Non-standard Preferences

Time preferences

Advanced course in Behavioural and Psychological Economics

Tampere University

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Link to updated version

Bibliography:

- DellaVigna, S. (2009). 'Psychology and Economics: Evidence from the field'. *Journal of Economic Literature*, 47(2): 315-372.
- Ericson, K. M., & Laibson, D. (2019). 'Intertemporal Choice'. *In Handbook of Behavioral Economics-Foundations and Applications* (Vol. 2, pp. 1-67).

Topics

Introduction

Standard theory poses:

$$\max_{x_t^i \in X_t} \sum_{t=0}^{\infty} \delta^t \sum_{s_t \in S_t} p(s_t) U(x_t^i \mid s_t) \tag{1}$$

- $U(x \mid s)$: utility
- x^t: period t payoffs
- $p(s)$: probability of state s
- δ: (time-consistent) discount factor

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... but utility discounting is **not just exponential**

Discounted Utility

Suppose:

$x \perp s$ (x is orthogonal to s)

- *Payoffs do not depend on states of the world*

- Individual i maximize $\sum_{t=0}^{\infty} \delta^t U(x_t^i)$

$$\sum_{t=0}^{\infty} \delta^t U(x_t^i) = \delta^0 U(x_t^i) + \delta U(x_{t+1}^i) + \delta^2 U(x_{t+2}^i) + \delta^3 U(x_{t+3}^i) + \dots$$

- For $\delta = .9$

$$\sum_{t=0}^{\infty} \delta^t U(x_t^i) = (1)U(x_t) + (.9)U(x_{t+1}) + (.81)U(x_{t+2}) + (.729)U(x_{t+3}) + \dots$$

Time Preferences

Theory

- Standard model assumes a **discount factor** (δ) that:
  - Allows comparing utility in different periods
  - Is independent of when utility is evaluated

    $\rightarrow$ i.e., *time consistency*

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Empirical Evidence

- Discounting is **steeper in the immediate future** than further ahead
  - Thaler (1981) finds people are indifferent between:
    - $\rightarrow$ \$15 now and \$20 in one month
    - $\rightarrow$ \$15 now and \$100 in ten years

Discount Rate

We can compute the annualized discount rate $(\delta) = \left(\frac{F}{P}\right)^{\frac{1}{t}} - 1$

1. 15 now versus 20 in one month
   - For $P = 15$ (Present value), $F = 20$ (Future value), and $t = 1$ month ($\frac{1}{12}$ years)

   $\delta_1 = \left(\frac{20}{15}\right)^{\frac{1}{\left(\frac{1}{12}\right)}} - 1 = 1.333^{12} - 1 \approx 30.57 = \boxed{\text{3,057\%}}$

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2. 15 now versus 100 in ten years
   - For $P = 15$ (Present value), $F = 100$ (Future value), $t = 10$ years

     $\delta_2 = \left(\frac{100}{15}\right)^{\frac{1}{10}} - 1 = 6.67^{\frac{1}{10}} - 1 \approx .21 = \boxed{21\%}$

Time Preferences

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Empirical Evidence

- Discounting is **steeper in the immediate future** than further ahead
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    - $\rightarrow$ \$15 now and \$20 in one month (3,057% annual discount!)
    - $\rightarrow$ \$15 now and \$100 in ten years (21% annual discount)
  - McClure et al. (2004) explores the neural underpinnings:
    - $\rightarrow$ Payoffs in the present activate different neural systems than decisions involving only payoffs in future periods

Self-Control Problems

- When evaluating the **distant future**:
  - More patience
  - People make plans to:
    - → Exercise
    - → Stop smoking
    - → Improve themselves
- When the **future gets near**:
  - Discounting gets steeper
  - People:
    - → Binge-eat
    - → Light (last) cigarette
    - → Stay put

Theoretical Framework

Following Laibson (1997) and O'Donoghue & Rabin (1999)

Suppose that an individual considers her utility throughout many periods:

$$U_t = u_t + \beta \sum_{t=1}^{\infty} \delta^t u_t = u_t + \beta\delta u_{t+1} + \beta\delta^2 u_{t+2} + \beta\delta^3 u_{t+3} + \dots \quad (2)$$

- u_t: period t utility
- δ: discount factor
- β: captures self-control problems, restricted to $\beta \leq 1$

Theoretical Framework

This model (*quasi-hyperbolic preferences*) differs from the *standard model* in β

- if $\beta < 1$ the discounting between present and future is higher
  - e.g., *if* $T = 2$, $\beta = .5$ *and* $\delta = .9$

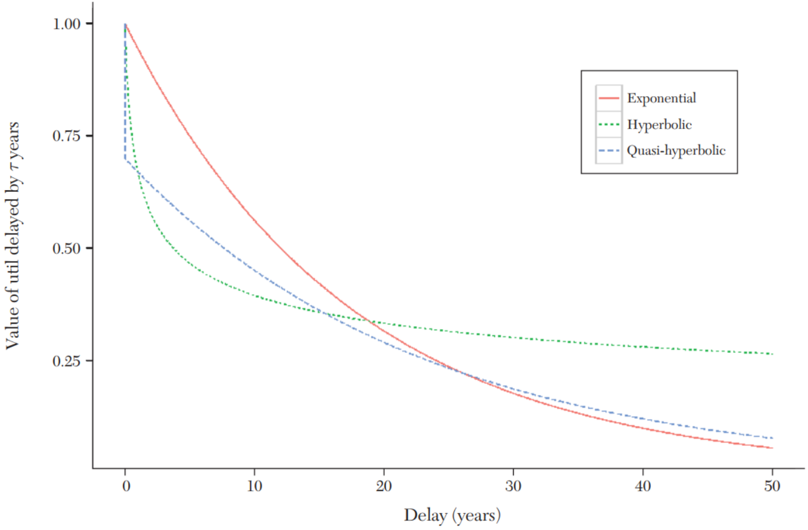
    $$U_t = u_t + \beta\delta u_{t+1} = u_t + (.5) \times (.9)u_{t+1} = u_t + (.45)u_{t+1}$$

    Period 2 utility is weighted at 45% of period 1 utility
- if $\beta = 1$ we have the *standard model*
  - e.g., *if* $T = 2$, $\beta = 1$ *and* $\delta = .9$

    $$U_t = u_t + \beta\delta u_{t+1} = u_t + (1) \times (.9)u_{t+1} = u_t + (.9)u_{t+1}$$

    Period 2 utility is weighted at 90% of period 1 utility

Theoretical Framework



Theoretical Framework

Following O'Donoghue & Rabin (2001)

Suppose that an individual expects her utility to be:

$$\hat{U}_{t+s} = u_{t+s} + \hat{\beta}\delta u_{t+s+1} + \hat{\beta}\delta^2 u_{t+s+2} + \hat{\beta}\delta^3 u_{t+s+3} + \dots \tag{3}$$

- $\hat{\beta}$: captures expectations about time preferences, restricted to $\hat{\beta} \geq \beta$

Theoretical Framework

- if $\hat{\beta} = 1$ the individual is *fully naive* about self-control problems
  - Will decide without considering that in the future she will have self-control problems
- if $\hat{\beta} > \beta$ the individual is *partially naive* about self-control problems
- if $\hat{\beta} = \beta$ the individual is *sophisticated*
  - Will take into account her self-control problems when deciding

An example

Consider the choice between eating a fruit or a chocolate bar as a dessert

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- **Chocolate bar**
    - Immediate reward: $u_1 > 0$
    - Future cost: $u_2 < 0$
- **Fruit**
    - Immediate cost: $u_1 < 0$
    - Future reward: $u_2 > 0$

An example

Consider the choice between eating a fruit or a chocolate bar as a dessert

- Focusing on the **chocolate bar** $(u_1 > 0, u_2 < 0)$:
  - Planning ahead
    - $\rightarrow$ Consume chocolate bar if $u_1 + \delta u_2 \geq 0$
  - Deciding in the moment
    - $\rightarrow$ Consume chocolate bar if $u_1 + \beta\delta u_2 \geq 0$
    - $\rightarrow$ Remember $\beta < 0$, so $|\beta\delta u_2| \leq |\delta u_2|$
  - I would consume more than what I would want to do beforehand!

An example

Consider the choice between eating a fruit or a chocolate bar as a dessert

- Focusing on the **fruit** $(u_1 < 0, u_2 > 0)$:
  - Planning ahead

    $\rightarrow$ Consume fruit if $u_1 + \delta u_2 \geq 0$
  - Deciding in the moment

    $\rightarrow$ Consume fruit if $u_1 + \beta\delta u_2 \geq 0$

    $\rightarrow$ Remember $\beta < 0$, so $|\beta\delta u_2| \leq |\delta u_2|$
  - I would consume less than what I would want to do beforehand!

An example

Consider the choice between eating a fruit or a chocolate bar as a dessert

- How can *sophisticated* agents solve this?
  - Look for **commitment devices** to:
    - → Increase investments
    - → Reduce present consumption
- Partially *naive* agents would still mispredict their consumption/investment decisions
  - Planning ahead (and focusing on fruit)
    - → Consume fruit if $u_1 + \hat{\beta}\delta u_2 \geq 0$
  - Deciding in the moment
    - → Consume fruit if $u_1 + \beta\delta u_2 \geq 0$
    - → With $\hat{\beta} > \beta$, then $|\beta\delta u_2| \leq \left|\hat{\beta}\delta u_2\right|$
  - Would still consume less than what wanted to do beforehand!

Cases

1. Exercise
2. Deadlines
3. Credit
4. Savings
5. Default effects

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Exercise

DellaVigna & Malmendier (2006): Health clubs in the US

Exercise

DellaVigna & Malmendier (2006): Health clubs in the US

- Setup:
  - X_M: Monthly membership for $L = \$80$
  - X_P: Pay-per-visit membership with $\$10$ per visit
- Optimal choice:
  - Choose monthly membership $\Leftrightarrow p \times E(x_M|X_M) \geq L$

    $\rightarrow$ Expected price per attendance (x_M) under X_M is lower than X_P

Exercise

DellaVigna & Malmendier (2006): Health clubs in the US

- Evidence:
  - Users choosing the monthly membership visit 4.4 times per month
  - This implies a cost of $\sim \$17$ per visit

    $\rightarrow$ Choosing X_M is more expensive than choosing X_P ($\$10$ per visit)

- Explanation:
  - Users are purchasing a **commitment device** to exercise more:

    $\rightarrow$ Marginal cost of each visit is $\$0$ under the monthly membership
  - **Overestimation of attendance**

    $\rightarrow$ Most consistent with post-intervention survey

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Deadlines

Ariely & Wertenbroch (2002): Professionals enrolled in executive education at MIT

Deadlines

Ariely & Wertenbroch (2002): Professionals enrolled in executive education at MIT

- Setup:
  - Course with 3 homework assignments required
  - Possibility to set binding deadlines:
    - → Delays imply lower grades
    - → No feedback until the end of the course
- Evidence:
  - 68% of deadlines were set before the end of the semester

Deadlines

Ariely & Wertenbroch (2002): Professionals enrolled in executive education at MIT

- Theory:
  - *Standard Model*:
    - → Incentive to set the last day of the semester as the deadline
    - → No constraints are better than constraints
  - *Self-Control:*
    - → Homework is an investment
    - → People spend less time than wished *ex ante*
    - → Deadlines force future self to spend more time

Deadlines

Ariely & Wertenbroch (2002): Professionals enrolled in executive education at MIT

- Open questions:
  - Does self-control improve performance?
  - Are chosen deadlines optimal?
- Experiment:
  - 3 error-detection homework assignments with 3 treatment conditions:
    - → `T0`: No deadlines (all due after 3 weeks)
    - → `T1`: Possibility to set binding deadlines
    - → `T2`: Equal-spaced deadlines (one every week)
  - Evidence:
    - → Self-set **deadlines improve performance**: score of 105 in `T1` vs. 70 in `T0`
    - → Self-set deadlines are not optimal (**partial naïveté in self-control**): 105 in `T1` vs. 130 in `T2`

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Credit

Ausubel (1999): Credit card offers

Credit

Ausubel (1999): Credit card offers

- Setup:
  - Credit card company randomly mailed offers:
    - → `T0`: 6.9% interest for first 6 months, 16% afterwards
    - → `T1`: 4.9% interest for first 6 months, 16% afterwards
    - → `T2`: 6.9% interest for first 6 months, 14% afterwards
- Evidence:
  - Average borrowings:
    - → $2000 during the first 6 months
    - → $1000 afterwards (up to 15 months after change of rate)

Credit

Ausubel (1999): Credit card offers

- Theory:
  - *Standard Model:*

    → In `T1` the offer is 2% rate for first 6 months

    → In `T2` the offer is 2% rate for last 15 months

    → Response to `T1` should be smaller than to `T2`

    → Calculation:

    in `T1`: $2000 \times \left(\frac{6}{12}\right) \times 2\% = 20$

    in `T2`: $1000 \times \left(\frac{15}{12}\right) \times 2\% = 25$

Credit

Ausubel (1999): Credit card offers

- Evidence:
  - Increase in take-up for `T1`: 386 per 100k
  - Increase in take-up for `T2`: 154 per 100k
  - `T1` vs. `T0` is 2.5 times larger than for `T2` vs. `T0`
  - Individuals over-respond to the first six-months discount
- Interpretation:
  - Individuals **naively believe** they will not borrow much after the discount period ends

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Savings

Ashraf, Karlan, & Wesley (2006): Savings behavior in the Philippines

Savings

Ashraf, Karlan, & Wesley (2006): Savings behavior in the Philippines

- Motivation:
  - How to reconcile?
    - → Liquid debt: ∼12% of annual income, implies high impatience
    - → Illiquid wealth accumulation: >200% of annual income towards retirement, implies high patience
  - Proposed solution: **Commitment device**

- Setup:
  - Philippine bank randomly assigned customers to:
    - → `T0`: Verbal encouragement to save
    - → `T1`: Commitment device

      Customers could not access savings until reaching a self-specified goal

Savings

Ashraf, Karlan, & Wesley (2006): Savings behavior in the Philippines

- Evidence:
  - High demand for commitment: $\sim$25% of customers accepted the commitment device
  - Savings increased:
    - → `T1`: 33.3% increase
    - → `T0`: 27.7% increase

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Default effects

Default effects

- Tendency for an agent to generally accept the default option
- One of the most robust findings in applied economics since 2000!
- Observed in contexts such as:
  - Health clubs
  - Organ donation
  - Insurance plan choice
  - Retirement plan choice
- Widely applied in public (and private) policy

Default effects

Madrian & Shea (2001): Company-offered 401(k) plans in the US

- Setup:
    - `T0`: Default is non-participation
        - → Employer match-up: 50% of contributions
    - `T1`: Default is participation at 3%
        - → Employer match-up: 50% of contributions
    - Employees can override default via phone call or form submission

- Evidence:
    - Participation rate:
        - → `T0`: 49%
        - → `T1`: 86%

Default effects

Madrian & Shea (2001): Company-offered 401(k) plans in the US

- Explanation:
  - **Transaction costs?**
    - → Unlikely: Costs are too low compared to benefits
    - → e.g., *Average match-up provides $1.2k in annual benefits*
  - **Self-control and naïveté?**
    - → Decisions involves:
      - Immediate disutility (i.e., *transaction cost*)
      - Delayed benefit
    - → Agent behavior:
      - Postpones decision (i.e., *self-control problem*)
      - Believes they will act tomorrow (i.e., *naïveté*)
    - → Can result in infinite procrastination

Default effects

Carroll et al. (2009): Forcing Choice as a Solution

- Setup:
  - New hires at a company:
    - → `T0`: Free to choose a retirement plan
    - → `T1`: Required to choose a retirement plan
- Evidence:
  - Participation rate:
    - → `T0`: 50% choose a 401(k) plan
    - → `T1`: 80% choose a 401(k) plan