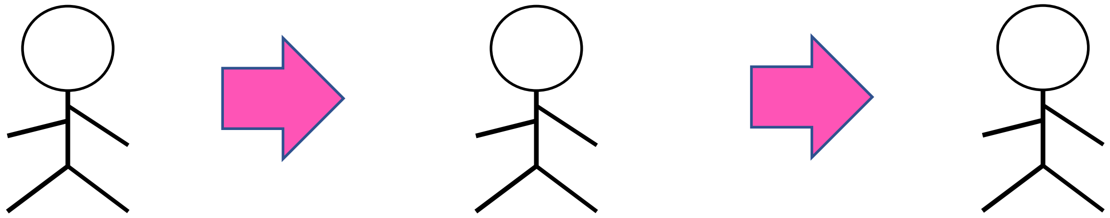
$$U^t = \begin{cases} \beta v_\tau - c_\tau & if\ \tau = t \\ \beta v_\tau - \beta c_\tau & if\ \tau > t \end{cases}$$

- For immediate rewards:

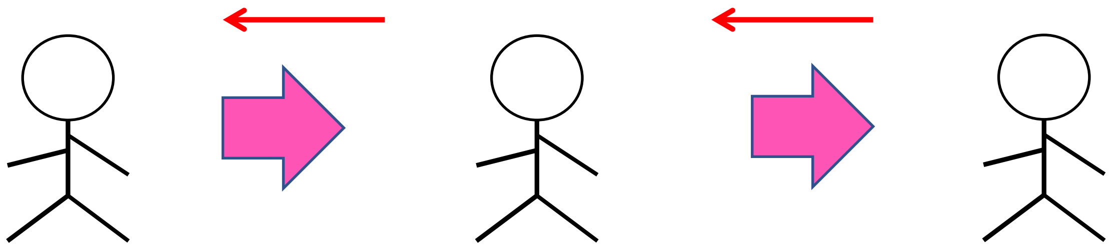
$$U^t = \begin{cases} v_\tau - \beta c_\tau & if\ \tau = t \\ \beta v_\tau - \beta c_\tau & if\ \tau > t \end{cases}$$

O'Donoghue&Rabin(AER 1999): TC, Sophisticates, Naifs

- There are 3 types of agents:
- ➢ **Time consistent**
- ➢ **Naifs**



- ➢ **Sophisticates**



O'Donoghue&Rabin(AER 1999): EX1 Immediate cost

- Suppose costs are immediate.
- $T = 4, \beta = \frac{1}{2}, \delta = 1$
- Reward schedule is $\mathrm{V} \equiv (0, \dots, 0)$.
- Cost schedule is $\mathrm{C} \equiv (3, 5, 8, 13)$.

➢ TC, with $\beta = 1$, will write the report on period 1 ($\tau_{TC} = 1$) because it maximizes utility (, here minimize cost).

	$\boldsymbol{\tau = 1}$	$\boldsymbol{\tau = 2}$	$\boldsymbol{\tau = 3}$	$\boldsymbol{\tau = 4}$
$U(\tau)$	-3	-5	-8	-13

O'Donoghue&Rabin(AER 1999): EX1 Immediate cost

❖Naif:

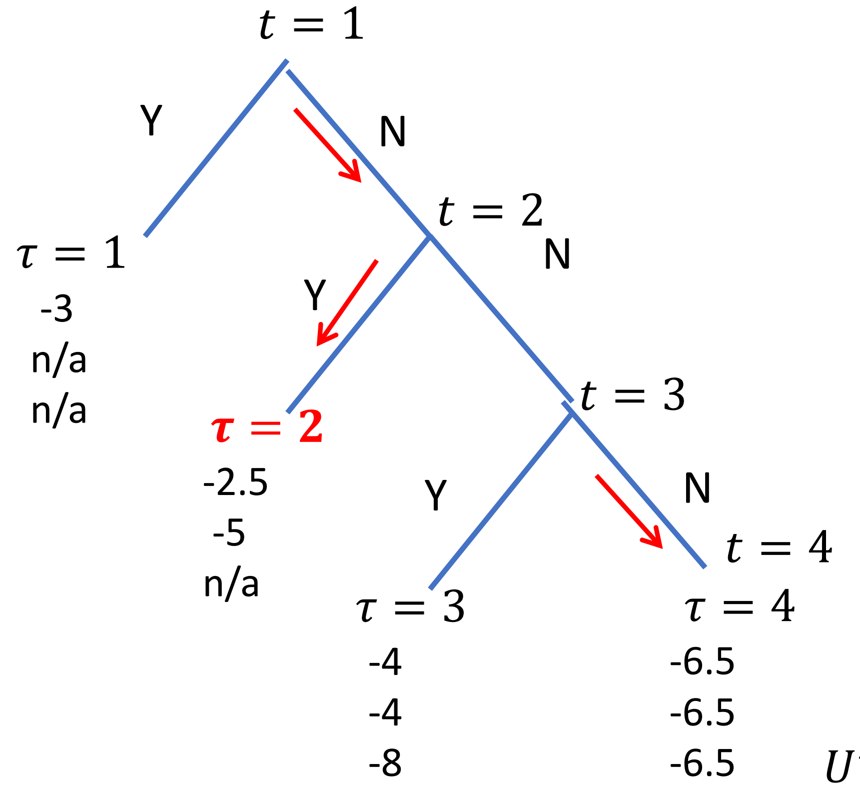
	$\boldsymbol{\tau = 1}$	$\boldsymbol{\tau = 2}$	$\boldsymbol{\tau = 3}$	$\boldsymbol{\tau = 4}$
At t $= 1$: $U^1(\tau)$	-3	-2.5	-4	-6.5
At t $= 2$: $U^2(\tau)$	n/a	-5	-4	-6.5
At t $= 3$: $U^3(\tau)$	n/a	n/a	-8	-6.5

- At t $= 1$: $U^1(2) > U^1(1) > U^1(3) > U^1(4)$ ➔ Wait on Day 1, Do Day 2
- At t $= 2$: $U^2(3) > U^2(2) > U^2(4)$ ➔ Wait on Day 2, Do Day 3
- At t $= 3$: $U^3(4) > U^2(3)$ ➔ Wait on Day 3, Do Day 4
- Have to do the report on Day 4 ($\tau_{naif} = 4$) with the cost equal to 13
- Naif ends up with procrastination.

O'Donoghue&Rabin(AER 1999): EX1 Immediate cost

❖Sophisticates:

	$\boldsymbol{\tau = 1}$	$\boldsymbol{\tau = 2}$	$\boldsymbol{\tau = 3}$	$\boldsymbol{\tau = 4}$
At t = 1: $U^1(\tau)$	-3	-2.5	-4	-6.5
At t = 2: $U^2(\tau)$	n/a	-5	-4	-6.5
At t = 3: $U^3(\tau)$	n/a	n/a	-8	-6.5



- $\tau_{sophisticate} = 2$

$U^4(4) = -13$

Partial naivete (O'Donoghue & Rabin, QJE 2001)

- Definition of Partial naifs
- A person with perceptions $\hat{\beta}$ believes that in the future she will behave like a sophisticate with present bias $\hat{\beta}$. Given this prediction about future behavior, she chooses her current action to maximize her current preferences, which depend on β.
- Also assume that the future selves are also sophisticates.

Partial naivete (O'Donoghue & Rabin, QJE 2001)

- ❖ Behave like sophisticates with $\hat{\beta}$
- ❖ On day 1, what are your beliefs about day-2 behavior?
  - ➢ I will be present bias with $\hat{\beta}$.

- ❖ What are your day-1 preferences?